Why do some students delay college enrollment? Does it matter?

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Abstract

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Over one third of students in the U.S. who started college in 2012 did not enroll in the fall immediately following their high school graduation. Despite the prevalence of delayed college enrollment, however, little is known about the reasons for the delay and the consequences for academic and labor markets outcomes. Conventional human capital theory suggests that formal education should precede work in order to maximize the period of benefiting from the returns of investment in education. As such, the reasons for students delaying their college enrollment are still unclear. Usually, it has been perceived either as an irrational behavior, or a constrained behavior caused by the imperfect market. The first chapter of this dissertation provides an overview of the studies that explain the phenomenon of delay, and I conclude that financial constraint is not the only explanation. Students might rationally adjust the timing of enrollment to maximize their welfare, based on their personal capabilities, preferences, and economic conditions. Factors such as behavioral bias and sociological constraints also influence students' educational decisions.

Based on the theoretical framework proposed in the first chapter, it is predominantly believed that college enrollment could be countercyclical, especially for students who are financially constrained. The second chapter takes advantage of a natural experiment and discovers one of the factors that causes college enrollment delay: the housing market boom. I use the Education Longitudinal Survey: 2002 and the Building Permit Survey to estimate the effect of local housing market booms on college enrollment timing. I find that an additional 100 increase in the annual change of building permits leads to 0.24 percentage-point increase in enrollment delay for male high school graduates. However, the temporary delay in transition to

college that is caused by a housing boom does not necessarily decrease the college enrollment rate eight years, but it makes returners less likely to enroll in four-year colleges.

Using data from the National Longitudinal Survey of Youth 1997, the third chapter of this dissertation examines the characteristics and earnings trajectories of delayers and the effects of this choice on academic and labor market outcomes. Propensity score matching results show that delaying college enrollment decreases individuals' likelihood of enrolling in college, and increases their tendency to enroll in two-year colleges if they return to school. The results also demonstrate that, consistent with the study's descriptive results, the early earnings benefits that are experienced by delayers diminish after their mid-20s and turn to significant losses over time. Oaxaca decomposition results indicate that differences in student characteristics only explain one third of the pay gap between the two groups; 60% of the pay gap is explained by delayers' reduced likelihood of attending and obtaining a degree at a four-year college.

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Preface

In the literature on college enrollment and college choice, a common assumption is that college-intending students begin postsecondary education in the fall after their high school graduation. However, according to the National Postsecondary Student Aid Study, 37% of undergraduate students in the 1992–93 academic year waited a year or more after high school graduation to attend college (Riccobono et al., 2001), as did a similar proportion of the 2011–12 cohort (Wine, Bryan, & Siegel, 2013). Despite the prevalence of delayed college enrollment, researchers have paid relatively little attention to this phenomenon or its consequences.

In recent years, educational counselors and universities have increasingly promoted the "gap year" model (Hoe, 2015). In fact, all eight Ivy League universities have encouraged admitted students to take a gap year to travel, work, or engage in other productive activities that may help to prepare them academically and developmentally for college. Some schools, including Princeton University, Tufts University, the University of North Carolina at Chapel Hill, the New School, and Elon University, even provide financial aid for students who take a gap year.

However, for students who have fewer resources or are not planning to attend selective institutions, a gap between high school graduation and college enrollment may mean something different. For the average student, given the rising cost of attending college, financial concerns heavily influence college enrollment behaviors. According to the Education Longitudinal Study of 2002, over half of the students who delayed college enrollment named financial concerns (30%) or a preference to work (25%) as reasons for doing so. Only 15% indicated that they took a gap year to pursue personal interests or take a break from their studies. Working instead of enrolling in college allows individuals to save for college, defer paying college tuition, and enjoy short-term consumption benefits (Kane, 1996). Some also believe that accumulating work experience before college may increase students' competitiveness in the labor market after college (Dellas & Sakellaris, 2003), although the extent to which pre-college experience matters for post-college employment remains unclear. Other life circumstances and events, such as military service, sickness, marriage, pregnancy, or a death in the family, may also cause students to defer college enrollment (Bozick & DeLuca, 2005).

A review of the literature suggests that college enrollment delay may lower students' likelihood of completing college, thus implicitly depressing the supply of skilled labor. A fact that has been ignored by prior studies is that some students who intend to delay their enrollment may never return to school once they deviate from the traditional educational trajectory. Even if all delayers eventually enroll, they may be unable to gain the same financial returns that they could have done if they had attended college immediately. Therefore, it is crucial for policymakers to identify the reasons for delayed college enrollment, and its results, yet few studies have rigorously analyzed the reasons for delay, or compared the outcomes of students who do not enroll in college immediately after high school (whom I refer to in this paper as "delayers") with those who do (whom I refer to as "on-time enrollees").

To address the gaps in the literature, this dissertation attempts to examine the reasons for not attending college on-time, and its consequences. Chapter 1 systematically reviews the research related to delayed enrollment, and provides descriptive evidence of the reasons for the delay. Although conventional human capital theory suggests that formal education should precede work in order to maximize students' period of benefiting from higher education, a significant portion of high school graduates still choose to postpone college enrollment. This chapter concludes that financial constraint is not the only explanation for the delay. Students might rationally adjust the timing of enrollment to maximize their welfare, based on their personal capabilities, preferences, and economic conditions. However, behavioral bias and sociological constraints may impede students' rational decisions and also lead to delay.

Chapter 2 examines housing booms as a possible cause of college enrollment delay, and investigates their influence on students' educational outcomes. Human capital theory suggests that college enrollment could be countercyclical, especially for students who are financially constrained. In this chapter, I exploit the natural experiment and discover the effect of local housing market booms on college enrollment timing. I examine the change in the number of county-level building permits, and argue that the occurrence of housing booms in some areas and not others is plausibly exogenous to latent confounders, such as innate ability or motivation, and leads to more frequent college enrollment delay. The results demonstrate that an additional 100 increase in the annual change of building permits leads to a to 0.24 percentage-point increase in enrollment delay for male high school graduates. However, this paper also finds that a temporary delay in transition to college that is caused by a housing boom does not necessarily decrease the eight-year college enrollment rate. Instead, college choice is affected by enrollment timing; delayers are more likely to choose two-year colleges if they re-enroll. Delay also leads to a lower completion rate in four-year colleges.

In Chapter 3, using data from the National Longitudinal Survey of Youth 1997, Vivian Liu and I examine the earnings trajectories of the delayers and the effects of delaying college on academic and labor market outcomes. Propensity score matching results confirm the conclusion from Chapter 2 that delaying college enrollment decreases individuals' likelihood of enrolling in four-year colleges and increases their tendency to enroll in two-year colleges. Consistent with the descriptive results, the propensity score matching estimates demonstrate that the earnings benefits that are experienced by delayers quickly diminish after their mid-20s and become significant losses over time. To investigate the key determinants of the wage differentials between on-time enrollees and delayers, we also exploit Oaxaca decomposition and find that differences in student characteristics only explain one third of the pay gap between the two groups; 60% of the pay gap is explained by delayers' reduced likelihood of attending and obtaining a degree at a four-year college.

This dissertation makes several contributions to the literature. Firstly, while most previous literature analyzes the consequences of enrollment delay for delayers who re-enroll in college eventually, my study is the first to attempt to answer the question of 'does delay only change the sequence of college and work, or does it make some students abandon higher education permanently?' Secondly, my analysis provides causal evidence for the effect of delay on academic and labor market outcomes. Although many other papers have considered the phenomenon that delayers tend to enroll in two-year colleges and earn less after graduation, their conclusion is often based on correlation analysis rather than causal inference. Thirdly, by using longitudinal data, I investigate the long-term consequences of delayed enrollment.

Chapter 1. Delayed college enrollment in the U.S.: Why do students deviate from the typical education trajectory?

1.1 Introduction

College enrollment in the U.S. has been expanding for decades. The postsecondary education attendance rate for high school graduates increased from 45.1% in 1960 to 68.4% in 2015 (Snyder et al., 2016a). However, less attention has been given to the timing of initial enrollment. There is an increasing amount of attention to later degree attaining (Bound et al., 2010; Turner, 2007), though scholars have not explore the connection between delayed enrollment and later degree attainment.

According to National Postsecondary Student Aid Study (NPSAS), among undergraduate students who enrolled in postsecondary education in the academic year 2011-2012, 38% of undergraduate enrollees did not enter college in the fall of the year they completed high school. Although not explicitly measuring delayed enrollment, the share of undergraduate students aged above 25 is partially attributable to delayed college enrollment after graduating from high school. Nontraditional students who were older than 25 have accounted for a significant part of enrollees since 1993. About 36% of all undergraduate enrollees in any type of postsecondary institution were over age 25 in 1993. Even though the ratio has been diminishing for years, nontraditional students still accounts for over 30% of the total undergraduate enrollment in recent years. (Snyder et al., 2016a).

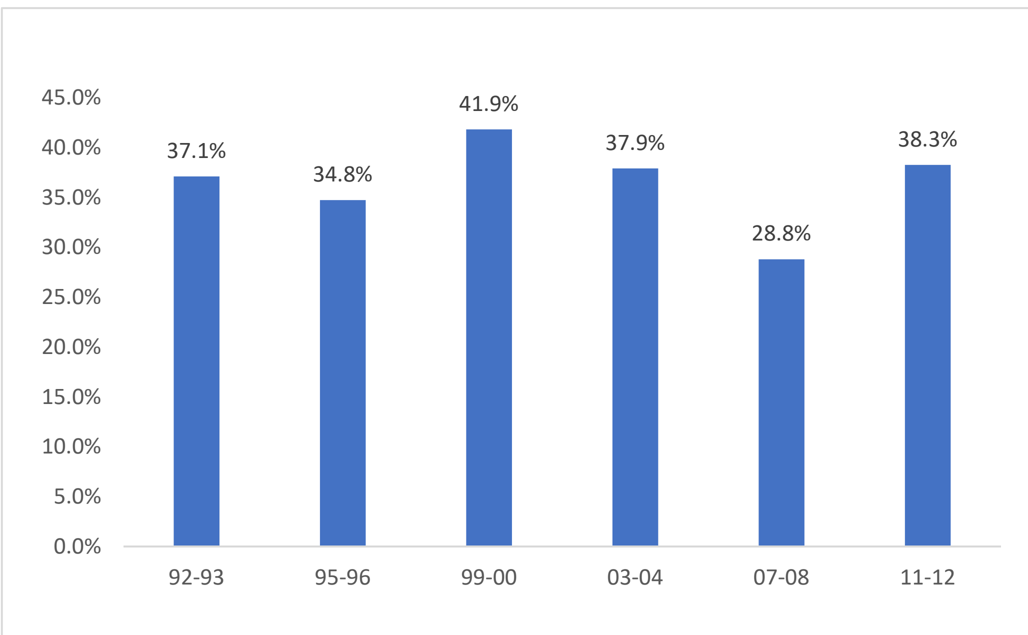
Lacking previous research in this topic, the reason for this phenomenon is under-investigated. But given the continuous rise in tuition over the past decades, one would naturally consider that the postponement in college enrollment is primarily due to financial constraints rather than a result of rational decision making under a perfect credit market. Economic concerns cannot fully explain the phenomenon. Horn et al. (2005) indicate that postponement is a universal behavior across all income levels. Even some students among the top income quartile whose decision should not be subjected to financial constraints also delay attending college. Bozick and DeLuca (2005) suggest non-pecuniary factors, such as social/cultural contexts, life shocks, and military service, can compel students to defer college enrollment. Nevertheless, most of the previous research lacks a comprehensive description of the mechanism through which students choose to delay college enrollment. Few have applied causal methods to examine the reason for enrollment delay.

The postponement between high school and college has been largely overlooked by policymakers. Previous studies suggest that college enrollment delay may lower the likelihood of completing college (Bozick & DeLuca, 2005; Horn et al., 2005; Niu and Tienda, 2013) thus implicitly depressing the supply of skilled labor. Some intended delayers may never return to school once they deviate from the traditional trajectory. Therefore, it is crucial for policymakers to identify the reasons for delayed college enrollment. To address the gaps in the literature, this chapter systematically reviews the research related to delayed enrollment from both theoretical and empirical perspectives. The rest of this chapter is organized as follows: In Section 2, I describe the extent of undergraduate delayed enrollment in past decades in the U.S. Section 3 introduces the theoretical framework of the college entry timing and predicts the factors that could influence late enrollment decision. Section 4 overviews the empirical literature on delayed enrollment. Section 5 concludes and provides policy recommendations.

1.2 Delayed Undergraduate Enrollment in the U.S.

Contrary to the common view, enrolling in college immediately after graduating from high school is not such a convention in the real world. Delayed enrollment is a widespread phenomenon. To explore the extent of delayed college enrollment, I first use the National Postsecondary Student Aid Study (NPSAS) for the analysis. NPSAS is a large, nationally representative sample of students in postsecondary institutions. It is based on a sample of all students in Title IV eligible postsecondary institutions throughout the U.S. during the surveyed academic year. As Figure 1.1 depicts, except for the 2007-2008 cohort, delayed enrollment accounted for over 30% of the total undergraduate enrollment[1]. It is important to note that the proportion of delayed enrollees in cohort of 07-08 decreased, and coincided with the onset of the Great Recession. I, therefore, hypothesize that students tend to invest higher education sooner

Figure 1.1 Proportion of Undergraduate Delayed Enrollment



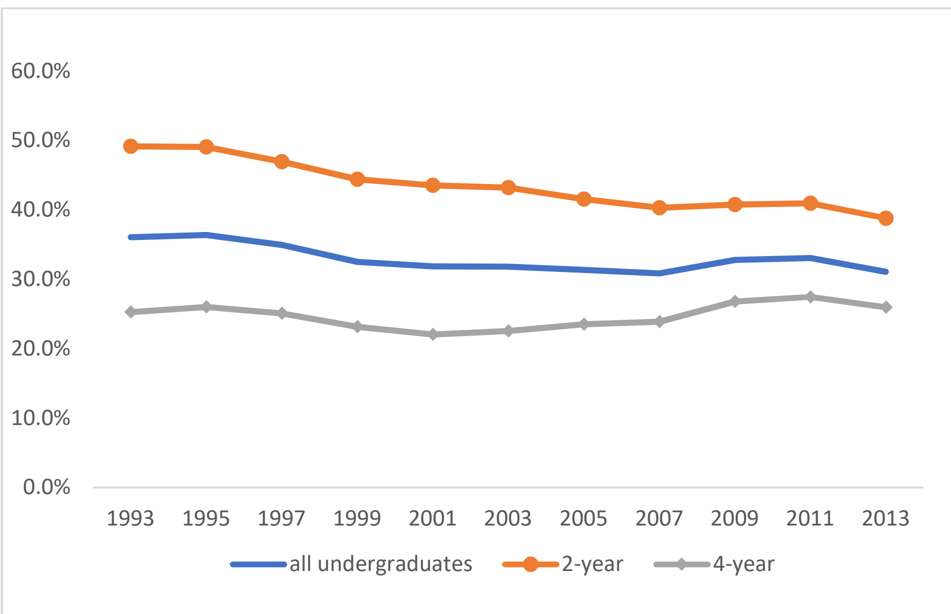
Data Source: National Postsecondary Student Aid Study

[1] The delay flag in NPSAS is defined by whether the gap between students' high school graduation year and initial postsecondary enrollment year is larger than zero. However, this definition assumes that high school graduation takes place in May or June, and college enrollment takes place in September of the same calendar year. This imputation would mistakenly deem students as delayers if they graduated in December and enrolled in college in the next spring. So, the delayed indicator in NPSAS may overestimate the proportion of delayers. In addition, I exclude respondents who have no information of high school graduation year and college enrollment year for consistency.

when employment opportunities became limited, leading to a higher ratio of undergraduate students entered college on-time. I will examine this hypothesis later in Chapter 2.

Alternatively, the National Center for Education Statistics (NCES) reports nation-wide nontraditional enrollees whose age is older than 25 every other year. Though not precisely measuring delayed enrollment, the share of older students is partially attributable to the proportion of delayed enrollment[2]. Figure 1.2 plots the percentage of older students by institution type since 1993. Even the ratio has been decreasing for years, nontraditional students still account for over one-third of the total undergraduate enrollment. Notably, the trend rebounded around the year 2007, which corresponded to the housing market crash and the beginning of the recession. This trend implicitly confirms the influence of local labor market on college

Figure 1.2 Proportion of Enrollment Aged 25 and above



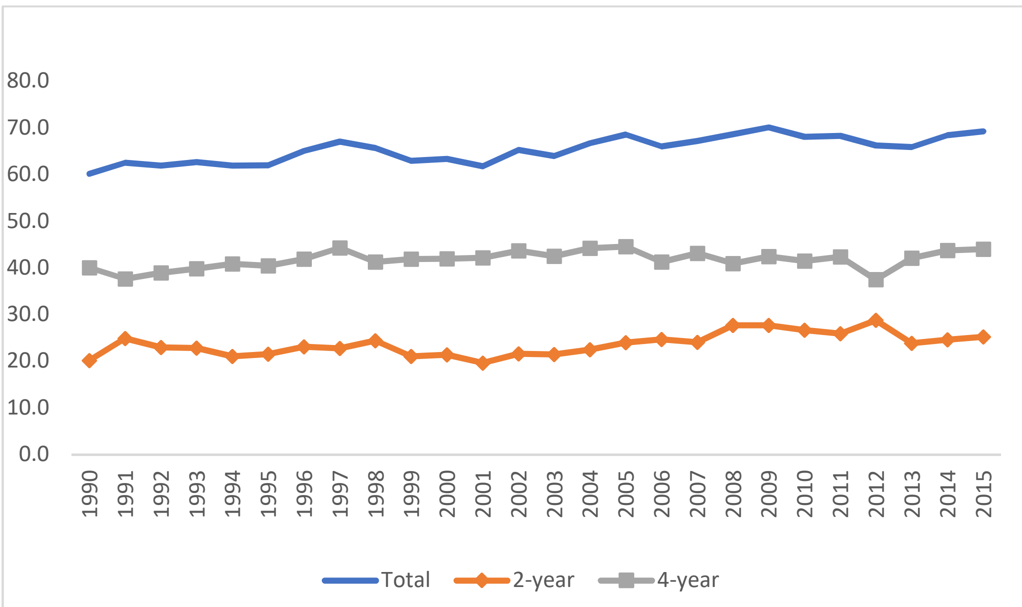
Data Source: Digest of Education Statistics (1995-2015)

[2] Nontraditional enrollment is unable to precisely reflect the delay entrance because it does not differentiate the sources of older enrollments. Enrollment aged above 25 could be a result of late high school completion, college incompletion, second degree pursuit, or interrupted college attendance. It also excludes short-term delayers who entered college 1 or 2 years later after high school graduation because their age is still below 25.

enrollment timing – not only high school graduates enrolled in college on-time, but also a higher ratio of adults returned to school after the economy collapsed. Two-year colleges have more nontraditional students– over 40% of the enrollees are aged 25 and above. Nevertheless, the uptrend of nontraditional enrollments in 2007 was mainly driven four-year universities, whose nontraditional enrollment rate climbed steeply after the recession. This trend suggests that delaying enrollment is no longer an isolated phenomenon for people returning to school for two-year/part-time vocational training. When the Recession hit, four-year universities experienced an increasing number of adult enrollments, who were not a large part of their typical student population decades ago.

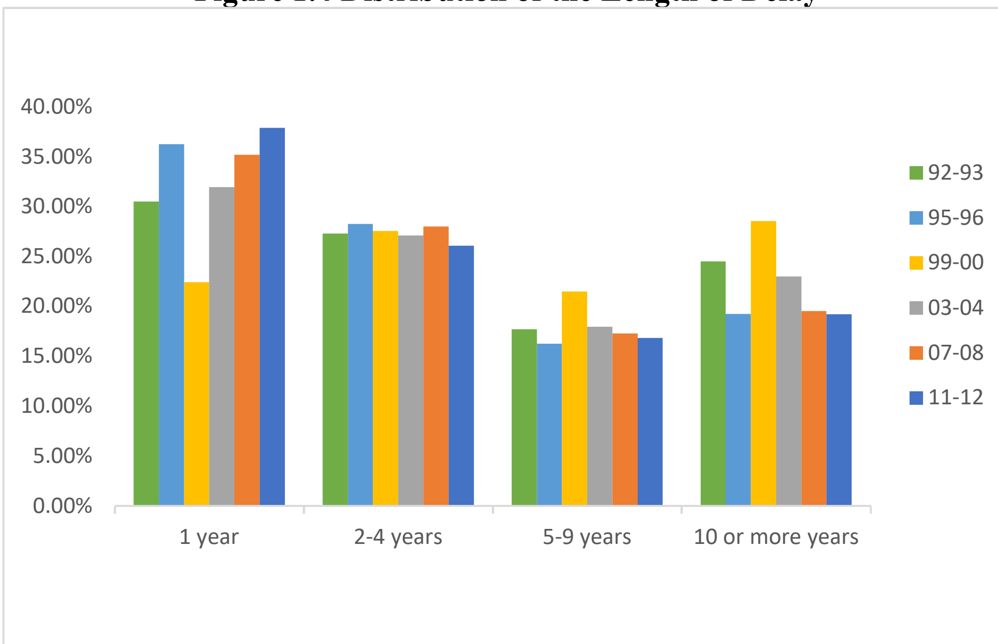
Neither of above two measures can accurately reflect the enrollment delay, as the definition of delay heavily relies on knowing students' plans. The share of delayed enrollees and nontraditional students only capture the delayers who successfully returned to college. However, when high school graduates decided to delay, some of them may never re-enroll. The nature of the delay makes it become extremely difficult to define the enrollment delay. Without knowing students' intention of re-enrollment, another alternative data point that could reflect college enrollment delay is the rate of immediate transition to college. Among the students who did not enroll in any postsecondary institutions immediately after high school, some proportion of them intended to re-enroll in the future. Compared to the share of delayed enrollees and nontraditional students other two measures, the immediate transition rate accurately measures student's college intention unconditional on student's educational outcomes, which are also affected by the delay, though it unnecessarily includes the students having no college intention. Thus, in the rest of the paper, the immediate transition rate is my preferred measurement of delay. Figure 1.3 shows that almost 30% of high school graduates defer their postsecondary education trajectory. It is not surprising that the immediate enrollment rate declined around 2004 and rose during the recession period, since high school completers tended to enroll immediately when the market is suppressed. The trend is especially obvious for two-year colleges, probably because the most vulnerable to the labor market shock are those on the margin of attending college. When the economy flourished, more students delayed four-year colleges, while more students enrolled immediately in two-year colleges when the housing market fell.

Figure 1.3 Percentage of recent high school completers who were enrolled in 2- or 4-year colleges immediately after high school completion, by level of institution: 1990–2015



NPSAS also contains information on the length of delay. Figure 1.4 illustrates the distributions of the duration of delay for the six cohorts from 1993 to 2012. One significant trend is that short-term delay became more common, mostly in the one-year range, while the proportion of longer delay dropped rapidly after 2000. The length of delay might reflect different reasons and motivations to delay and return. For instance, long-term delayers may never expect to return to college when they completed high school. The postsecondary education is more like an on-the-job training instead of a formal education for them. As a comparison, short-term delayers may deem delay as a rest during the transition. Gap years would not change their initial college choice. Thus, knowing the characteristics and the consequences of short-term and long-term delay becomes another significant topic. Chapter 3 will discuss these questions in detail.

Figure 1.4 Distribution of the Length of Delay



Source: National Postsecondary Student Aid Study

Given the extent of delayed enrollment, the question remains – what makes students decide to postpone their postsecondary education? The next section will attempt to answer this question conceptually.

1.3 Theoretical Framework

1.3.1 Theory of Human Capital Investment

Under the traditional model of human capital investment developed by Mincer (1958) and Becker (1962), the decision to defer college entry is based on the marginal benefit and the marginal cost of doing so. Kane (1996) models college enrollment decision to demonstrate that deferring college entry is not a rational decision under a perfect market as the present value of college payoffs is always larger than the present value of costs. Nevertheless, the assumptions of this model may not hold. In Kane's model, wages for high school graduate and bachelor degree holders are constant over time, therefore, the opportunity cost and the return to higher education is presumed to be time-invariant. In fact, wages increase during economic expansion and stagnate in recessions. Considering the fluctuations in opportunity cost, a student might strategically adjust their education plans in response to local labor market change, especially for those who lack information about the payoff to college (Bettinger et al., 2012), or face credit constraints that force them to put a high value on current income (Lochner & Monge-Naranjo, 2011).

Dellas and Sakellaris (2003)'s model of the cyclicality of schooling fills the gap of literature by pointing out that opportunity cost consideration makes schooling countercyclical. More importantly, the authors see work experience achieved outside schooling as on the job training, which increases human capital accumulation too. By adding time-variant costs of higher education and human capital developed by post high school working experience, Dellas and Sakellaris (2003) conclude that the propensity to enroll in college is negatively related to the current wage of unskilled labor, the real interest rate, and the direct cost of education, while positively related to the expected future wages of college graduates. Hence, people are more inclined to invest in educational activities when current wages are lower relative to future wages, which lowers the opportunity cost of enrolling school. Going to school is a safe port for students in an economic recession storm.

But what has been overlooked by both Kane and Dellas and Sakellaris is that the cost of obtaining human capital might be heterogeneous to students. Based on Ben-Porath (1967), the production function of human capital is determined by variety of factors, including innate or acquired abilities, the quality of co-operating inputs, and the constraints and opportunities offered by the institutional side. The time students devote to schoolwork may produce the diminishing marginal amount of human capital (Scott-Clayton, 2012). Therefore, continuing postsecondary education without breaks might not be optimal for all students in all situations. For example, for some students who were not yet prepared for college-level study and lack academic skills, immediate enrollment is costly in terms of time endowment. Students will balance the marginal benefit of delaying college against the marginal cost to their academic performance and progress. Individuals with greater academic preparation and achievement are more likely to enroll in postsecondary education immediately because they have a higher possibility to obtain admissions, and to successfully complete the educational program and realize earnings premium; students with greater personal financial resources are more likely to enroll in postsecondary education immediately because they have fewer financial constraints.

In conclusion, individuals might respond strategically to the change in the labor market by choosing to enroll in college when demand for skilled employment is higher or wages for unskilled employment are lower. The wage for high school graduate w_0 is positively related to the propensity of delaying college enrollment, while the wage for a college graduate w_1 is negatively related to the tendency of delaying enrollment. In addition, a higher discount rate imposes a higher cost for borrowing, leading students reluctant to borrow and more willing to work for income. Student ability is negatively associated with delayed enrollment – an academically disadvantaged student may find less benefit in immediate enrollment because he or she needs more years to complete college and obtain college wage premium. According to the model, the higher tuition level leads to delay because deferring tuition could be beneficial for students.

1.3.2 Behavioral Economic Model

Economic theories treat individuals as rational ones. But sometimes, people do not see education as an investment or use a rational, forward-looking sight to maximize lifetime welfare given various resource constraints. In the real world, people may not think in the long-term, and instead rely on rules of thumb of past habits, which usually lead to subprime outcomes. The behavioral economics that integrates the knowledge from psychology, neuroscience, and sociology can help us better understand individual decision making on enrollment timing.

Three key implications can be summarized from the behavioral economic model. First, some students focus too much on the present (Lavecchia et al., 2014). Young people are especially prone to the short-term sighting. For example, Bettinger and Slonim (2007) find that more than 43% of children in their sample aged from 5 to 16 are impatient and have a high implicit discount rate via an artefactual field experiment which examines the intertemporal choices between varying levels and timings of compensation received. Particularly on the decision of college enrollment timing, present-biased behavior leads to over-emphasizing the cost of college relative to the potential future benefit, thus stimulating some students to defer higher education plans and choose to earn wages immediately after high school.

Another implication of the behavioral economics is debt-aversion. As tuition has increased and federal grants have declined, loans have become the prominent form of student funding for postsecondary education (Long, 2008). Under a perfect market, although all students are free to borrow for college expense, not all students will choose to do so. Some students may overemphasize the risk by discounting future gain more than future losses. Long and Riley (2007) find the students of color tend to borrow a smaller amount on average. Perna (2008) surveyed students from 15 schools on their perception and willingness to take on student loans. The result suggests that students at low-resource schools are “generally reluctant to borrow, question whether the benefits of borrowing exceed the costs, and worry about the need to repay loans” (p. 601). As such, without enough savings and financial aids, risk-averse students may not choose to enroll in college immediately in order to smooth the current and future consumption.

Second, some students stay with routine more than others (Lavecchia et al., 2014). Routines could be problematic when students are in a transition period, which needs to break daily routines. The research on “summer melt” – a phenomenon that “college-intending high school graduates fail to matriculate anywhere in college in the year following high school” (Castleman & Page, 2015, p. 145) – explicitly explains how relying on routines affects students’ college trajectory. Castleman and Page (2014) find that low-income students who have been accepted to college and signaled their intent to enroll have a disproportionately higher attrition rate in the summer after high school graduation because they failed to finalize tasks associated with matriculation. After admission, there are a number of complex financial, procedural, and logistical tasks during the summer such as paying deposit, completing Federal Application for Financial Student Aid (FAFSA), and dormitory application (Castleman & Page, 2014). Despite these many requirements, the summer between high school and college is a nudge-free time, especially for low-income students, who no longer have access to high school counselors and may be unfamiliar with support resources available at their intended college (Castleman & Page, 2015). Their experimental study shows that creating “nudges” (by sending reminders of the key tasks they need to complete via text messages) helps students maintain focus and manage their time throughout the college planning process.

Third, insufficient information or complexity may set barriers to on-time enrollment (Lavecchia et al., 2014). For decades, researchers have found that students and parents are not fully aware of education costs, benefits, and options. A report from the Advisory Committee on Student Financial Assistance (2005) documents that students, parents, and adult learners are often intimidated by news stories about skyrocketing college cost of the most selective colleges, and have the impression that college is unaffordable. Avery and Kane (2004) demonstrate that low-income high school students especially have very little information about actual college tuition levels, financial aid opportunities, and the application process. While a low level of awareness can lead to suboptimal outcomes, complexity in terms of the application process can also be a source of informational barriers. For example, to receive Pell Grant or work-study funds, students need to complete the Federal Application for Financial Student Aid (FAFSA), which has been criticized for its length and complexity. Among students who did not complete FAFSA, more than 20% of them would have been eligible for Pell Grant (King, 2004). Faced with the time and cognitive burdens associated with college and financial aid applications, students may delay addressing or abandon a key step in the admissions process, particularly if students have preference for other activities in the present (Beshears et al., 2006; Castleman & Page, 2015; Madrian & Shea, 2000; Scott-Clayton, 2011). In two studies done by Castleman et al. (2012) and Castleman and Page (2015), misinformation is the another major reason for the summer melt phenomenon. Due to a lack of college-educated family members or college counselors, low-income students cannot confront challenges to complete the tasks they need to do during the summer in order to be prepared to start college on time.

Compared to the human capital model, the behavioral model emphasizes how disadvantaged background sets barriers to on-time enrollment - through misinformation, hyperbolic discount rate, and procrastination. Compared to the discount rate, the behavioral economic model considers that the implicit discount rate is more important for its effect on an individual's time-inconsistent preference. For this reason, a person with higher implicit discount rate will prefer work or other activities in the present, and be less likely to borrow for college in order to obtain higher future incomes. Like the behavioral economic theory, sociological theory believes low socioeconomics contributes to nontraditional enrollment. The following section will introduce the sociological model in detail.

1.3.3 Sociological Model

Individual's action should be fully understood while considering the social or cultural contexts in which the action occurs. The educational decision is not universal but may vary across social groups. Hearn (1992) raised four sociological mechanisms through which students' educational aspiration to traditional enrollment is obscured by their social or cultural background. First is an ascriptive influence – students choose nontraditional enrollment options because of pressures caused by traditionally ascribed social and cultural roles. For example, married women with or without children may face time constraints to attend colleges, so they have to delay college enrollment until time constraint is released. Similarly, those from certain minority backgrounds may face cultural constraints that impede college attending aspiration. The socioeconomic constraint is the second explanation for non-traditional enrollment patterns. Nontraditional enrollment is rooted in social-class socialization as well as financial concerns. A survey done by Hossler et al. (1999) shows that parental support is very important for students' postsecondary decisions. Educated parents can offer more support and encouragement not only in finance but also in information collection and aspirations. The third hypothesis is that academic marginality sets barriers for students to obtain higher education. Students choose to deviate from traditional educational trajectory because their modest academic abilities and achievements in secondary school isolate them from the college-intending track and resources

(Goldrick-Rab & Han, 2011). An individual with higher level of academic abilities and achievements also receives greater encouragement for educational aspirations from "significant others", such as parents, teachers, counselors, and peers (Hearn, 1984; Perna, 2006). Finally, students who choose a nontraditional enrollment are likely to end up with other nontraditional enrollment options. For example, a student who delayed higher education is very likely to enroll in part-time or non-degree-granting programs. Hearn concludes that certain students display consistent nontraditionality, which means certain individuals will be especially prone to nontraditional enrollment.

Different from the behavioral model, the sociological model explains the effect of SES status by its influence on educational aspirations, cultural/social capitals, and academic marginality. In summary, no single model can explain the reasons and mechanisms of college enrollment delay alone. Some factors may influence the decision via different channels. In the next section, I will revisit the hypotheses by overviewing the empirical literature. I will discuss the extent to which these studies are consistent with each theoretical model or not.

1.4 Overview of Empirical Evidence

1.4.1 Previous Research

Tuition is one of the primary determinants of college enrollment timing in the human capital model. Kane (1996) documents that delayed college entry happens more commonly in high-tuition states. Kane analyzes the college entry age by the state cohorts and concludes that it is primarily low-income students who are sensitive to tuition levels – a $1,000 increase in tuition is associated with a 10 percentage points decline in entry rates for blacks by age 18-19, compared to 3 percentage point for white youth. Because of the data limitation, Kane defines delayed enrollment as college entry between the ages of 20 and 23. However, as stated in the previous section, older enrollment might not be completely attributable to delayers. Other nontraditional enrolling behaviors, such as late high school completion, second-degree pursuit, or interrupted college attendance could lead to the older age of entry.

In addition, the local employment market helps to explain the difference in college enrollment patterns. Johnson (2013) uses the unemployment rate before students enrolled in college as a proxy of the opportunity cost of enrollment. Compared to the 7.9% unemployment rate for all students aged 18-20 in the sample, the unemployment rate for those who delayed college entry is 0.8 percentage points higher, suggesting that more delayers enrolled in college when the economy turned down and career opportunities were fewer. Both Ferrer and Menendez (2014) and Fortin and Ragued (2016) have the similar findings using a Canadian national survey of postsecondary graduates. Ferrer and Menendez (2014) find that one additional point increase in the unemployment rate at the time before high school graduation decreases two-year college enrollment delay by 24.9 percentage points and decreases four-year university enrollment delay by 8.5 percentage points. In addition, studies find men are more likely to delay college enrollment than women (Kane, 1996; Rowan-Kenyon, 2007), which is possibly explained by male's advantage in low-skilled jobs, which are mostly occupied by high school graduates.

Student ability also affects college enrollment timing. Horn et al. (2005) indicate that compared to traditional students, delayers completed more remedial math courses, less advanced math courses, and took lower academic intensity level curricula. Delayers usually have a lower class ranking, GPA, test score and SAT/ACT. This finding is consistent with the conclusion of Rowan-Kenyon (2007), whose research shows that immediate entrants have more than one-half higher standard deviation on math scores than delayed entrants. Goldrick-Rab and Han's study

(2011) provides evidence that students who have taken more science courses are less likely to delay college.

If facing a financial constraint, a student may not go to college even if the marginal benefit exceeds the marginal cost (Dellas & Sakellaris, 2003). Johnson (2013) finds that borrowing constraint is associated with delaying behaviors. Late enrollees are less likely to receive parent transfers, grants, and loans. If borrowing constraint is removed, immediate entrants would increase by one percentage point. Rowan-Kenyon (2007)'s study documents that 24% of the students who delay enrollment have zero financial aid contacts in the 12th grade, which is 7 percentage points higher than the immediate enrollment group.

In general, studies on the economic factors determining enrollment timing are consistent with human capital theory – students choose to enroll in college when demand for skilled employment is higher or the cost of attending college is lower. One limitation is the external validity that generalizes the result to the more current population. For example, Kane's study (1996) is based on a sample of 18-19 years old in 1970-1988. In that time period, it was possible/rational to delay college entry to save for college because tuition was lower and college costs did not rise as quickly. But in recent decades, deferring college enrollment because of tuition would only make students face higher tuitions later, as tuition and fees have continued growing at a faster rate than the real income. During the 2014-2015 academic year, the average cost (tuition, fees, room and board rates charged for full-time undergraduate students) was $ 21,728, which is 2.1 times the price in 1984-1985 in real terms (Snyder et al., 2016b). Likewise, it is less likely that working to save for college rather than borrowing could cover tuition and fees in recent decades. From 1984-2015, real median household income in the U.S. only increased by 8%. Moreover, students who work significantly the year before entering college will be penalized in the determination of the Expected Family Contribution (EFC), the amount that a family is estimated to be able to provide towards higher education expenses (Long, 2008). Consequently, working before college enrollment will decrease the amount and or imperil the possibility of receiving need-based financial aid, such as Pell Grants. Therefore, it is suspicious that working before college can really mitigate financial pressure nowadays. In addition, there are not so many studies employing experimental or quasi-experimental methods. Most of the studies focus on the correlations of student demographics and the delay, which cannot draw a causal conclusion.

There is a great deal of attention to college enrollment timing in the field of behavioral economics. The research on summer melt exploits the two major behavioral factors (Castleman et al., 2012; Castleman & Page, 2014, 2015; Castleman et al., 2013) – procrastination and misinformation. Castleman et al. (2012) use an experimental study to investigate the effect of providing college counseling to low-income students during the summer. They randomly assigned students at high schools to receive counseling services on securing additional financial aid, completing necessary paperwork, and alleviating concerns about going to college. Results show that providing college counseling to low-income students during the summer improves both the rate and quality of college enrollment. In the other experiment implemented in 2012 in both Dallas and Massachusetts (Castleman & Page, 2015), students were randomly selected to receive an automated and personalized text messaging about required pre-matriculation tasks and to connect them to counselor-based support. The interventions substantially increased college enrollment among students who had less academic-year access to quality college counseling or information. Though summer melt only represents one type of delay, these studies provide valuable causal evidence that behavioral problems lead some students to deviate from their initial college plan.

Sociological factors also affect the timing of college entry. It is widely accepted that students delaying college enrollment come from families from the underrepresented racial group or with lower SES, for instance, lower parental education, and larger family size (Bozick & DeLuca, 2005; Hearn, 1992; Horn et al., 2005; Johnson, 2013; Rowan-Kenyon, 2007). Horn et al. (2005) particularly study how the student characteristics differ by the duration of delay and indicate that the short-term delayer is at a severer socioeconomic disadvantage than long-term delayers.

Hearn (1992) indicates that one possible mechanism through which SES influences enrollment timing is by affecting educational aspirations. Johnson's study (2013) provides empirical evidence that the shock to a preference for schooling is the main contributor to delayed entry to college. Students face time constraints as well, such as marriage and parenthood. The role of spouse or parent alters the time use and financial resources distribution. As a result of early transition to adulthood, young adults being married or parents confront higher pressure in time allocation and financial resources (Bozick & DeLuca, 2005). Having a child and marrying prior to college increase the chance of college delay by 12.5% (Goldrick-Rab and Han, 2011). Compared to the normal entrants, delayers are significantly more likely to be financially independent under age 24, which is the typical age cut-off for independence (Horn et al. 2005).

1.4.2 Evidence from the Education Longitudinal Survey 2002

With the hypothesized factors listed above, in this section, I develop the descriptive analysis to explore the determinants of delayed enrollment using the Educational Longitudinal Survey (ELS) of 2002. The ELS:2002 is a national representative, longitudinal study of 10^{th}

graders in 2002. The second follow-up was conducted in 2006, two years post the year of high school graduation. The sample includes 1,220[3] students who postponed the college entry and returned within two years.

The most straightforward way to measure the reasons for delaying enrollment is to ask delayed students, "What is the major reason making you delay the college enrollment?" The ELS required all the delayed students in the sample to provide reasons for delaying enrollment in the second follow-up survey.

As Table 1.1 shows, in general, financial concern is an important factor influencing

Table 1.1 Main Reasons Delayed Continued Education

Reason	All	Female	Male	White	Black	Hispanic
Financial Constraints						
Could not afford to go on to school	6.9%	7.4%	6.4%	5.6%	7.4%	8.5%
Needed to earn money for school	8.7%	8.9%	8.8%	9.2%	8.3%	7.7%
Did not receive enough financial aid	4.1%	4.2%	3.8%	3.0%	6.5%	3.8%
Needed to help support family	7.2%	7.5%	6.2%	4.4%	11.1%	8.5%
Academic Preparation						
Not accepted at desired school(s)	1.9%	1.8%	1.6%	1.1%	4.2%	1.7%
To improve academic qualifications	2.1%	1.2%	3.3%	1.6%	4.2%	2.1%
Only admitted on deferred basis	1.2%	0.5%	2.0%	1.4%	0.9%	0.4%
Preferences						
Wanted to work	25.2%	20.6%	30.7%	25.7%	25.5%	29.9%
Wanted to serve in military	5.2%	2.2%	8.2%	5.6%	3.7%	3.8%
Wanted to travel/pursue interests	9.9%	9.9%	10.6%	11.6%	2.8%	9.4%
Life Shocks						
Traumatic experience	2.6%	3.9%	1.5%	2.1%	4.6%	2.1%
Personal health reasons	2.6%	3.5%	1.3%	3.0%	1.9%	2.1%
Pregnancy/childcare/marriage	4.0%	7.4%	0.2%	5.6%	5.1%	3.0%
Taking a break	4.9%	6.0%	3.7%	5.5%	8.3%	6.0%
Undecided on major, career, or school	2.9%	3.3%	2.4%	4.1%	0.9%	3.4%
Other specific reasons[1]	10.7%	11.9%	9.5%	10.4%	4.6%	7.3%
Observations	1,220	600	550	570	220	230

Note: 1. Other reasons including the educational aspiration factors like "feeling college is not for me", academic preparation factors like "not mentally ready for college, family relocation reasons, and procrastination factors like "apply late" etc.

[3] All the sample sizes of ELS: 2002 are rounded to the nearest ten protect the confidentiality.

students' decision to defer higher education. 6.9% of delayers said they could not afford to go on to school; 8.7% needed to earn money to pay for school; 4.1% had to delay because they did not receive enough financial aid. Academic disadvantage contributes another 4.0% in total, with the half failing to get desired offers and the other half waiting to improve academic qualifications for the future opportunity. The sociological factors are reflected here from the perspectives of military duty, health reasons, pursuing personal interests, deferred program, family issues, marriage/pregnancy/childcare, and taking a break. Although none of every single reason exceeds 10%, in total they comprise over 50% of the motives driving students to delay. What is also notable is that the preference for work is more significant than others as a single factor. This option is relatively different from the financial constraints such as "could not afford", "needed to earn money", and "did not receive enough aid". The motivations behind this reason can be multiple, such as aspirations, economic concerns (not necessarily constraints), and tastes.

If we separate the sample by gender, men are more likely to delay because they want to work and serve in the military, while women are more likely to delay because of earlier adulthood transition (pregnancy/childcare/marriage). It is worth investigating why males are more likely to delay for the reason "wanted to work". One tentative explanation is that men are more sensitive to local labor market shocks because they have relatively more advantage in low-skilled jobs for high school graduates, e.g. construction and mining workers. When there is a boom in demand for low-skilled workers, men are more likely to be lured to work after high school for the higher opportunity cost of attending college. I will examine this mechanism specifically in Chapter 2.

The reasons for delay also vary by race. Compared to whites, blacks and Hispanics are more likely to delay due to financial constraints and less likely to pursue personal interests during the gap years. Furthermore, black students face academic constraints slightly more than the other two groups. This finding is consistent with the sociological research that students from minority families are more likely to be constrained financially and sociologically in college attendance.

In conclusion, from both previous studies and evidence from ELS:2002, enrollment timing has many contributors including economic concerns, sociological constraints, as well as behavioral reasons. Although enrollment timing is ultimately based on a comparison of the benefit and cost of enrolling, assessments of benefit and cost are shaped by both individual's background and behavior, as well as social context. Sometimes, these factors take effect via multiple mechanisms, directly and indirectly.

1.5 Summary and Policy Implication

This chapter reviews the conceptual frameworks and empirical evidence to explain the phenomenon of delayed college enrollment. It concludes that enrollment delay cannot be explained solely by market failure or life shock as conventional human capital theory predicted. The tendency to delay varies by sociological contexts and individual's habitus. Economic concerns, demographic characteristics reasons, and behavioral factors all contribute to the postponement. In general, higher costs (direct and indirect cost) and lower benefits of attending college increase students' financial concern and the tendency of enrollment postponement. Some students may not take the optimal path because their behavior departs from economic rationality. Disadvantaged SES background creates social constraints for students to enroll on time. Last but not least, delayed enrollment extensively reflects the result of preferences to other activities, such as working, traveling, and taking breaks.

The primary implication we can learn from the previous literature is that college enrollment timing that departs from the human capital model's prediction is sufficiently common to receive more attention. It might be very costly for policymakers to identify the entire population who have the intention to delay college enrollment because, at the moment of leaving schools, some high school graduates who choose not to attend college have no idea whether they want to return to school in the future. However, for those who have been accepted to college and signaled their intent to enroll but ultimately do not enroll, it is worthwhile to define the target population and mitigate unnecessary attrition. From Castleman and Page (2014)'s estimation, 10% to 40% of low-income students who have been admitted by postsecondary institutions do not persist on their initial plan. At least for this specific group of delayers, Castleman et al. (2012)'s research suggests that for low-income students, active college counseling and nudging text message during the summer after high school graduation leads to substantially higher rates of college enrollment in the following fall.

Still, the consequences of delay are not discussed in this chapter. What has been ignored by prior studies is that some delayers may never return to school once they deviate from the educational trajectory. Even if all delayers eventually enroll, they may be unable to gain the same return as they could have gained when attending immediately. In addition, there is a gap in literature as to the causal effect of a specific factor on the possibility of delay, or to what extent, delay changes college choice/income? In the next two chapters, I will address the gap by providing causal evidence that, (1) changes to the opportunity cost of enrollment resulting from labor market shocks is a causal explanation for some students deferring college enrollment after graduated from high school, (2) enrollment delay reduces both academic and labor market outcomes.

Overall, enrollment timing is a field with little research attention. Chapter One addresses the gap via a comprehensive overview of the mechanisms through which students choose to delay college enrollment, as well as a summary of the previous empirical research that provides evidence for the determinants of college enrollment timing. However, more research is needed to draw a solid conclusion on the reasons and results of the enrollment delay. In the next two chapters, I will exploit natural experiments and propensity score matching to provide causal evidence for further discussion.

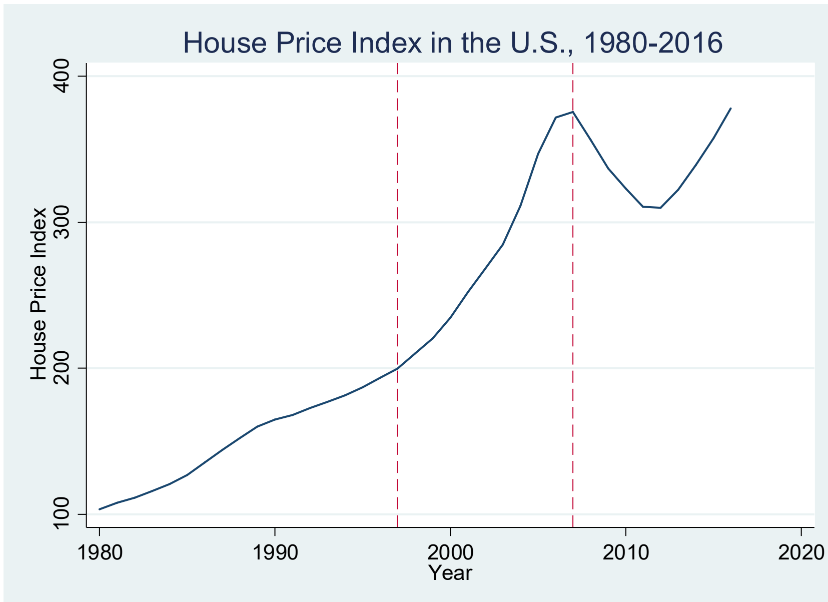
Chapter 2. Do temporary delays in the transition to college have long-term consequences? Evidence from housing market shocks

2.1 Introduction

As demonstrated in Chapter 1, one of the most pronounced patterns of the past decades is the relationship between college enrollment and the economy. It is widely believed that local economic shocks affect educational attainment countercyclically (Betts & McFarland, 1995; Black et al., 2005; Cascio & Narayan, 2015; Charles et al., 2015; Dellas & Sakellaris, 2003; Evans & Kim, 2006; Kane, 1994; Walstrum, 2014). However, the nature of economic shocks has meant that most previous studies have used census data to present macro-level information (state, city, commuting zone, etc.). They estimate the immediate educational response to labor market shocks, and arguably understate the possibility of long-term consequences. In addition, increasing evidence suggests that initial labor market conditions (e.g. graduating in a recession) can have long-term effects on earnings (Beaudry et al., 2016; Genda et al., 2012; Kahn, 2010; Oreopoulos et al., 2012; Schmieder & Von Wachter, 2010), but most of these papers explain the effect of macro-economic conditions through its influence on job placement rather than educational attainment.

This chapter examines how college enrollment timing responded to one of the most substantial housing bubbles in U.S. history, in mid-2000. From 1997 to 2007, after a decade of stable increase, national housing prices rose by approximately 50% (Figure 2.1), substantially increasing the demand for low-skilled construction labor. I exploit this natural experiment to discover the college enrollment timing across areas with different housing boom sizes. In contrast to the papers that estimate education elasticities to the price booms and busts in housing markets (Charles et al., 2018; Charles et al., 2015), I use the annual change in the number of building permits as a proxy for housing market shocks, arguing that the occurrence of the demand for low-skilled labors of construction in some areas and not others is plausibly

Figure 2.1 House Price Index in the U.S., 1980-2016



Data Source: Federal Housing Finance Agency (FHFA)

Note: vertical reference lines indicate year 1997 and 2007, the beginning and end of the housing boom.

exogenous of college enrollment delay. In comparison, the variation in housing prices also impact household wealth, which is endogenous to college enrollment decision. Thus, relying solely on housing prices may capture both the wealth effects on schooling among home-owning families and the substitute effects of changing labor market conditions on educational attainment among all peoples in a market. Using the change in building permits can isolate the boom effect on high school graduates from the effect on household wealth.

The notion that underlies this empirical approach is that the opportunity cost of college is a consideration for potential delayers, especially those who lack information about the return on investment from college (Bettinger et al., 2012), and those who face credit constraints that force them to place a high value on current income. Construction labor demand shocks have favored the less-educated, particularly males without a college degree (Charles et al., 2015), thus increasing the opportunity cost of college. The sample used for analysis is the restricted-use version of the Education Longitudinal Survey: 2002 (ELS:2002), which is a nationally representative, longitudinal study of tenth graders in 2002, conducted by the National Center for Education Statistics (NCES). Since the sample only contains one cohort, this paper exploits variation across counties in the quantity of the annual building permit changes as exogenous variation, and investigates the enrollment behaviors of the students who reside in different counties.

With a hypothesis that the local housing boom induced some high school graduates to delay their enrollment in college, this chapter also examines the long-term effect on student re-enrollment and completion. Previous research has not reached a consensus on the consequences of enrollment delay. Some studies have argued that the possible existence of barriers sorts delayed enrollees into inferior tracks, e.g., two-year colleges or part-time programs (Bozick & DeLuca, 2005; Horn et al., 2005). Others have indicated that delay has a positive return by giving students more years to resolve the uncertainty of educational returns before entering college (Ferrer & Menendez, 2014; Fortin and Ragued, 2016). Moreover, due to data limitation, almost all previous studies have focused on delayers who eventually enrolled in college (college-goers), which ignores the effect of delay on college re-enrollment. This chapter includes all high school graduates in the sample and provides additional causal evidence to the recent studies on the educational impacts of college enrollment delay.

I identify a small but precise booming effect on college enrollment delay: an additional increase of 100 building permits leads to a 0.24 percentage point increase in enrollment delay for male high school graduates. Although a local housing boom temporarily lures more male students to delay their college education, students who do not enroll immediately return to college within three years of high school graduation. By the end of the eighth year (2012), the booming effect has diminished to an insignificant 0.1 percentage points, meaning that there is no evidence to suggest that a local housing boom has a long-term effect on college enrollment. However, the estimation of college choice suggests that a housing boom makes returners less likely to enroll in four-year colleges and more likely to enroll in two-year colleges. The college completion rate eight years after graduating from high school is lower for the male delayers than the on-timers.

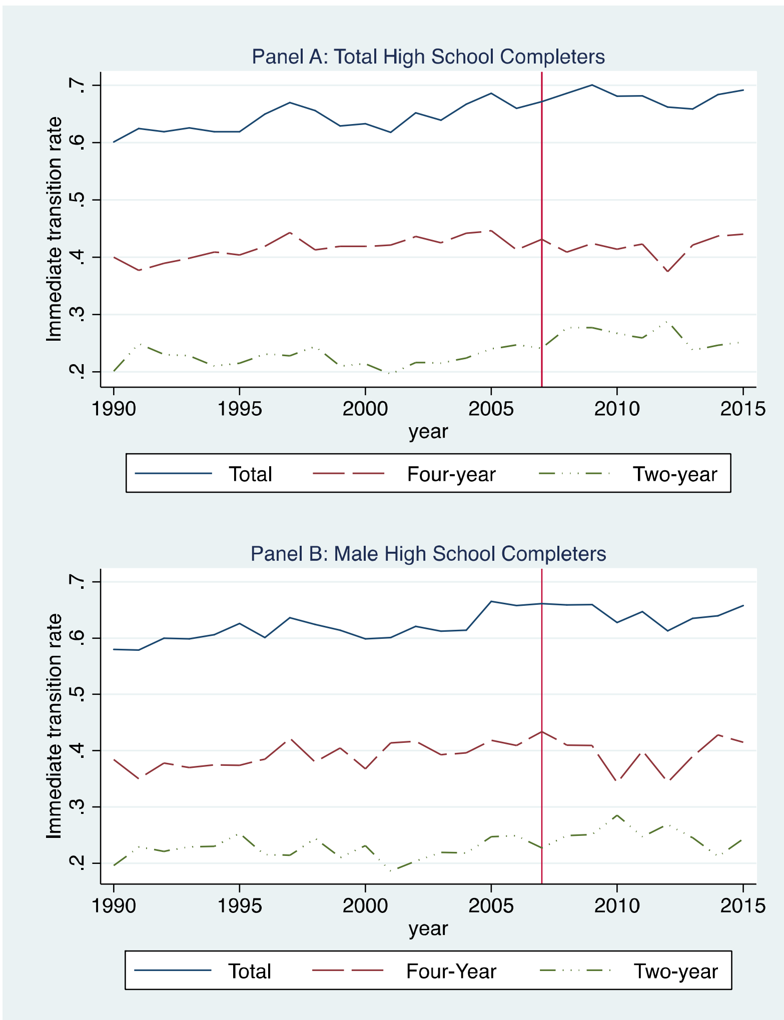
This chapter makes several contributions to the literature. Firstly, it is the first study to attempt to provide a causal explanation for college enrollment delay. Secondly, it predicts the effect of the housing boom on the delayers who returned to college. Thirdly, by using longitudinal data, this study is able to examine long-term consequences and more detailed educational outcomes that cannot be determined by using the census data.

The rest of this chapter is organized as follows. Section 2 presents a descriptive analysis of the extent of delayed undergraduate enrollment, and trends in the U.S. housing market in past few decades. Section 3 introduces the conceptual framework of the college entry timing, and predicts the factors that could influence enrollment decisions and their consequences. Sections 4 and 5 outline the research design and data. Section 6 discusses findings, and Section 7 concludes the chapter.

2.2 Descriptive Analysis

College enrollment in the U.S. has been increasing for decades; the post-secondary education attendance rate for high school graduates increased from 45% in 1960 to 68% in 2015 (Snyder et al., 2016). Meanwhile, students commonly delay their college enrollment after graduating from high school. To better understand the extent of delayed college enrollment and how it responds to macroeconomic conditions, I present the immediate college transition rate over the past twenty years. Panel A in Figure 2.2 illustrates that almost 70% of high school graduates in recent few decades immediately continued their education in two-year or four-year

Figure 2.2 Percentage of Recent High School Completers Who Were Enrolled In 2- Or 4-Year Colleges Immediately After High School Completion, By the Level of Institution: 1990–2015

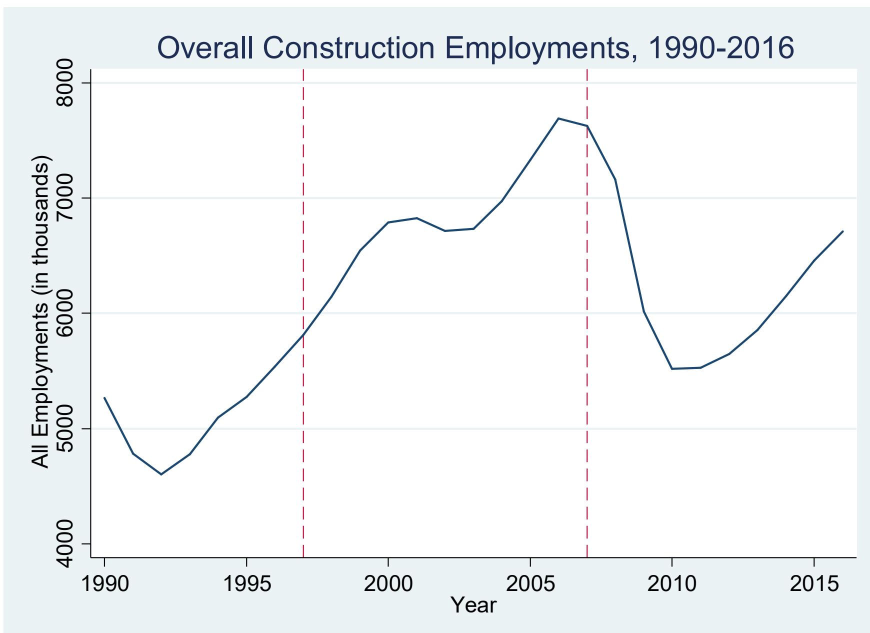


Data Source: Digest of Education Statistics (1990-2015)
Note: Vertical reference line indicates year 2007, the end of the housing boom.

colleges. The immediate enrollment rate declined in the era of the housing boom (1997-2001, 2005-2006) and rose during the recession; this trend is particularly remarkable for two-year colleges and males (Panel B). It implies that males at the margin of attending college are the most vulnerable population for labor market shocks.

Using data from the Bureau of Labor Statistics, Figure 2.3 shows overall employment in the construction sector, which apparently closely followed the price trend of the national housing market. From 1997 to 2007, total employment in the construction sector increased by more than 30%, from 5.8 million to 7.6 million. When the housing market collapsed, it dropped to 5.5 million in 2010.

Figure 2.3 Overall Construction Employments, 1990-2016

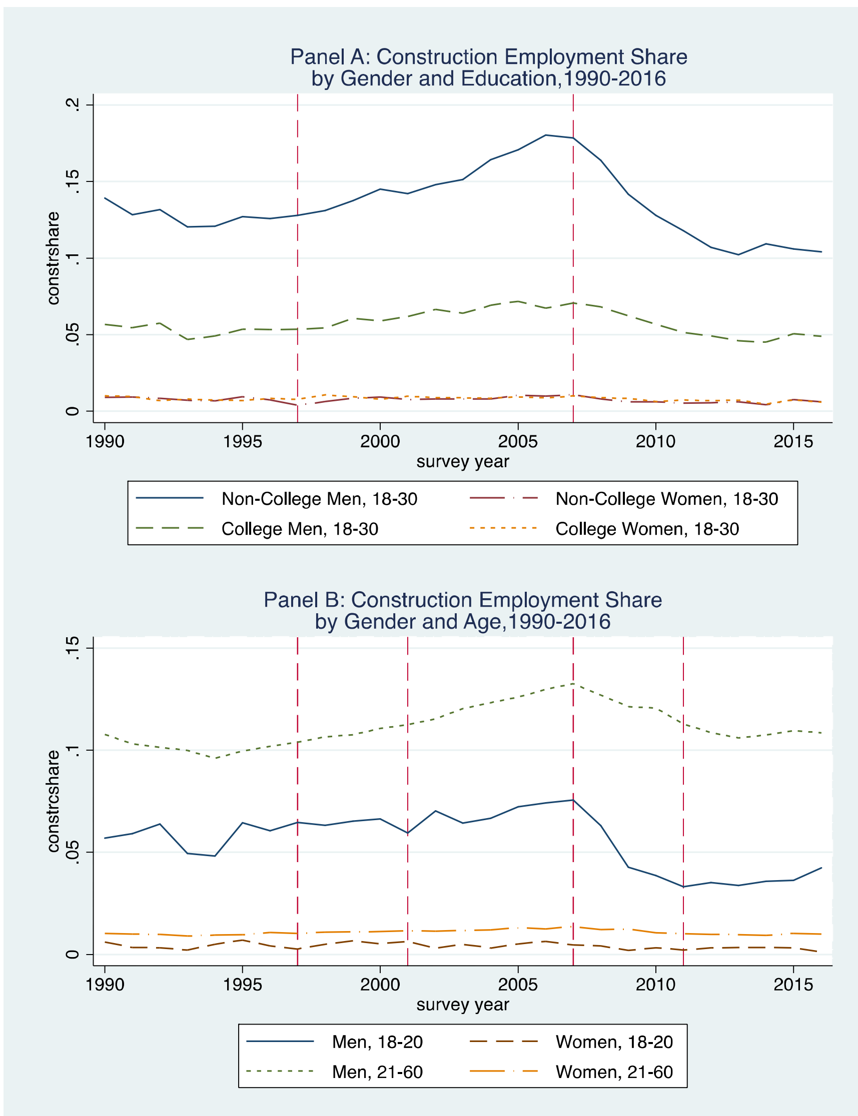


Data Source: Bureau of Labor Statistics

Note: Vertical reference lines indicate year 1997 and 2007, the beginning and end of the housing boom.

Panel A in Figure 2.4 depicts the fraction of total population employed in construction by gender and education groups. Clearly, employment in the construction sector was dominated by non-college males (aged 18 to 30), for whom the employment share in construction increased from 14% to 18% during the housing boom. For both education attainment levels, the share of women employed in the construction industry only accounted for a very small portion and changed little in the past few decades. More specifically, Panel B narrows the target population to those aged 18 to 20, which is mainly composed of high school graduates. Compared to females, young males were disproportionately overrepresented in the construction sector during the housing boom from 2001 to 2007. More notable still is the plummet of the share of young men after 2007, which suggests that male construction workers of college age were the most sensitive to the collapse of the housing market.

Figure 2.4 Construction Employment Share of Total Population, 1990-2016

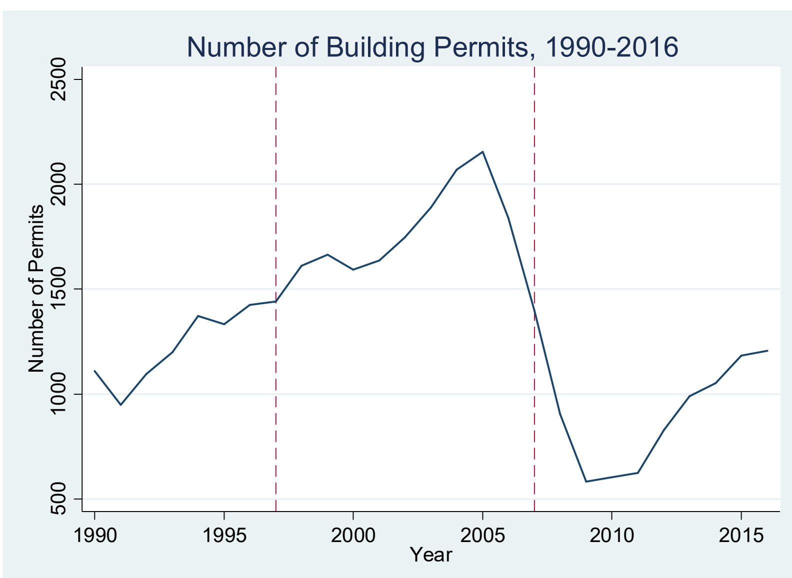


Data Source: Current Population Survey

Note: Vertical reference lines indicate year 1997 and 2007, the beginning and end of the housing boom.

Since variation in housing prices affects household wealth, high school graduates might be more likely to enroll in college immediately than to delay, as their household wealth increased during the boom. Thus, relying solely on housing prices may capture both the wealth effects on schooling among home-owning families and the substitute effects of changing labor market conditions on educational attainment among all peoples in a market. In order to measure the changing labor market clearly, I use the change of building permits on new privately-owned residential construction, as it represents discrete and acute demand shocks for the construction labor market. Figure 2.5 displays the total building permits in the U.S. between 1990 and 2016. In contrast to housing price and employment, the number of building permits reached a peak earlier than 2007. This is because no actual construction work can begin until a permit has been issued, thus the trend for building permits precedes the trend for the construction labor market.

Figure 2.5 Number of Building Permits, 1990-2016



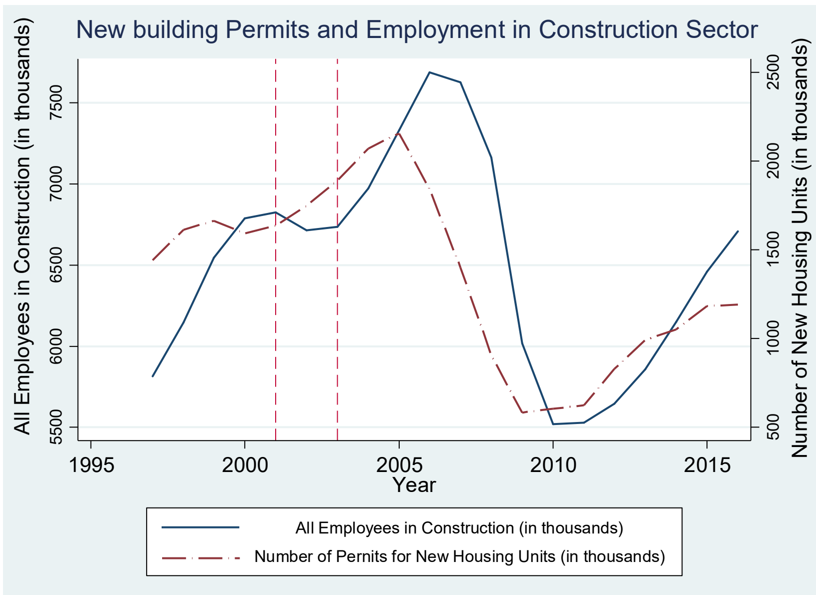
Data Source: Building Permit Survey, U.S. Census Bureau

Note: Vertical reference lines indicate year 1997 and 2007, the beginning and end of the housing boom.

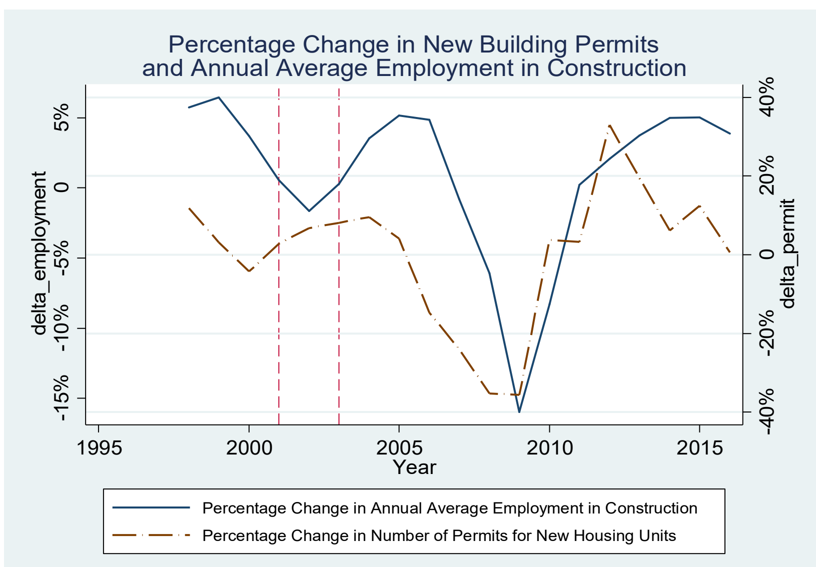
Panel A in Figure 2.6 demonstrates this lagged relationship more clearly by plotting the total employment in the construction sector and the number of building permits by years. Panel B presents the annual percentage of change in construction employment and building permits. Both panels demonstrate that an interval of approximately two years exists between the trends of building permits and construction employment.

Figure 2.6 New Building Permits and Construction Employments

Panel A



Panel B



Data Source: Bureau of Labor Statistics and Building Permit Survey

Note: Vertical reference lines indicate year 2001 and 2003, reflecting the two-year interval between change in permit and change in construction employment

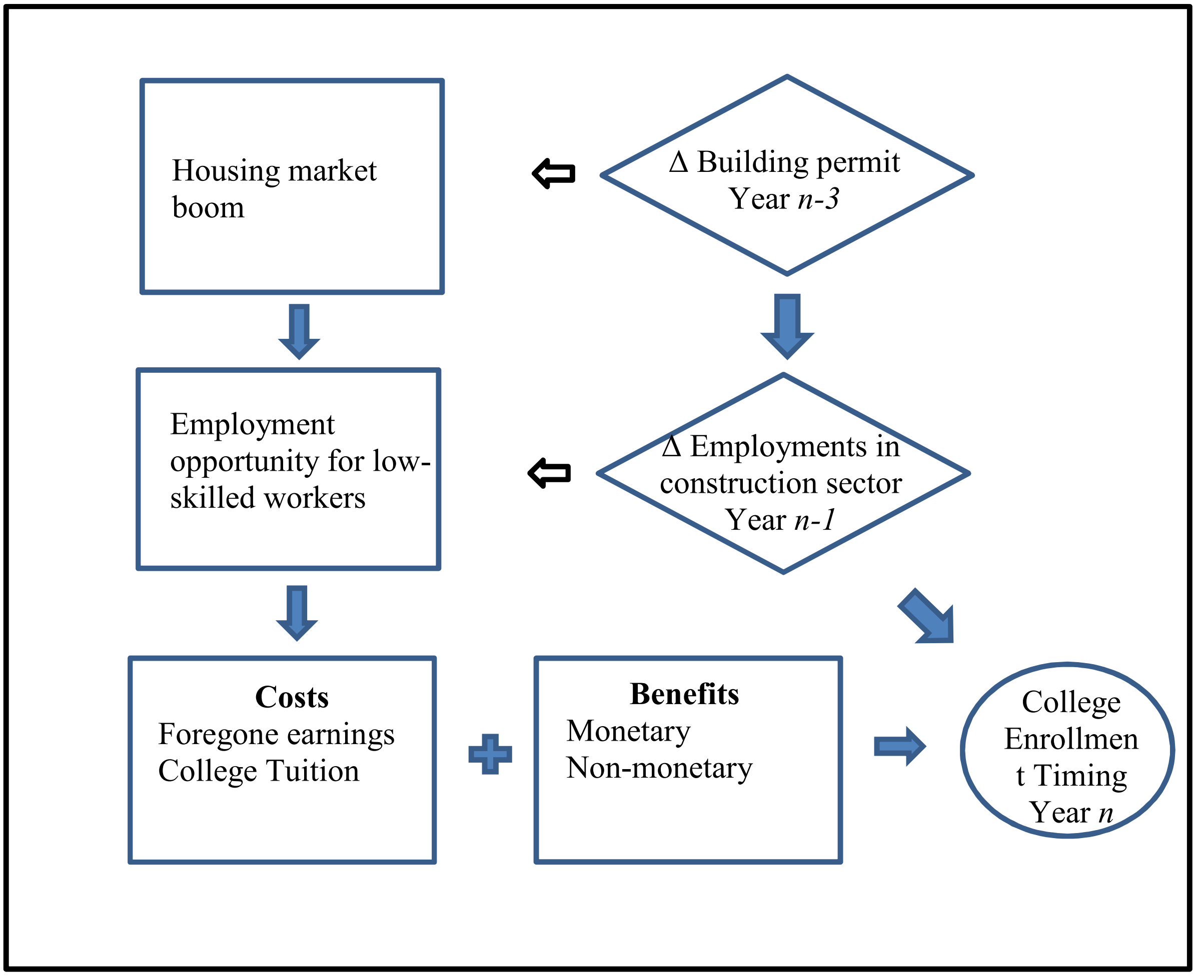
2.3 Conceptual Framework

Under the traditional model of human capital investment developed by Mincer (1958) and Becker (1962), the decision to defer college entry is based on the marginal benefit and the marginal cost of college enrollment. The higher opportunity cost of attending post-secondary education makes high school graduates less likely to enroll immediately[4]. When base wages rise or there is a positive economic shock, students tend to shift toward entering the labor market sooner and working longer hours. However, this shift is small when the expected skilled wage is higher than the unskilled wage, or when returns on human capital are high. An increasing amount of literature has identified post-secondary enrollment to be countercyclical with respect to national economic trends (Betts & McFarland, 1995; Cascio & Narayan, 2015; Charles et al., 2015; Dellas & Sakellaris, 2003; Evans & Kim, 2006; Walstrum, 2014). Occupations in construction are dominated by low-skilled workers according to the Bureau of Labor Statistics, and thus housing booms may increase the employment opportunities for high school graduates. This notion points to a possible mechanism that links local housing markets to students' college enrollment timing.

As illustrated in Figure 2.6, the pattern of change in new building permits is roughly two years ahead of the pattern of change in employment in the construction sector. Considering that high school students often decide between their junior and senior years to attend college, I examine the change in the number of local permits for new houses three years prior to high school graduation as the exogenous shock to opportunity cost, and use it as an instrumental variable (IV) for college enrollment delay[5]. To explain the mechanism visually, Figure 2.7

[4] The detailed theoretical model is presented in Appendix A.
[5] There are three reasons why I have selected annual change in the number of building permits rather than the percentage of change or the total number of building permits as a proxy of shocks to construction labor market. First, for some counties, the number of building permits increased from 0 in the base year. As such, a regular

Figure 2.7 Proposed Conceptual Model of College Enrollment



Note: Squares indicate the conceptual pipeline. Diamonds indicate the statistical pipeline.

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percentage of change cannot be calculated. Second, the percentage of change might not precisely reflect the size of local market shocks. For example, if the number of building permits increases from 1 in 2000 to 2 in 2001, it is a highly significant shock in terms of the percentage of change, but as a source of demand shock to labor, it does not lead to a sizable fluctuation in the local labor market. In the sample, over 900 out of 3,000 counties experienced such a small shock to their local labor markets (the number of building permits varied within 10 units). Third, the total number of building permits alone cannot reflect local labor market shocks. For example, compared to a county that issued 50 permits 5 years ago but issues 10 more permits annually, a county that issued 100 permits each year steadily for the past 5 years may not have an increasing labor demand in the construction sector. In addition, the total number of permits is more likely to be determined by local demographics that are persistent for years, e.g., population, income level, area, urbanity, etc. Thus, the students who lived in counties with larger housing markets might be fundamentally different to their counterparts from the perspectives of local educational resources, motivation, and family background.

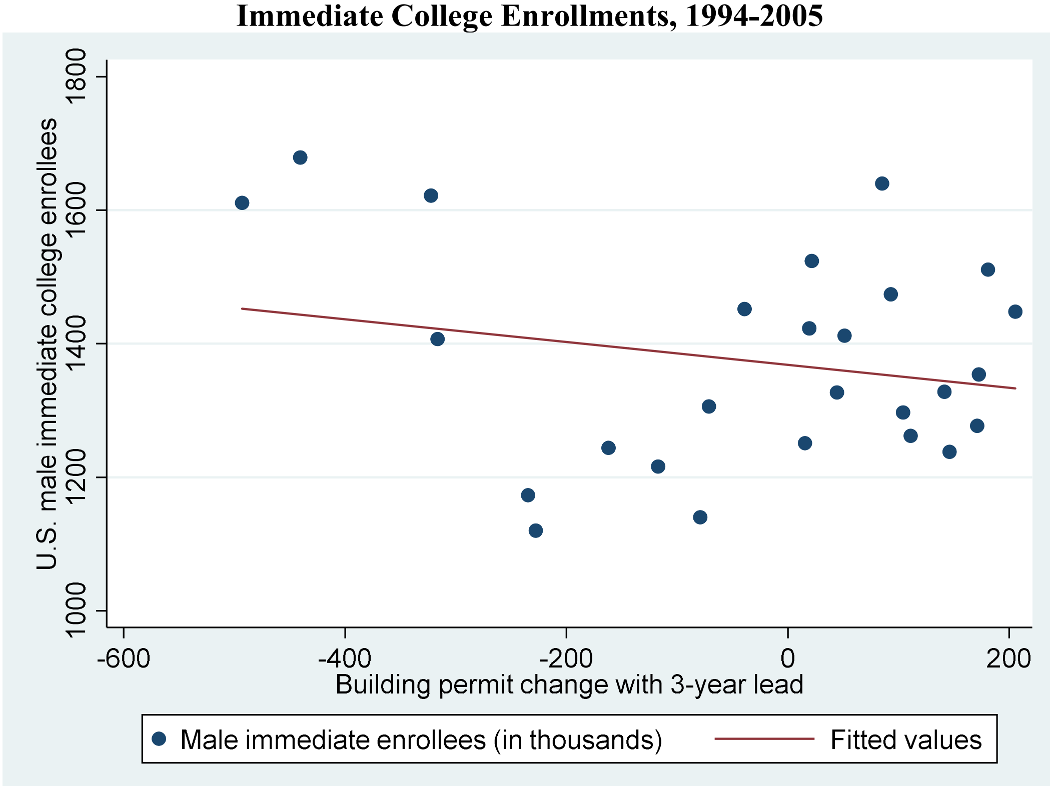
proposes a conceptual model. Consider a student who allocates the timing of college education and work in year *n*. Within the perfect capital market, the optimization of the human capital investment function occurs when the marginal cost of attending college immediately is equivalent to the marginal benefit of doing so. Thus, the propensity to enroll in college is negatively related to the current wage of unskilled labor, represented by the condition of employment in the construction sector in year *n-1*, the year before high school graduation. In some regions, the variation in the demand for construction labor is larger because of a speculative bubble in the housing market. Therefore, I use change in permits in year *n-3* as an indicator of the local housing market boom, as it can predict the employment condition in the construction sector two years in advance. In summary, the permit change in year *n-3* serves as an instrument for delayed enrollment by the mechanism of changing opportunity cost.

What does the theoretical framework tell us about the consequences of enrollment delay? One of the major concerns of policy implication is whether delayers could receive the same returns on a college education as those of immediate enrollees. As the human capital model predicts, students choose the timing of college enrollment in a countercyclical manner, adjusting the sequences of schooling and work to postpone the earnings trajectory. However, delayed enrollment can be harmful if it leads to a suboptimal result by lowering the return on education for delayers. For example, removed from their schooling cohort, delayers could be especially deficient in knowledge about college or financial aid, resulting in a higher possibility of attending schools with low quality or low completion rates, or of abandoning re-enrollment altogether. In addition, the education pursuits for delayers could be very different to those of immediate enrollees. Common pursuits for delayers are vocational training, preparation for promotion and changing job industries (Horn et al., 2005), for which two-year colleges and short-term certificate programs are more suitable. More importantly, the intention to return to college might weaken as the length of the delay increases. We do not know whether there exists an age after which the motivation to return to college is so low so that almost no one will return to college.

2.4 Empirical Strategy

To test whether the building permit is an effective instrument for delayed enrollment, Figure 2.8 illustrates the correlation between male immediate college enrollment and a three-year lead of building permit changes from 1994 to 2015. A downward fitted line indicates the negative correlation between immediate enrollment and the local housing market. Overall, college enrollment timing is correlated with the construction labor market and housing market,

Figure 2.8 U.S. Annual Change in the Number of Building Permits and Male Immediate College Enrollments, 1994-2005



Data Source: Building Permit Survey and Digest of Education Statistics and non-college young men play an important role in this effect. One of the potential limitations to my empirical strategy is the assumption that building permit changes can precisely capture low-skilled labor demand shock. To verify this assumption, I use females as a comparison group, who are likely to be affected less by shocks to the construction industry. If any other confounding factors exist, such as demand shocks for high-skilled labor, wealth effect caused by higher housing prices, or general economic trends, both males and females would be affected simultaneously. The other limitation is the assumption that labor market shocks can serve as an IV. The assumption of exclusion restriction can only be confirmed if building permit changes do not affect college enrollment outcomes directly or indirectly, but only via the effect on delayed enrollment that is conditional on all other covariates. For example, the IV would not be valid if students who lived in counties with larger labor market shocks were more likely to choose two-year colleges not only because they delayed more often, but also because they wanted to graduate sooner in order to work. For these hypotheses, I run multiple subgroup regressions to investigate the mechanism of the effect.

The previous studies on delayed enrollment have defined delayers as those who did not start college education immediately but returned to college after a period. The definition excludes a possibility that some students who had planned to enroll in college with a delay leave educational trajectory permanently. However, it is difficult to identify which student had the intention to return to higher education and which students decided not to enroll. I define delayers as all high school graduates of the ELS:2002 cohort who did not enroll in college immediately upon high school completion in 2004. Assuming that the non-compliers (those who never enroll) would not be affected by labor market shocks, this new definition can answer a more meaningful policy-related question: can students return to college if they do not enroll immediately?

For all high school graduates with valid geographical and college attendance information, I estimate how building permit changes influence enrollment timing in the short term by running an Ordinary Linear Regression (OLS) model only for males, who are considered to have an advantage in low-skilled construction jobs.

$$Delay_{ig} = \alpha_{ig} + \beta_{ig} \Delta Building\_Permit_{g(2001)} + X_{ig} + \varepsilon_{ig} \quad (1)$$

The enrollment timing of individual i who lived in county g is determined by the annual change in the number of permits of county g from 2000–2001, $\Delta Building\_Permit_{g(2001)}$, a vector of covariates, X_{ig}, which includes individual demographic variables, e.g., race, socio-economic status (SES) quartile, math ability, parental education, and county-level covariates, e.g., land area, population, urbanity index and unemployment rate. The dependent variable $Delay_{ig}$ is equal to 1 when high school graduate i has not attended college immediately after high school completion in 2004, regardless of his final enrollment decision by 2012. Robust standard errors are clustered at the county level.

Next, if we accept the assumption that the housing boom that occurred in 2001 (year $n - 3$) affects students' educational outcomes after 2004 (year n) only through the enrollment timing in 2004 (year n), I can use the building permit changes as an instrument to estimate the local average treatment effect (LATE) of not enrolling immediately on students' college enrollment eight years after high school graduation. By using equation (1) as the first stage, I employ a Two Stage Least Square (TSLS) strategy, with a second stage as follows:

$$College_{ig} = \mu_{ig} + \pi_g \widehat{Delay}_{ig} + X_{ig} + \epsilon_{ig} \quad (2),$$

where $College_{ig}$ is the college attendance dummy that indicates that student i had attended at least one post-secondary institution by the end of the most recent follow-up survey in 2012. For the analysis of the effect of not enrolling immediately on college choice, I apply the same instrument variable to estimate the influence on four-year college enrollment and two-year college enrollment by 2012. TSLS analysis attempts to provide a causal estimation of (1) whether not enrolling immediately affects the possibility of college enrollment eight years after high school graduation, and (2) how students' choice between two-year and four-year schools is influenced. I will also report the result for college completion, but the estimation could potentially be biased because some delayers might have started college and still been enrolled in 2012.

2.5 Data

Two different datasets are used for the study. The first is the educational data, which contains information on college enrollment timing and geographical variables, and the second is the data for local building permits. These two datasets are merged for the county of residence where students attended high school.

2.5.1 Education Data

The primary data for this study is the restricted-use version of the Education Longitudinal Survey: 2002 (ELS:2002). ELS:2002 is a nationally representative, longitudinal study of tenth graders in 2002, conducted by the National Center for Education Statistics (NCES) of the Institute of Education Sciences, U.S. Department of Education. The advantage of using ELS:2002 to analyze delayed enrollment is the rich information on geographical location, educational outcomes, and personal characteristics. In addition, the students who were in the tenth grade in 2002 faced the unprecedented housing boom when most of them graduated from high school in 2004. The base year survey contains a total of 16,200 students[6]. Three follow-up surveys were conducted in 2004, 2006, and 2012, respectively. By the third-round follow-up in 2012, 15,150 students had obtained a high school diploma. Most of them completed high school

[6] All the sample sizes of ELS: 2002 are rounded to the nearest ten protect the confidentiality.

in 2004 (90.3%). By the end of the third follow-up, 10,900 respondents had attended at least one post-secondary institution, while 1,740 had not. Students were asked to report the timing of their first post-secondary enrollment since the second follow-up in 2006. Delayed enrollees are defined as those who did not start their post-secondary education by October of their high school completion year (if they graduated from high school between January and July), or by the following February (if they graduated after July). Among all 16,200 respondents, around 15,500 have valid geographical information (e.g., state, county, zip code, etc.). Their locations are spread among 740 counties. Using the information on students' enrollment timing and detailed location, I can observe the college enrollment delay across different counties.

One of the disadvantages of using ELS:2002 is that all individuals in ELS:2002 come from the same cohort (the class of 2004). The only variation in labor market shocks comes from geographical difference. In addition, although the sample is nationally representative, this particular cohort might not be generalized to the entire population of high school graduates, as they faced an unprecedented housing boom upon completion of high school, followed by an unprecedented recession three years later. Any enrollment pattern observed from the sample could be explained by the distinct economy that this cohort faced in their 20s.

2.5.2 Building Permits

Next, I use the data from the Building Permit Survey conducted by the U.S. Census Bureau for the permits of new buildings approved to be constructed in each county. This dataset covers all places that issue building permits for privately-owned residential structures. Over 98% of all privately-owned residential buildings constructed are in locations that issue permits. The variation in labor market shocks faced by the sample is reflected in the county-level variation in changes of building permits from 2000 to 2001, three years before the cohort in question graduated from high school. The size of variation in local building permit changes might be correlated with county demographics; for example, a county with a larger population size has a higher demand for new houses. During the housing boom, a larger county may also have a more sizable demand shock to the construction market. To control for the local demographics, I supplement the main data sets with county-level covariates, including land area, population, urbanity index and the unemployment rate, which are obtained from the Inter-university Consortium for Political and Social Research (ICPSR, 2008) of the University of Michigan.

2.5.3 Summary Statistics

Table 2.1 displays the summary statistics of the main variables for the students in the sample. I exclude the observations with no response for college enrollment or geographic information. For students who reported college enrollment information in 2006 (F2) but did not respond in 2012 (F3), I keep the observations with their responses in F2[7]. On average, 33% of the sample did not enroll in college immediately. The mean duration of the enrollment gap is six years. Compared to female students, male students are more likely to delay, less likely to return, and wait longer to enroll in college. In 2001, there were an average of 115 building permit changes in the county where students lived in their senior year of high school. Figure 2.9 plots the distribution of the number of building permit changes. In most counties, the number of building permits increased or decreased within a range of 500 in 2001. However, a few counties, such as Maricopa County in Arizona, Clark County in Nevada, and Hillsborough County in Florida, issued over 4,000 more building permits than they had done in 2000. These counties were usually located in the states that experienced a larger housing "bubble" during the boom.

[7] If a student contradictorily states that he/she has attended college in F2 but has not attended in F3, I recode his/her college enrollment based on his/her answer in F2.

Table 2.1 Descriptive Statistics of ELS:2002

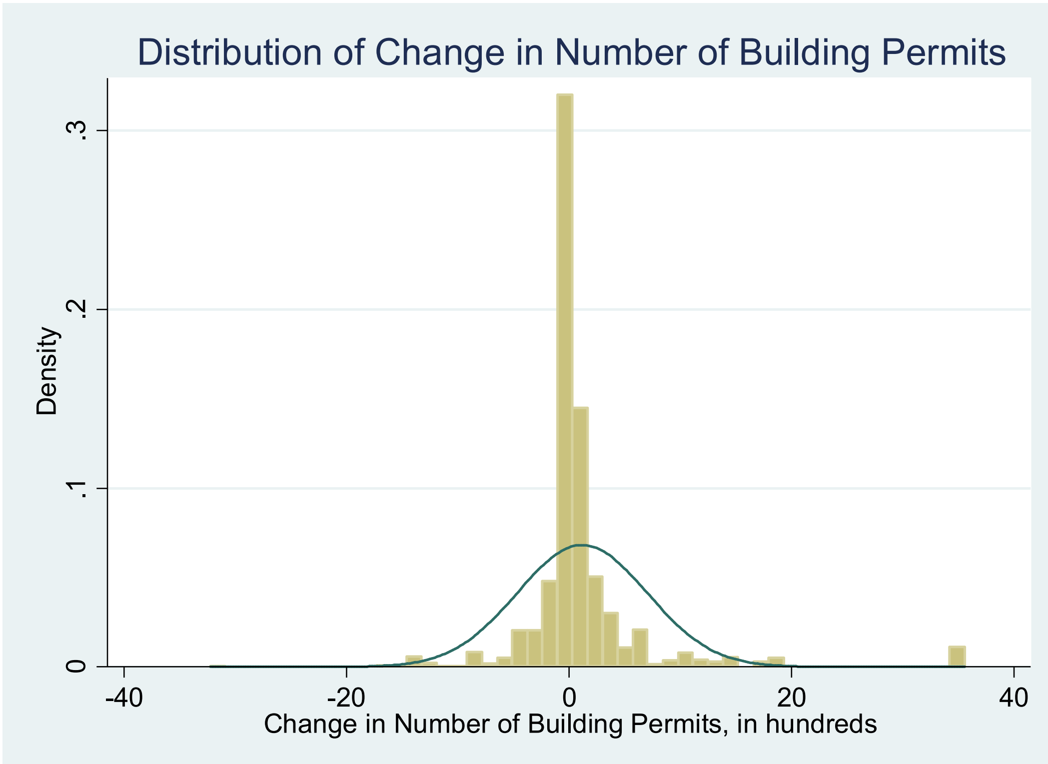
Selected Student Characteristics	Mean		
	All	Male	Female
Black	0.1530	0.1480	0.1578
Hispanic	0.1372	0.1336	0.1407
White	0.6552	0.6385	0.6715
High school graduation in 2004	0.8613	0.8337	0.8883
SES quartile (1=lowest)	2.5894	2.6134	2.5665
Math ability quartile (1=lowest)	2.6087	2.6584	2.5614
Parental education (1=receiving any postsecondary education)	0.7490	0.7550	0.7433
Ever applied postsecondary education	0.7964	0.7478	0.8437
Married	0.2774	0.2365	0.3172
Singer parent status	0.0294	0.0119	0.0465
Delayed college enrollment[1]	0.3379	0.3735	0.3031
Immediate college enrollment	0.6508	0.6034	0.6969
Have ever attended postsecondary education by 2012	0.8329	0.7807	0.8837
Reenrolled by 2012	0.1825	0.1775	0.1873
Never enrolled by 2012	0.1671	0.2193	0.1163
Length of delay	6.1527	5.8386	6.4586
Have attended four-year institutions	0.4530	0.4116	0.4932
Have attended two-year institutions	0.2970	0.2828	0.3109
Completing postsecondary education	0.3907	0.3398	0.4403
Change in building permits (in hundreds)	1.1545	1.1895	1.1203
Number of Observations	13,620	6,720	6,900

Data Source: Education Longitudinal Survey: 2002 restricted-use data

1. Delayed college enrollment is defined as not entering college in 2004.

All sample sizes are rounded to the nearest ten.

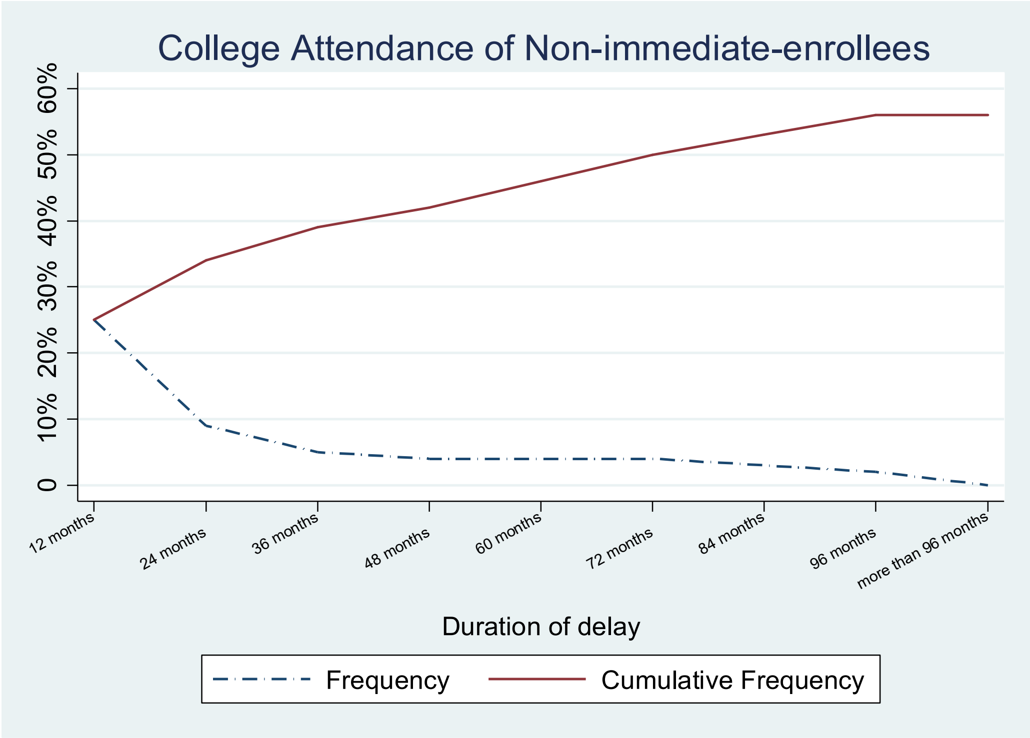
Figure 2.9 Distribution of Change in Number of Building Permits



Data Source: Building Permit Survey

Figure 2.10 depicts the frequency of college attendance by years for students who did not enroll in college immediately. If delayers returned to campus, most of them chose to do so in the first two years; 25% enrolled in the first year and 9% enrolled in the second year. This rate drops below 5% in the third year, after which it remains at approximately 2%. A cumulative frequency curve shows that the final enrollment rate for delayers remains stable at 56%, suggesting that half of the delayers are still unenrolled. Given the subtle change in the re-enrollment rate after three years, eight years is a reasonable time frame in which to observe delayers who have returned to college.

Figure 2.10 Frequency of College Attendance for Non-immediate-enrollees



Data Source: Education Longitudinal Survey: 2002 public-use data

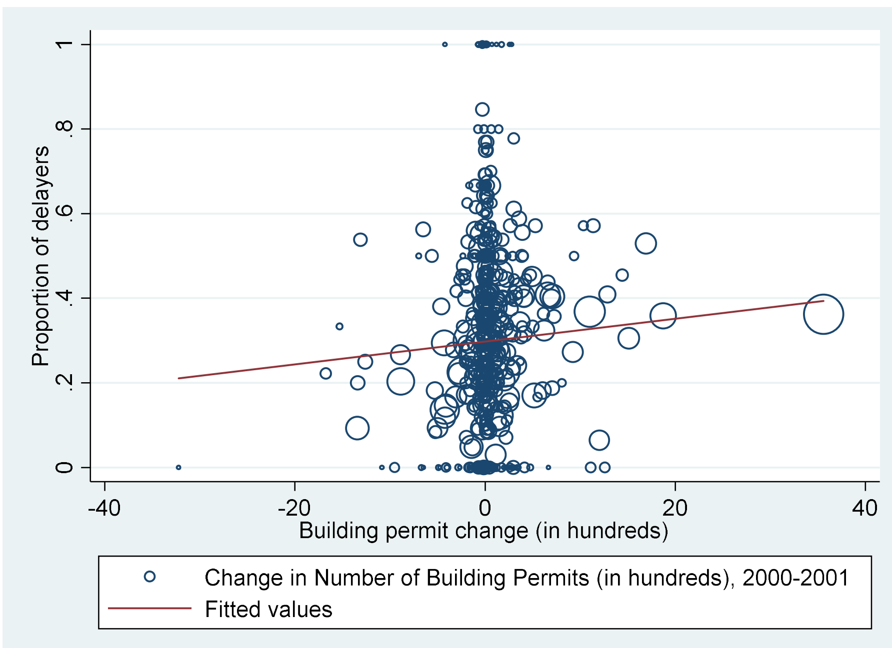
In the second follow-up wave in 2006, the delayed students who returned to college were asked about the reasons for the postponement, which is one of the best ways to measure the reasons for delaying enrollment directly. As stated in Chapter 1 (Table 1.1), the most notable factor is the preference to work, with males being more likely to delay for the reason that they "wanted to work". This pattern reflects the fact that men are more sensitive to local labor demand shocks because they are at a relative advantage in low-skilled jobs for high school graduates than women, e.g., construction workers. When there is a housing boom in demand of low-skilled workers, men are more likely to be attracted to work after high school due to the consideration of higher opportunity cost.

2.6 Findings

2.6.1 Booming Effects

Before discussing the result in numbers, I first visualize the correlation between building permit changes in 2001 and the proportion of non-immediate enrollment for males at the county level in Figure 2.11. Although most of the variation in permits is within 500 units, counties that experienced larger housing booms weigh more to the correlation. An upward fitted regression line suggests that a county with a larger increase in the permits issued in 2001 would have more male high school graduates who delayed their transition to college in 2004.

Figure 2.11 Proportion of Male Delayers vs. Building Permit Changes at County-level



Data Source: Education Longitudinal Survey: 2002 restricted-use data and Building Permit Survey

To clarify the relationship, Table 2.2 presents an estimation for the effect of building permit changes on enrollment delay for males. The OLS results suggest that, on average, an additional 100 increase in the annual change of building permits increase causes 0.24 percentage points more male high school graduates not to enroll in college immediately. In other words, one standard deviation increase in building permits will lead to a 0.17 standard deviation increase in college enrollment delay. Considering that four million students graduated from high school in

2004, this increase means that an additional 5,000 male students might delay their college enrollment if the change of building permits increases by 100 for each county.

Table 2.2 The Effect of Change in Number of Building Permits on College Enrollment Delay

Dependent Variable: College Enrollment Delay[1]	(1)	(2)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	0.0024***	0.0022**
	(0.0009)	(0.0009)
Black	-0.0097	-0.0040
	(0.0155)	(0.0162)
SES Quartile	-0.1067***	-0.1082***
	(0.0066)	(0.0066)
Math Ability Quartile	-0.1305***	-0.1314***
	(0.0055)	(0.0055)
Parental Education	-0.0196	-0.0217
	(0.0157)	(0.0157)
First-stage F-statistics	213.69	32.27
R^2	0.2106	0.2244
County Level Covariates[2]	Y	Y
State Fixed Effects		Y
N	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
Robust standard errors in parentheses
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

If the influence of local housing market shocks is only through the pipeline of increasing unskilled employment opportunities in the construction sector, women are presumed to be less affected. As a robustness check, the results for the females are listed in Table 2.3. In contrast to the findings for males, living in a county with a larger increase in building permits has a very small and insignificant effect on enrollment delay for females. The result for females confirms the validity of using building permits as an instrument. As a proxy of demand shocks for low-skilled labor in the construction sector, the change in building permits mainly influences opportunity cost for men, who have an advantage in labor-intensive industries. The lack of a significant effect on women's enrollment timing suggests that building permit changes are not confounded by other factors, such as demand for high-skilled labor, housing wealth, or general economic trends that should affect both males and females simultaneously[8].

Table 2.3. First Stage for Female Delayed College Enrollment Using Change in the Building Permits of New House in 2001 as Instrument Variable

Dependent Variable: College Enrollment Delay[1]		
	(1)	(2)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	0.0009	0.0003
	(0.0008)	(0.0009)
Black	-0.0019	0.0008
	(0.0144)	(0.0151)
SES Quartile	-0.0854***	-0.0845***
	(0.0060)	(0.0061)
Math Ability Quartile	-0.0135***	-0.1355***
	(0.0052)	(0.0052)
Parental Education	- 0.0429***	-0.0421***
	(0.0144)	(0.0145)
First-stage F-statistics	224.61	33.34
R^2	0.2076	0.2182
County Level Covariates[2]	Y	Y
State Fixed Effects		Y
N	6,870	6,870

Data Source: Education Longitudinal Survey: 2002 restricted-use data
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
Robust standard errors in parentheses
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

[8] The OLS and TSLS estimations for females are presented in Table B1. Since the first stage for females is insignificant and weak, it exaggerates the TSLS result and the standard error, weakening the statistical significance

Housing booms may have a persistent influence on students' re-enrollment decisions. To estimate the enduring booming effect, I present the cumulative effect on male college enrollment for each post-high school graduation year[9]. Table 2.4 indicates that the negative effect of the booming housing market on overall college enrollment diminished two years after high school graduation.

Table 2.4 The Effect of Change in Number of Building Permits on Male College Enrollment Delay

	(1)		(2)	
Outcomes	Coefficient	SE	Coefficient	SE
Ever enrolled in college by…				
1 year after high school completion	-0.0015**	(0.0007)	-0.0018**	(0.0009)
2 years after high school completion	-0.0007	(0.0007)	-0.0010	(0.0007)
3 years after high school completion	0.0004	(0.0009)	0.0001	(0.0008)
4 years after high school completion	0.0008	(0.0010)	0.0005	(0.0009)
5 years after high school completion	0.0003	(0.0010)	0.0000	(0.0009)
6 years after high school completion	0.0003	(0.0009)	0.0000	(0.0008)
7 years after high school completion	0.0002	(0.0008)	0.0000	(0.0008)
8 years after high school completion	-0.0006	(0.0007)	-0.0002	(0.0007)
County Level Covariates	Y		Y	
State Fixed Effects			Y	
N	6,420		6,420	

Data Source: Education Longitudinal Survey: 2002 restricted-use data
Note: County Level Covariates include population size, unemployment rate, and urbanity index.
Robust standard errors in parentheses
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

This result supplements the findings from previous studies that the negative effect of labor market shocks on education attainment is often on a temporal basis. Students who did not continue higher education in 2004 slowly returned over two years, and it is consistent with the descriptive statistics that most of the returners re-enrolled in college in the first two years. This

of the estimation. Given the insignificance of the first stage for women, there is no need to repeat the estimation for women.

[9] I exclude the students who reported college enrollment but did not provide their year of attendance, and those who provided conflicting information.

phenomenon may be correlated to the housing market bust in 2006 and 2007; the delayers who were affected by the housing boom might have returned to college when the economy declined. I examine this effect further in the following analyses. Beyond academic outcomes, I also examine the long-term booming effect on other long-term outcomes, such as the time taken to receive a bachelor degree, amount of loans, working full/part-time, etc. Overall, housing boom only has an effect on the total amount of student loans and working part-time; it decreased the total amount of student loans and decreased the number of people in part-time employment. The complete results are available in the appendix.

2.6.2 Delaying Effects

Does short-term delay have a long-term effect on college enrollment? If the housing boom that occurred in 2001 only impacted long-term educational outcomes through the booming effect on college enrollment delay in 2004, I can use the building permit changes as an instrument to estimate the effect of delay on student academic outcomes. Table 2.5 presents the effect of delay on college enrollment in eight years for male high school graduates. The first two columns report the OLS estimates. It is not surprising to see significant negative coefficients in OLS results; 48% of delayers did not re-enroll in college by 2012, which is consistent with descriptive results. However, this does not mean that the possibility of college enrollment for delayers is 48 percentage points lower than for immediate enrollees. Firstly, the definition of the delay in my analysis may overestimate the number of "true delayers", who have the intention to re-enroll after deferring their higher education plans. Among the delayers, some of them may not intend to enroll in college once they have completed high school. Secondly, OLS estimates are biased by self-selection and unobserved factors. Delayers are fundamentally different from non-delayers in terms of demographics, educational aspiration, etc. These fundamental differences could produce the result that fewer of them attended college compared to non-delayers.

Table 2.5 OLS Estimates and TSLS Estimates of Effect of Delay on Male College Attendance in 8 Years

Dependent Variable: Male College Attendance by the Third Follow-up in 2012

	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)
Not enroll immediately[1]	-0.4829***	-0.4824***	-0.3741	-0.5297*
	(0.0091)	(0.0092)	(0.2626)	(0.3175)
Black	0.0312***	0.0323***	0.0323***	0.0319***
	(0.0113)	(0.0119)	(0.0119)	(0.0119)
SES quartile	0.0135***	0.0126***	0.0252	0.0075
	(0.0049)	(0.0050)	(0.0286)	(0.0348)
Math ability quartile	0.0332***	0.0335***	0.0473	0..0271
	(0.0041)	(0.0042)	(0.0346)	(0.0420)
Parental Education	0.0485***	0.0464***	0.0514***	0.0460***
	(0.0115)	(0.0115)	(0.0127)	(0.0136)
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data
Note: This table reports OLS and TSLS estimates of not enrolling immediately for the ELS2002 sample having valid geographic information and college attendance information.
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

The third and fourth columns report preferable TSLS results using building permit changes as an instrumental variable[10]. Among males, the TSLS results with county-level covariates demonstrate a slightly smaller but insignificant effect on overall college enrollment, while the coefficient magnitude with both county-level and state-level controls in Column 4 is comparable to the OLS ones and significant at 0.1 level. Both estimates imply that male delayers are substantially unlikely to re-enroll in eight years. However, such noisy coefficients cannot

[10] For a smaller standard error, TSLS with only county-level covariates is my preferred estimate. I focus on the results in column (3) in the following estimations.

reject the null hypothesis that there is no statistically significant difference in the college enrollment rate between immediate college enrollees and delayers. This result is primarily driven by the reduced form: at least for men at the margin of college attendance, whose college enrollment timing is intensively affected by local construction markets, not enrolling in college immediately after high school does not necessarily make them abandon their college plans completely. When local housing markets flourish, some of the male high school graduates who had the intention to attend college may have postponed enrolling in college in favor of work, but gradually returned to school as the economy declined. This result is also consistent with the findings in the study of Charles et al. (2015), which documents the temporary negative effects of the housing boom on educational attainment, but in the long term, the cohort that has experienced larger housing market shocks will have "caught up" their on-time peers in terms of schooling by the end of the full boom and bust cycle.

The results for college choice are presented in Table 2.6. Although a weak significant result is found in overall college enrollment, marginal effects on four-year college enrollment and two-year college enrollment are substantial and statistically significant. A one-percentage increase in enrollment delay will cause a decrease of 2.21 times that in four-year college enrollment and an increase of 1.87 times that in two-year college. This result implies that enrollment delay changes student college choice significantly by channeling more marginal students to two-year colleges from four-year colleges, although it does not change overall college enrollment in general.

Table 2.6 TSLS Estimates of Effect of Delay on Male 4-Year/2-Year College Attendance in 8 Years

Dependent Variable: Male 4-Year/2-Year College Attendance by the Third Follow-up in 2012				
	4-Year (1)	4-Year (2)	2-Year (3)	2-Year (4)
Not immediately enroll[1]	-2.2104***	-1.5691**	1.8667**	1.0370
	(0.7305)	(0.6481)	(0.8041)	(0.6791)
Black	0.0780**	0.0898***	-0.0444	-0.0561**
	(0.0330)	(0.0243)	(0.0363)	(0.0255)
SES quartile	-0.1448*	-0.0793	0.1768**	0.0902
	(0.0796)	(0.0709)	(0.0876)	(0.0743)
Math ability quartile	-0.1329	-0.0534	0.1849*	0.0804
	(0.0963)	(0.0856)	(0.1060)	(0.0897)
Parental Education	-0.0269	-0.0179	0.0771**	0.0623**
	(0.0355)	(0.0277)	(0.0391)	(0.0290)
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data
Note: This table reports OLS and TSLS estimates of not enrolling immediately for the ELS2002 sample having valid geographic information and college attendance information.
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

Nevertheless, the magnitude of the effect might be caused by other mechanisms besides delay. For example, if the building permit change directly affects four-year and two-year college enrollment, or via a path other than delay, the large reduced form will lead to an enlarged TSLS result. In the following mechanism analysis section, I disentangle these effects.

Table 2.7 presents the results for college completion. Compared to immediate enrollees, delayers are 87 percentage points less likely to complete any type of post-secondary education. In general, most of the negative effect on college completion is attributable to a lower four-year college completion rate. I find no significant result for two-year college enrollment, which is probably a mixed consequence of delayers' higher tendency to enroll in two-year college and lower probability to complete a degree. However, this estimation may be biased if some delayers who enrolled in four-year colleges were still enrolled in 2012. As such, the results are only presented as suggestive estimates of the impact of delay on college completion.

Table 2.7 TSLS Estimates of Effect of Delay on Male 4-Year/2-Year College Completion in 8 Years

Dependent Variable: Male College Completion by the Third Follow-up in 2012

	(1)	(2)	(3)	(4)	(5)	(6)
	College Completion	College Completion	4-Year College Completion	4-Year College Completion	2-Year College Completion	2-Year College Completion
Not enroll immediately [1]	-0.8740***	-0.6100*	-1.0240***	-0.6620**	0.0902	-0.0187
	-0.319	-0.335	-0.355	-0.3351	-0.2052	-0.3061
Black	-0.0373*	-0.0330*	0.0112	0.0172	-0.0478***	-0.0495***
	-0.0197	-0.0185	-0.0193	-0.0164	-0.0131	-0.0133
SES quartile	-0.0321	-0.0041	-0.0435	-0.0044	0.0052	-0.0075
	-0.0354	-0.0367	-0.0385	-0.0389	-0.0243	-0.0355
Math ability quartile	-0.0363	-0.00436	-0.0384	0.0058	-0.0043	-0.0182
	-0.0424	-0.0444	-0.0479	-0.0443	-0.0277	-0.0396
Parental Education	-0.0072	-0.0004	-0.0176	-0.0107	0.0091	0.0085
	-0.0211	-0.0199	-0.0224	-0.0164	-0.0162	-0.0161
County Level Covariates[2]	Y	Y	Y	Y	Y	Y
State Fixed Effects		Y		Y		Y
N	6,420	6,420	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data
Note: This table reports OLS and TSLS estimates of not enrolling immediately for the ELS2002 sample having valid geographic information and college attendance information.
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

2.6.3 Mechanism Analysis

To discuss the possible intermediate mechanism that IV takes effects through, I disaggregate the same reduced form for the college choice outcomes of immediate enrollments to observe whether building permit changes have any effect on immediate college choice. If the effect of the permit on college choice is entirely attributable to delayed enrollment, there should not be any observable effect on the choice to attend college immediately; high school students who experienced a larger housing boom should be less likely to attend either four-year or two-year college to the same extent. However, the estimates in Table 2.8 demonstrate that the increase in building permits results in more immediate two-year college enrollments and fewer immediate four-year college enrollments, which suggests that the local housing boom also reduces the likelihood of high school graduates to attend four-year colleges immediately. The negative effect on immediate college enrollment in Table 2.2 is a combined effect of the positive effect on immediate two-year college enrollment and the disproportionately larger negative effect on immediate four-year college enrollment.

Table 2.8 Reduced Form for Male Immediate College Enrollment Choice

	4-year Immediate College Enrollment		2-year Immediate College Enrollment	
	(1)	(2)	(3)	(4)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	-0.0046***	- 0.0028***	0.0026***	0.0008
	(0.0008)	(0.0009)	(0.0008)	(0.0009)
Black	0.0801***	0.0791***	-0.0803***	-0.0848***
	(0.0149)	(0.0155)	(0.0146)	(0.0151)
SES Quartile	0.1003***	0.1018***	0.0039	0.0040
	(0.0063)	(0.0063)	(0.0062)	(0.0061)
Math Ability Quartile	0.1552***	0.1531***	-0.0275***	-0.0246***
	(0.0052)	(0.0052)	(0.0051)	(0.0051)
Parental Education	-0.0080	0.0025	0.0260*	0.0225
	(0.0148)	(0.0148)	(0.0145)	(0.0144)
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

However, delay still affects college choice. When we consider the reduced form by using delayed four-year/two-year college enrollment (delayers who re-enrolled) in Table 2.9, there is a significant effect for delayed two-year college enrollment, which suggests that delayed students who re-enrolled in college within eight years were inclined to choose two-year programs.

Table 2.9 Reduced Form for Male Delayed College Enrollment Choice

	4-year Delayed College Enrollment		2-year Delayed College Enrollment	
	(1)	(2)	(3)	(4)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	-0.0007	-0.0006	0.0016**	0.0014*
	(0.0004)	(0.0005)	(0.0007)	(0.0007)
Black	0.0168**	0.0192**	0.0262**	0.0279
	(0.0080)	(0.0083)	(0.0112)	(0.0127)
SES Quartile	-0.0110***	-0.0106***	-0.0235***	-0.0250***
	(0.0034)	(0.0028)	(0.0051)	(0.0052)
Math Ability Quartile	0.0004	0.0004	-0.0290***	-0.0303***
	(0.0028)	(0.0028)	(0.0043)	(0.0043)
Parental Education	0.0240***	0.0192**	0.0157	0.0178
	(0.0079)	(0.0079)	(0.0121)	(0.0122)
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data

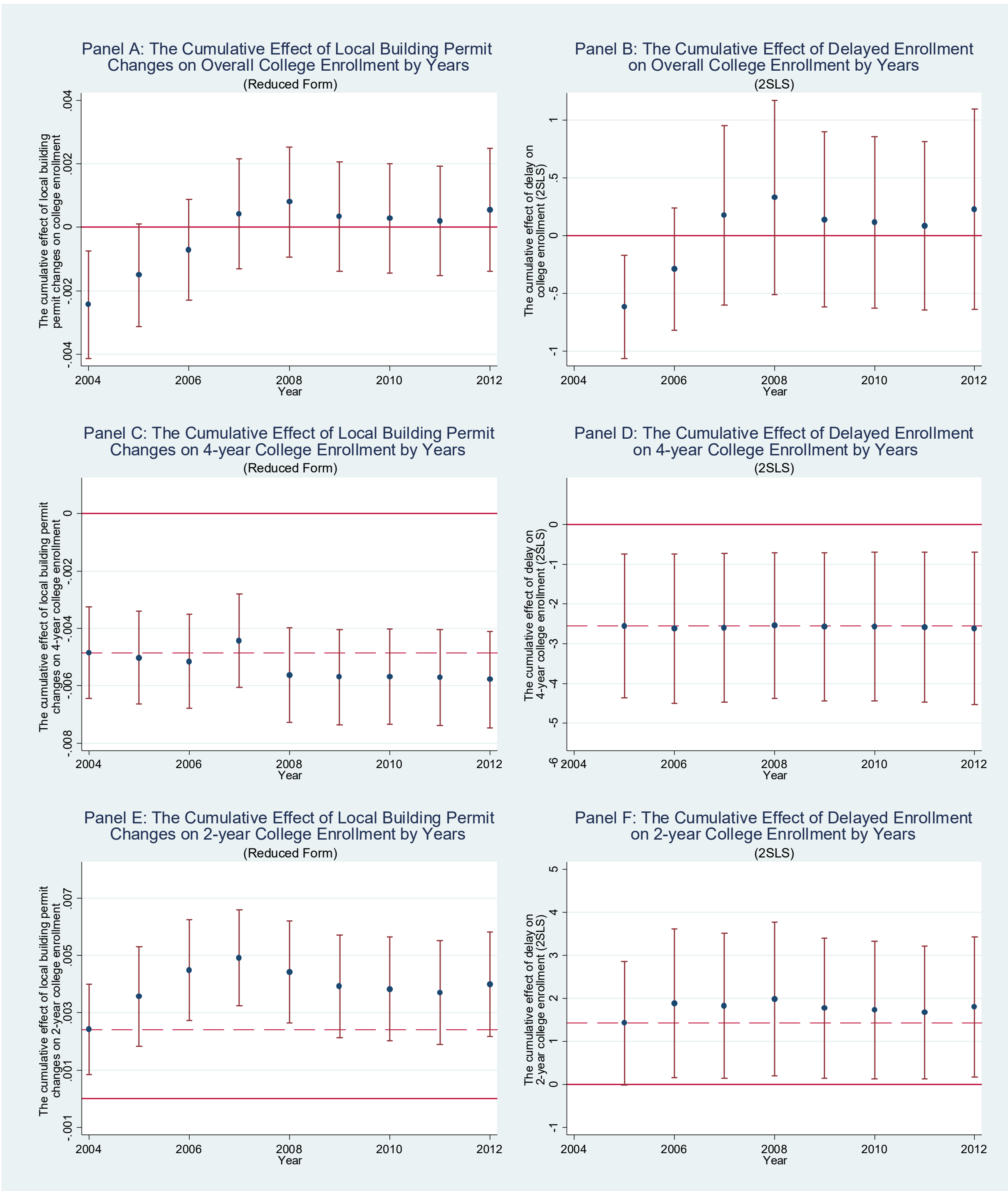
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.

* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

All sample sizes are rounded to the nearest ten.

The other explanation for the extraordinarily large TSLS coefficients is that the housing market boom may have had a persistent influence on students' enrollment decisions. To illustrate the enduring effect, I present the cumulative effect on overall enrollment and four-year/two-year college enrollment in the years after high school graduation in Figure 2.12. Specifically, Panel A visualizes the reduced form effect of building permit changes on the cumulative enrollment rate over the years presented in Table 2.3. For example, the cumulative effect in 2006 means the

Figure 2.12 The Cumulative Effect of Local Building Permit Change on College Enrollment by Years



Data Source: Education Longitudinal Survey: 2002 restricted-use data effect on the accumulated college enrollment rate by 2006 (including those who enrolled in 2004, 2005 and 2006). The result for four-year and two-year college enrollment confirms the existence of the persistent effect on college choice. Again, the immediate positive effect on two-year college enrollment in 2004 suggests that the local housing boom directly attracted more immediate enrollees in four-year colleges to attend two-year colleges. However, the effect size on two-year college enrollment increases yearly as delayers slowly return to school. This is the same for the TSLS cumulative effect. It implies that enrollment delay affects returners by channeling more of them into two-year colleges.

Tables 2.10 and 2.11 present the estimations for various subgroups to examine heterogeneity in the booming effect. Table 2.10 presents heterogeneity in the first stage, measuring the temporary influence of the local housing market on college enrollment delay for male students by SES quartiles, and Table 2.10 shows the results by racial subgroups. Surprisingly, estimation indicates that the third quartile and fourth quartile are the most vulnerable groups in both SES and mathematical ability subgroup regressions. In contrast, there is nearly no significant effect on the lowest two quartiles. Seemingly, the bottom two quartiles and are "non-compliers", whose college enrollment timing is barely affected by local housing markets, while the third and fourth quartiles are the groups whose actions comply with local housing markets. When we examine the heterogeneous effects by race, it is white students who are affected by the housing boom. This phenomenon might stem from the dominance of white workers in construction. According to the Bureau of Labor Economics, 88% of employees are white, while blacks only represent 6% of the total employed.

Table 2.10 Effect of Local Building Permit Change on Enrollment Delay by SES quartiles

Dependent Variable: College Enrollment Delay[1]

	(1) 1st Quartile (Lowest)	(2) 2nd Quartile	(3) 3rd Quartile	(4) 4th Quartile (Highest)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	0.0001	-0.0008	0.0070***	0.0035**
	(0.0013)	(0.0019)	(0.0015)	(0.0017)
Black	-0.0113	-0.0312	-0.0104	0.0209
	(0.0350)	(0.0412)	(0.0451)	(0.0504)
Math ability Quartile	-0.1393***	-0.1251***	-0.1386***	-0.1176***
	(0.0157)	(0.0141)	(0.0128)	(0.0140)
Parental Education	-0.0152	-0.0301	-0.0230	Omitted
	(0.0305)	(0.0323)	(0.0497)	Omitted
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	1,400	1,510	1,590	1,920

Data Source: Education Longitudinal Survey: 2002 restricted-use data

1. Students who did not enroll in college by 2004 are defined as delayers.

2. County Level Covariates include population size, unemployment rate, and urbanity index.

* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

All sample sizes are rounded to the nearest ten.

Table 2.11 Effect of Local Building Permit Change on Enrollment Delay by Racial quintiles

Dependent Variable: College Enrollment Delay[1]			
	(1) White	(2) Black	(3) Hispanic
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	0.0038**	-0.0028	-0.0002
	(0.0019)	(0.0022)	(0.0014)
Black	-0.1038***	-0.0688***	-0.0331
	(0.0107)	(0.0234)	(0.0224)
Math ability Quartile	-0.1043***	-0.1107***	-0.0907***
	(0.0095)	(0.0226)	(0.0156)
Parental Education	-0.0237	-0.0577	-0.0314
	(0.0280)	(0.0497)	(0.0430)
County Level Covariates[2]	Y	Y	Y
State Fixed Effects	Y	Y	Y
N	3,600	790	870

Data Source: Education Longitudinal Survey: 2002 restricted-use data
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
Robust standard errors in parentheses.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.
All sample sizes are rounded to the nearest ten.

2.6.4 Robustness Check

Table 2.11 presents the correlation between changes in building permits and employment in construction. The first row shows that, after accounting for a full set of county-level controls, building permit changes strongly predict the changes in overall construction employment; every increase in permit change by 100 in 2001 will lead to an increase of 42 employees in the construction labor market in 2003. In other words, counties with the larger size of building permit changes in 2001 experienced a larger increase in construction employment in 2003.

The result of using the percentage of change in permits instead of the number of permit changes is presented in Appendix. The insignificant result suggests that the percentage of change in permits is not an appropriate instrument for determining employment in the construction market. As mentioned previously, this is because percentage change might not be able to precisely reflect the size of local market shocks when the number of permit changes is small but the percentage of changes is large. Although a total number of building permits is significantly correlated to the total employment in the construction sector, it reflects the baseline housing market conditions instead of any local market shocks.

To ensure that three years is an appropriate leading span, I conduct a falsification test using a two-year lead for building permit changes instead. The results are presented in Appendix. Clearly, no significant results are found. Similarly, only the estimation for the test using a lead of one year for building permit changes with county-level covariates is statistically significant, while insignificant results are reported for the estimation with both state-fixed effects and county-level covariates. The falsification test result suggests that a three-year lead for building permit changes is appropriate and has the strongest first stage.

2.7 Summary

This study contributes to the existing literature by providing new evidence that, firstly, the opportunity cost of college enrollment (i.e., foregone employment opportunities) has an influence on the decision of enrollment timing, and secondly, enrollment delay affects students' choice of college. The empirical evidence supports the hypothesis that higher opportunity cost would deter the students at the margin of college attendance from obtaining a post-secondary education, particularly young males whose employment heavily depends on the low-skilled job market. Furthermore, not enrolling immediately makes delayers more likely to choose two-year colleges, which usually leads to lower completion rates. Therefore, policies designed to improve the employment and earnings opportunities of low-skilled workers, such as public jobs programs, wage subsidies, and minimum wage increases, could have the unanticipated effect of enticing students to postpone their education plans.

This research will benefit policies that are designed particularly for students who are vulnerable to the cost of attending college. When unskilled job markets flourish, delaying college could well be a rational decision. Nevertheless, some students might be led to a suboptimal decision if they mistakenly place more emphasis on the present. Therefore, it is imperative to identify the target population and investigate how to effectively help them during the transition from high school to college.

Overall, enrollment timing is a field with little research attention. My study addresses this gap by providing evidence for the determinants of college enrollment timing and the consequences of delay. In contrast to the prior literature (e.g. Charles et al., 2015), my study documents a significant effect of housing boom on male high school graduates and no effect on females, as my study is able to examine the substitute effect without the confounding from the wealth effect caused by the boom. My findings are consistent to other papers on low-skilled biased labor market shocks (Black et al., 2005; Cascio & Narayan, 2015), which show local labor demand shocks have been biased toward low-skilled males.

However, there are still several limitations to this research. Firstly, my paper only addresses the causes of delay. Once students delay, what makes them re-enroll (or not)? This question remains unanswered in this paper, but it is extremely crucial when we consider the outcomes of delay. Secondly, due to the limitations of the data, the external validity of my research is subject to the specialty of the cohort. It is important to reiterate that the cohort in the sample is unique, as it faced an unprecedented housing boom in high school and an equally unprecedented recession in later years. It is unclear whether delayers would ultimately return to college even in the absence of a recession. Third, I cannot conclusively state the effect of delay on labor market outcomes, since the most recent survey was conducted in 2012, when some of the delayers were still enrolled and their earnings were not stable. Furthermore, the local labor demand shock is not appropriate for the research on delayer's labor market outcomes. A great deal of literature has shown the initial labor market conditions can have direct long-term effects on earnings (Beaudry et al., 2016; Genda et al., 2012; Kahn, 2010; Oreopoulos et al., 2012; Schmieder & Von Wachter, 2010). To address this gap, Chapter 3 examines the earning outcomes by using the matching method and longitudinal datasets with a longer time-span.

Chapter 3. Timing Matters: How Delaying College Enrollment Affects Earnings Trajectories[11]

3.1 Introduction

In recent years, educational counselors and universities have increasingly promoted the "gap year model" (Hoe, 2015). Malia Obama, President Obama's daughter, was called a "trendsetter" by taking a gap year prior to her enrollment at Harvard University (McPhate, 2016). Nowadays, all eight Ivy Leagues universities have encouraged their admitted students to take a gap year to travel, work, or engage in productive activities that may better prepare them academically and developmentally. Some schools, including Princeton, Tufts, the University of North Carolina at Chapel Hill, the New School, and Elon University actually provide financial aid for students doing so[12]. However, not all students choose to delay. According to the ELS:2002 (Table 1.1), 27 percent of the delayed enrollees name financial concerns as the main reason for delay respectively. This rate is higher for black and Hispanic students, more than 30 percent delay constrained financially. Less than 10 percent use the gap year to pursue interests or take a break.

Yet there is very little rigorous research to compare the earning outcomes, let alone earning trajectories of delayers and on-time enrollees. On the one hand, Kane (1996) suggests that working instead of enrolling in college allows individuals to save for college, defer paying college tuition, and enjoy short-term consumption benefit. Some also believe that accumulating working experience before college may increase the competitiveness of delayers after college (Dellas & Sakellaris 2003) though to what extent the returns to pre-college experience matter for post-college employment remains unanswered. On the other hand, delay enrollment may lower

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[11] This chapter is coauthored with Vivian Yuen Ting Liu.
[12] Information is from Gap Year Association (https://www.gapyearassociation.org/financial-aid.php).

the likelihood of enrolling and completing a college education, thus implicitly depresses the supply of skilled labor.

While most returns to education studies compare the earning outcomes at certain points in time, a number of recent papers have pointed out the effect of education credentials on both the starting wage and earning's growth over time (Böckerman et al., 2017; Hanushek et al., 2017; Jaggars & Xu, 2016; Minaya & Scott-Clayton, 2017). For example, as Jaggars and Xu (2016) suggest that the sizable parts of positive returns of community college credentials are not due to immediate gains in earnings right after graduation, but rather to increases in earnings growth over time. Inspired by these emerging studies, we speculate the earnings difference between delayers and on-time enrollees may change over time. In addition, since delayers tend to work before college and during college, it would be interesting to see how their earning trajectories are different from on-time enrollees who have little work experience prior to graduation.

In this chapter, we use data from the National Longitudinal Survey of Youth 1997 (NLSY97) to address four research questions:

1. What are the characteristics of individuals who delay college enrollment?
2. Do different types of delayers and on-time enrollees have different labor market trajectories?
3. How does delaying college enrollment affect educational and labor market outcomes over time?
4. What are the key determinants of the wage differentials between on-time enrollees and delayers?

Our primary contributions to the research literature are threefold. First, while most studies on the returns to education have looked at outcomes four to six years after initial college enrollment, we analyze student outcomes up to 13 years after high school completion. Second, in addition to comparing earnings outcomes at certain points in time, we examine the effects of delayed college enrollment on earnings trajectories. Finally, almost all existing studies on the effects of delayed college enrollment on labor market outcomes are conditional on eventual college enrollment and therefore exclude delayers who failed to return. Since college attendance is one of the outcomes of delay, Angrist and Pischke (2008) recommend against estimating on a sample conditional on an outcome, since it will introduce selection bias. Our study attempts to reduce this selection bias by including non-college-attendees in the analysis. As the data have no information on student's college intentions, we might include some non-enrollees who had no intention to pursue postsecondary education and cause a slight overestimation of the impact of the delay[13].

Our main results indicate that delayers enjoy an earnings advantage over on-time enrollees during the first five years after high school graduation, after which their earnings trajectories reverse and on-time enrollees experience much greater earnings gains than delayers do. The earnings penalty associated with delayed college enrollment is positively correlated with the duration of the delay. Differences in student characteristics explain only one-third of the pay gap between delayers and on-time enrollees; the rest is explained by delayers' reduced likelihood of attending and obtaining a degree at a four-year college.

The rest of this chapter is organized as follows. In Section 2, we review related literature on the outcomes associated with delayed college enrollment. In Section 3, we introduce a conceptual framework for college entry timing and predict the effects of delayed college enrollment on labor market trajectories. In Section 4, we describe our data and the empirical

[13] We attempt to mitigate such overestimation by examining the cumulative effects over years and investigating the change in the effect sizes, which decreases the impact from the never enrollees to some extent.

methods we use to estimate the effects of delayed college (propensity score matching, or PSM) and the mechanism of the effects (Oaxaca decomposition). Section 5 presents the results, and Section 6 concludes the paper.

3.2 Background

Only a few studies have looked at the academic and employment outcomes of delayed college enrollment. Most of these focused on cohorts prior to 1990, and the only two that employed quasi-experimental approaches used more recent Canadian data. More research on this topic is clearly needed.

Prior studies have shown that college postponement could harm individuals' academic aspirations and outcomes. Using data from the National Education Longitudinal Study of 1988, Bozick and DeLuca (2005) found that delayers were 64 percent less likely to complete a bachelor's degree, since only 24 percent of delayers enrolled in four-year institutions. Niu and Tienda (2013), looking at a sample of students who graduated from Texas high schools in 2002, similarly found that delayers were 40 percentage points less likely than on-time enrollees to be enrolled at a baccalaureate-granting institution four years after high school. In the descriptive analysis, Horn, Cataldi, and Sikora (2005) found that delayers were 18 percentage points less likely than on-time enrollees to complete any college credential.

To our knowledge, only seven studies have examined the effects of interrupted schooling on labor market outcomes. Two looked specifically at interruptions between high school and college (Ferrer and Menendez, 2014; Holmlund, Liu, and Skans, 2008), and five investigated schooling interruptions that were less specific in timing (Fortin and Ragued, 2016; Griliches, 1980; Light, 1995; Marcus, 1984; Monks, 1997), with mixed results. Five of the studies found that interrupted schooling had a negative to zero effect on earnings (Marcus, 1984; Monks, 1997;

Light, 1995; Griliches, 1980; Holmlund, Liu, and Skans, 2008), while the two Canadian studies found positive returns.

As previous research has suggested that delayers tend to be of low socioeconomic status (SES) or relatively low academic ability (Bozick and DeLuca, 2005; Hearn, 1992; Horn, Cataldi, and Sikora, 2005; Johnson, 2013; Rowan-Kenyon, 2007), directly comparing the outcomes of delayers and on-time enrollees may produce biased estimates. Therefore, among the studies mentioned above, the three quasi-experimental studies—Light (1995), Ferrer and Menendez (2014), and Fortin and Ragued (2016)—are of greatest interest.

Using a random effect approach, Light (1995) exploited the deviations from individual means of each time-varying factors as instrumental variable and found that work experience gained during gap years was not valued as highly in the labor market as work experience obtained after college. She found that a college graduate who delays college enrollment to work for four years receives a 17 percent lower wage than an on-time enrollee who has four years of post-college work experience. This finding is consistent with descriptive results from Holmlund, Liu, and Skans (2008) indicating that the returns to post-college work experience at age 35 are 3.5 times larger than the returns to precollege work.

Fortin and Ragued (2016) and Ferrer and Menendez (2014) reached opposite results and suggested that full-time work before college can increase subsequent wages by helping delayers learn about their abilities and aspirations and the labor market returns to a degree. These two studies used unemployment rate before high school graduation as instrumental variable and studied different cohorts of the Canadian National Graduates Survey. Fortin and Ragued concluded that temporary schooling interruptions led to an average increase of 21 percent in post-college starting wages for men who worked full-time during their out-of-school spell. Ferrer and Menendez found that the returns to schooling interruptions between high school and college are 10 percent for bachelor's degree holders and 14 percent for two-year degree holders.

Overall, the literature on delayed college enrollment to date is mixed. Two quasi-experimental studies found positive results from delayed enrollment, but their focus on Canadian students means they may have limited implications within the context of the United States, and the restriction of their samples to college graduates means they do not capture any effects of delay on college enrollment and completion. Using a PSM method and national data from the United States, our paper contributes to the existing literature by addressing issues related to selection bias, focusing on a broader range of students, and providing implications for the U.S. postsecondary context.

3.3 Conceptual Framework

In the traditional model of human capital investment developed by Mincer (1958) and Becker (1962), the decision to defer college enrollment is based on its marginal benefits and costs. Kane (1996) argued that according to the human capital model, deferring college entry is not a rational decision in a perfect market with no borrowing constraints and perfect information: Postponing enrollment allows individuals to enjoy short-term employment benefits and defer the costs of college, but in doing so, they also defer the returns to postsecondary education. As long as higher education is beneficial, deferring college payoffs is more harmful in the long run, and postponing college entry would result in lower lifetime earnings.

To illustrate this theoretically, Scenario 1 in Figure 3.1 depicts earnings trajectories for on-time enrollees and delayers under the best-case scenario for delayers.[14] Suppose two individuals graduate from high school at the same time at age 18: One, represented by the solid

[14] Delayers who failed to reenroll in college are not specifically discussed in the theoretical framework, as their earnings trajectory is conceptually equivalent to the typical high school graduate's.

red line, enrolls in college immediately after graduating high school, and the other, depicted by the black dashed line, works for four years between high school and college. We make three assumptions in our model:

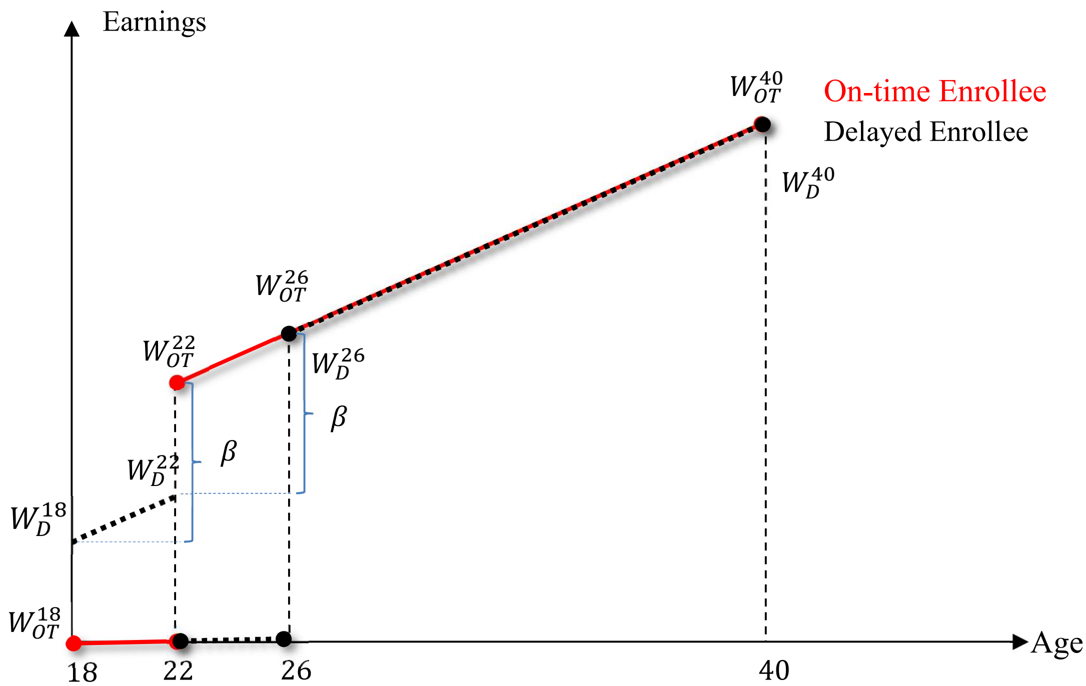
1. Both individuals take four years to complete college.

2. Returns to college are the same regardless of students' age at college entry.

3. Salaries increase at the same rate with experience regardless of whether the work experience takes place before or after college, following Kane's (1996) model.

Figure 3.1 Theoretical Wage Trajectories for On-Time Enrollees and Delayers

Scenario 1:
Both Groups Experience the Same Returns to College and Work Experience



Under these assumptions, the on-time enrollee begins college at age 18 and enters the workforce after graduating at age 22, earning a starting salary of W_{OT}^{22}. Assuming wage growth is consistent over time, this individual will receive a salary of W_{OT}^{40} at age 40. The delayer, meanwhile, enters the workforce after high school graduation and earns a starting salary of W_{D}^{18}. This salary grows to W_{D}^{22} by age 22, at which point the delayer enrolls in college. After graduating from college, the delayer earns W_{D}^{26}, which equals the wage he or she received prior to entering college plus the returns to a college degree, and from that point onward has the same wage trajectory as the on-time enrollee. In this model, the wage premium for having a college degree versus a high school diploma is $\beta = W_{\mathrm{D}}^{26} - W_{\mathrm{D}}^{22} = W_{\mathrm{OT}}^{22} - W_{\mathrm{D}}^{18}$ for both individuals; the delayer experiences no wage penalty.

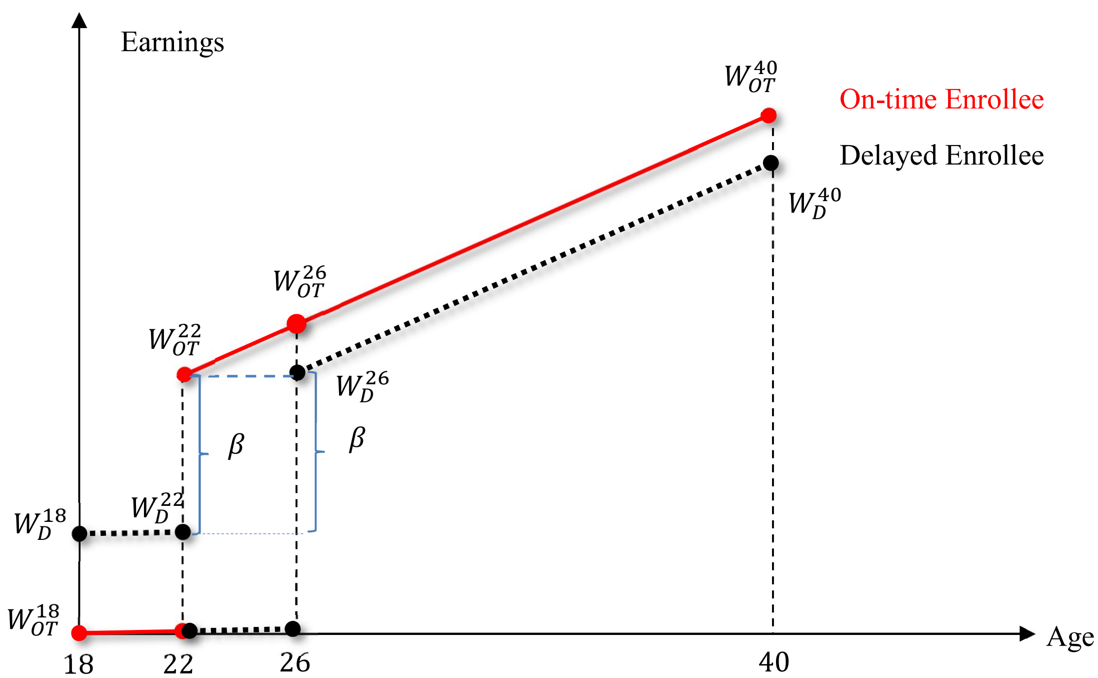
This model may not be realistic, however, since not all human capital investment and on-the-job training yields the same returns (Ben-Porath, 1967). Work experience accumulated prior to college may not be relevant to employers after college graduation, so the returns to this experience may be lower than the returns to post-college experience. In Scenario 2, therefore, we relax our third assumption so that precollege work experience is not valued in the labor market after college. In this scenario, the delayer has a horizontal wage trajectory before college and the same starting salary as the on-time enrollee ($W_{\mathrm{D}}^{26} = W_{\mathrm{OT}}^{22}$). In this case, at every age post-college, the delayer makes less than the on-time enrollee.

Finally, we relax our first and second assumptions to account for the potential effects of delayed enrollment on college choice, degree completion, and earnings. For example, most delayers do not have access to high school counselors after graduation, and without sufficient information on colleges, they may apply to and enroll in colleges that are poorly matched to their abilities (Dillon and Smith, 2013; Roderick, Nagaoka, and Coca, 2009). Horn, Cataldi, and

Sikora (2005) found that delayers are less likely to persist and graduate, thus lowering the returns to college education. Such a scenario is illustrated in Scenario 3, where the delayer experiences lower returns to college ($W_D^{26} - W_D^{22} < W_{OT}^{22} - W_D^{18}$) and slower wage growth. Here, the loss experienced by the delayer is caused not only by the delayed college payoff but also by the wasted precollege work experience and lower returns to higher education

Figure 3.1 Theoretical Wage Trajectories for On-Time Enrollees and Delayers

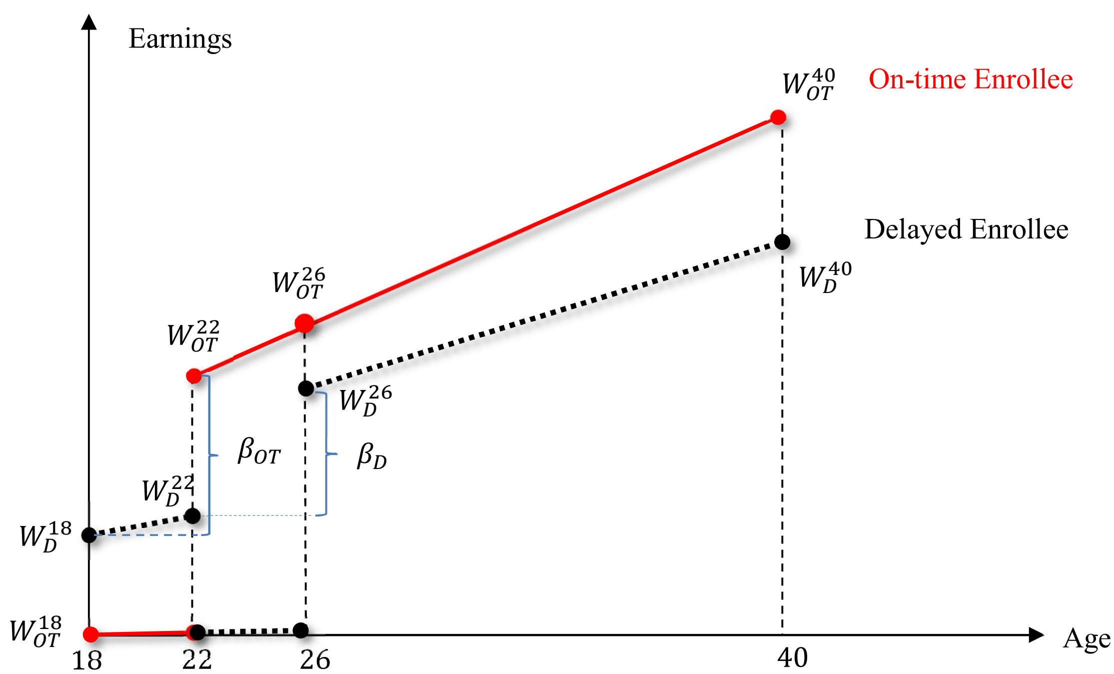
Scenario 2:
Precollege Work Experience Yields No Post-College Returns



Yet even Scenario 3 may not truly reflect the difference in the earnings trajectories of delayers and on-time enrollees. Having received full-time earnings for a few years, it may be difficult for delayers to reduce their work hours and enroll full-time. The academic momentum literature indicates that part-time enrollment is related to lower completion rates and a longer time to degree (Calcagno, Crosta, Bailey, and Jenkins, 2007; Choy, 2002), so the earnings trajectories of delayers may be shifted to the right even further. For a similar reason, delayers may opt for short degree programs, such as those offered by community colleges (Horn, Cataldi, and Sikora, 2005). While some selective community college programs offer similar returns to a bachelor's degree, the average wage of a bachelor's degree holder is still higher than that of a community college graduate. For some, choosing to delay enrollment may prevent them from ever going to college as they may lose the eligibility to scholarship[15] or be unable to resume full-time study after several years of gap. Under this worst-case scenario, the earning trajectories of delayers would be the same those of high school graduates.

Figure 3.1 Theoretical Wage Trajectories for On-Time Enrollees and Delayers

Scenario 3:
Precollege Work Experience Yields No Post-College Returns, and College Yields Lower Returns for Delayers



[15] For example, students who work significantly the year before entering college will be penalized in the determination of the Expected Family Contribution (EFC), the amount that a family is estimated to be able to provide towards higher education expenses (Long, 2008). Consequently, working before college enrollment will decrease the amount and or imperil the possibility of receiving need-based financial aid, such as Pell Grants.

3.4 Method

3.4.1 Data

To compare the outcomes of delayers and on-time enrollees, we draw on data from the NLSY97, a nationally representative longitudinal survey of Americans born between 1980 and 1984 who were 12 to 17 years old during their initial interview in 1997. This cohort has been surveyed 17 times—annually from 1997 to 2011 and biennially thereafter (in 2013 and 2015). The NLSY97 contains comprehensive data on educational and labor market outcomes, as well as detailed individual information on respondents' demographics, household characteristics, SES, academic performance, and social activities.

We define delayers as those not attending college by October of their high school graduation year if they graduated between January and July or by the following February if they graduated after July. Our definition includes individuals who eventually entered college and those who never attended college. Previous studies on delayed enrollment have often excluded individuals who never enrolled in college, but because delaying enrollment may impact individuals' decision to enroll and their choice of college, examining outcomes conditional on college enrollment may positively bias our estimates.

Our final sample contains 6,717 respondents who graduated from high school between 1998 and 2003. Table 3.1 provides a descriptive summary of the sample disaggregated by enrollment timing. About 58 percent of respondents enrolled in college on time; 21 percent delayed college enrollment but enrolled by 2015; 21 percent never enrolled in college. Disproportionately more Black, Hispanic, and male students delayed college enrollment. Short-term delayers (those who delayed college enrollment less than three years) were more likely to live in metropolitan areas, where job opportunities may be ample. In general, delayers tended to

Table 3.1 Descriptive Statistics Summary

	All	On-Time Enrollees	Delayed < 3 Years	Delayed 3–7 Years	Delayed > 7 Years	Never Enrolled
Individual demographics						
White	61%	65%	53%	52%	49%	58%
Black	24%	21%	28%	34%	35%	27%
Hispanic	20%	17%	25%	23%	19%	24%
Other race	13%	13%	17%	13%	14%	14%
Female	51%	55%	51%	50%	49%	40%
Birth year	1982	1982	1982	1982	1982	1982
High school graduation year	2000	2000	2000	2001	2000	2001
Lived in urban area in 1997	73%	73%	79%	73%	73%	67%
Lived in Northeast in 1997	18%	18%	18%	15%	16%	17%
Lived in North Central region in 1997	24%	25%	21%	22%	25%	22%
Lived in South in 1997	36%	34%	34%	41%	39%	38%
Lived in metropolitan area in 1997	82%	84%	85%	79%	76%	77%
Household demographics						
Household size	4.49	4.42	4.54	4.49	4.54	4.64
Highest years of parental education	13.57	14.33	12.98	12.96	12.76	12.05
Household net worth in 1997	78,234	101,130	53,535	49,979	41,030	42,241
Household income in high school graduation year	61,196	73,127	48,402	39,989	37,932	45,174
Lived with both parents in high school graduation year	55%	62%	47%	40%	31%	46%
High school characteristics						
Public school	94%	91%	96%	98%	99%	98%
< 299 students	6%	7%	5%	6%	6%	6%
300–499 students	10%	10%	8%	8%	10%	10%
500–749 students	20%	20%	20%	17%	17%	20%
750–999 students	16%	15%	14%	18%	12%	19%
Pupil–teacher ratio < 14	22%	23%	18%	21%	22%	22%
Pupil–teacher ratio 14 to < 18	33%	33%	31%	31%	36%	32%
Pupil–teacher ratio 18 to < 22	21%	21%	22%	23%	15%	21%
Academic preparation						
High school grade point average	2.91	3.10	2.75	2.64	2.51	2.55
ASVAB score percentile	50.90	60.17	46.39	42.12	39.22	29.94
Expectation to earn college degree by 30	78%	88%	77%	67%	66%	59%
Other characteristics in high school						
Married/cohabiting in graduation year	6%	3%	7%	11%	13%	12%
Pregnant/got someone pregnant in graduation year	6%	3%	9%	14%	16%	10%
Number of children in graduation year	0.06	0.02	0.09	0.15	0.14	0.09
Health condition in graduation year (5 = excellent)	4.04	4.12	3.94	3.97	3.96	3.87
Arrests in high school	0.06	0.03	0.07	0.07	0.10	0.11
Ever drank alcohol in graduation year	61%	64%	60%	55%	60%	53%
N	6,717	3,919	762	349	269	1,418

Note. ASVAB = Armed Services Vocational Aptitude Battery.

Source: NLSY 97

come from families with lower parental education and fewer financial resources. Among delayers, those who delayed for over seven years were the least likely to live with both parents the year they completed high school. High school characteristics were comparable for delayers and on-time enrollees, Academic performance varied substantially across the groups, with greater lengths of delay corresponding with lower academic preparation levels (i.e., lower high school grade point averages [GPA]) and expectations regarding educational attainment. Delayers were also more likely to be married or cohabiting, to become pregnant or impregnate someone, to have children, to experience health problems, and to be arrested in the year of their high school graduation.

3.4.2 Propensity Score Matching

The ideal way to estimate the effects of delayed college enrollment on student outcomes would be to randomly assign students to delay or enroll on time, so that any difference in their outcomes could be attributed to their enrollment timing. However, such randomization is not possible in practice. Even if a group of students were willing to participate in a randomized controlled trial (which is extremely unlikely), the ideal random assignment would involve multiple steps. First, after high school graduation, some students would need to be randomly selected to attend college and others to decline to enroll. Second, among college attendees, some would need to be randomly selected to attend college immediately and some to delay their enrollment. Third, researchers would need to track these students for a lifetime and compare their educational and employment outcomes. Moreover, the effects of delaying college enrollment would accumulate over time, such that students would encounter obstacles impeding them from reenrolling and completing college. For researchers to estimate the effects of delaying enrollment conditional on college enrollment or completion, they would have to conduct additional randomizations to assign some students to return to college, and then to complete college, making this “ideal” experimental design extremely complex.

Even if a randomized experiment fulfilled all these requirements, it still would not be able to provide evidence on the real-world factors that cause students to delay college enrollment, which is necessary to inform policy. We are therefore unable to employ an experimental design, so we need to address issues of selection bias in our empirical strategy. However, this “ideal experiment” guides our empirical approach to studying the effects of delayed college enrollment in cumulative ways.

To mitigate observable selection bias, we use a propensity score matching (PSM) approach to compare the outcomes of delayers and on-time enrollees with similar propensities to delay college enrollment. Although PSM does not eliminate unobservable selection bias, incorporating PSM still confers several advantages above a simple ordinary least squares (OLS) regression. First, OLS can only control for confounding factors by adding covariates, but observations lacking common support cannot be compared directly by linear exploration via covariates. PSM ensures that the treated individuals are compared only with those in the control group who are most similar in terms of observable characteristics. Second, a PSM approach sheds light on the treatment selection process, describing factors that correlate with delayed college enrollment.

Even though it is impossible to rule out unobservable biases using PSM, this approach is suitable for investigating our research questions. First, our data are longitudinal and include measures of the main time-variant and time-invariant factors that we suspect lead to delayed enrollment, such as detailed individual demographics, family income, school characteristics, student ability, and some key life events. Second, other than these controlled factors, enrollment delay can be affected by some known idiosyncratic components, such as sudden economic or academic shocks. Third, our sample includes a large number of delayers, enabling us to build treatment and control groups with enough common support.

To investigate the determinants of delayed enrollment empirically, then, we first model student enrollment timing using logistic regression:

$$Pr(Delay = 1) = \Phi(X'\beta) \quad (1)$$

In this model, Φ is the cumulative distribution function of a standard normal distribution, and X is a vector of factors that might affect enrollment timing. According to our conceptual framework, the timing of students' college enrollment choice is a function of the marginal benefits and marginal costs of college enrollment. We include geographic information,[16] high school graduation year, and their interaction in the model to control for local market differences. (For a complete list of variables included, see Table 3.2.) We also implement the logistic regression model for men and women separately to see if the determinants affect them differently.[17]

To implement PSM, we apply the resulting parameters from the first logistic model to construct each individual's propensity score. The basic idea of PSM is to form a counterfactual comparison group of on-time enrollees whose likelihood of delaying college enrollment is similar to the delayers'. By comparing the outcomes of two groups with similar pretreatment characteristics, we can calculate the differences in outcomes that can be attributed to the treatment. The underlying identifying assumption is that the selection is based on observable characteristics. Any factors that jointly affect both treatment and subsequent outcomes have to be

[16] Detailed geographic information, such as state, metropolitan statistical area, and county, is not available in the public-use NLSY97 data. The smallest geographic division we are able to disaggregate our sample by is census region.
[17] In addition to looking at the determinants of delayed enrollment in general, we use a multinomial logistic model to examine the determinants of different lengths of delay. The full results are presented in the appendix.

included in the model. If the assumption holds and there is overlap between the groups, the PSM estimator for the average treatment effect for the treated is the mean difference in outcomes of the treatment and comparison groups with sufficient common support, appropriately weighted by the propensity score distribution of delayers. Our outcomes of interest include enrollment and completion at four- and two-year colleges, earnings, and work hours, all of which we examine by years relative to high school graduation.

We then use caliper matching with a radius caliper of 0.05, with replacement and excluding observations without common support. This procedure allows us to match each delayer with an on-time enrollee within 0.05 on either side of the treatment propensity score.[18] We also use alternative methods of matching, but the results are highly robust, as we discuss in the results section.

3.4.3 Oaxaca Decomposition

To examine the factors contributing to the wage gap between delayers and on-time enrollees, we use an Oaxaca decomposition (Oaxaca, 1973). Equations 4 and 5 model the wages of delayers and on-time enrollees respectively as a function of college enrollment ($Enroll$), degree attainment ($Degree$), and individual characteristics (X).

$$wage_{\mathrm{OT}} = \beta^1_{\mathrm{OT}} Enroll_{\mathrm{OT}} + \beta^2_{\mathrm{OT}} Degree_{\mathrm{OT}} + \beta^3_{\mathrm{OT}} X_{\mathrm{OT}} + \mu_{\mathrm{OT}} \quad (4)$$

$$wage_{\mathrm{D}} = \beta^1_{\mathrm{D}} Enroll_{\mathrm{D}} + \beta^2_{\mathrm{D}} Degree_{\mathrm{D}} + \beta^3_{\mathrm{D}} X_{\mathrm{D}} + \mu_{\mathrm{D}} \quad (5)$$

An Oaxaca decomposition disaggregates the raw differences in log earnings between the two groups into portions that can be explained by differences in these three types of factors. In our analysis, we focus on how college enrollment and degree completion contribute to the earnings

[18] Caliper matching helps us avoid the risk of bad matching posed by nearest-neighbor matching if the nearest neighbor is far away. The caliper imposes a tolerance level on the maximum propensity score distance that meets the requirement of common support.

difference between the groups. Including both college enrollment and degree completion in the same equation could cause a severe multi-collinearity problem, so we conduct separate decompositions for them.

3.5 Results

3.5.1 Earnings Trajectories

We begin by taking a graphical look at labor market trajectories for on-time enrollees and different types of delayers. Figures 3.2 and 3.3 show the patterns of earnings and annual hours worked over time by initial college enrollment timing relative to high school graduation.

On-time enrollees started out earning less than the other groups and eventually earned the most. Their annual earnings were around $35,000 13 years after high school graduation, while delayers earned slightly above $30,000 at most.[19] The earnings for on-time enrollees started to grow faster and exceed the earnings of delayers in the sixth year. From the seventh year onward, the earnings of on-time enrollees continued on an upward trajectory, while the earnings growth for the rest of the sample decelerated. These trajectories are most consistent with the third scenario we outlined in our conceptual framework (Scenario 3, Figure 3.1). Individuals who delayed college enrollment for more than seven years had the least favorable outcomes, with earnings trajectories even lower than those of individuals who never enrolled in college—which suggests that the college completion rate for this group is likely very low and that college is not worth the cost for long-term delayers.

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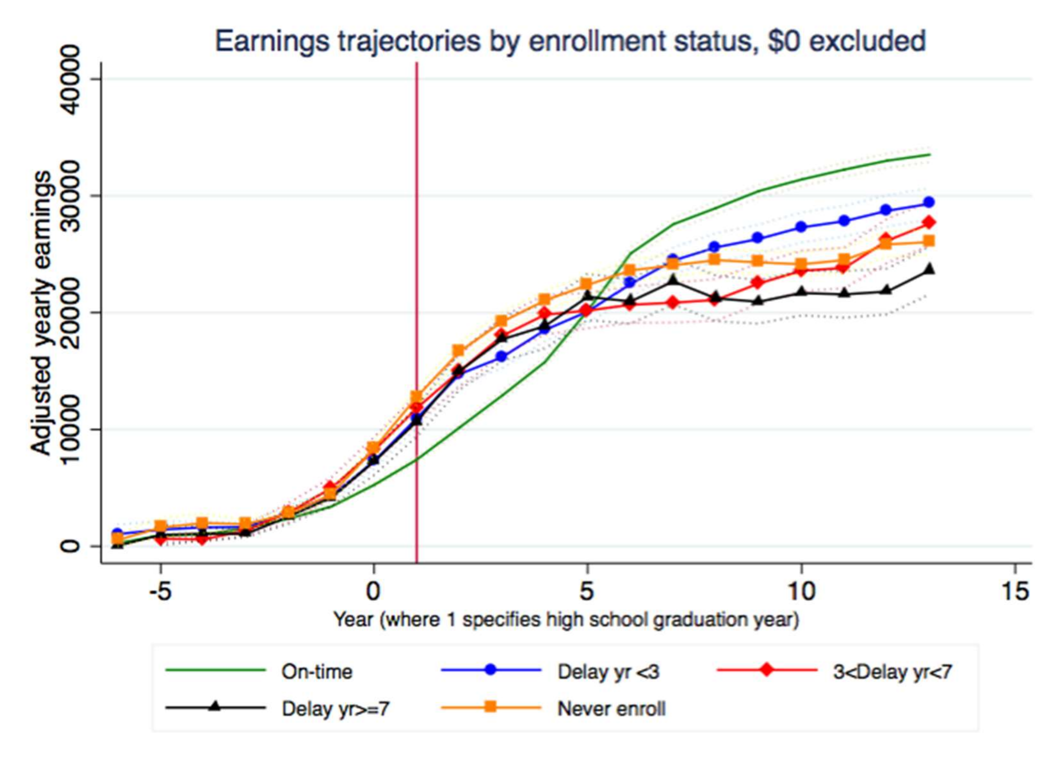
[19] Only positive earnings are included in these figures. Panel B of Figure 3.2 shows the earnings trajectories with zero earnings included, and the trends are similar but magnified.

Figure 3.2 Adjusted Yearly Earnings by Enrollment Status

Panel A: $0 Excluded



Panel B: Valid $0 Included

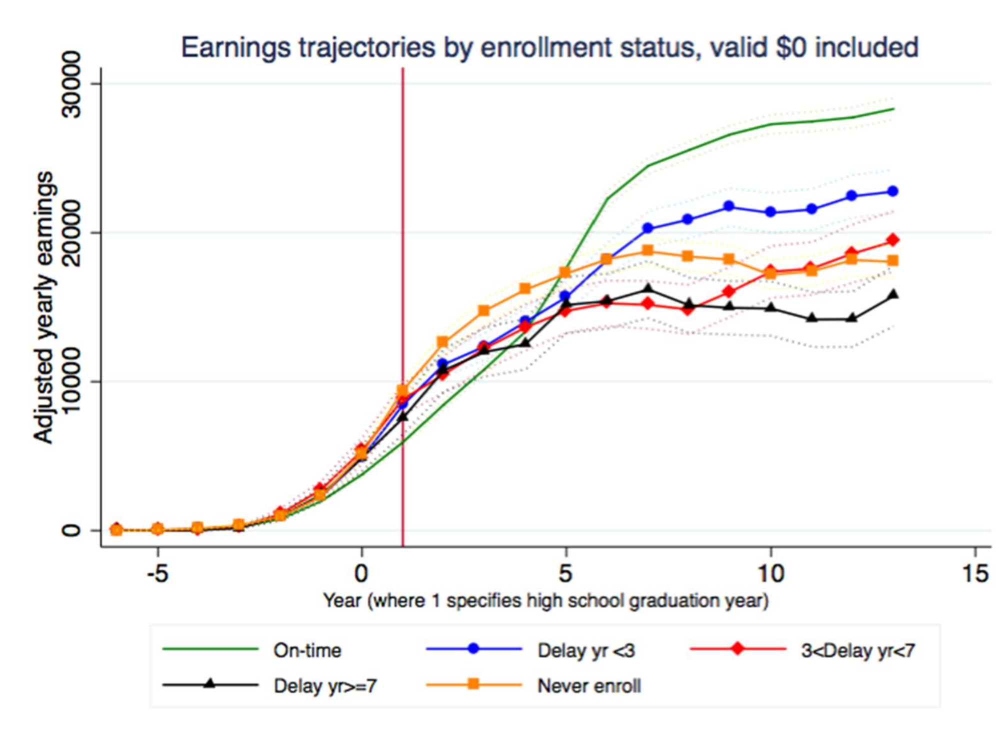
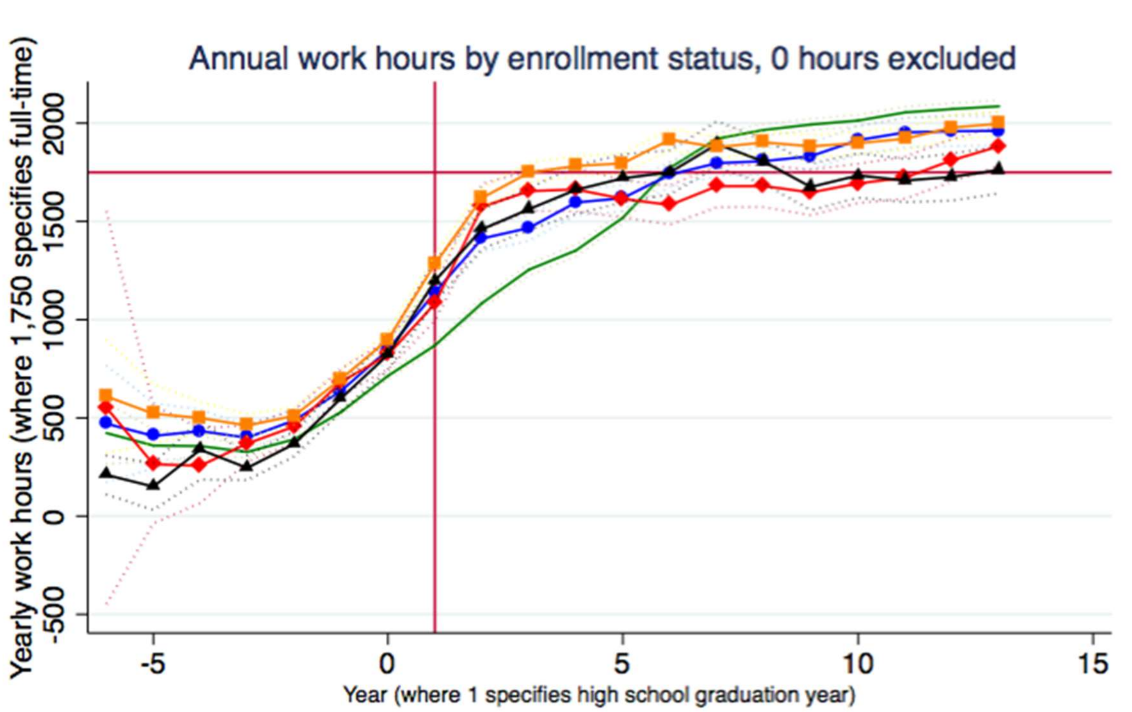


Figure 3.3 presents the annual work hour trajectories for different types of delayers and on-time enrollees. The horizontal red line marks 1,750 hours, which is equivalent to full-time employment.[20] There are three important observations to be made from this figure. First, on-time enrollees tended to work part-time during college and started to have similar work hours to delayers after the sixth year post-high school graduation, as members of both groups on average worked full-time then. Second, delayers tended to work full-time even after they went back to school, which might explain why they experienced lower returns to postsecondary education: Full-time workers tend to choose two-year colleges or part-time programs that usually have lower completion rates (Bozick and DeLuca, 2005). Finally, short-term delayers (those who delayed enrollment less than three years) tended to work part-time before entering college, while

Figure 3.3 Annual Work Hours by Enrollment Status



longer-term delayers more often worked full-time. Therefore, for short-term delayers, the

[20] The full-time employment definition is from the U.S. Department of Labor's Bureau of Labor Statistics (2014) and the United States Census Bureau (2000) and is equivalent to 35 hours per week for 50 weeks.

opportunity cost of returning to school and studying full-time was lower than it was for longer term delayers.

Both the earnings trajectories and the work hour trajectories suggest that delaying college enrollment produces less desirable labor market outcomes. Returning to school is also not an optimal choice for those who have delayed college enrollment for over seven years.

3.5.2 Logistic Regression

Table 3.2 reports the coefficients for each potential factor predicting delayed college enrollment for the full sample and by gender. Table A3 in the appendix reports the multinomial regression results for selection into different delay lengths.

Both Black and Hispanic high school graduates are less likely than Whites to delay college enrollment. This is an unexpected finding, given that a higher proportion of Black and Hispanic students delayed college enrollment. It is possible that the job market for high school graduates prefers White candidates, so White graduates are more likely to work and delay college enrollment. Compared with women, men are more likely to delay enrollment, which probably reflects men's preference for work, military duty, or other activities.

Household characteristics are also important for predicting college enrollment timing. Students with more educated parents are less likely to delay enrollment, as more educated parents are able to provide more educational resources and more support during the college application and matriculation process, which helps keep students on the traditional education track. Both household net worth and household income are also negatively correlated with delayed enrollment, as more financial inputs decrease students' need to work to save for college.

School inputs influence college enrollment timing via school type and class size. Smaller class size and lower pupil-teacher ratios are negatively correlated with delayed enrollment.

Table 3.2 Logistic Regression Analysis: Potential Determinants of College Enrollment Delay

	All		Male		Female	
	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
Individual demographics						
Black	-0.526***	[0.088]	-0.522***	[0.126]	-0.549***	[0.128]
Hispanic	-0.250**	[0.101]	-0.135	[0.140]	-0.369**	[0.149]
Other race (except White)	-0.181*	[0.106]	-0.360**	[0.149]	0.008	[0.152]
Female	-0.505***	[0.064]				
Birth year	-0.130**	[0.051]	-0.234***	[0.070]	-0.008	[0.076]
High school graduation year	-0.004	[0.073]	0.101	[0.101]	-0.120	[0.107]
Lived in urban area in 1997	-0.033	[0.078]	-0.094	[0.109]	0.033	[0.114]
Lived in Northeast region in 1997	0.488	[0.357]	0.788	[0.482]	0.042	[0.558]
Lived in North Central region in 1997	-0.056	[0.309]	0.122	[0.411]	-0.278	[0.476]
Lived in Southern region in 1997	0.409	[0.287]	0.351	[0.393]	0.452	[0.427]
Lived in metropolitan area in 1997	-0.313***	[0.088]	-0.347***	[0.124]	-0.276**	[0.128]
Household demographics						
Household size	0.040*	[0.022]	0.055*	[0.031]	0.024	[0.031]
Highest year of parental education	-0.123***	[0.012]	-0.127***	[0.017]	-0.120***	[0.018]
Household net worth in 1997 (thousands)	-0.002***	[0.000]	-0.002***	[0.000]	-0.001***	[0.000]
Household income in high school graduation year (thousands)	-0.004***	[0.001]	-0.004***	[0.001]	-0.003***	[0.001]
Lived with both parents in high school graduation year	-0.324***	[0.066]	-0.328***	[0.093]	-0.324***	[0.097]
Attended public high school	0.892***	[0.186]	0.815***	[0.248]	0.981***	[0.286]
High school demographics						
School size < 299 students	0.154	[0.143]	0.110	[0.197]	0.246	[0.210]
School size 300–499 students	-0.128	[0.120]	-0.131	[0.168]	-0.121	[0.175]
School size 500–749 students	0.039	[0.093]	0.029	[0.131]	0.037	[0.136]
School size 750–999 students	-0.009	[0.095]	-0.030	[0.135]	0.014	[0.138]
Pupil–teacher ratio < 14	-0.261**	[0.105]	-0.169	[0.147]	-0.366**	[0.152]
Pupil–teacher ratio 14 to < 18	-0.121	[0.090]	-0.137	[0.128]	-0.109	[0.129]
Pupil–teacher ratio 18 to < 22	-0.113	[0.093]	-0.118	[0.133]	-0.124	[0.131]
Academic preparation						
High school GPA	-1.307***	[0.079]	-1.226***	[0.111]	-1.403***	[0.116]
ASVAB score percentile	-0.019***	[0.001]	-0.020***	[0.002]	-0.017***	[0.002]
Other characteristics						
Married or cohabiting	0.865***	[0.136]	0.650**	[0.270]	0.995***	[0.161]
Pregnant/got someone pregnant in high school graduation year	0.583***	[0.136]	0.297	[0.216]	0.725***	[0.177]
Number of children	0.683***	[0.153]	0.330	[0.530]	0.719***	[0.164]
Health condition in high school graduation year (5 = excellent)	-0.167***	[0.036]	-0.172***	[0.052]	-0.175***	[0.050]
Arrests in high school graduation year	0.422***	[0.119]	0.415***	[0.137]	0.446*	[0.244]
Ever drank alcohol	0.010	[0.069]	0.095	[0.098]	-0.083	[0.100]
Observations	6,454		3,177		3,277	
Year * region interaction	Yes		Yes		Yes	

*$p < .1$. **$p < .05$. ***$p < .01$.

Note: The dependent variable is if the student delay college enrollment after high school graduation
Source: NLSY 97

Compared with private high school students, public high school students have a higher tendency to delay enrollment. Two proxies for academic ability, ASVAB scores and high school GPA, are both positively related to on-time college enrollment.[21]

Unexpected life events in high school also affect college enrollment timing by imposing time constraints on students. Marriage and parenthood are the two major sources of such constraints. The role of spouse or parent alters time use and the distribution of financial resources (Bozick and DeLuca, 2005). Notably, most of the negative effects of marriage and parenthood on college enrollment timing are experienced by women. Arrests and health problems increase the likelihood of delayed enrollment equally for men and women.

Overall, the logistic regression results are consistent with human capital theory and other sociological theories that posit that financial and time constraints obstruct on-time college enrollment.

3.5.3 Propensity Score Matching

Using the logistic regression results, we first show common support between the delayers and on-time enrollees in terms of their propensity to delay college enrollment. Figure 3.4 plots the distributions of delayers and on-time enrollees across the range of estimated propensity scores before and after matching. After matching, both groups have similar propensity scores. There is also sufficient overlap between the groups across the range of propensity scores, assuring common support.

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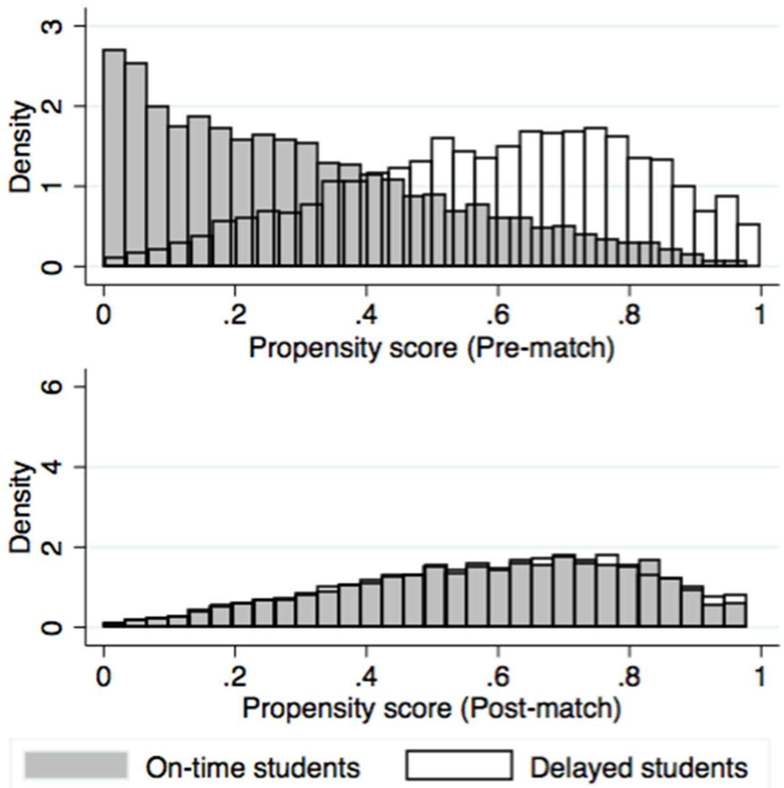
[21] We did not include measures for educational attainment expectations or ACT score because more than half of the sample has no data for these two variables.

Figure 3.4 Density of Propensity Scores Pre- and Post-Matching

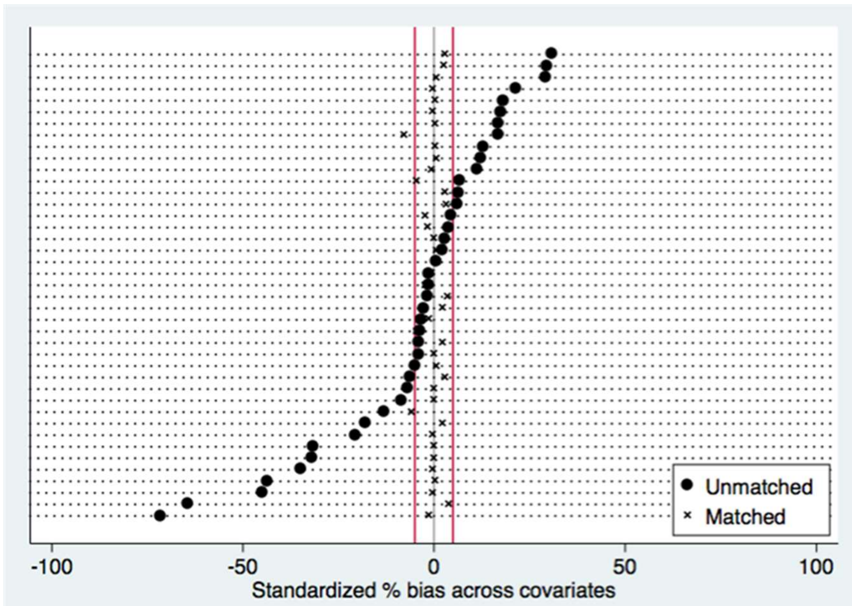


Next, we check the match quality. Figure 3.5 shows that our observations for both delayers and on-time enrollees are well matched across the selected observable covariates. Each circle and asterisk represents the standard bias of the unmatched and matched observable covariates respectively.[22] In most empirical studies, a standard bias below 5 percent after matching is seen as sufficient (Caliendo and Kopeinig, 2008). In our model, the standard bias of most covariates is under 5 percent, except for Hispanic (7.5 percent) and living in a metropolitan

[22] The standardized bias is the difference between the sample means of the treated and untreated subsamples as a percentage of the square root of the average sample variance in both groups.

statistical area (5.7 percent). Given the small bias for a large number of other characteristics, we consider our model to be balanced.[23]

Figure 3.5 Bias Reduction from the Propensity Score Matching Procedure



We then examine two types of outcomes—education and labor market outcomes. The appendix tables include the complete results for both the OLS and PSM estimates of college enrollment, degree completion, and labor market outcomes by year and type of college. In general, the results confirm a small negative bias of the OLS estimations as a result of the selection into the decision to delay college enrollment.

Figure 3.6 plots the PSM results for ever having enrolled in college by year, where each data point is a separate regression representing the effect of delaying college by the *x*th year after high school graduation.[24] In the first year after high school graduation, delayers were 87 percentage points less likely to have ever enrolled in any type of college. The absolute value of the effect size decreases with time, suggesting that some delayers have entered college gradually.

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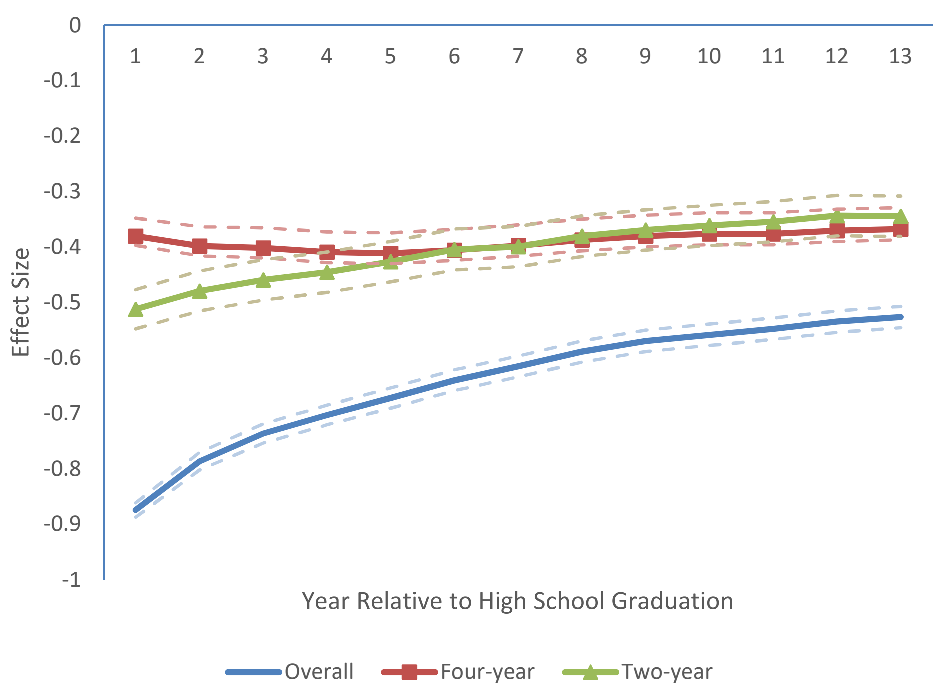
[23] Full results and the balance test are provided in the appendix.
[24] All the results are statistically significant.

By the 13th year after high school graduation, delayers were still over 50 percentage points less likely to have ever attended college. Notably, the trends for ever having enrolled in four-year and two-year colleges move in opposite directions – the effects on four-year college attendance are almost the same in the first year and thirteen year (38.7 percentage points vs. 37.5 percentage points), while the effects on two-year college attendance reduced from 52.3 percentage points to 34.5 percentage points[25]. It implies that delayers who returned to school were rarely to enroll in a four-year college. Albeit the larger effect on two-year college, delayers slowly re-enrolled in two-year colleges in the next thirteen years. The opposite trends indicate the students who are at the margin of attending two-year colleges are those mostly vulnerable to delay.

Figure 3.6 PSM Effects of Delaying on College Enrollment

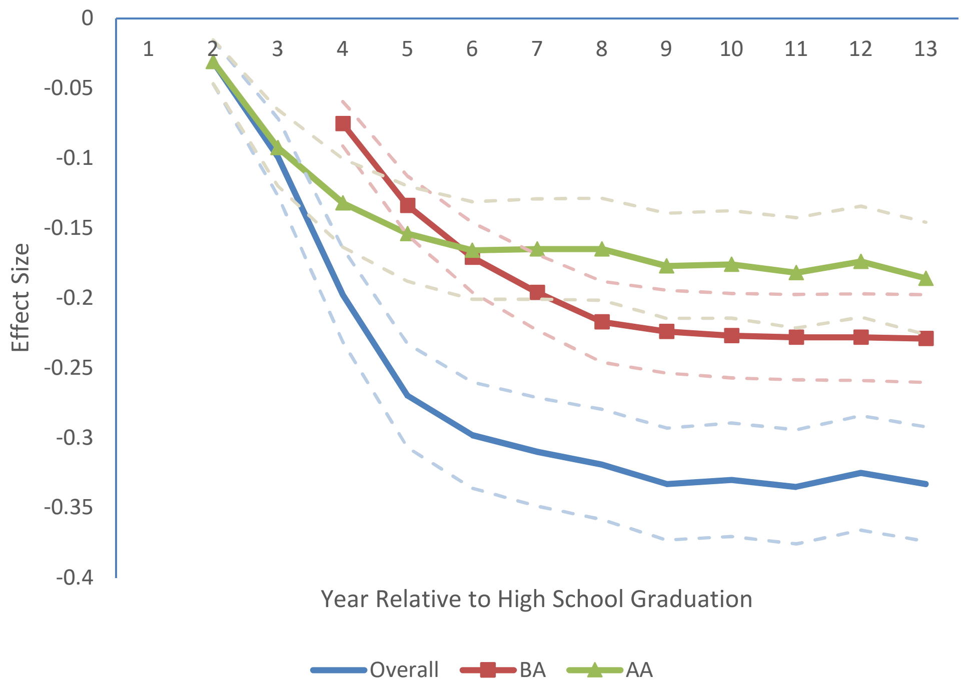


Source: Authors' calculation based on NLSY 97

[25] The sum of the effects on two-year and four-year college enrollment does not equal to the overall effect because some students attended both types of institutions.

Figure 3.7 displays the PSM results for bachelor's degree and associate degree completion over time. In general, delayed enrollment produces long-term negative effects on degree completion, and the gap between delayers and on-time enrollees does not shrink over time. By the seventh year, when many on-time enrollees have completed postsecondary education, the gap in the overall completion rates reaches 32 percentage points. The pattern is

Figure 3.7 PSM Effects of Delaying on College Completion



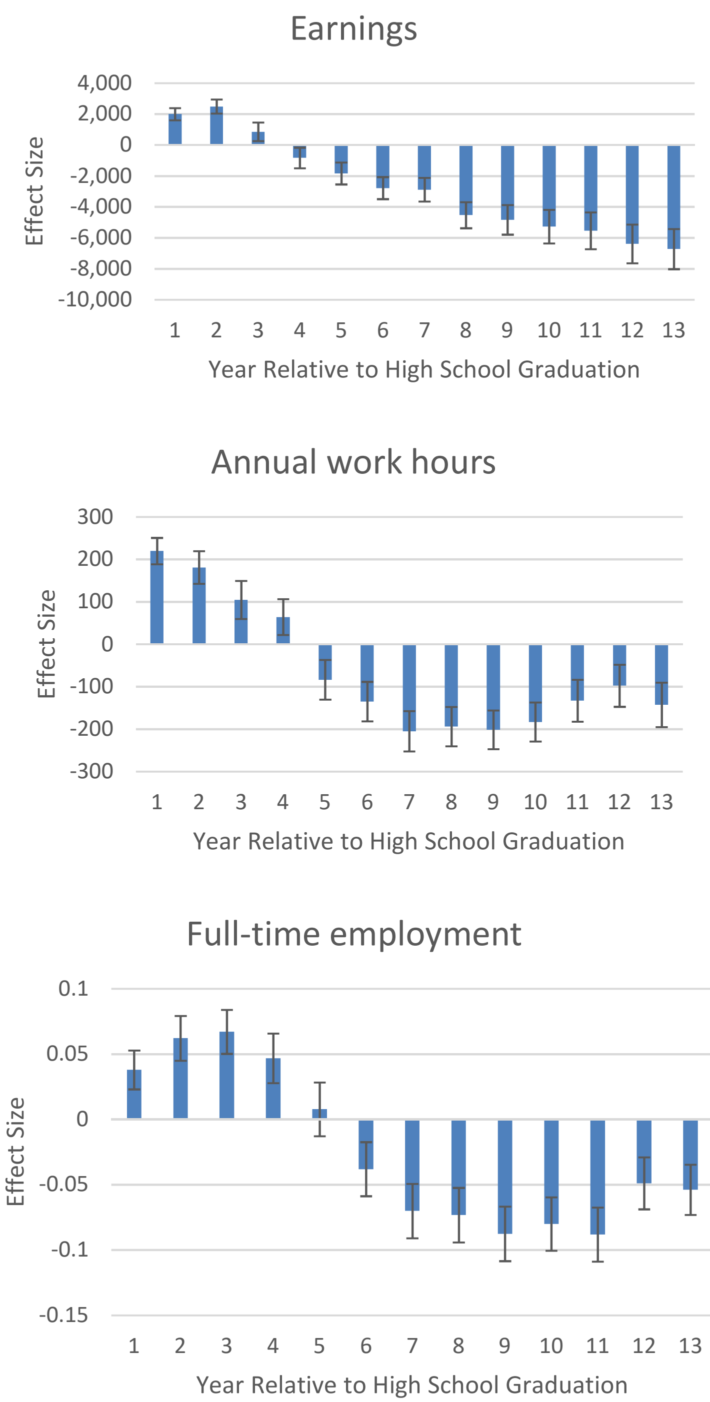
Source: Authors' calculation based on NLSY 97

similar when broken down into bachelor's and associate degree completion, though the overall gap in associate degree completion rates is about 5 percentage points smaller than the overall gap in bachelor's degree completion rates. The PSM results show that even though the enrollment gap between delayers and on-time enrollees narrows with time, delayers are unlikely to complete a degree, resulting in a stubborn gap in completion.

We next examine the effects of delayed college enrollment on labor market outcomes and trajectories. Figure 3.8 shows that delaying college enrollment has a negative impact on long-term earnings, work hours, and full-time employment. In the first three years after high school graduation, delayers had higher earnings than did on-time enrollees, since most of the latter were still enrolled in college, while the delayers were working. In the second year after high school graduation, delayers earned $2,097 more than on-time enrollees did. However, delayers' earnings gains in the fourth year dropped to -$704, as on-time enrollees began completing their postsecondary education and starting to work full-time. After that point, the earnings losses experienced by delayers only deepened. In the 13th year after high school graduation, delayers generally earned $7,470 less than on-time enrollees. The growing disparities between the two groups suggest that delayers earned much less than on-time enrollees did as a result of their lower college enrollment and completion rates. The early earnings benefits of delaying college enrollment cannot offset this long-term earnings penalty.

The trends for work hours and full-time employment are similar. In the first four years after high school, delayers worked more and were more likely to work full-time. After that, the effects of delayed college enrollment on work hours were slightly negative. Delayers worked 100 to 200 hours less per year than on-time enrollees did and were approximately 4 to 9 percentage points less likely to work full-time. The impacts on work hours and employment status are relatively small, given that on-time enrollees worked 1,875 hours on average and that 66 percent of them worked full-time in the 13th year after high school graduation. Consistent with the results shown in Figures 3.2 and 3.3, the result indicates that delayers were very likely to work full-time and work longer hours than on-time enrollees were when enrolled.

Figure 3.8 PSM Effects of Delayed College Enrollment on Labor Market Outcomes by Year



Source: Authors' calculation based on NLSY 97
Note: Error bars are shown on the columns

3.5.4 Robustness to Alternative Specifications

One major criticism of the PSM approach is that it may not adequately account for self-selection bias. If our model ensures that two individuals have the same propensity to delay college enrollment, then what explains why one enrolls on-time and the other does not? For students at the margin of delaying college enrollment (who have a low propensity to delay), enrollment timing may be determined by some idiosyncratic variations (e.g., exogenous variations in local labor markets or sudden life shocks). But for students who have a higher propensity to delay but do not delay, the decision to enroll in college is more likely to be based on self-selection, and we may fail to capture this endogenous selection in the matching process.

To eliminate such endogenous selection, we run a robustness check for inframarginal individuals only (observations with *p*-scores less than .6) as proposed by Scott-Clayton and Minaya (2015). The full results are presented in Appendix Tables A8 to A10. The effects of delaying on enrollment, completion, and employment are still negative and significant, but the effect sizes are slightly smaller.

In addition, we test the robustness of our results using a wider caliper, using nearest-neighbor matching, and using a probit regression instead of a logit regression to calculate *p*-scores. Our results are consistent across all these alternative specifications.

3.5.5 Sensitivity to Unobservable Selection

Even after controlling for an extensive list of observable factors, we cannot rule out the possibility that delayers are different from on-time enrollees in unobservable ways. For this reason, it is important to measure the extent to which unobservables would bias our estimators. Following Oster's (2017) approach, which assumes that unobservable selection is proportional to observable selection, for each estimation we calculate δ, the degree of selection on unobservables relative to observables that would be necessary to cancel out the effect. We use the value of $\delta = 1$ as an appropriate cutoff suggested by Oster, meaning the unobservables must be at least as important as the observables to produce a treatment effect of zero.

The results show that the effect of delaying on overall enrollment within 13 years is robust to unobservables that are up to 2.65 times as important as observables. The effect of delaying enrollment on overall degree completion is robust to unobservable factors that are up to 3.59 times as important as observed factors. Finally, the negative δs for the effects on earnings mean that adding unobservable controls increases the magnitude of the effects, so unobservable bias would have to go in the opposite direction to cancel out any observable effects. The full results can be found in the Appendix Table A11.

3.5.6 Oaxaca Decomposition

Table 3.3 presents the results for three Oaxaca decomposition models, indicating the portion of the earnings gap between delayers and on-time enrollees explained by (1) student characteristics alone (Model 1), (2) student characteristics and college enrollment (Model 2), and (3) student characteristics and degree completion (Model 3).[26] In total. on-time enrollees earned \$12,126 more than delayers in the 13th year after high school graduation. Model 1 shows that student characteristics alone explain \$6,227, or 51 percent, of the gap, leaving 49 percentage unexplained. After adding college enrollment information to Model 1, Model 2 is able to explain 61 percent of the earnings gap: 42 percent is explained by individual characteristics and 19 percent by enrollment outcomes.[27] Finally, adding degree completion portion to Model 1, Model

[26] We also tested the model by including student characteristics, college enrollment, *and* degree completion. The results suffered severely from multicollinearity; the contribution from college enrollment was almost absorbed by the contribution from degree completion.

[27] Up to 23 percent of the wage gap can be explained by lower four-year enrollment rates among delayers. Yet since more delayers earn two-year degrees, reducing the wage gap, only 19 percent of the wage gap is explained by college enrollment overall.

3 estimates the contribution of both individual characteristics and degree completion, which is collinear with college enrollment. The explanatory power of the entire model increases to 85 percent—30 percent due to student characteristics and 55 percent due to the lack of degree attainment, mainly bachelor's degree attainment (54 percent), among delayers.

Table 3.3 Oaxaca Decomposition of the Earnings Gap between On-Time Enrollees and Delayers

	Model 1		Model 2		Model 3	
	Mean ($)	% of Raw Difference	Mean ($)	% of Raw Difference	Mean ($)	% of Raw Difference
Raw difference (annual wage) between on-time enrollees and delayers	12,126***	100%	12,126***	100%	12,126***	100%
Total explained by the predictors						
Student characteristics	**6,227*****	**51%**	**5,101*****	**42%**	**3,612*****	**30%**
College enrollment			**2,339*****	**19%**		
4-year college			2,759***	23%		
2-year college			-420***	-3%		
College completion					**6,726*****	**55%**
Bachelor's degree					6,534***	54%
Associate degree					192***	2%
Unexplained	**5,899*****	**49%**	**4,685*****	**39%**	**1,788****	**15%**

Note. We compare the earnings in the 13th year after high school graduation.
$*p < .1$. $**p < .05$. $***p < .01$.

The Oaxaca decomposition results have three key takeaways. First, individual characteristics explain only one-third of the earnings gap between delayers and on-time enrollees, suggesting that the earnings gap could be drastically reduced by encouraging on-time enrollment. Second, four-year college enrollment and bachelor's degree completion are the most influential factors contributing to the earnings gap between delayers and on-time enrollees. Finally, the ability of Model 3 to explain 85 percent of the wage gap gives us confidence in the validity of our Oaxaca decomposition model.

3.6 Summary

High school graduates often delay college enrollment. Over 40 percent of those in our sample did not enroll in college immediately, and 21 percent never enrolled in college by the end of the most current survey. Factors such as family resources, high school quality, academic performance, marriage, and teen pregnancy are key determinants of college enrollment timing. Female high school graduates are especially vulnerable to teen pregnancy compared with their male peers.

Delaying college enrollment has long-term consequences for students' academic attainment. Our PSM results suggest that delayers are much less likely to re-enroll in college, and if they do, they tend to attend two-year colleges. Compared with on-time enrollees, delayers in our sample were 37 percentage points less likely to have ever enrolled in a four-year college and 34 percentage points less likely to have ever enrolled in a two-year college 13 years after high school graduation. Delayers were also 23 percentage points less likely to have completed a bachelor's degree and 19 percentage points less likely to have completed an associate degree by the end of the tracking period.

Furthermore, though delayers earn more during the first several years after high school graduation, while on-time enrollees are attending college, their earnings soon begin to lag behind those of on-time enrollees, and this earnings gap increases substantially with time. The total earnings penalty experienced by delayers compared with on-time enrollees is at least $41,000 in the first 13 years after high school graduation. The lifetime penalty would be at least three times higher. Our Oaxaca decomposition results show that bachelor's degree completion is the most important factor contributing to the earnings gap between delayers and on-time enrollees; differences in individual characteristics only explain about one-third of the wage gap.

In considering the implications of our findings, it is important to keep in mind that there are several limitations to this study. First, our definition of delay may overestimate the number of "true delayers" by including individuals who do not intend to enroll in college. The lower college enrollment rates among delayers may therefore not entirely reflect decisions by high school graduates to delay college enrollment. Yet limiting the sample to college enrollees would obscure one of the most important effects of delayed enrollment—its role in impeding students from reenrolling college, which is the primary consideration for students making decisions on enrollment timing. Second, although we found that individuals who delay college enrollment for different lengths of time have different labor market trajectories, the small sample size of the NLSY97 prohibits us from conducting a causal analysis for each type of delayer. Finally, though our validity tests provide some assurance that our method for estimating the effects of delayed enrollment is reasonable, our PSM results may still contain residual bias, as it is impossible to prove that we have fully accounted for all unobservable characteristics in our matching procedure.

Despite these limitations, our study has clear policy implications. Delayed college enrollment is associated with lower college completion rates and lifetime earnings trajectories. Therefore, policymakers should encourage on-time enrollment and provide financial and informational guidance, especially for low-SES high school graduates. One obvious way to increase college-going would be to prevent "summer melt," the phenomenon in which recent high school graduates who have been accepted to college decide not to enroll in the fall. Castleman, Arnold, and Wartman (2012) found that targeted college counseling and nudging text messages during the summer after high school graduation lead to substantially higher rates of college enrollment in the fall. Interventions could also potentially target recent high school graduates who are not in college and therefore have access to neither high school nor college counselors. High schools generally keep records of which of their students went to college, and reaching out to recent graduates who did not enroll in college could potentially increase their college enrollment and improve their college choices.

Finally, our descriptive results show that long-term delayers have lower earnings than students with no college experience. Long-term delayers may encounter greater barriers in transitioning from being a full-time worker to being a college student. Addressing the barriers experienced by nontraditional enrollees is thus important, especially for four-year universities, which serve primarily traditional students.

Conclusion

I find that a great proportion of high school graduates delay their college enrollment, meaning a "typical" student who proceeds an uninterrupted transition is not a convention as in our usual impression. This study will contribute to the existing literature by providing new evidence that, first, the opportunity cost of college enrollment (that is, foregone employment opportunities) matters for the decision of enrollment timing and, second, enrollment delay affects student college re-enrollment and choice. Third, this dissertation examines how delay affects earnings trajectories. And fourth, it identifies the key determinants of the wage differentials between on-time enrollees and delayers.

I conclude that financial constraint is not the only explanation for the delay. Students might rationally adjust the timing of enrollment to maximize the welfare based on their personal capabilities, preferences, and economic conditions. Behavioral bias and sociological factors greatly influence college enrollment as well. I find out housing boom can influence student's educational outcomes, especially for male students whose employment is heavily influenced by the low-skilled job market. However, this paper finds a temporary delay in transition to college caused by a housing boom does not necessarily decrease 8-year college enrollment rate. Instead, college choice was affected by enrollment timing – four-year college enrollment rate declined, and two-year college enrollment rate rose, suggesting that delayers are more likely to choose two-year colleges if they re-enrolled. Propensity score matching results show that the earnings benefits experienced by delayers quickly fade out after their mid-20s and turn to significant losses over time. In the 13th year after high school graduation, delayers generally earned $7,470 less than on-time enrollees. We find that 60 percent of the pay gap is explained by delayers' reduced likelihood of attending and obtaining a degree at a four-year college.

This research will enlighten policy designing particularly for students vulnerable to the cost of attending college. It might be extremely difficult for policymakers to identify the entire population who have the intention to delay college enrollment because at the moment of leaving schools, some high school graduates who choose not to attend college immediately have no idea whether they want to return to school in the future. However, for those who have been accepted to college and signaled their intent to enroll but end up in some other places, it is relatively easy for policymakers to define the target population and mitigate unnecessary attrition. From Castleman and Page (2014)'s estimation, 10% to 40% of low-income students who have been admitted by postsecondary institutions do not persist on their initial plan. At least for this specific group of delayers, Castleman et al. (2012)'s research provides an effective and efficient solution to improve summer attrition issues. For low-income students, active college counseling and nudging text message during the summer after high school graduation leads to substantially higher rates of college enrollment in the following fall.

From the perspective of colleges, preparation to address the barrier associated with non-traditional enrollees is important. Apparently, college enrollment delay is not a temporary social phenomenon. It is necessary for institutions to make more effort on providing services to non-traditional students. For example, although many community colleges offer flexible courses and programs, they typically provide little guidance to help new students choose a program of study and develop a plan for completing it (Bailey et al., 2015). For well-prepared traditional students, such flexibility is helpful. But the choices can be overwhelming for poorly prepared non-traditional students. A well-defined degree map can be designed to ensure that the student is taking courses that will be applied toward degree requirements and also to ensure that a student can develop skills and abilities that can lead to increased success in the future. Summer bridge programs adopted by some universities seem to be another promising approach for college to reach out to low-income, first-generation admitted students early in the summer before school begins (Castleman et al., 2012; Kezar, 2000).

Overall, enrollment timing is a field with so little research attention. My study addresses the gap via a comprehensive overview of the mechanisms through which students choose to delay college enrollment, as well as provides evidence for the determinants of college enrollment timing and the consequences of delay. However, my research still has several limitations. First, my study attempts to emphasize the effect of delay on college re-enrollment by including high school graduates. However, this definition may unnecessarily overestimate the delaying effect by including the students who never planned to enroll. Second, due to the limitation of the data, the external validity of my research is subject to the cohorts of the two datasets I use. Furthermore, my study cannot answer the question of how delaying length affects academic and employment outcomes, let alone the heterogeneous effects caused by different activities during the gap year. It is worthwhile to continue my research to further examine this crucial topic in the future.

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Appendix A: Theoretical Model

My theoretical model is built based on Dellas and Sakellaris (2003)'s model on the cyclicality of schooling. In order to analyze the factors affecting college enrollment decision, I develop a human capital investment function whose object is to maximize the net present value of life-long earning. Assume at time 0, all high school graduates face two options: attending college or working until t_0. Regardless of his/her postponement decision, a student needs c years to receive a bachelor degree. Accordingly, a student entering college immediately starts to earn bachelor degree wage income w_1 from year c, or $w_1(c)$. For the student who choose to delay enrollment till t_0, he/she earns high school degree wage w_0 from time 0, or $w_0(0)$. He/she re-enters the labor market at $t_0 + c$ after completing postsecondary education and the college degree wage is $w_1(t_0 + c)$. In both situations, one retires at T. r represents the discount rate. To make the decision of enrollment timing, he/she faces the following life-time wealth objection function:

$$\max_{t_0} Y = V[w_0(0), t_0, r] - V[g, (t_0 + c), r] + V[w_1(t_0 + c), (T - t_0 - c), r] -$$

$$V[w_1(c), (T - c)\ , r] + V[g, c, r]. \qquad (1)$$

In equation (1), the lifetime wealth is determined by the subtraction of the total utility of delay and the total utility of not delay. The former is constituted of $V[w_0(0), t_0, r]$, the utility received from working as a high school graduate from time 0 to t_0, $-V[g, (t_0 + c), r]$, the utility of the tuition cost, and $V[w_1(t_0 + c), (T - t_0 - c), r]$, the utility received from earning after one graduates from college at $t_0 + c$. The latter contains $V[w_1(c), (T - c)\ , r]$, the utility lost from not enrolling college at time 0, and $-\ V[g, c, r]$, the utility of the tuition cost. To maximize the wealth, I take the first order condition for this function,

$$\frac{\partial\{V[w_0(0), t_0, r] - V[g, (t_0 + c), r] + V[w_1(t_0 + c), (T - t_0 - c), r]\}}{\partial t_0}$$

$$- \frac{\partial\{V[w_1(c), (T - c)\ , r] - V[g, c, r]\}}{\partial t_0} = 0 \qquad (2)$$

I decompose $V[w_1(c), (T - c)\ , r]$ to two parts by the time of attending college t_0, $V[w_1(c), t_0\ , r]$ and $V[w_1(c), (T - t_0 - c)\ , r]$. If assume that students have no ability to predict the college wage change, w_1 can be seen the same regardless of the graduation time, $w_1(c) = w_1(t_0 + c)$. We have the new equation,

$$\frac{\partial\{V[w_1(c), t_0\ , r]\}}{\partial t_0} = \frac{\partial\ \{V[g, c, r] - V[g, (t_0 + c), r] + V[w_0(0), t_0, r]\}}{\partial t_0}. (3)$$

The left side of equation (3) now is the marginal cost of delaying college entrance – deferring the college payoff for one additional year. The right side represents the marginal benefit to college delay – the deferred tuition and the wage earned immediately after high school graduation. The optimization occurs when marginal benefit equals marginal cost

Appendix B: Appendix Figures and Tables

Table A1. The Effect of Change in Number of Building Permits on Other Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Time to Bachelor Degree	Total Student Loan	Total Federal Loan	Total Loan	Full-time Job	Part-time Job	Meet the Educational Expectation	Ever Have Loan
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	-0.0958	-75.4605*	-44.8420	-25.7767	0.0001	-0.0026**	0.0007	0.0006
	(0.0798)	(40.1164)	(34.2989)	(40.5249)	(0.0010)	(0.0010)	(0.0007)	(0.0007)
Hispanic	0.8001	-407.3253	-655.9340	64.2182	0.1070***	-0.0538*	-0.0037	0.0612**
	(1.4672)	(1,571.0288)	(1,560.3452)	(1,751.3552)	(0.0324)	(0.0302)	(0.0311)	(0.0294)
Black	2.3639	1,038.2851	3,120.5236**	4,354.3466**	0.0491	0.0298	-0.0598**	0.1058***
	(1.5555)	(1,531.8081)	(1,524.0550)	(1,705.3469)	(0.0316)	(0.0315)	(0.0292)	(0.0301)
SES Quartile	-1.4902***	2,056.5155***	2,311.9937***	2,357.7431***	-0.0008	0.0071	0.0334***	0.0179**
	(0.3783)	(472.9768)	(466.7096)	(523.3042)	(0.0085)	(0.0079)	(0.0085)	(0.0084)
Math Ability Quartile	-0.4317	3,807.3648***	3,310.2750***	3,044.8459***	0.0008	-0.0056	-0.0013	0.0673***
	(0.3330)	(367.9669)	(334.7041)	(376.4497)	(0.0075)	(0.0069)	(0.0076)	(0.0071)
Parental Education	1.7376*	1,470.0752*	63.6704	-172.1846	-0.0206	0.0105	-0.0275	0.0520***
	(0.9799)	(866.0166)	(860.3516)	(934.7766)	(0.0208)	(0.0185)	(0.0191)	(0.0200)
County Level Covariates[2]	Y	Y	Y	Y	Y	Y	Y	Y
State Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
N	2,217	6,216	5,619	5,619	5,185	5,185	5,185	6,216

Table A2. OLS Estimates and TSLS Estimates of Effect of Not Enrolling Immediately on Female College Attendance in 8 Years

Dependent Variable is Female College Attendance by the Third Follow-up in 2012				
	OLS (1)	OLS (2)	TSLS (3)	TSLS (4)
Not enroll immediately [1]	-0.3586***	-0.3584***	0.9065	2.4680
	(0.0081)	(0.0081)	(1.2659)	(8.0695)
Black	0.0469***	0.0487***	0.0499**	0.0459
	(0.0096)	(0.0101)	(0.0208)	(0.0445)
SES quartile	0.0135***	0.0137***	0.1224	0.2532
	(0.0041)	(0.0041)	(0.1089)	(0.6828)
Math ability quartile	0.0242***	0.0238***	0.1953	0.4067
	(0.0036)	(0.0036)	(0.1714)	(1.0936)
Parental Education	0.0393***	0.0395***	0.0919	0.1569
	(0.0096)	(0.0097)	(0.0579)	(0.3421)
County Level Covariates[2]	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,880	6,880	6,870	6,870

Note: This table reports OLS and TSLS estimates of not enrolling immediately for the ELS2002 sample having valid geographic information and college attendance information.
1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

Table A3. Employment Change in the Construction Sector Using Change in Permits of New Housing Units in 2001 as a proxy

Dependent Variable: Over-the-year Change in Employment in the Construction Sector, 2003

	(1)	(2)
Change in Number of Permits of New Housing Unit, 2001 (in hundreds)	43.8909***	41.3837***
	(3.5272)	(3.5125)
First-stage F-statistics	42.05	7.77
R^2	0.0714	0.1373
County Level Covariates	Y	Y
State Fixed Effects		Y
N	2,742	2,742

Data Source: Bureau of Labor Statistics and Building Permit Survey

Note: This table reports the OLS results for all matched 2,742 counties, who have valid information on construction employment in BLS.

* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

All sample sizes are rounded to the nearest ten.

Table A4. Falsification Test: First Stage for Percentage Change in/Total Employment in the Construction Using Percentage Change in/Total Permits of New Housing Units in 2001 as Instrument Variable

Panel A: Dependent Variable: Over-the-year Percentage Change in Employment in the Construction Sector, 2003

	(1)	(2)
Percentage Change in Number of Permits of New Housing Unit, 2001	0.2090	0.2095
	(0.4508)	(0.4534)
First-stage F-statistics	11.20	2.77
R^2	0.021	0.0560
County Level Covariates	Y	Y
State Fixed Effects		Y
N	2,621	2,621

Data Source: Bureau of Labor Statistics and Building Permit Survey
Note: This table reports the OLS results for all matched 2,621 counties, who have valid information on construction employment in BLS and have issued at least one building permit in 2000.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

Panel B: Dependent Variable: Total Employment in the Construction Sector, 2003

	(1)	(2)
Total Number of Permits of New Housing Unit, 2001 (in hundreds)	218.4244***	222.5511***
	(3.8676)	(4.0015)
First-stage F-statistics	6831.10	633.00
R^2	0.9258	0.9284
County Level Covariates	Y	Y
State Fixed Effects		Y
N	2,742	2,742

Data Source: Bureau of Labor Statistics and Building Permit Survey
Note: This table reports the OLS results for all matched 2,742 counties, who have valid information on construction employment in BLS.
* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

Table A5. Falsification Test: Using 2-year or 1-year Leaded Permit Change as Instrument

Dependent Variable is Not Immediately Enroll in College[1]				
VARIABLES	(1) Delta permits 2002	(2) Delta permits 2002	(3) Delta permits 2003	(4) Delta permits 2003
Change in Number of Permits of New Housing Unit (in hundreds)	0.0007	0.0012	0.0013***	0.0011
	(0.0007)	(0.0009)	(0.0004)	(0.0008)
Black	-0.0108	-0.0042	-0.0099	-0.0043
	(0.0181)	(0.0189)	(0.0181)	(0.0189)
SES Quartile	-0.1071***	-0.1080***	-0.1071***	-0.1080***
	(0.0081)	(0.0079)	(0.0080)	(0.00786)
Math Ability Quartile	-0.1313***	-0.1313***	-0.1302***	-0.1313***
	(0.0068)	(0.0069)	(0.0068)	(0.0069)
Parental Education	-0.0202	-0.0224	-0.0199	-0.0222
	(0.0185)	(0.0186)	(0.0185)	(0.0186)
County Level Covariates	Y	Y	Y	Y
State Fixed Effects		Y		Y
N	6,420	6,420	6,420	6,420

Data Source: Education Longitudinal Survey: 2002 restricted-use data

1. Students who did not enroll in college by 2004 are defined as delayers.
2. County Level Covariates include population size, unemployment rate, and urbanity index.

Robust standard errors in parentheses

* Statistically significant at the .1 level; ** at the .05 level; ***at the .01 level.

All sample sizes are rounded to the nearest ten.

Table A3
Multinomial Regression Analysis: Potential Determinants of the Length of Delay

	Delayed	Delayed < 3 Years	Delayed 3–7 Years	Delayed > 7 Years	Never Enrolled
Individual demographics					
Black	-0.526***	-0.193	-0.214	-0.411**	-0.874***
	[0.088]	[0.125]	[0.174]	[0.196]	[0.110]
Hispanic	-0.250**	-0.014	0.051	-0.502**	-0.470***
	[0.101]	[0.139]	[0.207]	[0.252]	[0.126]
Other race (except White)	-0.181*	-0.026	-0.246	0.148	-0.346***
	[0.106]	[0.143]	[0.220]	[0.251]	[0.132]
Female	-0.505***	-0.255***	-0.429***	-0.430***	-0.711***
	[0.064]	[0.091]	[0.132]	[0.151]	[0.080]
Birth year	-0.130**	-0.038	0.075	-0.039	-0.241***
	[0.051]	[0.073]	[0.100]	[0.109]	[0.060]
High school graduation year	-0.004	-0.054	-0.246	-0.266*	0.135
	[0.073]	[0.098]	[0.153]	[0.153]	[0.088]
Lived in urban area in 1997	-0.033	0.207*	0.053	0.011	-0.220**
	[0.078]	[0.117]	[0.162]	[0.184]	[0.095]
Lived in Northeast region in 1997	0.488	0.422	1.235*	0.67	0.305
	[0.357]	[0.484]	[0.701]	[0.789]	[0.420]
Lived in North Central region in 1997	-0.056	-0.558	0.468	-0.985	0.174
	[0.309]	[0.466]	[0.664]	[0.916]	[0.360]
Lived in Southern region in 1997	0.409	0.108	1.314**	-0.018	0.365
	[0.287]	[0.401]	[0.603]	[0.736]	[0.340]
Lived in metropolitan area in 1997	-0.313***	-0.174	-0.449***	-0.485**	-0.341***
	[0.088]	[0.131]	[0.172]	[0.190]	[0.107]
Household demographics					
Household size	0.040*	0.032	0.018	0.085*	0.045*
	[0.022]	[0.030]	[0.042]	[0.045]	[0.026]
Highest year of parental education	-0.123***	-0.079***	-0.064**	-0.086***	-0.179***
	[0.012]	[0.017]	[0.025]	[0.029]	[0.015]
Household net worth in 1997 (thousands)	-0.002***	-0.001***	-0.001*	-0.002**	-0.002***
	[0.000]	[0.000]	[0.001]	[0.001]	[0.000]
Household income in high school graduation year (thousands)	-0.004***	-0.004***	-0.007***	-0.007***	-0.003***
	[0.001]	[0.001]	[0.002]	[0.002]	[0.001]
Lived with both parents in high school graduation year	-0.324***	-0.273***	-0.382***	-0.828***	-0.264***
	[0.066]	[0.094]	[0.135]	[0.158]	[0.082]

Table A3 (cont.)
Multinomial Regression Analysis: Potential Determinants of the Length of Delay

	Delayed	Delayed < 3 Years	Delayed 3–7 Years	Delayed > 7 Years	Never Enrolled
High school characteristics					
Public school	0.892***	0.681***	1.320**	1.728**	0.852***
	[0.186]	[0.261]	[0.524]	[0.732]	[0.257]
< 299 students	0.154	0.014	0.196	0.312	0.2
	[0.143]	[0.216]	[0.282]	[0.327]	[0.175]
300–499 students	-0.128	-0.094	-0.433*	0.088	-0.131
	[0.120]	[0.177]	[0.262]	[0.266]	[0.147]
500–749 students	0.039	0.182	-0.153	-0.14	0.023
	[0.093]	[0.128]	[0.191]	[0.220]	[0.115]
750–999 students	-0.009	-0.141	0.018	-0.291	0.107
	[0.095]	[0.140]	[0.187]	[0.235]	[0.115]
Pupil–teacher ratio < 14	-0.261**	-0.453***	-0.171	-0.461*	-0.114
	[0.105]	[0.149]	[0.212]	[0.239]	[0.130]
Pupil–teacher ratio 14 to < 18	-0.121	-0.230*	-0.162	-0.113	-0.031
	[0.090]	[0.125]	[0.184]	[0.200]	[0.113]
Pupil–teacher ratio 18 to < 22	-0.113	-0.163	-0.038	-0.564**	-0.026
	[0.093]	[0.127]	[0.184]	[0.227]	[0.115]
Academic preparation					
High school GPA	-1.307***	-0.993***	-1.380***	-1.715***	-1.482***
	[0.079]	[0.106]	[0.149]	[0.168]	[0.097]
ASVAB score percentile	-0.019***	-0.008***	-0.010***	-0.014***	-0.031***
	[0.001]	[0.002]	[0.003]	[0.003]	[0.002]
Other characteristics					
Married or cohabiting in high school graduation year	0.865***	0.479**	0.660***	0.998***	1.128***
	[0.136]	[0.192]	[0.241]	[0.247]	[0.156]
Pregnant/got someone pregnant in high school graduation year	0.583***	0.463**	0.949***	0.815***	0.501***
	[0.136]	[0.181]	[0.219]	[0.238]	[0.160]
Number of children	0.683***	0.749***	0.822***	0.853***	0.560***
	[0.153]	[0.189]	[0.221]	[0.235]	[0.174]
Health condition in high school graduation year (5 = excellent)	-0.167***	-0.131***	-0.109	-0.068	-0.219***
	[0.036]	[0.050]	[0.071]	[0.079]	[0.043]
Arrests in high school graduation year	0.422***	0.397***	0.403***	0.446***	0.445***
	[0.119]	[0.134]	[0.141]	[0.139]	[0.124]
Ever drank alcohol	0.01	0.121	-0.074	-0.003	-0.031
	[0.069]	[0.099]	[0.139]	[0.157]	[0.085]
Year * region interaction	Yes	Yes	Yes	Yes	Yes
Observations	6,454	6,454	6,454	6,454	6,454

Table A4
Balance Check: Summary Statistics by Treatment Status
Before and After Propensity Score Matching

	Unmatched/	Mean		% reduction		*t*-test	
Variable	Matched	Treatment	Control	% bias	|bias|	*t*	*p* > |*t*|
Black	Unmatched	0.2733	0.19872	17.6		7.05	0
	Matched	0.2734	0.27347	0	99.9	-0.01	0.996
Hispanic	Unmatched	0.23168	0.16422	17		6.81	0
	Matched	0.23143	0.26116	-7.5	55.9	-2.53	0.011
Other race (except White)	Unmatched	0.14328	0.12062	6.7		2.67	0.008
	Matched	0.14339	0.15831	-4.4	34.1	-1.53	0.126
Female	Unmatched	0.44862	0.55068	-20.5		-8.14	0
	Matched	0.44874	0.45007	-0.3	98.7	-0.1	0.922
Birth year 1980	Unmatched	0.19705	0.17892	4.6		1.85	0.065
	Matched	0.19651	0.20519	-2.2	52.1	-0.8	0.426
Birth year 1981	Unmatched	0.21768	0.20781	2.4		0.96	0.338
	Matched	0.21842	0.21464	0.9	61.6	0.34	0.736
Birth year 1982	Unmatched	0.21657	0.20112	3.8		1.51	0.131
	Matched	0.21582	0.22118	-1.3	65.4	-0.48	0.635
Birth year 1983	Unmatched	0.19374	0.20433	-2.7		-1.05	0.293
	Matched	0.19354	0.18418	2.3	11.7	0.88	0.381
Birth year 1984	Unmatched	0.17495	0.20781	-8.4		-3.3	0.001
	Matched	0.17571	0.17481	0.2	97.3	0.09	0.931
High school graduation year	Unmatched	2000.5	2000.4	6.6		2.62	0.009
	Matched	2000.5	2000.5	3.2	51.1	1.2	0.23
Household size	Unmatched	4.5871	4.4204	11.4		4.59	0
	Matched	4.5806	4.5871	-0.4	96.1	-0.15	0.878
Highest years of parental	Unmatched	12.49	14.327	-64.3		-25.38	0
education	Matched	12.501	12.382	4.1	93.6	1.47	0.143
Household net worth in 1997	Unmatched	48.095	104.06	-43.4		-16.62	0
(thousands)	Matched	48.335	47.897	0.3	99.2	0.17	0.864
Household income in high school	Unmatched	29.569	47.235	-32		-12.31	0
graduation year (thousands)	Matched	29.658	29.58	0.1	99.6	0.07	0.947
Attended public high school	Unmatched	0.6954	0.71356	-4		-1.58	0.114
	Matched	0.69428	0.69318	0.2	93.9	0.09	0.93
Lived in urban area in 1997	Unmatched	0.71455	0.73014	-3.5		-1.38	0.167
	Matched	0.71471	0.73394	-4.3	-23.4	-1.58	0.114
Lived in Northeast in 1997	Unmatched	0.16538	0.18374	-4.8		-1.91	0.056
	Matched	0.16493	0.16152	0.9	81.4	0.34	0.735
Lived in North Central region in	Unmatched	0.22983	0.25568	-6		-2.38	0.017
1997	Matched	0.22994	0.21742	2.9	51.6	1.1	0.27
Lived in South in 1997	Unmatched	0.36759	0.33779	6.2		2.48	0.013
	Matched	0.36887	0.35288	3.3	46.3	1.22	0.222
Lived in metropolitan area in	Unmatched	0.79153	0.84194	-13.1		-5.22	0
1997	Matched	0.79309	0.81495	-5.7	56.6	-2.02	0.043

Table A4 (cont.)
Balance Check: Summary Statistics by Treatment Status
Before and After Propensity Score Matching

Variable	Unmatched/ Matched	Mean Treatment	Mean Control	% reduction % bias	% reduction |bias|	*t*-test *t*	*t*-test *p* > |*t*|
School size < 299 students	Unmatched	0.06041	0.0698	-3.8		-1.5	0.133
	Matched	0.05944	0.05349	2.4	36.7	0.95	0.345
School size 300–499 students	Unmatched	0.09576	0.10538	-3.2		-1.26	0.207
	Matched	0.0951	0.0982	-1	67.7	-0.39	0.7
School size 500–749 students	Unmatched	0.19558	0.20059	-1.3		-0.5	0.619
	Matched	0.19651	0.19855	-0.5	59.2	-0.19	0.851
School size 750–999 students	Unmatched	0.16317	0.15245	2.9		1.17	0.243
	Matched	0.16382	0.1628	0.3	90.5	0.1	0.92
Pupil–teacher ratio < 14	Unmatched	0.20884	0.23723	-6.8		-2.7	0.007
	Matched	0.20951	0.20916	0.1	98.8	0.03	0.975
Pupil teacher ratio 14 to < 18	Unmatched	0.32486	0.33271	-1.7		-0.66	0.508
	Matched	0.32281	0.30543	3.7	-121.5	1.37	0.17
Pupil teacher ratio 18 to < 22	Unmatched	0.20958	0.20647	0.8		0.3	0.762
	Matched	0.20951	0.20531	1	-35.2	0.38	0.704
High school GPA	Unmatched	1.831	2.4209	-44.7		-17.63	0
	Matched	1.8349	1.8373	-0.2	99.6	-0.07	0.943
ASVAB score percentile	Unmatched	30.002	51.463	-71.5		-27.99	0
	Matched	30.155	30.541	-1.3	98.2	-0.52	0.6
Lived with both parents in high school graduation year	Unmatched	0.46262	0.63359	-34.9		-13.87	0
	Matched	0.46397	0.46543	-0.3	99.1	-0.11	0.914
Married or cohabiting in high school graduation year	Unmatched	0.10424	0.03076	29.6		12.25	0
	Matched	0.09955	0.09241	2.9	90.3	0.89	0.374
Pregnant/got someone pregnant in high school graduation year	Unmatched	0.1046	0.03183	29.2		12.06	0
	Matched	0.10067	0.09859	0.8	97.1	0.26	0.799
Ever had a child	Unmatched	0.08287	0.01658	30.9		12.92	0
	Matched	0.07875	0.07183	3.2	89.6	0.96	0.336
Health condition in high school graduation year (5 = excellent)	Unmatched	3.6243	3.9874	-31.5		-12.65	0
	Matched	3.6282	3.6264	0.2	99.5	0.05	0.959
Ever arrested	Unmatched	0.05267	0.02728	13		5.28	0
	Matched	0.05052	0.04986	0.3	97.4	0.11	0.912
Ever drank alcohol	Unmatched	0.56022	0.64643	-17.7		-7.04	0
	Matched	0.56092	0.54866	2.5	85.8	0.9	0.366
Household income missing	Unmatched	0.35617	0.36266	-1.4		-0.54	0.592
	Matched	0.3581	0.36858	-2.2	-61.4	-0.8	0.424
Public vs. private high school attendance missing	Unmatched	0.28766	0.21423	17		6.79	0
	Matched	0.28863	0.28709	0.4	97.9	0.13	0.901
High school GPA missing	Unmatched	0.30018	0.22038	18.3		7.3	0
	Matched	0.30163	0.2994	0.5	97.2	0.18	0.858
ASVAB score percentile missing	Unmatched	0.1989	0.15218	12.3		4.92	0
	Matched	0.19948	0.19694	0.7	94.6	0.23	0.815
Health condition in high school missing	Unmatched	0.09797	0.04306	21.6		8.81	0
	Matched	0.09881	0.09908	-0.1	99.5	-0.03	0.973

Table A5
Effects of Delay on College Enrollment by Year, OLS and PSM

	OLS		PSM	
Outcomes	Coefficient	*SE*	Coefficient	*SE*
Panel A: Ever enrolled in college by…				
1 year after high school completion	-0.844***	(0.00821)	-0.872***	(0.00646)
2 years after high school completion	-0.744***	(0.00966)	-0.785***	(0.00791)
3 years after high school completion	-0.685***	(0.0102)	-0.735***	(0.00849)
4 years after high school completion	-0.651***	(0.0104)	-0.703***	(0.00877)
5 years after high school completion	-0.617***	(0.0105)	-0.671***	(0.00900)
6 years after high school completion	-0.583***	(0.0106)	-0.639***	(0.00918)
7 years after high school completion	-0.557***	(0.0106)	-0.614***	(0.00930)
8 years after high school completion	-0.532***	(0.0106)	-0.587***	(0.00940)
9 years after high school completion	-0.515***	(0.0105)	-0.570***	(0.00944)
10 years after high school completion	-0.504***	(0.0105)	-0.558***	(0.00948)
11 years after high school completion	-0.493***	(0.0105)	-0.547***	(0.00950)
12 years after high school completion	-0.480***	(0.0105)	-0.534***	(0.00951)
13 years after high school completion	-0.473***	(0.0104)	-0.527***	(0.00952)
Panel B: Ever enrolled in a four-year college by…				
1 year after high school completion	-0.453***	(0.0112)	-0.387***	(0.0133)
2 years after high school completion	-0.458***	(0.0119)	-0.402***	(0.0141)
3 years after high school completion	-0.455***	(0.0123)	-0.407***	(0.0145)
4 years after high school completion	-0.458***	(0.0126)	-0.417***	(0.0150)
5 years after high school completion	-0.455***	(0.0127)	-0.418***	(0.0151)
6 years after high school completion	-0.447***	(0.0129)	-0.414***	(0.0152)
7 years after high school completion	-0.438***	(0.0130)	-0.406***	(0.0154)
8 years after high school completion	-0.428***	(0.0131)	-0.396***	(0.0155)
9 years after high school completion	-0.422***	(0.0132)	-0.389***	(0.0156)
10 years after high school completion	-0.416***	(0.0132)	-0.383***	(0.0157)
11 years after high school completion	-0.413***	(0.0133)	-0.382***	(0.0158)
12 years after high school completion	-0.409***	(0.0133)	-0.377***	(0.0158)
13 years after high school completion	-0.407***	(0.0133)	-0.375***	(0.0158)
Panel C: Ever enrolled in a two-year college by…				
1 year after high school completion	-0.454***	(0.0119)	-0.523***	(0.0141)
2 years after high school completion	-0.408***	(0.0130)	-0.484***	(0.0146)
3 years after high school completion	-0.389***	(0.0134)	-0.462***	(0.0148)
4 years after high school completion	-0.375***	(0.0136)	-0.448***	(0.0149)
5 years after high school completion	-0.357***	(0.0137)	-0.433***	(0.0148)
6 years after high school completion	-0.334***	(0.0140)	-0.411***	(0.0149)
7 years after high school completion	-0.321***	(0.0141)	-0.400***	(0.0149)
8 years after high school completion	-0.304***	(0.0142)	-0.381***	(0.0150)
9 years after high school completion	-0.292***	(0.0142)	-0.370***	(0.0149)
10 years after high school completion	-0.284***	(0.0143)	-0.362***	(0.0149)
11 years after high school completion	-0.277***	(0.0143)	-0.354***	(0.0149)
12 years after high school completion	-0.268***	(0.0143)	-0.345***	(0.0150)
13 years after high school completion	-0.267***	(0.0143)	-0.345***	(0.0149)

*$p < .1$. **$p < .05$. ***$p < .01$.

Table A6
Effects of Delay on Degree Completion by Year, OLS and PSM

	OLS		PSM	
Outcomes	Coefficient	*SE*	Coefficient	*SE*
Panel A: Ever received a college degree by…				
2 years after high school completion	-0.0230***	(0.00400)	-0.0252***	(0.00501)
3 years after high school completion	-0.0836***	(0.00677)	-0.0850***	(0.00892)
4 years after high school completion	-0.195***	(0.00988)	-0.181***	(0.0116)
5 years after high school completion	-0.274***	(0.0116)	-0.247***	(0.0133)
6 years after high school completion	-0.315***	(0.0122)	-0.287***	(0.0142)
7 years after high school completion	-0.332***	(0.0128)	-0.309***	(0.0148)
8 years after high school completion	-0.334***	(0.0131)	-0.314***	(0.0152)
9 years after high school completion	-0.340***	(0.0133)	-0.326***	(0.0156)
10 years after high school completion	-0.336***	(0.0135)	-0.326***	(0.0159)
11 years after high school completion	-0.329***	(0.0136)	-0.322***	(0.0161)
12 years after high school completion	-0.320***	(0.0138)	-0.314***	(0.0162)
13 years after high school completion	-0.318***	(0.0138)	-0.318***	(0.0162)
Panel B: Ever received a bachelor's degree by…				
4 years after high school completion	-0.0959***	(0.00671)	-0.0714***	(0.00574)
5 years after high school completion	-0.171***	(0.00869)	-0.126***	(0.00771)
6 years after high school completion	-0.214***	(0.00957)	-0.166***	(0.00930)
7 years after high school completion	-0.240***	(0.0102)	-0.190***	(0.0102)
8 years after high school completion	-0.259***	(0.0107)	-0.209***	(0.0110)
9 years after high school completion	-0.266***	(0.0110)	-0.217***	(0.0116)
10 years after high school completion	-0.269***	(0.0112)	-0.219***	(0.0119)
11 years after high school completion	-0.271***	(0.0114)	-0.221***	(0.0121)
12 years after high school completion	-0.271***	(0.0116)	-0.220***	(0.0123)
13 years after high school completion	-0.272***	(0.0118)	-0.221***	(0.0125)
Panel C: Ever received an associate degree by…				
2 years after high school completion	-0.0217***	(0.00396)	-0.0246***	(0.00500)
3 years after high school completion	-0.0730***	(0.00642)	-0.0777***	(0.00866)
4 years after high school completion	-0.109***	(0.00836)	-0.118***	(0.0107)
5 years after high school completion	-0.126***	(0.00972)	-0.137***	(0.0120)
6 years after high school completion	-0.140***	(0.0105)	-0.155***	(0.0130)
7 years after high school completion	-0.140***	(0.0113)	-0.161***	(0.0137)
8 years after high school completion	-0.139***	(0.0118)	-0.161***	(0.0141)
9 years after high school completion	-0.143***	(0.0122)	-0.168***	(0.0147)
10 years after high school completion	-0.141***	(0.0126)	-0.172***	(0.0151)
11 years after high school completion	-0.137***	(0.0129)	-0.170***	(0.0154)
12 years after high school completion	-0.130***	(0.0132)	-0.164***	(0.0156)
13 years after high school completion	-0.129***	(0.0134)	-0.171***	(0.0158)

*$p < .1$. **$p < .05$. ***$p < .01$.

Table A7
Effects of Delay on Labor Market Outcomes, OLS and PSM

Outcomes	OLS Coefficient	OLS *SE*	PSM Coefficient	PSM *SE*
Panel A: Income (adjusted $2010)				
1st year after high school completion	2,309***	(277.1)	2,094***	(340.0)
2nd year after high school completion	2,462***	(344.9)	2,097***	(383.8)
3rd year after high school completion	1,443***	(416.3)	871.7*	(480.8)
4th year after high school completion	-9.650	(458.6)	-704.3	(560.8)
5th year after high school completion	-1,507***	(504.1)	-1,961***	(603.4)
6th year after high school completion	-3,131***	(544.0)	-2,836***	(591.3)
7th year after high school completion	-4,933***	(580.1)	-3,814***	(634.1)
8th year after high school completion	-6,116***	(638.7)	-5,046***	(677.8)
9th year after high school completion	-6,266***	(678.4)	-4,915***	(698.2)
10th year after high school completion	-7,285***	(729.0)	-6,208***	(803.4)
11th year after high school completion	-7,864***	(783.7)	-6,818***	(881.3)
12th year after high school completion	-8,224***	(835.2)	-7,048***	(924.5)
13th year after high school completion	-8,596***	(917.3)	-7,470***	(978.4)
Panel B: Total work hours				
1st year after high school completion	223.4***	(22.50)	222.7***	(25.72)
2nd year after high school completion	223.5***	(26.46)	196.2***	(30.37)
3rd year after high school completion	131.7***	(28.34)	111.6***	(33.81)
4th year after high school completion	112.9***	(29.62)	63.46*	(34.95)
5th year after high school completion	-26.94	(29.78)	-65.66*	(36.53)
6th year after high school completion	-112.1***	(29.70)	-117.6***	(34.19)
7th year after high school completion	-212.7***	(30.58)	-230.3***	(37.96)
8th year after high school completion	-259.1***	(30.77)	-247.0***	(36.89)
9th year after high school completion	-259.0***	(30.76)	-225.0***	(35.57)
10th year after high school completion	-257.7***	(31.92)	-229.0***	(37.40)
11th year after high school completion	-250.6***	(32.30)	-228.8***	(37.93)
12th year after high school completion	-229.9***	(33.30)	-184.5***	(39.75)
13th year after high school completion	-237.0***	(33.91)	-202.2***	(40.46)
Panel C: Full-time work status (> 35 hours/week for 50 weeks)				
1st year after high school completion	0.0605***	(0.0091)	0.0493***	(0.0104)
2nd year after high school completion	0.0823***	(0.0114)	0.0728***	(0.0129)
3rd year after high school completion	0.0622***	(0.0126)	0.0505***	(0.0142)
4th year after high school completion	0.0710***	(0.0132)	0.0525***	(0.0147)
5th year after high school completion	0.0412***	(0.0136)	0.0225	(0.0156)
6th year after high school completion	-0.0216	(0.0140)	-0.0180	(0.0158)
7th year after high school completion	-0.0742***	(0.0144)	-0.0810***	(0.0165)
8th year after high school completion	-0.0805***	(0.0144)	-0.0797***	(0.0164)
9th year after high school completion	-0.105***	(0.0145)	-0.0980***	(0.0166)
10th year after high school completion	-0.0897***	(0.0145)	-0.0916***	(0.0166)
11th year after high school completion	-0.0943***	(0.0146)	-0.0957***	(0.0166)
12th year after high school completion	-0.0803***	(0.0142)	-0.0666***	(0.0161)
13th year after high school completion	-0.0726***	(0.0135)	-0.0641***	(0.0156)

Note. NLSY97 follow-up surveys were not conducted annually after 2011. We imputed the labor market outcomes for 2012 and 2014 by averaging the outcomes from the years immediately before and after.

*$p < .1$. **$p < .05$. ***$p < .01$.

Table A8
Effects of Delay on College Enrollment by Year, Restricted to "Thick Support" Sample

	OLS		PSM	
Outcomes	Coefficient	*SE*	Coefficient	*SE*
Panel A: Ever enrolled in college by…				
1 year after high school completion	-0.844***	(0.00821)	-0.827***	(0.0103)
2 years after high school completion	-0.744***	(0.00966)	-0.713***	(0.0123)
3 years after high school completion	-0.685***	(0.0102)	-0.644***	(0.0130)
4 years after high school completion	-0.651***	(0.0104)	-0.607***	(0.0132)
5 years after high school completion	-0.617***	(0.0105)	-0.569***	(0.0134)
6 years after high school completion	-0.583***	(0.0106)	-0.532***	(0.0134)
7 years after high school completion	-0.557***	(0.0106)	-0.510***	(0.0134)
8 years after high school completion	-0.532***	(0.0106)	-0.487***	(0.0134)
9 years after high school completion	-0.515***	(0.0105)	-0.469***	(0.0134)
10 years after high school completion	-0.504***	(0.0105)	-0.458***	(0.0134)
11 years after high school completion	-0.493***	(0.0105)	-0.447***	(0.0133)
12 years after high school completion	-0.480***	(0.0105)	-0.432***	(0.0133)
13 years after high school completion	-0.473***	(0.0104)	-0.424***	(0.0133)
Panel B: Ever enrolled in a four-year college by…				
1 year after high school completion	-0.453***	(0.0112)	-0.482***	(0.0138)
2 years after high school completion	-0.458***	(0.0119)	-0.482***	(0.0148)
3 years after high school completion	-0.455***	(0.0123)	-0.470***	(0.0154)
4 years after high school completion	-0.458***	(0.0126)	-0.460***	(0.0158)
5 years after high school completion	-0.455***	(0.0127)	-0.454***	(0.0160)
6 years after high school completion	-0.447***	(0.0129)	-0.443***	(0.0163)
7 years after high school completion	-0.438***	(0.0130)	-0.431***	(0.0164)
8 years after high school completion	-0.428***	(0.0131)	-0.421***	(0.0167)
9 years after high school completion	-0.422***	(0.0132)	-0.414***	(0.0167)
10 years after high school completion	-0.416***	(0.0132)	-0.406***	(0.0168)
11 years after high school completion	-0.413***	(0.0133)	-0.402***	(0.0169)
12 years after high school completion	-0.409***	(0.0133)	-0.399***	(0.0169)
13 years after high school completion	-0.407***	(0.0133)	-0.399***	(0.0169)
Panel C: Ever enrolled in a two-year college by…				
1 year after high school completion	-0.454***	(0.0119)	-0.417***	(0.0146)
2 years after high school completion	-0.408***	(0.0130)	-0.362***	(0.0160)
3 years after high school completion	-0.389***	(0.0134)	-0.339***	(0.0165)
4 years after high school completion	-0.375***	(0.0136)	-0.320***	(0.0168)
5 years after high school completion	-0.357***	(0.0137)	-0.295***	(0.0172)
6 years after high school completion	-0.334***	(0.0140)	-0.272***	(0.0174)
7 years after high school completion	-0.321***	(0.0141)	-0.262***	(0.0175)
8 years after high school completion	-0.304***	(0.0142)	-0.244***	(0.0177)
9 years after high school completion	-0.292***	(0.0142)	-0.231***	(0.0177)
10 years after high school completion	-0.284***	(0.0143)	-0.222***	(0.0178)
11 years after high school completion	-0.277***	(0.0143)	-0.212***	(0.0178)
12 years after high school completion	-0.268***	(0.0143)	-0.203***	(0.0178)
13 years after high school completion	-0.267***	(0.0143)	-0.203***	(0.0178)

*$p < .1$. **$p < .05$. ***$p < .01$

Table A9
Effects of Delay on Degree Completion by Year, Restricted to "Thick Support" Sample

	OLS		PSM	
Outcomes	Coefficient	*SE*	Coefficient	*SE*
Panel A: Ever received a college degree by…				
2 years after high school completion	-0.0230***	(0.00400)	-0.0195***	(0.00473)
3 years after high school completion	-0.0836***	(0.00677)	-0.0704***	(0.00770)
4 years after high school completion	-0.195***	(0.00988)	-0.195***	(0.0116)
5 years after high school completion	-0.274***	(0.0116)	-0.286***	(0.0142)
6 years after high school completion	-0.315***	(0.0122)	-0.320***	(0.0152)
7 years after high school completion	-0.332***	(0.0128)	-0.331***	(0.0161)
8 years after high school completion	-0.334***	(0.0131)	-0.333***	(0.0166)
9 years after high school completion	-0.340***	(0.0133)	-0.336***	(0.0169)
10 years after high school completion	-0.336***	(0.0135)	-0.326***	(0.0171)
11 years after high school completion	-0.329***	(0.0136)	-0.318***	(0.0173)
12 years after high school completion	-0.320***	(0.0138)	-0.307***	(0.0174)
13 years after high school completion	-0.318***	(0.0138)	-0.300***	(0.0174)
Panel B: Ever received a bachelor's degree by…				
4 years after high school completion	-0.0959***	(0.00671)	-0.113***	(0.00763)
5 years after high school completion	-0.171***	(0.00869)	-0.202***	(0.0104)
6 years after high school completion	-0.214***	(0.00957)	-0.239***	(0.0115)
7 years after high school completion	-0.240***	(0.0102)	-0.264***	(0.0125)
8 years after high school completion	-0.259***	(0.0107)	-0.280***	(0.0131)
9 years after high school completion	-0.266***	(0.0110)	-0.286***	(0.0134)
10 years after high school completion	-0.269***	(0.0112)	-0.289***	(0.0138)
11 years after high school completion	-0.271***	(0.0114)	-0.292***	(0.0142)
12 years after high school completion	-0.271***	(0.0116)	-0.290***	(0.0144)
13 years after high school completion	-0.272***	(0.0118)	-0.291***	(0.0146)
Panel C: Ever received an associate degree by…				
2 years after high school completion	-0.0217***	(0.00396)	-0.0181***	(0.00468)
3 years after high school completion	-0.0730***	(0.00642)	-0.0599***	(0.00715)
4 years after high school completion	-0.109***	(0.00836)	-0.0909***	(0.00975)
5 years after high school completion	-0.126***	(0.00972)	-0.105***	(0.0118)
6 years after high school completion	-0.140***	(0.0105)	-0.114***	(0.0130)
7 years after high school completion	-0.140***	(0.0113)	-0.108***	(0.0141)
8 years after high school completion	-0.139***	(0.0118)	-0.108***	(0.0148)
9 years after high school completion	-0.143***	(0.0122)	-0.109***	(0.0153)
10 years after high school completion	-0.141***	(0.0126)	-0.106***	(0.0158)
11 years after high school completion	-0.137***	(0.0129)	-0.102***	(0.0162)
12 years after high school completion	-0.130***	(0.0132)	-0.0926***	(0.0165)
13 years after high school completion	-0.129***	(0.0134)	-0.0843***	(0.0167)

**p* < .1. ***p* < .05. ****p* < .01

Table A10
Effects of Delay on Labor Market Outcomes by Year, Restricted to "Thick Support" Sample

	OLS		PSM	
Outcomes	Coefficient	*SE*	Coefficient	*SE*
Panel A: Income (adjusted $2010)				
1st year after high school completion	2,309***	(277.1)	2,601***	(345.8)
2nd year after high school completion	2,462***	(344.9)	2,900***	(424.0)
3rd year after high school completion	1,443***	(416.3)	2,232***	(499.6)
4th year after high school completion	-9.650	(458.6)	825.1	(553.0)
5th year after high school completion	-1,507***	(504.1)	-789.4	(623.1)
6th year after high school completion	-3,131***	(544.0)	-3,183***	(677.6)
7th year after high school completion	-4,933***	(580.1)	-4,965***	(724.0)
8th year after high school completion	-6,116***	(638.7)	-6,003***	(798.3)
9th year after high school completion	-6,266***	(678.4)	-6,051***	(836.9)
10th year after high school completion	-7,285***	(729.0)	-7,676***	(886.8)
11th year after high school completion	-7,864***	(783.7)	-8,853***	(953.4)
12th year after high school completion	-8,224***	(835.2)	-9,272***	(1,011)
13th year after high school completion	-8,596***	(917.3)	-9,639***	(1,113)
Panel B: Total work hours				
1st year after high school completion	223.4***	(22.50)	218.9***	(28.44)
2nd year after high school completion	223.5***	(26.46)	226.2***	(33.13)
3rd year after high school completion	131.7***	(28.34)	137.6***	(34.16)
4th year after high school completion	112.9***	(29.62)	160.8***	(36.18)
5th year after high school completion	-26.94	(29.78)	4.979	(36.62)
6th year after high school completion	-112.1***	(29.70)	-99.31***	(36.97)
7th year after high school completion	-212.7***	(30.58)	-177.7***	(38.11)
8th year after high school completion	-259.1***	(30.77)	-235.7***	(38.04)
9th year after high school completion	-259.0***	(30.76)	-269.3***	(38.31)
10th year after high school completion	-257.7***	(31.92)	-242.0***	(39.45)
11th year after high school completion	-250.6***	(32.30)	-261.1***	(39.80)
12th year after high school completion	-229.9***	(33.30)	-281.4***	(40.11)
13th year after high school completion	-237.0***	(33.91)	-275.8***	(42.06)
Panel C: Full-time work status (> 35 hours/week for 50 weeks)				
1st year after high school completion	0.0605***	(0.00906)	0.0669***	(0.0115)
2nd year after high school completion	0.0823***	(0.0114)	0.0923***	(0.0148)
3rd year after high school completion	0.0622***	(0.0126)	0.0604***	(0.0162)
4th year after high school completion	0.0710***	(0.0132)	0.0814***	(0.0169)
5th year after high school completion	0.0412***	(0.0136)	0.0530***	(0.0172)
6th year after high school completion	-0.0216	(0.0140)	-0.0178	(0.0177)
7th year after high school completion	-0.0742***	(0.0144)	-0.0521***	(0.0181)
8th year after high school completion	-0.0805***	(0.0144)	-0.0679***	(0.0181)
9th year after high school completion	-0.105***	(0.0145)	-0.0981***	(0.0181)
10th year after high school completion	-0.0897***	(0.0145)	-0.0744***	(0.0182)
11th year after high school completion	-0.0943***	(0.0146)	-0.0843***	(0.0182)
12th year after high school completion	-0.0803***	(0.0142)	-0.0927***	(0.0178)
13th year after high school completion	-0.0726***	(0.0135)	-0.0822***	(0.0169)

Note. NLSY97 follow-up surveys were not conducted annually after 2011. We imputed the labor market outcomes for 2012 and 2014 by averaging the outcomes from the years immediately before and after.

**p* < .1. ***p* < .05. ****p* < .01

Table A11
Sensitivity to Unobservable Selection, δ for β = 0

	Panel A: College enrollment		
	Ever enrolled in college by…	Ever enrolled in a four-year college by…	Ever enrolled in a two-year college by…
1 year after high school completion	1.33	10.34	2.20
2 years after high school completion	1.66	7.69	1.73
3 years after high school completion	1.83	6.52	1.63
4 years after high school completion	1.89	5.45	1.59
5 years after high school completion	2.05	4.95	1.56
6 years after high school completion	2.23	5.01	1.48
7 years after high school completion	2.25	4.94	1.48
8 years after high school completion	2.33	4.78	1.45
9 years after high school completion	2.43	4.73	1.49
10 years after high school completion	2.50	4.67	1.50
11 years after high school completion	2.51	4.53	1.46
12 years after high school completion	2.59	4.56	1.47
13 years after high school completion	2.65	4.70	1.47

	Panel B: College completion		
	Ever received a college degree by…	Ever received a bachelor's degree by…	Ever received an associate degree by…
2 years after high school completion	-3.32		-3.24
3 years after high school completion	5.25		3.85
4 years after high school completion	4.46	12.37	2.44
5 years after high school completion	3.07	8.93	0.87
6 years after high school completion	3.43	9.24	0.97
7 years after high school completion	3.71	7.29	0.95
8 years after high school completion	3.87	6.19	0.95
9 years after high school completion	3.24	5.04	0.86
10 years after high school completion	3.13	4.69	0.94
11 years after high school completion	3.44	4.71	0.87
12 years after high school completion	3.42	4.80	0.83
13 years after high school completion	3.59	4.54	0.93

	Panel C: Employment outcomes		
	Income (adjusted $2010)	Total work hours	Full-time work status (> 35 hours/week for 50 weeks)
1 year after high school completion	1.85	1.39	0.54
2 years after high school completion	2.79	1.09	1.31
3 years after high school completion	0.59	0.78	0.91
4 years after high school completion	-0.65	0.37	0.58
5 years after high school completion	-3.25	-0.39	0.69
6 years after high school completion	-6.21	-4.01	-0.45
7 years after high school completion	-8.02	2.30	-14.88
8 years after high school completion	-6.20	5.85	1.45
9 years after high school completion	-6.10	-18.77	1.08
10 years after high school completion	-24.62	18.06	2.14
11 years after high school completion	-31.81	-19.39	1.66
12 years after high school completion	-7.38	-2.84	0.95
13 years after high school completion	-4.23	-2.11	1.23