Applying Event History Analysis to Investigate the Impacts of Developmental Education on Emerging Adults' Degree Completion

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Shu-Chen Chiang

Graduate Program in Education

The Ohio State University

2012

Dissertation Committee:

Joshua D. Hawley, Advisor

John B. Casterline

David S. Stein

Abstract

The low degree completion rate for college students is problematic in the U.S. Many scholars and practitioners focus on the effects of developmental education due to its cost and effort incurred by students and institutions. However, research has not decisively concluded that developmental education is either bad or good. This study extended this important stream of research by examining the factors that contribute to emerging adults' degree completion over time. Event History Analysis (EHAs) was applied to treat participation in developmental education as a time-varying indicator of degree completion. Other primary time-varying indicators include enrollment status and GPA.

The results are as follows. After the third year of enrollment, students have a greater likelihood of degree completion. Behaviors such as enrolling as a full-time student and the attainment of a higher GPA outweigh the disadvantage of taking developmental education. Findings show that students' declaration of major is driven by financial aid, rather than the motivation of career choices. Given that empirical studies fail to examine the relationship between developmental education and students' declaration of major, a further investigation from a sociological approach was conducted. Based on this study, solutions to deal with bureaucratic dysfunctions include: Workshops as a means to reach consensus and to strengthen sentiments in bureaucracy, and reforms of implementing a proper ratio of counselors to students. Moreover, surveys are suggested for future research to clarify the relationship between participation in developmental education and students' declaration of major.

To my family and friends, who encouraged me to persist with a belief

Acknowledgments

Great appreciation goes to my advisor, Dr. Josh Hawley. With his cordially response to my inquiry back to 2007, I had the courage to pursue my dream of study in the U.S. A flashback to the time of making choices reminds me the abstracting feelings of leaving home in Taiwan. Equally important is the sympathy support from my former advisor, Li-Yun Wang. Her considerate and timely mentorship helped me determine in each transitional moment. I cannot make a Ph.D. without the two great mentors.

I am indebted to Dr. Casterline and Dr. Setin for their teaching and sharing in the process of writing my dissertation. Dr. Casterline has been responsive to and patient with any inquiry I have. Dr. Stein provides me with insightful thoughts of seeing research.

All the way, I have been nourished by various organizations related to Taiwanese, such as Tzu-Ching Organization, National Taiwan Alumni Association, and Taiwanese Student Association. By making friends through these organizations, I am lucky to have their support and care, which walked me through every important moment in the Ph.D. process. Thanks to their generosity, I enjoy my life here.

My family and friends have been the drive empowering me to keep learning and dreaming in this scholarly career. With the encouragement, I dare to follow the voice inside and challenge my own ability. So glad I made it finally. I know the completion of a degree is a beginning instead of a period. Afterwards, I wish to fulfill myself as well as the whole society as a responsible researcher.

Vita

1996-2000 .....B.S. Foreign Language & Literature, National Taiwan University

2000-2002 .....M.A. Education, National Taiwan Normal University

2002-2003 .....Student teacher, Hsin-Chu High School

2003-2006 .....English teacher, Mauli County Yuanli Comprehension High School

2006-2007 .....English teacher, National Yuanlin Agriculture & Industry Vocational School

2007 to present .....Graduate Research Associate, The Ohio State University

Publications

Hawley, J. D. & Chiang, S.-C. (invited, in process). Development education for adults and academic achievement. In International Handbook of Student Achievement, 2012, Kentucky: Routledge.

Fields of Study

Major Field: Education

Table of Contents

List of Tables

List of Figures

1: Introduction

1.1 The Intriguer— Jack's story

Jack, a 19-year-old boy, often wore a black T-shirt, which made his skin look extraordinarily pale. Jack's pseudo name came because friends called him Jack when playing online video games. The fact that Jack stopped going school in sixth grade made him an extreme case given the crucial issue of K-12 attrition in the U.S. Yet personally, Jack didn't identify himself as a dropout and said: "I don't think it is dropping out. It is just, we have some problems at school, so we stop going. And then we cannot find another one to go to. So I mean. I just stayed at home." According to Jack, his older brother and he stopped going to school at the same time due to his brother's involvement in violence. Now Jack is working on his GED (General Education Development) while working full-time in a local factory. Faced with so many choices of programs in college, he intended to be a nutritionist. He said: "You got to have something to do, you know…and I cannot think anything else. I don't want the other obvious things like lawyers or doctors that kind of staff. I just knew my uncle said that, (you know)…if he can start over again, he probably will want to be a nutritionist. So that is the only career I can think of that I can do. So I just, you know…" By talking to Jack, we learn about problems transitioning from school to work, which is especially challenging for the youths with very limited resources from family. Youths may drop out from school voluntarily or involuntarily. However, they eventually find out themselves landing in

low-paid, labor-intensive jobs, namely, jobs with no future. Sooner or later, they will try to return to school to have a better chance of finding good jobs.

In essence, Jack is still exploring his own identity before settling down as an adult. At this point of time, the exploration of work seems to outweigh other areas of life such as love and marriage. Even though he had been depending on his mother for a long time, he was asked to be self-sufficient when he turned 18. He started the job as a grinder in a local factory. Jack sees returning to school as an opportunity to have more sustainable work. As he said, "You got to have something to do." During the process of growing up, the necessity to be self-sufficient enhances the connection between work and being an adult. Therefore, the attainment of higher education plays an important role in making the transition to work. By stopping schooling as early as the sixth grade, Jack needs extra work and effort to be college-ready. In this sense, he is reaching a door but still unprepared for college-level courses. Specifically, the necessity of building up basic skills for college-level material makes developmental education a tremendous task at the higher education level. The challenge ahead of Jack can be foreseen as he goes through the process. By studying the persistence issue during the higher education process, we expect that this study can bring insights into youths' transition from school to work, helping them not only persist to succeed at school, but also benefit by obtaining a satisfying lifelong career.

1.2 Background

The preparation of youth for adult work differs across national borders (Shanahan, Mortimer, & Kruger, 2002). Given an increasing opportunity to receive education at primary or secondary level in developing countries in recent decades (National Research Council, 2005), educational expansion in the U.S. is formed by a goal of "college for all" (Rosenbaum, Deil-amen, & Person, 2006). Ultimately, the economic role of postsecondary education is to prepare youth for work, facilitating their school-to-work transition with a more structural institutional function (Tanner, Arnett, & Leis, 2009). Degree holders can distinguish themselves in the job market with credentials as a signal to attract potential employers (Collins, 1971).

The changing skills needed in today's workforce means that postsecondary credentials and individual economic security are closely interwoven (Carnevale, 2008). Individuals without any postsecondary degrees or training are expected to "flounder" or "mill around" in the school to work transition (Kerckhoff, 2001; Neumark & Wascher, 2001), representing a vulnerable population in the job market. It is especially true for a large percentage of youth who drop out from high school or do not attend college right after high school. Research points out that the instability of youth employment in the U.S. has been considered costly or even painful both at individual and societal level (Shanahan, Mortimer, & Kruger, 2002).

The school-to-work transition gets even problematic with youth delayed entry to stable adult roles. While it is a new phenomenon in the U.S. and other industrialized countries, "emerging adulthood" is defined as a stage of development and is generally referred to youths in age 18 to 29. Youth in this particular age range are exploring various life issues. The process of looking for an identity in work and love (marriage) stresses youth instable exploration (Arnett, 2000, 2004, 2006, 2009; Tanner, Arnett, & Leis, 2009). Given this, the higher education process is characteristic of a volatile potential.

Emerging adulthood theory helps gain an insight into the degree completion problems of youth. In fact, emerging adults in the 18 to 29 age range represent up to 70% of entrants in colleges (NCES, 2009). As a majority of the college group, the characteristics of emerging adults deserve more attention. Undoubtedly, today's increasing access to higher education broadens youth opportunities for educational and career choices.

The nature of exploration requires a pattern of reassessing and settling down to stable adult work. Specifically, this potential uncertainty accompanying most youths implies their development both socially and psychologically (Tanner, 2006) and complicates their school-to-work transition. As a form of individual identity, work is growing in importance with time (Csikszeniminalyi & Schneider, 2000). Therefore, a full-time and stable job plays a key role as adults.

Work constitutes the center of human existence based on the conventional assumption of career development studies (Porfeli & Vondracek, 2009). Given the

changes in the nature of work and consequent developments in schooling, the interplay of human development and education is multi-faced. Indeed, the bleak economic prospects of nowadays potentially heighten this connectedness, accompanying a growing discrepancy in wages between high school diploma holders and college graduates (Yeats, 2005) . In this sense, college experience plays a decisive role in preparing youth for the tangible tasks of adulthood, such as a gainful employment to assure financial independence. Namely, college completion bridges the gap, playing a salient role to facilitate youth school-to-work transition in their life stage of exploration.

The effort to facilitate college completion rates comes from governmental intervention, representing a major thrust of research these years (Attewell, Lavin, Domina, & Levey, 2006; Bahr, 2010; Bailey, 2009; Bailey, Jeong, & Cho, 2010; Bettinger & Long, 2005; Bettinger & Long, 2009; Boatman & Long, 2010; Calcagno & Long, 2008). Given the widespread provision of developmental education for entering freshmen, the annual expenditure in developmental education reaches $1 billion for public colleges (Martorrell & McFarlin, 2011). Therefore, the effects of developmental education have been the center of controversy.

Developmental education, also called remediation, is a series of courses that provide instructions in basic skills such as math and language. Ideally, the design of developmental education aims to bring weak academic college students up to adequate college-level (Bailey, Jeong, & Cho, 2010). Remediation functions as a make-up device to assure students who are ready for college. It is also seen as a mechanism to secure equity for the disadvantaged group in the U.S. However, the use of developmental

education is substantially controversial in practice. Given no consistency in school policy regarding its implementation, mixed results are found in prior research.

Equally important is youth declaration of major, which should be considered a significant process connected with their settlement into adulthood. In light of this, the timing of declaring a college major should be related to students' completion of a degree, influencing the likelihood of a smooth transition to work. Indeed, the beginning of college was proposed a noteworthy starting point of transitioning to work, instead of taking the point of degree completion conventionally (Reitzle, Vondracek, & Silbereisen, 1998). Namely, the importance of higher education is pinpointed not only at the time of degree completion but also at the process, reflecting the factor of time related to various educational activities.

In sum, the relationship among students' participation in developmental education, the timing of declaration of major, and degree completion will be investigated by event history analysis in this study. With the ability to deal with time-varying factors through EHA, both the changing nature in developmental education and students' declaration of major can be captured. Therefore, what contributes to degree completion over time can be described. To that end, this study will employ event history analysis as a method of studying emerging adults to learn their higher education process in community college.

1.3 Statement of the Problem

College completion has become an increasingly important policy intervention in the U.S. Given the fact that a high-skilled workforce is needed, states strive to graduate more college students. Specifically, college degrees or certificates have become the prerequisite to hold a sustainable job in today's labor market (Perdue, 2008). However, of the 150 million workers aged above sixteen in the U.S., nearly half have a high school diploma or less (Jacobs & Tolbert-Bynum, 2009). Those adults are considered a pool of potential enrollees for college.

With an open access policy, community colleges function as an entry point to enroll most academically underprepared adults in contrast to selective universities. However, community colleges fail to graduate students, which is shown by stubbornly low college completion rates since 1970s (Bowen, Chingos, & McPherson, 2009; Horn & Berger, 2004). In fact, college completion rates have changed very little in decades even with an over five-time increase in access to community colleges (Rosenbaum, Deil-amen, & Person, 2006). As the pressures have grown on institutions at the higher education level to enhance student success, so has the research examining various programmatic interventions on student outcomes (Pascarella & Terenzini, 2005).

The effectiveness of developmental education has been a thrust of research due to the tremendous effort and cost incurred by stakeholders such as states, colleges and students. Ideally, the design of developmental education helps those who are underprepared for college in core subjects like math and language, which are required to

move towards degree completion. Almost all four-year or two-year colleges offer some form of developmental education. Developmental education accounts for between 25 percent to nearly up to 80 percent of courses at colleges (Grubb et al., 1999). Noticeably, the provision of remediation is reported to consume at least 1 billion in nationwide public colleges annually (Martorell & McFarlin, 2011; Melguizo, Bos, Prather, & Melguizo, 2011). Because of the expenditures at the postsecondary level, the effectiveness of developmental education has drawn considerable attention (Pascarella & Terenzini, 2005).

However, research yields mixed results of developmental education on persistence and college completion (Attewell, Lavin, Domina, & Levey, 2006; Bahr, 2010; Bettinger & Long, 2009; Calcagno, Crosta, Bailey, & Jenkins, 2007a; Calcagno & Long, 2008; Hawley & Chiang, 2011a; Melguizo, Bos, Prather, & Melguizo, 2011). Namely, it is hard to describe the impact of remediation on degree completion due to the complexity and inconsistency among state policies and practices.

Given there are no common or standardized exams that serve as the access requirements to take developmental education in most states, it is important to validate the effects of developmental education (Bailey, Jeong, & Cho, 2010). Moreover, varying criteria to decide study groups exacerbate the problems of comparing the impacts of developmental education. For instance, traditional-aged (18 to 20 years old) enrollees in Ohio public college with the intent to seek four-year degree were studied by Bettinger & Long (2009). All enrollees in the California community College System were included in

Bahr (2010). Given the difficulty to reach a common conclusion, more research is needed to enhance our understanding about the impact of developmental education.

The purpose of this study is to learn how time-varying factors affect students' persisting through degree completion. These primary factors include participation in developmental education and students' declaration of major. Specifically, degree completion defined as the attainment of an Associates or higher degree is the final outcome in this paper. Applying emerging adulthood theory as a means of truncating the age of the subjects, this paper investigated the impact of developmental education on degree completion for the age group 18-29 in particular.

This paper employs administrative longitudinal data sets to study emerging adults' experiences at community colleges. The employment of administrative data sets functions as a reliable source to learn the higher education process since the same students are tracked over a long period of time. Students are observed for six years in this study, corresponding to the same observation period of most studies and state reports (Bettinger & Long, 2009; Boatman & Long, 2010; BOR, 2006a; Calcagno, Crosta, Bailey, & Jenkins, 2007b).

The application of longitudinal data sets makes it possible to examine the complicated higher education process over time. As Pascarella & Terenzini (2005) pointed out, the impact of academic performance varies over time, which contributes to the complexities of realizing persistence and degree completion issues. In light of this, time plays an increasingly important role during the process, suggesting a promising prospect to deal with degree completion issue—event history analysis.

Event history analysis, with the ability to deal with the momentum in time, fits with studies of the higher education process for emerging adults. Often a vast majority of researchers measure the change of various intermediate factors in two time points (the start and finish period) to predict the impact of changes on final outcome. However, the dynamic nature of the higher education process is ignored in this way (Calcagno, Crosta, Bailey, & Jenkins, 2007b). Instead, history event analysis can easily deal with the changing effects over time, or even time-varying covariates that are rarely modeled conventionally (Pascarella & Terenzini, 2005; DesJardins, 2003). In sum, this study aims to examine how time affects factors changing on college completion with a focus on emerging adults using event history analysis.

1.4 Research questions

The following research questions will be explored:

1. Does the participation in developmental education affect the timing of declaring a major?

2. To what extent does the varying participation in developmental education affect the hazard rate (probability) of earning an Associates or higher degree for emerging adults?

3. To what extent does the varying enrollment pattern (full-time vs. part-time) affect the hazard rate (probability) of earning an Associates or higher degree for emerging adults?

4. To what extent does the varying yearly GPA affect the hazard rate (probability) of earning an Associates or higher degree for emerging adults?

5. Overall, how time-varying variables as a whole, including developmental education participation, enrollment pattern, and GPA, affect the hazard rate (probability) of earning an Associates or higher degree for emerging adults?

1.5 Definition of terms

Event history analysis

Event history analysis (EHAs) is a modeling technique similar to regression. EHAs can be used to analyze the occurrence of an event over time. Specifically, it is capable at dealing with time-varying factors, which are often found in the higher education process.

Developmental Education

Developmental education, also called remediation, is a series of courses that provide instructions in basic skills such as math and language. Placement tests are often developed by school or regulated by states. Students who fail to reach certain placement test scores are required to take developmental education before they are eligible to take college-level courses.

Emerging adults

Emerging adults in this study are defined by emerging adulthood theory and referred to those individuals aged 18 to 29. Youths in this particular age range are characterized by continuous exploration in a unique stage of life.

1.6 Significance of the study

This study has theoretical and practical implications for understanding what led to the stagnant college completion rate. Focusing on the emerging adults in community colleges, this study helps to shed light on the college persistence issue. Moreover, both intended and unintended outcomes of developmental education will be examined. Most important of all, this study will reflect the changing nature of higher education process.

This study is distinct from prior research by studying individuals at community colleges. A great deal of prior research focuses on four-year universities, which creates difficulty in applying these lessons to community colleges. Given that the two types of institutions are so different in nature: Substantial discrepancies arise from the structure of institutions, the ways students are enrolled, and different student groups. Moreover, criticisms remain because a tremendous increase in enrollment has not led to rising completion rates in most community colleges (Bowen, Chingos, & McPherson, 2009). In light of this, the issue of college completion in community colleges deserves more attention.

Both unintended effects and intended outcomes are examined to gain a better understanding about the impact of developmental education policy. That is, this study makes efforts to meet the gap of evidence showing if remediation has a negative effect on students' declaration of a major. By doing so, it enhances the significance of this study in at least two ways. One is to justify the statement regarding a negative effect of

participating in developmental courses related to students' declaration of major; the other is to fulfill the evaluation of developmental education from an alternative perspective.

Furthermore, the factor of time is expected to enhance the predictability of explanatory variables like developmental education, which is often examined as unvarying factors. More factors such as enrollment status or grade performance change over time show the changing nature of higher education process. Therefore, adding the effect of time allows us to further examine how various time-varying factors can affect the final outcome like degree completion. The findings are expected to better equip community colleges to help more students succeed.

1.7 Limitations of the study

There are several limitations in this present study. In essence, limitations primarily arise from the availability of data.

First, measures regarding psychological and environmental factors are not included in this study. Specifically, variables such as satisfaction, stress, financial aid, and emotional support from family are missing. Based on prior research, factors of external environment are reported to have determinative effects on adult learners' persistence (Bean, 1982; Bean& Metzner, 1985). However, they will be ignored or controlled only in this study due to the lack of information. On the other hand, the quality of data is a concern. Students' intention, for instance, is a one-time measure while they enrolled. This is the primary limitation of this study.

Second, the sample is restricted to students at 10 community colleges because the data of placement testing can be obtained from these 10 schools. Caution should be taken when trying to generalize the findings to other states.

2: Review of literature

This chapter is a review of the literature regarding college persistence. It starts with introducing emerging adulthood theory in order to produce insight into the development of youth, reflecting the changing nature of their explorations. Next, primary theories of persistence are included to have a general picture of what affects persistence and degree completion. In terms of the primary explanatory variable, prior research about developmental education and its impact on educational outcomes are discussed, with a particular lens of quasi-experimental designs. The declaration of a major is included to understand the issue of college completion. Finally, other factors such as age at the time of entry, background characteristics, personal intention, pre-college readiness, and college performance are discussed since they pertain to college persistence. Specifically, factors like enrollment patterns and college GPA are discussed since both are characteristics that change with time.

The articles reviewed in this chapter are retrieved by descriptors such as college persistence, developmental education, college remediation, and the declaration of college major. The descriptors are used to search multiple databases, including Education Research Complete, Educational Resources Information Center (ERIC), and Social Sciences Citation Index (SSCI), representing the education and social science literature (Stein & Wanstreet, 2006). In addition, the search engine Google Scholar was employed (van Aalst, 2010).

2.1 Emerging adulthood theory

Most youths enter the postsecondary level beyond their teen and late twenties, presenting a unique stage in life course. Specifically, the theory of emerging adulthood proposed by Arnett (2000, 2004, 2006) defines youths in age 18 to 29 with five features: 1) the age of identity exploration; 2) the age of instability; 3) the self-focused age; 4) the age of feeling in-between; 5) the age of possibilities.

Emerging adulthood represents a distinct period in one's life. On the one hand, emerging adults are different from the adolescents in that they are less dependent on adults. The independence represents a maturity cognitive development in emotion-regulation and decision making from late teens through the twenties (Tanner, Arnett, & Leis, 2009). Yet on the other hand, youths in the age range 18-29 should not be considered young adults since most of them have not yet entered long-term and stable adult roles**.**

The existence of emerging adulthood depends on how tolerant society is of new adults' dependence economically and socially. One indication of the tolerance of society is the fact that many families have welcomed young adults back in to the home during this period of economic decline. Therefore, the phenomenon of youth delayed transition into adulthood is found in industrialized countries or the growing middle-class in developing countries since these societies have more tolerance on youth postponement to adulthood (Arnett, 2000; Tanner, Arnett, & Leis, 2009).

Based on Arnett (2009), the cultural context is a significant factor that contributes to the prolonged period of exploration of independent roles in one's late teens through twenties. In the U.S., demographic changes such as the extension of schooling and the median age of marriage facilitate this formation of emerging adulthood like most industrialized countries (Arnett, 2000, 2004, 2006). Realizing this, it is not surprising to see a trend of prolonged persistence in both two-year and four-year institutions as reported in Horn & Berger (2004). Namely, the apparently delayed transition to adult roles may cause individuals to stay longer in college compared to the previous generation.

By recognizing the existence of a distinct period of time between the teenage years and adulthood, we are distinguishing this theory from more general developmental or adult learning theories. Yet neither Maslow's Hierarchy of needs nor Erikson's crisis of identify, no specific age range is identified for the emerging adulthood. Therefore, this study adopts the theory of emerging adulthood as a lens of exploring youth school-to-work transition, the issues of higher education and work in particular.

In Arnett's words, "college is a temporary safe haven" where emerging adults can explore any possibility in work, love, and world views with lots of adult responsibilities minimized or postponed (Arnett, 2004:140). With different goals driven to enroll in college, individuals are allowed to have the freedom to develop personal identity and explore majors that fit well with their abilities and interests. Even though it is hard to ascertain how colleges affect youth development, evidence shows that most individuals

develop the formation of identity and ideas about career development in the college years (Pascarella & Terenzini, 2005).

The concept of work is seen differently for youths in emerging adulthood compared with adolescents (Arnett, 2004). Instead of some additional money for personal use, work is expected to be related to or enhance lifelong career. In this sense, youth continuous exploration is coincident with the pursuit of a lifelong career in emerging adulthood. Specifically, the importance of job-seeking in emerging adulthood is not just having one but also "the right one," which makes youth growth in identity extremely crucial.

Based on Erikson's stages of development in one's life course, youth is a stage of identity issue (Erikson, 1994). Specifically, identity versus role confusion is a central challenge or crisis for individuals starting in adolescence. Extended to the crisis of identity in today's youth, Arnett (2004) proposes that emerging adults are focused on identifying questions of who they are and what they want to do for work. Using interviews with this age group, Arnett (2004) reports that youth may "fall into" certain kind of job that clicks in his or her interest and ability but the chance is few. Therefore, more structural assistance from the educational system is helpful.

Effort to enhance the college completion rates can potentially smooth youth school-to-work transition, especially for those individuals who are academically underprepared. Specifically, the provision of developmental education serves as a make-up function to bring the underprepared up to the college-level. In light of this, higher

education experiences should be examined from a lens of emerging adulthood, which makes the aim of this study.

2.2 Theories of persistence

There is a wealth of literature on the issue of persistence, referring to continued student enrollment in college. Various durations of time as students enroll before graduation are used to define persistence. Persistence is seen as a necessary process but not a sufficient condition towards degree completion (Pascarella & Terenzini, 2005). In essence, continuous persistence indicates the effort students spend on study towards degree completion (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006).

A rich body of literature regarding college persistence has been generated as an effort to enhance degree completion. However, the literature on persistence is primarily based on studies at full-time traditional-aged students in four-year institutions. Therefore, the existent literature lays a foundation of knowledge for the issue of college persistence, but the focus on two-year colleges requires us to understand the differences.

According to Astin (1975), the extent of student involvement is decided by the amount of physical and psychological energy involving in academic activities. In this sense, "involvement" is different from motive because involvement emphasizes both the psychological and behavioral states. The value of student involvement theory is the implication for persistence conceptually. As Astin indicated later on, the amount of student involvement can be expressed in both quantitative and qualitative forms (Astin, 1984).

Following this logic, student involvement theory provides a conceptual frame to signify the importance of students' academic performance. Understandably, academic

performance like grade point average (GPA) is a powerful predictor of persistence and degree attainment (Adelman, 2006; Pascarella & Terenzini, 2005; Voelkle & Sander, 2008). In a sense, GPA reflects the quality of students' involvement in educational activities, so as accumulated credit hours express the quantity of involvement.

The other two primary theories exploring the issue of persistence are Tinto's (1993) student integration model[1] and Bean's (1982) student attrition model. Tinto's effort is to investigate the factors which enhance students' persistence; Bean's is from an institutional perspective to discuss the determinants that cause students to drop out. There are different focuses but commonalities can be found in the midst. For instance, the recognition of pre-college characteristics of individuals and the match to institutions can be found in both models (Cabrera, Castaneda, Nora, & Hengstler, 1992). In this sense, these two models should be seen as mutually complementary instead of exclusive (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006).

As the title reveals, the student integration model focuses primarily on integration both academically and socially. In Tinto (1993), institutional departure, defined as students' departure from their original institutions, comes from two different levels—individual and institution. At the individual level, personal intention and commitment are proposed to be the primary factors. As his book reveals, "the higher the level of one's educational/occupational goals is, the greater the likely of college completion can be" (Tinto, 1993). Instead, at the institutional level, issues such as

[1] According to Tinto (1993), his model highly depends on the concepts built by Durkheim's Theory of Suicide. Besides, Spady (1970)'s clarification is reported to be helpful to build Tinto's model of persistence.

adjustment, difficulty, incongruence, and isolation are indicated to be negative factors that lead students leave school (Tinto, 1993).

Tinto's model of institutional departure refers to the integration of academic system and social system, implying the longitudinal nature in the process. Academic integration is defined as student perception of intellectual gain as in the form of GPA (Tinto, 1997), while social integration refers to interactions with other students and faculty in or out of classroom, accompanying the norms and culture on campus as well.

In this sense, social integration can be expressed by students' participating in school events as well as informal interactions. In essence, Tinto's model emphasizes students' perception, an interaction system model, the interplay of social and academic integration at school (Tinto, 1993). Therefore, the issue of persistence should be seen differently from the decision to participate because the context of institution is significant after students enroll.

Instead, Bean's (1982) student attrition model represents an institutional perspective to persistence. With 1,574 full-time, unmarried freshmen who were under the age of 21, Bean (1982) listed the most significant factors related to students' attrition. Ten factors were ranked according to their influence, including intent to leave, grades, opportunity to transfer, practical value, certainty of choice, loyalty, family approval, courses, student goals, and major and job certainty (Bean, 1982). Overall, intent to leave was proposed the best predictor of actual attrition

Meanwhile, the degree of institutional commitment is considered one main factor in Bean's model but to less extent in Tinto's integration model. As a result, both models signify the interplay of persons and the system around, pointing out the important role of institutions. In essence, it is the nature of interaction among individual characteristics, institutional traits and situations embedded that closely connects to student outcomes, which is clearly acknowledged in these models.

These models point out what influences student success from an integrated perspective. Among numerous variables, personal intention is salient since it explains students' active involvement in learning, which can be learned from their academic performance. Also, institutions will enhance the graduation rates if the match with particular characteristics of students can be identified and so are the proper interventions developed. In light of this, studies should put more emphases on community colleges since learning from their four-year counterparts may not be applicable given varying characteristics of students and situations in both types of institutions.

Therefore, what can be learned from prior persistence models yielded two principles: One is categories of variables identified and the other is the temporal order of these variables. To clarify, variables consisting of several categories such as personal background characteristics, pre-college readiness, environmental factors, potential financial support and most important of all, academic performance are all critical to persistence (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). Moreover, the nature of temporal effect of these variables is contributed to several theories.

Specifically, Tinto (1993) clearly specified the process of active engagement in college for students. For example, there are some pre-college characteristics such as high school experience and college readiness, which should be recognized before students enroll in college. Once students enroll, both social and academic integration will interact with their inherent characteristics. In light of this, the temporal influences of various factors need to be clarified.

The sequence of factors interacting with the longitudinal process of persistence should be recognized as researchers intend to examine the magnitude of particular factors. Take this present study for example, both background characteristics and pre-college readiness should be included in the model before the impact of developmental education on degree completion is to be estimated.

In sum, insights from prior theories are various components and factors contributing to persistence and student success. Indeed, it is difficult to investigate all potential factors accounting for student final outcomes. Realizing this, of particular interests in this study are two forces from different levels separately. One is state governments' intervention through the implementation of developmental education; the other is individual behaviors such as enrolling either full-time or part-time. As a result, the following sections will illustrate these two forces from institutional and individual levels, representing the primary explanatory variables in the present study.

2.3 Developmental education as state efforts to enhance degree completion

Given the stubbornly low college completion rates in the U.S., states strive to graduate more college students by various programmatic interventions. The provision of developmental education shows efforts from colleges and universities to enhance the academic performance and persistence of academically underprepared students. However, the implementation of developmental education varies greatly in content, structure, and duration, making the investigation into the effectiveness of developmental education difficult (Pascarella & Terenzini, 2005).

Developmental education mainly affects students' academic progress since students do not usually receive college credits from these courses. It is especially the case for community college students. According to recent studies, half of the cohort or even nearly two thirds of all community college students are referred to developmental education in at least one area (Jenkins, Jaggars, & Roka, 2009). Besides, students can be intimated by the necessity of taking developmental education (Bailey, Jeong, & Cho, 2010). Based on the same report by Bailey and his colleagues, few remediated students progress forward the layers of developmental education successfully, not to mention the next step, to earn college credits or a degree.

Often, placement tests are employed to determine if students need to take developmental education. Alternatively, referral from instructors is also used to assign students in need (Martorell & McFarlin, 2011). In terms of the cutoff scores to execute students from developmental education, states have different policies. In Ohio, for

example, no common placement tests for the purpose of placement in developmental education are imposed. Therefore, two tests including Accuplacer and Campus as well as school-developed tests are found in a recent report, indicating the diversity and inconsistence regarding remediation in practice (Hawley, Chiang, & Lechman, 2011).

Efforts aim to investigate effects of developmental education can be found from mainly two sources: Institutional practices as well as empirical studies with longitudinal data sets. In practice, math remediation has attracted considerable attention given the fact that participants in math remediation outnumber English participants by two times (Biswas, 2007). Therefore, related studies are often targeted on math remediation.

In Texas, high-touch mentoring services target students in lower-level math courses by showing continuous attention on students (Visher, Butcher, & Cerna, 2010). Moreover, schools in Connecticut, Colorado and Virginia designed non-traditional structures to provide flexible, self-paced learning opportunities for students (Biswas, 2007). As a part of these efforts, a report from Texas revealed developmental education instructors lack credentials or professional development, illustrating the barriers to successfully improve the quality of teaching in developmental education (Neeley & Paredes, 2007). Therefore, the quality of teaching in remediation can be a critical concern as states strive to graduate more college students.

Besides investigating the best practices in the classroom, researchers make efforts to examine the relationship between developmental education and student outcomes from a quasi-experimental approach, which is the attempt to seek for evidence (Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007). One report from Community College

Research Center (CCRC) affirms the significance of evidence, suggesting the need to emphasize the measurement of outcomes in community colleges (Bailey, Alfonso, Calcagno, Jenkins, Kienzl, & Leinbach, 2004). Therefore, we employ empirical study as the criterion to choose papers discussed below as well as making sure diverse sources from various states.

2.3.1 Findings from empirical research

Table 2.1 lists ten studies representing findings from six states—Florida, Ohio, Virginia, California, Tennessee and Texas— as well as other results from datasets on a national scale. All studies are ordered chronologically. As indicated in Table 2.1, studies regarding the effects of developmental education are divided into early and long-term outcomes.

To clarify, early outcomes include first college-level courses and persistence of various durations; long-term benefits can be credential attainment, upward transfer from two-year to four-year institutions, and increases in incomes. It is worth noting that degree completion such as the attainment of Associates degree or credential is often treated as the dependent variables in these studies.

In terms of outcomes pertaining early measures, three are positive; three are negative, while two are indifferent and the last two are non-applicable. Positive outcomes indicate remediated students perform fair compared with their non-remediated counterparts in various outcomes, otherwise is negative.

Long term outcomes are indicated as the column on the far right of Table 2.1: Three studies refer to positive effects of remediation, three are indifferent, one is negative, one is mixed and two are non-applicable. Specifically, both the two non-applicable results focus on progress in layers of remediated courses without further measures in the long run. Overall, the ten studies with various outcomes are discussed in detail. Then we will summarize early and long-term outcomes subsequently.

Table 2.1 Empirical Studies on impacts of developmental education

Study	Data Source	Early Outcomes	Long-term Outcomes
Attelwell, Lavin, & Levey (2006)	National Education Longitudinal Study (NELS:88)(1988-2000)	(—)	**(+)**
Calcagno, Crosta, Bailey &Jenkins (2007b)	28 community colleges in Florida (1998-2004)	N/A	(—)
Calcagno & Long (2008)	28 community colleges in Florida (1997-2000)	**(+)**	**(~)**
Bettinger& Long (2009)	Two-year and four-year public colleges in Ohio(1998-2003)	**(+)**	**(+)**
Hawley & Chiang (2011a)	10 community colleges in Ohio (2003-2009)	**(+)**	**(~)**
Jenkins, Jaggars, & Roska (2009)	Virginia Community College System (VCCS) (2005-2008)	**(~)**	N/A

continued

Table 2.1

continued

Bahr (2010)	104 community colleges in California (1995-2001)	N/A	**(+)**
Bailey, Jeong, & Cho (2010)	Achieving the Dream initiative (AtD) (2004-2006)	**(—)**	N/A
Boatman& Long (2010)	Two-year and four-year public colleges in Tennessee (2000-2006)	**(—)**	Mixed
Martorell &McFarlin (2011)	Two-year and four-year public colleges in Texas (1999-2005)	**(~)**	**(~)**

Notes: N/A not applicable (+) positive (-) negative (~) indifferent

Early outcomes: Earning 10 or fewer credits/ first college-level course-taking / total credits completed / 1st& 2ndterm (year) persistence/

Long-term outcomes: Associates or higher degree attainment/ upward transfer (two-year to four-year institutions)

Applying the nationwide scale of NELS: 88, Attelwell, Lavin, Domina, & Levey (2006) examined two groups of entrants in four-year and two-year colleges separately. In terms of the effect of remediation, their findings suggested remediation decreases the possibility of graduation for four-year college students by 11% in reading remediation, lowers 5% by the possibility with one or more math remediation. Interestingly, the outcomes are reversed for two-year entrants. Remediation participants in community colleges are more likely to graduate with a degree compared with their capable peers with similar family background and high school preparation and skills.

With data from Florida, Calcagno and his colleagues compared the impact of remediation for traditional-aged and older learners above age 25 during 17 successive semesters. Results suggested remediation has a negative effect on graduation for all; however, older learners are less deterred by remediation than their younger peers (Calcagno, Crosta, Bailey, & Jenkins, 2007b). Moreover, their findings revealed that math remediation is particularly influential to older adults relative to other subjects like reading and writing, indicating institutions need to retool differently to meet the need of varying age groups of students.

Another study about Florida comes from Calcagno & Long's (2008), which dealt with methodological problem. In reality, program participants choose to enroll by themselves, indicating that these participants could have certain unobserved characteristics different from nonparticipants. In case of remediation, those who are assigned to take remediation are less academically prepared in contrast to nonparticipants. Therefore, the comparisons are biased. Moreover, there is a possibility of

re-testing in some institutions, which may influence results given that testing is the mechanism to decide if students are required to take remediation.

With regression-discontinuity design (RD) to examine the effects of developmental education, Calcagno & Long (2008) found developmental education could be beneficial to student persistence until the second year at school. Their findings suggest that developmental education promotes the total credits earned (including remediation) with 2 to 3.8 percentage point increase in the first-year persistence, but there is no evidence of benefit in the long run (Calcagno & Long, 2008). This statement is particularly true for students on the margin of requiring remediation, suggesting that it may not apply to those who are either far below or above the cutoff scores.

Bettinger & Long's (2009) study with Ohio data showed positive effects both on early- and long-term outcomes. In terms of persistence, both math and English remediation promote participants to persist until the fifth year. Also, students joining developmental education are more likely to complete a bachelor's degree within four to six years than their non-remedial counterparts with similar test scores and backgrounds. It is worth noting that math remediation increases the possibility of studying math-related field, for those who express interests in math before enrolling. Instead, English remediation showed the effect of discouragement. Overall, their study on Ohio reveals promising outcomes both in the early- and long term.

Another study focusing on the community colleges in Ohio revealed the positive effect of taking remediation in the short term, rather than long-term. Employing logistic models as well as propensity score matching techniques, Hawley & Chiang (2011a)

found remediated participants perform fair in the first and second year persistence; yet no further evidence can be found in the long-term outcomes like the attainment of an Associates or higher degree and certificates. Moreover, caution should be taken since the study sample was limited to older adults above age 24, not all enrollees in community colleges.

With a large sample of California community colleges students, Bahr (2010) examined the efficacy of developmental education by investigating the "depth" and "breadth" of skill deficiency in college preparedness. Namely, depth means a varying-degree deficiency in one certain subject; breadth indicates the deficiency in varying combination of several subjects. Findings suggest the positive effects of remediation, pointing out that students who remediated successfully perform similar to their college-prepared peers in credential attainment and upward transferring. It makes no difference either in math or English, even a combination of deficiency in both. Bahr's encouraging findings affirm the benefits of implementing developmental education, especially for those students who remediate successfully till earning a certificate.

Another study with Tennessee data, Boatman & Long (2010) examined the effects of developmental education with a specific focus on students referred to lower levels of remediation. Ironically, their results reveal the most disadvantaged effects were found in the marginal group whose scores are close to the cutoff range; however, the negative effects of remediation faded, turning into positive effects from writing remediation. This outcome differs from previous research by Calcagno & Long (2008), which applied discontinuity regression (RD) design as well. Reasons to explain the different outcomes

could be variance in data and selected study groups. Besides the different data source, Boatman & Long's (2010) study specified different subgroups by the level of their first remediated course. Their study showed students in lower remediated levels actually benefit from participation compared to their peer in higher level of remediation.

Jenkins, Jaggers, & Roska's (2009) findings from the Virginia Community College System (VCCS) revealed a large percentage of students failed to enroll in remediation, which corresponds to Bailey and his colleagues' study based on colleges joining Achieving the Dream initiate (Bailey, Jeong, & Cho, 2010). Yet no significant difference can be found for students skipping remediation compared with participants in VCCS study. Both of these two reports do not report long-term results since they focus on the progress students made by joining remediation.

Lastly, Martorell &McFarlin (2011) used a sample from both two-year and four-year colleges in Texas. They intended to estimate short-term outcomes such as attempted credits, transfer, and degree completion, as well as higher earnings as long-term outcomes. However, there is no evidence or only slightly negative effects on the outcomes. Similar to Calcagno & Long (2008), the findings pertain to students whose test scores are close to the cut-off since discontinuity regression approach was applied.

Based on these ten papers discussed so far, results of early and long-term outcomes can be summarized as follows:

Early outcomes

Attelwell and his colleagues reported that remediation decreases the possibility of earning 10 or fewer credits even thought the magnitude is small (6 percent). Among the two studies with Florida data, the 2007 work by Calcagno and his colleagues did not report short-term results. The second study suggested remediation might promote the total credits earned as well as first-year persistence (Calcagno & Long, 2008).

Two studies using data from Ohio found that remediation stimulates participants to persist until the second year (Hawley & Chiang, 2011a), and even up to the fifth year (Bettinger & Long, 2009). Jenkins, Jaggers, & Roska's (2009) findings from the Virginia Community College System (VCCS) revealed a large percentage of students failing to enroll in remediation, which corresponds to the report from Bailey and his colleagues' study based on colleges joining the national project Achieving the Dream (Bailey, Jeong, & Cho, 2010).

Yet no significant difference can be found for students skipping remediation compared with participants in VCCS study, allowing the conclusion that there was no major impact of remediation. Similarly, a recent study based on Texas data provides no difference between remedial and non-remedial undergraduates in the number of attempted credits, or persistence in the first year (Martorell & McFarlin, 2011). Moreover, Tennessee study shows that remediation harms the accumulation of credit hours (Boatman & Long, 2010).

Long-term outcomes

With findings indicating mixed effects of developmental education, Boatman & Long (2010) found the likelihood of degree attainment varies among remediated students at different levels. Writing remediation has positive effects on long-term outcomes, but negative effects occur with math remediation. In terms of studies indicating positive effects, findings from a national dataset show that remediation in reading and writing specifically can improve the possibility of earning credentials for community college entrants (Attewell, Lavin, Domina, & Levey, 2006).

Also in the case of California, positive effects of developmental education are strongly supported in terms of credential attainment and upward transfer (Bahr, 2010). Moreover, findings from Ohio data indicate students that complete remediation courses successfully are more likely to complete a bachelor's degree in six years in Bettinger & Long (2009). However, no discernable influence was found in Hawley & Chiang (2011a).

Findings from Florida convey different outcomes in the long run. The work of Calcagno and his colleagues suggested developmental education decreases the possibility of graduation for all (Calcagno, Crosta, Bailey, & Jenkins, 2007b). Yet intriguing enough, they found older learners who were 25 or older are less affected by remediation than their younger peers. The other study about Florida found no evidence to support the effect of developmental education on earning college certificates, association degree completion, or transfer to a public four-year college (Calcagno & Long, 2008).

Also, the results of a Texas study yielded no evidence, indicating no impact of developmental education on either graduation or accumulated wages or labor market outcomes (Martorell & McFarlin, 2011). Notably, Martorell & Mcfarlin's (2011) data related to income is only attained by the seventh year, which shows it is difficult to estimate the impact of developmental education in the long run. Namely, a longer duration should be needed since a prevailing delay was observed in contemporary college completion (Horn & Berger, 2004).

We see the trend of estimating the impact of developmental education mainly with a focus on community college students. Logically, two-year community colleges are the primary institutions that provide remediation since they educate most academically underprepared adults compared to their four-year selective counterparts. Moreover, states seem to reach a consensus to reduce or restrain the provision of remediation to community colleges due to the concern of cost-saving, also partly because criticism of the responsibility of college-readiness should be taken by the high school level (Bahr, 2010). In light of this, studies on remediation in community college are extremely important as a timely response to the current issue.

Since it is difficult to estimate the effects of developmental education due to the problem of selection bias, a great amount of research intends to reduce the bias with more sophisticated techniques. Among these ten papers discussed earlier, we see effort to verify the effect of remediation from quasi-experimental designs.

2.3.2 Efforts to eliminate selection bias

In essence, sophisticated statistical techniques used in these empirical studies aim to provide evidence that remediation is related to student achievement. Researchers spend significant time addressing the impact of remediation in the context of selection bias, and attempt to eliminate it by research design.

To clarify, selection bias indicates subjects choose to participate in certain programs, suggesting certain unobserved characteristics different from nonparticipants. For example, adults who enroll in remediation in community colleges may have different levels of motivation from nonparticipants.

In general, two techniques are used to deal with this methodological issue. One is regression discontinuity design (RD) employed in Calcagno& Long (2008), Bettinger & Long (2009), Boatman& Long (2010) and Martorell &McFarlin (2011); the other technique—propensity score matching (PSM)— is found in Attelwell, Lavin, & Levey (2006) and Hawley & Chiang (2011a).

Particularly, the RD approach employs the margin group whose scores are close to the range of cutoff to generate a counterfactual situation, indicating the difference resulted from the effect of experiments (Murnane & Willet, 2011). In this sense, the RD approach allows researchers to deal with unobserved heterogeneity of subjects. Instead, the PSM technique compares the treated impact (or experiments) by modeling observed heterogeneity available as a means of dealing with selection bias (Hawley & Chiang, 2011a).

Given mixed results regarding the impact of developmental education, it is difficult to reach an indecisive conclusion. Different from prior research, this present study examined the effects of developmental education by reflecting the factor of time. Most prior studies deal with remediation by treating it as time invariant variables as a whole; technically, a dummy variable is coded (yes vs. no) such as Attelwell, Lavin, & Levey (2006) and Hawley & Chiang (2011a). In fact, the necessity of participation in remediation for students is changing with time. The ability to treat varying participation in developmental education over time can be helpful to reveal its impact more precisely. Moreover, many educational measurements such as enrollment patterns like part-time or full-time statuses, and GPA should be treated as time-varying covariate to more accurately capture their relationships with degree completion.

Moreover, the necessity of taking developmental education is proposed to have a negative effect on students' declaration of major. Based on Gordon (1994), students' participation in developmental education may not only interfere with the progress toward a degree program, but also prolong the timing of making a decision about educational or occupational choice. However, the statement can be questioned without empirical support. The following section deals with the potential relationship between developmental education and students' declaration of major.

2.4 The major issue in emerging adulthood

Given a variety of programs provided in college, students can choose certain academic major which fits their career goals (Gordon, 1994). Ideally, the choice of an academic major represents interest and ability of students, reflecting individual free will to some extent. However, other factors involving the higher education process are likely to interact with students' declaration of major.

Few studies have ever made attempts to bridge the relationship between developmental education and the issue of college major. Understandably, the potential delay of declaring a college major can be seen as an unintended outcome associated with the participation in developmental education. However, researchers claim developmental education is detrimental to the declaration of major without further questioning (Bettinger & Long, 2009; Gordon, 1994; Pascarella & Terenzini, 2005).

In light of this, there is a need to examine whether a negative relationship exists regarding the declaration of major for developmental education participants. Moreover, the issue of declaring a college major reveals youth career development, reflecting a potential connection to adult work. Therefore, applying emerging adulthood theory can enhance our understanding about the major issue in this particular group.

Besides a vantage point from a theoretical perspective of emerging adulthood, another advantage of studying the issue of declaring a major is a potential of seeing students as active agents in the higher education process, which corroborates the statement in Adelman (2006), "students are the partners of their own education fate

(p.103).” Namely, students should be seen as active agents who take the responsibility for their future.

Emerging adulthood theory suggests that emerging adults are at a stage of life positively seeking any possibility with high hopes (Arnett, 2004). Any possibility in life comes from youth exploration in various life issues, which emphasizes the characteristics of active individuals. This study makes itself distinct to examine the issue of major through a lens of emerging adulthood theory, reflecting an expression of educational choices by this group of youth.

2.4.1 Why does the declaration of major matter?

Studies regarding major declaration and degree attainment vary across disciplines; the majority of related studies come from the field of counseling psychology. Mostly, research related to "vocational maturity" or "readiness for career choice" belongs to this family of inquires (Reitzle, Vondracek, & Silbereisen, 1998). These studies are usually conducted to test the accuracy of psychometrics and its relation to college majors, or further to certify student outcomes such as degree completion, job obtainment or the accumulation of wages (Barak & Rabbi, 1982).

For example, the level of congruence between student interests and their academic environments is referred to as interest-major congruence (Allen & Robbins, 2010). Particularly, researchers contend that the level of interest-major congruence can be considered as person-environment fit, which is widely used to predict individual satisfaction and final outcomes (Allen & Robbins, 2010). For example, students' internal consistency in choosing a major was proven to be a good predictor in their persistence in college, stability of major choice, and educational achievement (Barak & Rabbi, 1982).

A recent study of sophomores reveals that the more students are satisfied with their majors, the higher their academic performance during the surveyed semester (Graunke, Woosley, & Graunke, 2005). Furthermore, Graunke and his colleagues suggest institutions should make efforts to aid sophomores' transition from a general curriculum to specific fields of study. Based on these studies, it is plausible to state that the declaration of major plays a significant role in leading to students' degree completion.

However, a contradictory statement came from DesJardins, Ahlburg & McCall (2002). With 2373 freshmen enrolling in fall 1991 at the University of Minnesota-Twin Cities, their model included a variable indicating how confident students were to pursue a major. Surprisingly, the results showed that students who are very sure of their major are more likely to drop out compared to their counterparts.

The authors proposed two reasons to explain their counterfactual findings: First, these students who are very sure of their field of study cannot be enrolled in their intended programs so they dropped out; second, this group of students may have unrealistic expectation on the chosen programs and end up dropping out (DesJardins, Ahlburg & McCall, 2002). The mixed results may be intriguing especially given the contradictive findings. However, they also emphasize that the impact of college major on persistence deserves more attention because a further clarity is needed.

If we examine the major issue for emerging adults, the family background and the life stage they are in can bring about various trajectories in deciding a major. As Arnett (2004) reveals, emerging adults optimistically believe in many possible life pathways. In this sense, emerging adults' explorations result in either good or bad outcomes, but they will learn from repeated trial and error during the process. Given this, it is not surprising to see the changes of major from a majority of students (Gordon, 1994). It is especially the case for those emerging adults who are struggling between original family situation and the future life situation, the dilemma of educational choice or even career choice is expected (Newman, 2006).

2.4.2 Studies relevant to the major issue

Research about the connection between developmental education and the issue of declaring a college major is not as common as the rich literature exploring the effects of developmental education on persistence (Attewell, Lavin, Domina, & Levey, 2006; Bahr, 2010; Bettinger & Long, 2009; Calcagno, Crosta, Bailey, & Jenkins, 2007b; Calcagno & Long, 2008; Hawley & Chiang, 2011a; Melguizo, Bos, Prather, & Melguizo, 2011). A recent attempt from Bettinger& Long (2009) could shed some light on the connection between developmental education and the issue of major.

Specifically, Bettinger& Long (2009) examined whether participation in developmental education affects student interest either in math or English by adding an interaction term indicating interests and choices of math- or English-related major. It is noted that the study of field was measured while students are taking placement exams, meaning the reported interests won't be influenced by test results. Interestingly, findings suggest the impact of developmental education differs between two subjects. In brief, English remediation discourages students who express interest in major related to English. Instead, math remediation increases the likelihood of taking a math-related major.

Consequently, Bettinger & Long (2009) proposed that participation in different subjects of developmental education may change students' study of interested majors. In this sense, students may benefit from their change of major due to their acknowledging reality. However, it cannot be used to ascertain that developmental education has a

negative effect in the issue of declaration of major as a whole, not to mention its impact on degree completion. Namely, their study does not deal with the timing of declaring a major and its relationship to final outcomes.

In fact, the issue of declaring a major in community college has been examined clearly. Unlike four-year universities, the declaration of a major is not mandatory in community colleges; moreover, there is no specific period to decide the field of study, such as the sophomore year in general universities. Consequently, findings from this study can not only enrich our understandings about the issue of major operated in community colleges but also help them retool to enhance degree completion.

Additionally, the reason why previous models of persistence have to be structured differently for emerging adulthood students. Previous studies often pay attention to examine the effect of outcomes by differentiating fields of college majors (St. John, Hu, Simmons, Carter, & Weber, 2004), instead of investigating the process like "the timing of initial declaration of major." The missing of such studies pertaining the timing may result from the incapability of dealing with time for conventional regression models.

In essence, this study is to examine if the participation in developmental education does have a negative effect on the timing of declaring a major in community college. The factor of time examined in this present study could be an important indicator to realize what contribute to degree completion in the process of higher education.

2.5 Age at entry and other explanatory variables

In light of the heterogeneous group enrolling in postsecondary education, age plays a primary indicator to distinguish individuals in different life stages accompanying various roles and situations. As Adelman (2006) concluded: "There is an enormous difference by age at entry to the postsecondary system in these measures," (p.105) which could include process and outcome. Accordingly, age is an indispensable variable that correlates with other important factors such as family responsibilities or hours of employment for older learners (Bean & Metzner, 1985). Therefore, age is an important concern when researchers intend to study the issue of college completion.

As emerging adulthood theory suggests, the years between age 18-29 are intertwined with lots of life issues, which further causes the exploration of emerging adults. Like Arnett (2006) reports, during the "age of possibilities", emerging adults are in the life stage with unlimited opportunities. Undoubtedly, their access to college is one of these possibilities.

However, the age range 18-29 can vary greatly since it goes across individuals in distinct situations. Arguably, a great variance may exist since emerging adulthood is a volatile stage in life (Arnett, 2004). Therefore, the group of emerging adulthood was divided into two age groups: 18 to 19 and 20 to 29, as a means to differentiate the factor of age at the entry to college. In this sense, the group age 18 to 19 is composed of traditional-aged high school graduates, while another group age 20 to 29 is relatively older with longer delay to college.

Besides the need to distinguish the age at entry, other explanatory variables are also included in the model because they are related to the focal outcomes—persistence and degree completion in this study. In light of prior research, these factors can be categorized into several groups such as background characteristics, precollege experiences, environmental situations, educational activities and academic performance during college.

Based on the line of literature regarding persistence, both Tinto's and Bean's models suggest the necessity to distinguish subgroups by gender and ethnic status. Furthermore, precollege experiences should be controlled to justify student progress in the higher education process. For example, the best source indicating students' high school performance such as transcripts was employed in Adelman (2006) to assure a valid comparison.

Instead, without the availability of a record from high school, the scores of placement tests are usually the substitute as seen in a great deal of studies to investigate the effect of developmental education (Bettinger & Long, 2009; Boatman & Long, 2010; Calcagno & Long, 2008; Martorell & McFarlin, 2011). This present study takes the same approach by limiting the whole data set to ten institutions that provide placement test scores. Unavoidably, it is one of the shortages of the data source due to the necessity of a reduced sample size.

In addition to placement test scores, precollege experiences in the present study include a federal index of poverty to distinguish the relationship among poverty, education as well as work. For emerging adults, the responsibility of parenthood or the

financial burden from their original family usually competes with the opportunity of returning to school. In Newman's (2006) study on low-wage workers, she chose to profile the workers in a fast food restaurant to explore their long-run career patterns. Newman's work successfully portrays changing life of low-wage workers between 1993 to 2002, including work, family, and poverty (Newman, 2006). Emerging adults experience the changing nature from these issues due to their unique stage in life. Therefore, it is rational to include the variable denoting the poverty level.

In terms of educational activities and performance, the adoption of enrollment patterns and college GPA acknowledge Astin's (1984) involvement theory to some extent. That is, both enrollment pattern and GPA should be considered crucial indicators of the extent to which students are involved in their college education. Unsurprisingly, research continuously reveals that the better students' GPA, the more likely the possibility of degree completion (Budden, Hsing, Budden, & Hall, 2010; Voelkle & Sander, 2008; Wang, 2009). Equally important is students' enrollment pattern, it lends support to Chen's (2007) findings based on a large scale of data set (1996/01 Beginning Postsecondary Students Longitudinal Study). In brief, Chen's (2007) study echoes persistence theory by confirming that part-time enrollment is negatively associated with the likelihood of persistence and degree completion.

2.5.1 Part-time vs. full-time status of enrollment

The number of credit hours which students enroll in college is used to differentiate the enrollment status of students (Bettinger & Long, 2009; Hawley & Chiang, 2011a). Often the measurement of eleven credit hours or less each semester or quarter is defined as part-time. Ironically, the pattern of course-taking may vary greatly, depending on various life situations of individuals. Namely, students are likely to change their enrollment of status from time to time, especially for those who enroll in community college (Chen, 2007).

In general, most studies often take the total number of credits taken in first term as a way to assign enrollment status to each student, or choose the status of ever part-time as an alternative proxy to measure the impact of enrollment status on outcome variables. To capture the effect of different statuses more accurately, the change with time should be accommodated in the analysis but prior research hardly achieve this as we learned from relative studies as follows.

Employing part-time status as a primary explanatory variable to examine both student-faculty interaction and educational gains, Laird & Cruce (2009) employed Hierarchical Linear Model (HLM) to deal with the nested nature in education (e.g. students within institutions). Their modeling comprises 55,915 senior students who are randomly sampled from 224 public participating institutions. Surprisingly, findings reveal part-time status has effect on student-faculty interaction, meaning institutions

should aim for an increase in student-faculty interaction among part-time students, especially in institutions with a great percentage of part-time students.

However, the limitation of this study still relates to the measurement of part-time status. As the authors pointed out, possible lags between institutional records (students were recorded as part-time) and individual reports may exist due to different sources of information. Furthermore, the change of part-time vs. full-time status before students' senior year could complicate the verification of part-time status. One could argue that this problem will be solved if enrollment status can be treated as time-varying variables in the modeling.

Another effort was shown in Chen (2007) with longitudinal data from a national representative sample in the 1996/01 Beginning Postsecondary Students Longitudinal Study to examine the effect of part-time enrollment on educational outcome. The findings confirm that part-time enrollment is negatively associated with the likelihood of persistence and degree completion. Chen (2007) reveals that students with exclusive part-time enrollment beginning in 1995-96, only 15 percent completed a degree or certificate. In addition, 27 percent persisted in completing course-work six years later. Meanwhile, 64 percent of their peers with exclusive full-time enrollment completed a degree or certificate and 72 percent persisted. The differential remains even after controlling for a wide range of variables.

Interestingly, Chen's (2007) study also specifies those students who fit the profile of full-time characteristics (i.e., age 23 or younger, financially depend on parents, graduated from high school with a regular diploma) but still enroll part-time. He found

that these part-time students still lag behind their full-time counterparts even though they greatly resembled full-time students. Following this logic, it will be helpful to clarify the true effect of enrollment intensiveness over time. In this study, the change of enrollment statuses yearly, which was defined by 24 credit hours, will be one of the primary explanatory variables examined.

2.5.2 College GPA

The latest studies reiterate Bean's (1982) model, showing that college GPA is a significant predictor of student persistence (Budden, Hsing, Budden & Hall, 2010; Crockem, 2008; Voelkle & Sander, 2008; Wang, 2009). The importance of college GPA parallels the findings of previous studies (Pascarella & Terenzini, 2005; Adelman, 2006). Notably, a majority of studies limited their observation window to the first year except some employing longitudinal data.

With first-year persistence as the dependent variable, Budden and his colleagues found that persistent students have higher probability of a higher cumulative GPA in college, taking first-year orientation program, and the previous experience of returning in previous semester (Budden, Hsing, Budden & Hall, 2010). Based on a sample of 2,137 students at one four-year institution, the three characteristics were proved to be significant determinant of student persistence among the total sixteen explanatory variables in the logistic regression model.

Another study of first-year persistence was found in Crockem (2008). The sample includes 2000 first-time freshmen at a Texas open admissions university. The three different dependant variables that he examined include, "if students are college-ready, defined as exempt from taking developmental education, the students' first-semester GPAs, and the number of hours attempted by students." Crockem (2008) found that first-semester GPA and the number of hours attempted is significantly related to students' first-year persistence. Interestingly, the same finding indicated that "the

students' level of college readiness is not a significant predictor of persistence" (p.65), which deserves more attention when discussing the impact of developmental education.

The attempt to conduct longitudinal study regarding college persistence was found in Germany (Voelkle & Sander, 2008). With a sample of 1,096 students observed during four semesters in one university, their findings show that college GPA is an important indicator of future dropout. Moreover, they indicated high school GPA is highly related to college academic performance; yet it may only have indirect effect on student persistence. In light of this, longitudinal individual data is proven to be a better source than cross-sectional to study student persistence.

The connectedness of college GPA with persistence is also the case for transfer students. Utilizing National Education Longitudinal Study of 1988 and Postsecondary Education Transcript Study, Wang (2009) found psychological attributes like perceived locus of control and community college GPA are significant predictors of persistence for those transfers who began their higher education at two-year community college and then transferred to four-year university. Namely, the role of college GPA on persistence and degree completion is important for students who transferred up successfully as well.

More studies confirm the importance of college GPA from nationwide scale data sets. Employing national data, Adelman (2006) indicated that if college GPA falls on the first two quintiles, their possibility to earn a degree increases almost 22 percent. Moreover, Precarella & Terenzini (2005) reported that the effect of accumulated academic performance may decrease upon time. The paradoxical statement revealed that the factor of time in the higher education process deserves more attention.

In fact, performance in the second year is also recognized as a valuable to predict if students will complete a bachelor degree (Adelman, 2006). Undoubtedly, the history of the first year can be used to explain the follow-up in the second year. Yet with the potential intervention of non-additive credits in remedial courses, the efforts in the second year are expected to be harsh for those who lag in their first year. Moreover, second year's performance also make a good predictor of student's ultimate drop-out in a period of 8.5 years (Adelman, 2006).

In light of this, progress in time is expected to be more likely to predict students' degree completion instead of fixing to the first or the second year performance. Namely, most prior research is handicapped by treating both enrollment patterns and GPA as time-invariant variables without capturing the changing nature with time. In light of this, a more promising approach that can be used to deal with the change with time should be implemented.

From a time perspective to examine what affects degree completion, this study focused on various time-varying variables such as participation in remediation, timing of changing majors, varying part-time or full-time enrollment and academic performance like college GPA. Moreover, this present study intends to apply emerging adulthood theory to reveal the impact of remediation on the degree completion issue from a different perspective. Besides, environmental factors to identify if students were in a poverty situation are expected to shed lights to the college completion issue. Overall, various independent variables as well as the ability to capture the change with time are expected to be the contribution of this study in contrast to prior research.

2.6 The model of inquiry

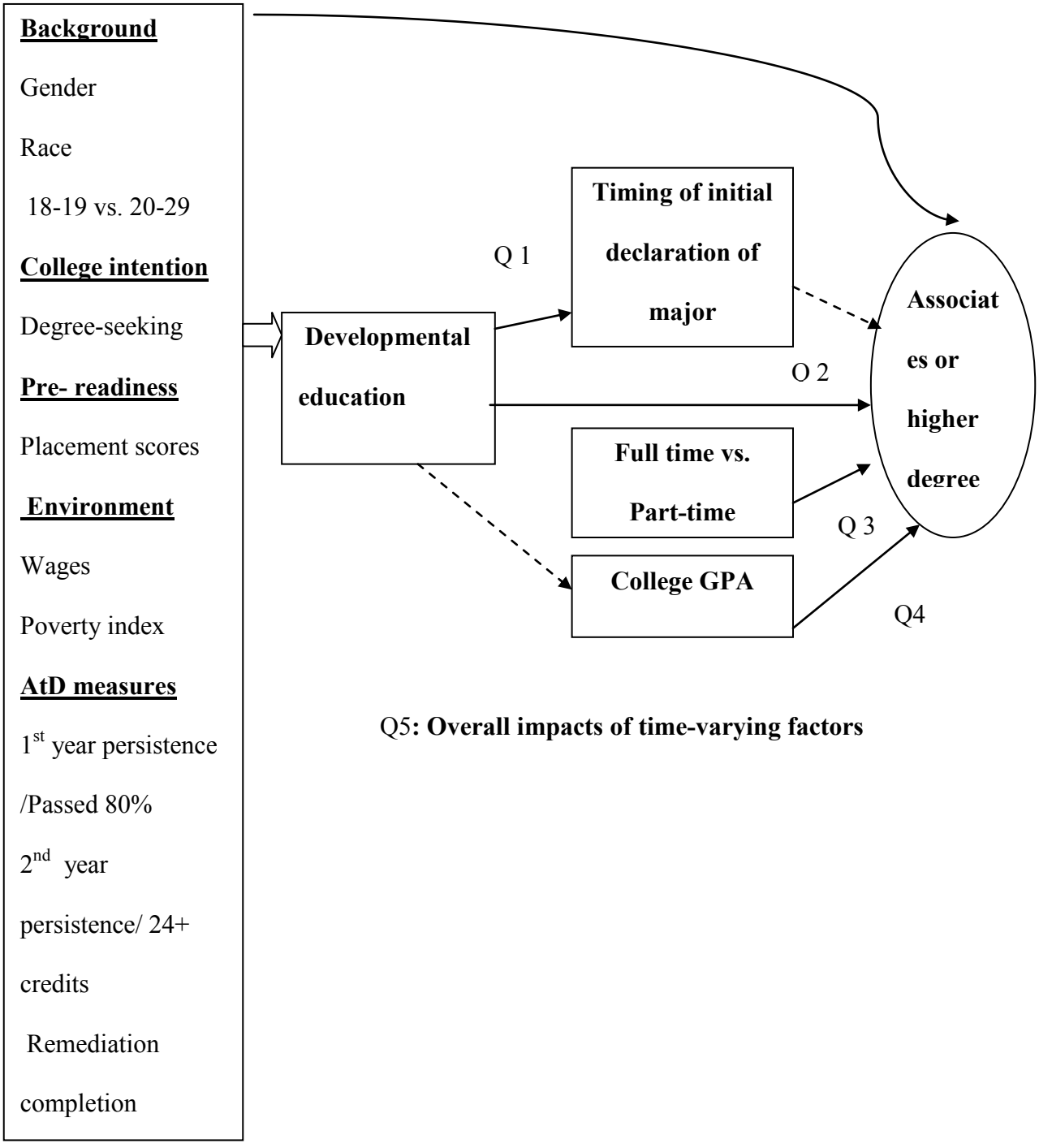
Based on reviews of literature, variables including enrollment pattern, academic performance as well as participation in developmental education are expected as important predictors of college persistence. Moreover, the nature of these three variables changes over time, which reflects the value of applying EHAs to study the higher education process. Numerous variables are included as controls to reflect the power of primary indicators such as participation in developmental education.

A potential model is proposed as Figure 2.1 on next page. The attainment of an Associates degree or higher is the dependent variable. Namely, we would like to estimate the probability of participation in developmental education as a function of the attainment of an Associates degree or higher in any given period, holding other variables constant. The same inquiry is for the other independent variables.

To clarify, independent variables include primary time-varying variables, and control variables. Specifically, control variables in the model are precollege characteristics, college intention and environmental measures. Moreover, AtD measures are used to benchmark student performance in the first three years.

Five research questions are identified in Figure 2.1. Arrows are used to indicate the relationship between two variables. Research question 1 through 4 follows this rule. The question five aims to estimate the results of time-varying variables as we see the model as a whole.

Figure 2.1 A Conceptual Model of Investigating the Persistence Issue over Time



3: Methodology

This chapter describes the data and research methods employed to answer research questions. This chapter has four sections. The first section introduces the facts about Ohio and the data sets used in this study. The second section describes the research type. The third section defines the variables. The fourth section discusses descriptive data analysis for the sample used.

3.1 Facts about Ohio and the data sources

Assessment and placement tests used in Ohio

Given that state policies vary for developmental education, there is a need to introduce the remediation implemented in Ohio. The facts mainly come from an online survey conducted by Hawley & Chiang (2011b). Overall, their study reports the assessment and placement tests used by twenty-three public Technical and Community Colleges in Ohio. The ways schools administer the placement tests and how they use the results are discussed.

In Ohio, no common test is used for the purpose of placement into developmental education. According to Hawley & Chiang (2011b), 19 out of 23 schools use the Compass test as the primary instrument to determine college readiness. The other three schools use Accuplacer test and the other one develops its own instrument for placement tests. Act test is used as a secondary placement test by ten schools. Differences can be

found from school to school, even among three main subjects such as math, reading, and writing.

Meanwhile, not all entering students receive a placement test and it depends on institutional policies. Hawley & Chiang's (2011b) study showed that less than half of (eleven) schools testing all or nearly all students. The reasons to waive the placement test include: Alternative test scores are available or students are not seeking a certificate or degree. Moreover, the results of placement tests are not strict by all schools. Some schools allow students have the options to re-take the tests or to meet the Chair if they don't like the results.

There is no consistency for schools to implement developmental education. In practice, no common tests exist, not to mention a standard cutoff score used to determine if students are ready for college-level courses. In light of this, it is problematic to verify or compare the effectiveness of developmental education even though we focus on schools in Ohio only.

The data sources

Data for this paper are coming from three administrative sources and are longitudinal in nature. First, the data incorporate annualized data on each individual that enrolled in Ohio community and technical colleges for the first time in 2002-3[2] and was traced till 2009. These data are commonly known as the Higher Education Information

[2] The native data are stored by units: Individual and term. Some colleges in Ohio operate on a quarter basis and others operate on a semester basis. The formula for converting all data to an annualized basis was created by the Ohio Board of Regents.

(HEI) System and are managed by the Ohio Board of Regents. Moreover, the data are derived from student information registration databases for 10 community colleges that provided placement test scores, and include an identification code for matching. In this way, both individual attributes and courses were merged into one on an annual basis. Finally, data are matched for each individual for a single quarter's earnings record from the State of Ohio's Unemployment Insurance System. Derived from the Unemployment Insurance data files[3], individuals' total earning is the sum of the earnings across multiple jobs.

This paper is based on a sample of 7,376 first-time students, who enrolled in one of ten Community or Technical College institutions, participating in this phase of the study (2002-2009). Originally, there are 14,324 subjects who are defined as emerging adults with age 18-29, representing over 70% of the roughly 20,000 students who enrolled in 10 public two-year colleges in the summer or fall of 2002. Emerging adults in the ten schools account for seventy percent of total enrollment, a percentage similar to the national data (NCES, 2009). Moreover, the 10 institutions are a cross section of the total 23 two-year schools in Ohio, including both large metropolitan campuses and smaller rural and growing suburban institutions. They include schools that participated in larger national level projects like Achieving the Dream to improve Community College outcomes, as well as colleges that represent more traditional viewpoints of college instruction.

[3] The State of Ohio's Unemployment Insurance data file contains three primary files, 1) total amount earned, 2) number of weeks worked, and 3) employer identification number.

In order to construct event history modeling, participants in the ten schools were limited to those who attained an Associates or higher degree by 2009 as event occurrences and those who still enrolled with more than 30 credits by 2009 as right censored cases. To clarify, the assumption behind EHAs is that the event will occur eventually. The technique is to treat those have not happened by the end of observation as right-censored in EHAs. In this study, we set the criteria to limit right-censored cases since we do not believe every student will earn an Associates or higher degree in the end.

As a result, the sample size is reduced to 7,376 individuals, whom were separated into two groups. First, traditional-aged college students refer to those who age 18-19, represented individuals without a delay of entry to college. Second, the other group aged 20 to 29 is older, who postponed the entry to college. As shown in Table 3.2, the sample sizes of two groups account for 58 percent and 42 percent, separately. That is, around every one in two emerging adults enrolling in these ten schools is a traditional-aged undergrad.

In a sense, the classification can result in a better way to explain research results since individuals who delay their entry to college may vary greatly by background characteristics. Namely, it is the age at entry that makes the difference (Adelman, 2006). In light of this, the whole sample of emerging adults was separated by the characteristic of age at entry to college.

Sensitivity Test

In general, sensitivity tests compare different observations or variables with an aim to verify the accuracy of final model. In this study, we arbitrarily limited right-censoring cases as decided by the condition of keeping enrolled by 2009 with thirty credit hours. Therefore, the decision to limit right-censored cases can be interpreted as: We believe students who have earned 30 credit hours or above and still kept themselves enrolled will earn an Associates degree or higher in the end.

The decision to choose 30 credit hours as the criteria coincides to prior research. For instance, the national project Achieving the Dream applies the benchmark of 30 credit hours as one of student final outcomes[4] by the end of six-year duration. And the same measurement was also used in Adelman's (2006) report based on the data of a national scale. Meanwhile, it is valuable to learn that thirty credit hours account for almost half of total credits required for a general Associates degree, which requires 64 credit hours in total (BOR, 2006b).

To further verify the implement of thirty credit hours, individuals who still enrolled by 2009 with thirty-five and twenty-five are modeled to reveal the differences. The different sample sizes are shown in Table 3.1. Understandably, the group of students decreases with the threshold going up. Furthermore, the impact of developmental education on degree completion is calculated in the final hazard model. Specifically, Table 3.1 suggests that the odds ratio[5] varies little among 25, 30, and 35 credit holders.

[4] The measurements of final outcomes include the attainment of a certificate or an Associates or higher degree, individuals who still enrolled with more than 30 credits as well.
[5] Odds is defined as the probability that comes from the percent of success divided by the percent of failure. For more details, please see page 69.

More importantly, the attainment of 30 credits result in similar values in the remediation odds ratio. Therefore, the impact of developmental education on degree completion is similar when we use the benchmark of either 30 or 35 credits to decide the right-censored cases.

Table 3.1 Sensitivity test among students with credits up to 25, 30 and 35 by 2009

Credit hours obtained by 2009	25	30	35
Students who still enrolled but no degree	8256	7854	7569
The odds ratio of developmental education in model with background and test scores	0.441	0.443	0.443

3.2 Method of analysis

Event history analysis (EHAs) aims to analyze the time to the occurrence of an event (Cleves, Gould, Gutierrez, & Marchenko, 2008). In this study, the event is the timing of attaining an Associates or higher degree during the observation period 2003-2009. Survival methods can help to understand if a transition happens or when it occurs (Singer & Willett, 2003). Namely, EHAs can be used to inform the time events occur.

In particular, the methods EHAs make it possible to cope with the factor of time. The treatment of time is expected to shed some light on the complicated higher education process. Given that temporal changes are prevalent, the changes include the enrollment status, course-taking pattern, or student performance in college. Specifically, EHAs can easily deal with changes over time and time-varying covariates.

Its characteristic of dealing with time flexibly is proper to study educational activities. For instance, variance in student academic performance is measured at a specific point of time and this changing nature can contribute to students' final success. This is especially true in the case of participating in developmental education. Students are assigned to complete varying number of remediated courses before any formal college-level credits can be counted towards a degree. Logically, students' progress in academic performance will be quite different at a later time in contrast to the early period.

Due to its relative scant visibility in the field of education research, several characteristics of EHAs will be discussed below, which also functions as a rationale to apply EHAs in this study. In brief, the characteristics of timing, time-varying variables,

and right-censoring are introduced. The present study is used as an example to illustrate these characteristics.

Timing

With a regression-like formula, event history models are a group of techniques with a focus on hazard or risk of event occurrence over a period of time. Particularly, the essence of event history analysis is the timing of events occurring. Besides applying the whether or not (yes vs. no) kind of answers to the final model, the information about the time events occur also contributes to the event history models. The importance of timing is especially crucial in the higher education process as we strive to realize what matters over time. In essence, the treatment of time is considered the motivation to do the modeling since EHAs can treat time as continuous or discrete units conceptually. For example, researchers have to select a specification for the main effect of time before further modeling (Allison, 1982). Like this present study with discrete-time models, it is necessary to compare a model that categorizes time into various units and another one with complete general specification of time, revealing the importance of time in EHAs. In contrast to conventional regression models, the idea of hazard (conditional probability) that a student will complete Associates or higher degree in certain period given he did not do so in previous periods can signify the factor of time during the higher education process.

Time-varying variables

Time-varying explanatory variables are also known as "time-varying covariates" (TVCs), meaning the values of explanatory variables change over time. Namely, predictor variables can reflect the variance over time. In the case of this present study, we learn from the previous literature that college GPA is a powerful predictor of student persistence, especially in the first several years. Yet GPA is likely to change over time. Therefore, the way we capture the momentum of change in GPA and its impact on degree completion can benefit from event history analysis greatly.

In general, time-varying explanatory variables are hard to deal with by methods like general regressions. By choosing two time points, one cannot take the changes in various durations into account. Under the umbrella of history event analysis, the discrete-time approach, in particular, functions well to accommodate the changing nature of time-varying variables. Specifically, discrete-time hazard analysis can examine differentials in the rate of transition from time-period by time-period, and easily accommodates changes in the values of explanatory variables.

Given this, the explanatory variables can take on different values each time-period, presenting no fundamental estimation problems. In this study, values of the varying intensity of remediation over 6 years will help to explain the differentials in various units of time on the hazard of degree completion. In light of this, the effect of potential explanatory variables over time will be better informed in EHS analyses.

Right-censoring

By definition, censored cases are those individuals who have not experienced the event by the time of observation but the risk of event occurrence exists as time progresses. In essence, it informs the researcher about event nonoccurrence, which contributes to the knowledge of primary study interests—event occurrence (Singer & Willett, 2003). Specifically, by treating "non-informative[6]" censored cases (cases with unknown event times) as continuous observation, researchers can generalize the results of the risk set back to the whole population (DesJardins, 2003).

From a statistical perspective, right-censored subjects contribute to the estimation of the hazard by providing time at risk of the event up to the time of censoring. In effect, they contribute to the denominator, but not the numerator, of the hazard rate. Therefore, if "right-censored" cases are treated as missing data, the whole estimates will be downward biased of the timing of the event (Reitzle, Vondracek, & Silbereisen, 1998). In light of this, we consider the methods EHAs valuable to deal with the college persistence issue since the trend shows that students take more time to complete their degrees.

In this study, non-informative censored cases will contribute their at-risk transition on time to degree completion since most college students may take more than six years (the observation period of this study) to complete their degree (Calcagno, Crosta, Bailey, & Jenkins, 2007b). In fact, the ability to treat potential cases as right-

[6] Non-informative censoring is resulted from an investigator's control, usually determined in advance by design. Instead of actions taken by participants like dropping out, a non-informative censoring mechanism is independent of the risk of event occurrence. In this sense, non-informative censored cases are representative of all individuals who remain in the study censored not occurred (Singer & Willett, 2003).

censoring up to the time of observation is believed one of the most appealing features of event history models (Singer & Willett, 2003).

Technically, to further capture the risk set resulted from those who have not encounter the "event" (earning an Associates or higher degree), the "right-censored" group is limited to students who attained 30 credit hours at least by 2009, which functions as an important index for those who have not completed a degree or certificates by the end of observation.

Specifically, the characteristic of right-censoring, contributing exposure to risk set in each observation period helps us study student persistence. In the case of student degree attainment in college, not all students will change their state from enrollment to graduation in a specific time. For example, if we set six years as the duration of observation, most students may remain enrolled but have not earned a degree yet.

The similar concern can be found in studies applying to large scale datasets like NELS: 88. In fact, the duration of eight years and half (1992-2000) is already two times of normal graduation from four-year colleges, but researchers still propose that success rates will rise if time of observation can be extended (Adelman, 2006; Attewell, Lavin, Domina, & Levey, 2006). In this sense, the application of history event models can treat these students as right-censored cases to learn how their higher education process changes over time.

The technique of discrete-time event history analysis will be employed in the present study since student records are often kept in school terms; treating time as a series

of discrete units makes sense in applying longitudinal panel data sets. Furthermore, another advantage of applying discrete-time event analysis is a way of dealing with time-varying variables compared to other techniques. Several time-varying variables will be tested in this study, consisting of the intensity of developmental education participation and the timing of major declaration, which reveal the amount of time and effort students devoted to degree completion to some extent.

3.2.1 Discrete-time hazard models

As part of the family of event history analysis, discrete-time approach distinguishes itself from other techniques by taking time categorically, instead in continuous measurements[7]. In practice, time can be treated as a dichotomy indicating the value of certain period of time. Therefore, the hazard model can be expressed:

$$h(E_{ij}) = [\alpha_{year1}D_{Year1} + \ldots + \alpha_{yearj}D_{Yearj}] + \beta_0 + [\beta_1 X_{1+} \beta_2 X_{2+} \beta_3 X_{3\ldots.}] \quad (1)$$

In the formula, $h(E_{ij})$ refers to the hazard that if an event occurs (i) during time period (j). Specifically, various units of time function like indicators. The indicator, $\alpha_{year1}D_{Year1,}$ refers to the value of outcome for the first year (2003). It will indicate 1 in the first period of time for the cohort enrolling in 2003; the other years will be identified as 0. Overall, the main effect of time will be shown by the first set of variables in bracket, which can be used to capture duration-dependence absolutely.

The set of time indicators can be used to describe the baseline group without constraints put the shape of the baseline hazard (Singer & Willett, 2003), indicating the potential advantage. In this sense, the hazard function composed by time indicators will invoke the most flexible representation compared to a linear specification used conventionally.

[7] The concept of treating time as units of categories can be relaxed technically. For instance, time can still be included in models with forms of polynomial representations. More details can be found in Singer & Willett (2003).

Equally important is a proper form of data organized to apply discrete-time approach. Before conducting discrete-time hazard model, the researcher has to make sure the data set is in form of person-period. That is, different from only one observation for each student. The records show multiple observations for each student every year till he or she completed the transition of event, or for those who kept enrolled with more than 30 credits by 2009. Therefore, the hazard can be measured by counting the probability of failure and survival separately.

For simplicity, a logit specification is used to express the hazard of if event occurs till the end of observed period. In this sense, the form of logit (odds log) is a "link" function that connect predictors to outcomes (Singer & Willet, 2003). Although it is proper and popularly expressed in discrete-time hazard models, the form of logit is difficult to communicate the outcomes. So the conventional way is to transform results into odds, which can be understood better. Namely, the odds contain the ratio indicating the probability of intended events (success) versus the probability of no intended events (failure).

Noticeably, odds differ from hazard in nature even if the fact that they are treated almost the same as researchers report the results of discrete-time hazard model. According to Singer & Willet (2003), the discrepancy is so small when odds are small. The relationship is understandable if we list two formulas parallel as:

$$\text{Odds} = P(\text{success}) / 1 - P(\text{success}) \quad (2)$$

$$\text{Probability} = \text{odds}/1+\text{odds} \quad (3)$$

Therefore, it can be assured that it doesn't make much difference as odds are so small that the denominator will be close to 1. In light of this, a logit transformation from discrete-time hazard models is actually based on the assumption of proportional odds instead of proportional hazards.

3.3 Measurements

To investigate research questions, both dependent and independent variables are constructed before modeling. In this study, the attainment of an Associates or higher degree is the desired outcome. Moreover, some measures derived from the nationwide project Achieving the Dream will be used as intermediate measures, showing the level of persistence in the first three years. Besides variables indicating the participation in developmental education, several sets of variables are included in the model as controls in light of prior research. In general, sets of explanatory variables are background characteristics, the pre-college readiness, the intention at entry, and measurements of performance in college.

Dependent Variables

The event in this study is whether community college students attain an Associates or higher degree by 2009. The way to measure the "failure" of a particular event in EHAs is coded as the occurrence in certain time period. For example, those students who completed an Associates or higher degree in 2004 will be coded as 2, and 7 for students do so in 2009.

To clarify, both the attainment of certificate and transfer module are neglected due to their relative low percentage of attainment (2% & 1.5%) for the group of study. Consequently, they are not measured as alternative outcomes in this study.

Achieving the Dream Measures

Ohio is one of 15 states that participate in Achieving the Dream (AtD), a project to encourage states and their colleges to collect, analyze, and apply data to improve student progress and outcomes in community colleges. AtD has adopted a set of measures by which to gauge student success over a period of six years from the year of initial enrollment. These are the performance metrics used in the present study, including Year 1, 2 and 3 measurements.

Specifically, Year 1 measurements include persistence in the first year and pass rates of courses taken. Enrollment in both fall and spring of the first year is coded 1 if the individual was enrolled in both of the first two terms for at least one unit, and 0 otherwise. Passing at least 80% of the credit hours was coded 1 if the individual passed at least 80% of their academic classes in the first year and 0 otherwise.

Year 2 measurements include the enrollment in year 1 plus year 2 and a completion of 24 credit hours or more by year 2. Enrollment in both the fall of the first year and the fall of the second year is coded 1 if the individual had at least 1 credit in both of the first two falls of enrollment and 0 if they did not. The completion of 24 credit hours or more is a binary variable, which is equal to 1 if the individual attained at least 24 academic credit hours by year 2 and 0 if they did not.

Year 3 measurement is coded if an individual has completed developmental education by the third year. 1 is coded as students have completed developmental courses and 0 indicates that individuals still take developmental education in the third year.

Explanatory variables

Consistent with the research questions, primary explanatory variables of this study include the participation in developmental education, enrollment patterns and academic performance as well as other important variables revealed in previous studies. The participation of developmental education denotes a timing-varying variable, indicating if participants enrolled in developmental education each year. It is 0 otherwise in any given year. In addition, the results of changing major are coded yearly since students can only change their study of fields once on the basis of data recorded by semester.

Demographic factors contain gender indicating by female, normal age showing if participants belong the age group 18 -19, race (White, Hispanic, African-American, Other). These variables are coded as 1 if the individual has the characteristic and 0 otherwise. All demographic factors are all time-invariant. In terms of college intention, there were five declared reasons for enrolling in college as revealed in Table 3.2, including personal interest, job skills, college transfer, certificate, and to obtain an Associates or bachelor degree.

Placement test scores in math and English are converted into the quartile of the maximum math or reading/writing scores. The procedure of transformation is the same for either the ACT or Compass tests as individuals took upon the entry to community college. Particularly, the distribution of individuals in each quartile is shown on Table 3 by the difference in developmental education participation for the group of individuals with test scores.

College performance includes two time-varying variables. Full-time enrollment is defined as taking 24 credit hours or more each year; GPA varies with the value that yearly total credit points divided by total credits taken. Environmental factors are expressed by a code indicating if students are under the federal index of poverty. Moreover, individuals enrolled in two schools (Sinclair Community College and Owens Community Colleges) were denoted by a variable (big college) since the total enrollment of the two school accounts for fifty-five percent of the whole sample.

3.4 Limitation

Limitation of this study arises from two sources. One is the representative of datasets due to the lack of information. The other is the restriction of methodology, which cannot assure causality perfectly so the results should be used with caution.

The ten colleges that supplied data for this portion of the present study include a range of larger and smaller colleges in Ohio. Two of the colleges account for over half of the total number of students in the sample and over half of the students with reported test scores. The proportion of students with reported test scores varies widely among schools, ranging from less than 40 percent at two schools to over 60 percent or more at 2 others. This variation may be due to differences in student population characteristics, testing policies, or some combination of both. The study is unable to account for differences that are due to institutional policies about which students are tested and which are assigned to developmental education.

In addition, some weaknesses of the data must be noted. First, the intention code is a one-time measurement conducted as the time students enrolled in college. Given that, the intention code may fail to be a powerful predictor of students' subsequent educational attainment level because educational goal or degree aspiration is likely to change with time (Pascarella & Terenzini, 2005). Consequently, it is a pity that this study can only reveal the initial intention but no information available after students enroll.

Another set of limitations derives from the statistical techniques available to use with these data. The analysis is not used to make causal statements. Rather, the intent is

to describe the factors that influence the likelihood of graduation from two-year schools in Ohio. The statistical methods used in this paper provide a basis for understanding the factors that contribute to student success, and the role that developmental education plays in persistence and graduation.

3.5 Descriptive analysis

Descriptive data are shown as Table 3.2 for background characteristics and Table 3.3 for the distribution of test scores, limited to individuals with test scores available. It is noteworthy that this final sample limits to those emerging adults who attained an Associates degree or higher by 2009, and those who still enrolled with 30 credit hours or more by 2009. Namely, the population could present the young group who are the most likely to succeed in degree completion among their older counterpart (above age 29), the peers who have stopped going school by 2009, or those students who were still enrolled but below 30 credit hours by 2009. To clarify, both Table 3.2 and Table 3.3 are presented as initial indicators of outcomes across groups, and cannot be considered the basis of conclusions with sophisticated methodology techniques afterwards.

The final sample of 7,376 participants were separated into two groups by whether they join remediation, and then divided into two age groups. In total there are four columns indicating individuals with different conditions. Specifically, the age group of 18-19 contains 1) 2,824 that had a placement test score[8] and took at least one developmental education course, and 2) 1,458 that had a placement test score but did not take any developmental education. The other age group of 20-29 has 1,613 remediated students with test scores and 1,481 individuals with test scores only. There is still a possibility for individuals enrolling in the ten schools but without test scores available since variances exist in institutional policy regarding placement tests. Given less than 2

[8] The placement tests include Compass, ACT, or Accuplacer tests since there is no common placement tests enforced in Ohio. As a result, the three tests were converted into one measure to make it consist.

percent (134 individuals) of the sample did not have test scores, they are not listed separately on Table 3.2.

Individual characteristics

There are some important differences on background characteristics among groups. Table 3.2 shows that the individuals taking developmental education are most likely to be female (57% for age 18-19 vs. 64% for age 20-29) and African-American (9% for age group 18-19 vs. 16% for age group 20-29) proportionally. Moreover, variance in college intention reveals students' motivation to some extent, which was measured at the local college level during the registration process. The individuals that took developmental education were most likely to report that they are in college to obtain an Associates or B.A. degree, and least likely to report entering college to obtain job skills. In terms of race, it does not make much difference between remediated and non-remediated individuals because whites account for a large percentage in each category, from 70 up to 90 percent. Indeed, the results reflect the fact that whites make up the majority of population in Ohio.

Achieving the Dream (AtD) measures

As mentioned previously, the reason why the present study chose to adopt AtD measures is because Ohio is one of the 16 participant states nationwide. In addition, these comparative measures function as benchmarks to inform institutions and those who are

considered the progress of students in colleges. For simplicity, only measures for first three years were reported in Table 3.2.

Overall, the age 18-19 group with test scores but without developmental courses perform better in all yearly measures except Year 1 measurement of passing eighty percent of courses taken or more. Strikingly, the remediated older group (age 20-29) performs the best in the first year with eighty-seven percent rate of passing in contrast to sixty-one percent for younger remediated group. Noticeably, the older remediated group actually performs fair in contrast to their non-remediated counterparts in the first two year. It seems that remediation helps participants persist and perform fair, especially for the age group 20-29.

In terms of the younger age group, the remediated individuals represent the largest population in this sample. Namely, it may reflect the phenomenon that most youths enroll in college shortly after high school graduation but without college-level skills. Moreover, it is noticeable that their rates of passing eighty percent of courses taken or more ranked the last. More or less, the discouraging effect of remediation reported in Bailey et. (2010) reminds us to pay attention to the young remediated group. Recognizing this difference, the variance in age should be identified in predicting student persistence.

Final outcomes

At the end of the period of observation (33% in age group 18-19 vs. 26 % for age group 20-29) of the individuals that participated in developmental education (and had a test score) completed an Associates degree or higher in a public school that is part of the Ohio Board of Regents.[9] In comparison, (54% in age group 18-19 vs. 45 % for age group 20-29) of the individuals that did not take developmental education (but had a test score) received an Associates or higher degree. In sum, the test group who did not take developmental education has a considerable advantage in attaining Associates degree or higher over those developmental education participants who had test scores by the end of observation.

Placement test scores

The differences in degree attainment are understandable if the placement test scores are taken into consideration. As Table 3.3 revealed, the test only group tends to have a larger percentage of the fourth quartile in math (50%) and verbal (46%) test scores. By contrast, the group of developmental education participants with test scores has 19% in math and 27% in verbal test scores of the fourth quartile. Given that membership in a higher quartile of test scores (for example, 4^{th} over 1^{st} math quartile) has a relative positive impact on student success, more individuals in the test only group are expected more likely to complete a degree than those who participated in developmental education.

[9] It is important to note that some unknown number of non-graduates actually completed at private schools or other state's public institutions that are not covered by the BOR data.

However, we should keep in mind that test scores are not the only factor that decides if students succeed in college. Moreover, there are various factors that influence student persistence and degree completion, for instance, the participation in developmental education and their enrollment patterns. As Table 3.3 indicates, developmental education groups converged on the lower quartile like 1st and 2nd ones compared to the test only group, which explains that they were more likely to be diagnosed as non- college readiness at the time of entry to college. Yet more sophisticated techniques are needed to clarify the effects of developmental education after we have the impression of these descriptive data.

Estimated hazard of completion by remediation

Figure 3.1 shows the empirical hazard for the attainment of an Associates or higher degree by the remediated experience. During the observation period of six years, it depicts the time when students are at the greatest risk of graduating. Namely, the year individuals are most likely to achieve an Associates or higher degree is the time after Year 3. Both curves have an inverted U shape, indicating that remediated students and their non-remediated peers have a higher risk of completing a degree among the middle years.

Table 3.4 reveals the risk set during the six-year period, which corresponds to the curves in Figure 3.1. To clarify, the risk set is confined to those students who completed an Associates degree or higher by 2009, and also those who still enrolled with more than thirty credit hours by 2009. As Table 3.4 indicates, both groups reach similar rates of

hazard in completion after term 4. Noticeably, the hazard rates increase gradually due to the diminishment of denominator and we should be cautious when interpreting the results.

Specifically, students without remediation are at highest risk of achieving an Associates or higher degree around the fourth year. On the other hand, after the fourth year and around the fifth year is the highest risk of duration for students who have ever taken developmental education. Understandably, the difference of taking remediation causes one-year delay of being at the highest risk of obtaining a degree between two groups. Yet it is striking to learn the discrepancy of hazard rate if we see the curves horizontally. Based on Figure 3.1, remediated students have much lower risk of degree completion compared to their non-remediated peers. Therefore, the true effect of remediation is expected to be further clarified by reflecting the factor of time.

In essence, only groups with test scores will be employed in the analysis since test scores function as measures of pre-college readiness to further compare students' degree completion. The existence of non-test group reveals the inconsistency regarding testing policy in Ohio to an extent (BOR, 2006a). Interestingly, this non-test group is relatively small (134) compared with the present sample (7,376) but it still plays an important role if institutions aim to graduate more students with a degree. In light of this, institutions should pay more attention on their non-test enrollees. Equally important, the enrollment policy in various institutions should be examined at the same time.

Table 3.2 : Descriptive Statistics for Study Sample **(all emerging adults age 18-29 that entered Ohio Community and Technical Colleges in 2002-3 (limited to 10 schools)**

	Traditional-aged 18-19		**Age 20-29**	
TOTAL	**4282 (58%)**		**3094 (42%)**	
	Test Only	**Test + Deved**	**Test Only**	**Test + Deved**
SAMPLE SIZE	1458	2824	1481	1613
Female (%)	48.6%	56.7%	51.2%	64.4%
Race				
White	93.0%	84.4%	82.7%	74.5%
African American	2.7%	9.3%	7.6%	16.4%
Hispanic	0.6%	2.0%	1.3%	3.7%
Other	0.9%	1.4%	2.4%	2.2%
College Intention				
Personal Interest	2.6%	3.1%	7.0%	3.3%
Job Skills	3.8%	3.1%	11.5%	7.0%
College Transfer	13.5%	14.6%	17.2%	8.7%
Certificate	2.4%	3.3%	6.2%	5.9%
Associates or B.A. Degree	77.8%	75.9%	58.2%	75.1%
AtD Measures				
Passed 80% or more (Year 1)	80.5%	61.3%	78.9%	86.6%
Enroll Fall to Spring (Year 1)	82.6%	81.9%	72.9%	75.6%
Fall to fall enroll (Year 1 & 2)	93.6%	91.2%	86.8%	87.4%
Completion of 48 credits+ (Year 2)	74.6%	62.5%	59.5%	48.7%
Remediation Completion (Year 3)	100%	90.6%	100%	89.6%
Associates or greater Completion	54.2%	33.4%	45.1%	25.5%

Table 3.3 : Differences between the test only and test + samples on developmental education test scores

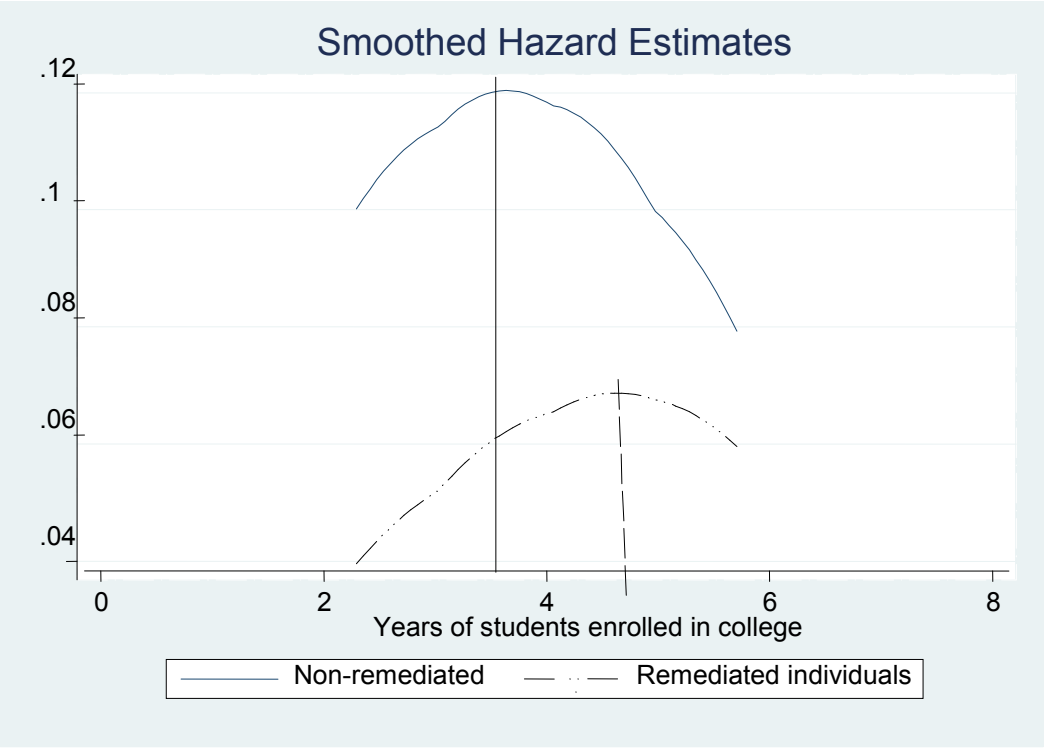
	Percentage in each quartile			
	First Quartile	Second Quartile	Third Quartile	Fourth Quartile
Math Scores				
Test Only	10.5%	15.0%	24.6%	49.9%
Test +	24.2%	30.2%	26.4%	19.2%
English Scores				
Test Only	10.8%	15.4%	27.9%	45.9%
Test +	17.7%	26.0%	29.7%	26.6%

Analysis of test data from 10 colleges

Table 3.4 Risk set in any given year by the participation in remediation

Term	Year	Total	Number of students completed a degree	right-censored cases	rate of non-completion	Completion rate
			Remediated Students			
1	0_1	2939	54	0	0.9816	.0184
2	1_2	2885	322	0	0.8721	.1095
3	2_3	2563	458	0	0.7162	.1559
4	3_4	2105	259	0	0.6281	.0881
5	4_5	1846	173	0	0.5692	.0589
6	5_6	1673	126	0	0.5264	.0428
7	6_7	1547	67	1480	0.5036	.0228
			Non-remediated			
1	0_1	4437	3	0	0.9993	.0007
2	1_2	4434	76	0	0.9822	.0171
3	2_3	4358	313	0	0.9117	.0705
4	3_4	4045	344	0	0.8341	.0776
5	4_5	3701	275	0	0.7721	.062
6	5_6	3426	206	0	0.7257	.0464
7	6_7	3220	139	3081	0.6944	.0313

Figure 3.1 Sample hazard of completion by remediation



4. Results

This chapter is composed of two main sections. The first section introduces the final hazard model in general; the other one answers previous research questions. Results yield preliminary answers regarding research questions. Specifically, the third year is a key threshold year as shown in Table 4.1. Moreover, remediated students need more time to complete a degree compared to their peers without remediation. Time-varying behaviors such as enrolling full-time and the attainment of a higher GPA increase the possibility of attaining an Associates or higher degree by the end of observation.

4.1 Overall results

The data constructed reveal different stories. In event history analysis, person period data can be used to easily calculate the rate of event occurrence versus non-occurrence in each period of time. Namely, variables can present different values in any given period, indicating the true effect of time-varying variables such as students' participation in remediation in any given year.

In term of the choice of subjects, the inclusion of right-censored cases unavoidably increases the total sample in the hazard model. However, the application of right-censored cases actually decreases the hazard rate due to the addition in the denominator. In this sense, the characteristic of right-censoring represents an alternative effort to capture potential cases instead of regarding them as missing values. As a result, the characteristic of right-censoring has an advantage in dealing with individuals who

need more than six years to complete a degree, which is a common phenomenon in today's postsecondary education system (Horn & Berger, 2004).

Moreover, emerging adults are the younger group enrolling in community college in comparison to their counterparts who aged above 30. In this sense, the age range 18-29 of emerging adults is used to truncate the age of college students. Generally, traditional aged students, defined as age under 24, are more likely to complete a degree since they usually free from environmental factors such as the source of financial or family responsibility (Bean & Metzner, 1985). In this sense, the results of this present study come from individuals who have a better change to be successful in college compared with their older counterparts. This recognition of variables and subjects chosen should be kept in mind before we interpret the results.

In terms of the final hazard model, several categories of variables are discussed in sequence. They are the variables indicating background, personal intention, placement test scores, environmental factors, as well as Achieving the Dream measures.

4.1.1 Modeling of the final hazard model

At the beginning of a simple baseline function, time was specified as shown in Appendix A. Specifically, the general specification of time and time treated as dummy variables were compared by the difference of likelihood ratio, which will follow the distribution of chi-square tests (Allison, 1982). As Appendix A revealed, 94 is the value doubled after subtracting the likelihood ratio of the general specification of time, which is by far bigger than the critical value (16.81) of chi-square with 5 degrees of freedom at $p < .01$. (The probability of Type I error was maintained at .01). Therefore, time treated as dummy variables by including six indicator variables improves greatly, showing that the form of categorical units works better than a general specification of time.

Once the form of specification regarding time was decided, a simple baseline function of the model was further extended to incorporate 18-19 age range (age 20-29 is the reference group), sex, race (White is the reference group) as basic background controls. Moreover, four different statements of intention (Interest, indicating personal interests as the reason to enroll college, is the reference group), placement test scores in both language and math (membership in the first quartile is the reference group), environmental factors such as poverty index and if students enrolled in either one of the two big colleges, as well as five variables indicating benchmarks in the first three years were included in the model.

The participation in remediation in any given year is coded as a time-varying variable. Namely, students enrolled in developmental education in any given year were

coded 1, 0 otherwise. As revealed in the formula (1) of discrete-time model section, there are seven person periods denoting students' participation in remediation during 2003-9.

Besides the varying participation in remediation yearly in the final model, enrollment patterns, and changes of major are coded either in 1 or 0, allowing the change over time captured by the discrete-time approach of event history analysis. As for GPA, the values show the results of total credit points divided by total credit hours except remediated credits. Therefore, the true value of GPA students obtained in any given year is captured.

Noticeably, the assumption of proportionality for discrete-time modeling should be examined before we further interpret the outcomes of hazard modeling. The test of proportionality is particularly important for main explanatory variables since we want to hold the assumption: The rates of covariates stay unchanged among subgroups. In this case, a dummy variable indicating if students have ever taken remediation was tested as revealed in Appendix B. Graphs in Appendix B show the probabilities of completing an Associates or higher degree for remediated and non-remediated groups are roughly parallel and it still holds true after introducing variables indicating varying participation in remediation. So the proportional assumption is obtained in groups of students separated by their participation in developmental education.

To obtain the final hazard model, different models in Appendix C were compared by including placement test scores, environmental factors, the enrollment pattern, GPA, and change of major in sequence. As Appendix C suggests, the coefficients indicating the impact of developmental education on degree completion do not vary greatly, ranging

from .41 to .46. Noticeably, the coefficients denoting that the age group 18-19 seems to have a higher risk rate of degree completion compared to another age group 20-29 in the early stage of modeling. However, their advantage over the older group 20-29 is not statistical significantly after including GPA.

The last column in Appendix C represents the final model, which was shown in Table 4.1, suggesting the best model fit with developmental education treated as time-varying variables. Overall, the results of the final model are reported as follows:

4.1.2. Results of the final model

Table 4.1 suggests that students who participated in remediation are at a lower likelihood of completing an Associates or higher degree in any given period providing other factors hold constant. In the first row of Table 4.1, the coefficient .428 represents that remediated students are .428 times as likely to complete an Associates or higher degree in any given year as their non-remediated peers. Corresponding to the assumption of proportionality, the odds of different groups by remediation in each year (2003-9) are proportional with a ratio of .428, referring to a relatively lower rate of degree completion in each year due to the participation in remediation. The effect is statistically significant at .001 level ($p < .001$.).

In terms of the factor of time, achieving an Associates or higher degree is at a higher risk after the third year compared to the beginning year (year 0_1), holding other factors constant. There is a trend to see that students are more and more likely to complete a degree after the third year in contrast to the beginning year, which is reflected by increasing coefficients from 1.425 (year3_4) to 1.828 (year6_7) in the first column of Table 4.1.

Both year 1_2 and year 2_3 have a lower likelihood of degree completion compared to year 0_1, providing the effects are statistically significant at .01 level ($p < .01$.) Understandably, students gradually accumulate the hazard rates of degree completion in a later time except year 1_2 and year 2_3 compared with the beginning

year, suggesting the importance of persistence in the first three years. The third year is a key threshold year as revealed in Table 4.1.

There is a trend of increasing likelihoods of degree completion in the following years. Arguably, a reversed U shapes in survival analysis should reflect values with ups and downs. In fact, an increasing likelihood is formed by time-varying variables in this model collectively. To clarify, the variance of degree completion rates for the data as a whole is calculated in Appendix E and so is Figure E.1 denoting the sample. As completion rates in each year reveal, the trend of completion rates actually goes up and down afterwards. Moreover, the peak of the reversed U shape falls on the duration after the third year, confirming the importance of persistence after year 3.

Other variables in the background category included gender, groups divided by age 19, and race. Similarly, these estimated coefficients represent effects on the conditional hazard rate of achieving as Associates degree or higher in any given year (Calcagno, Crosta, Bailey, & Jenkins, 2007). Table 4.1 suggests that the students belonging to the younger age group 18-19 are more likely to complete a degree in any given year, in contrast to the other age group 20-29. The effect is not statistically significantly since the academic performance (GPA) is controlled. A higher risk rate of achieving a degree during the event period exists in female students compared to male. Yet in comparison of Whites, Africa Americans, Hispanics, and individuals of other race are less likely to graduate with an Associates or higher degree in any year during 2003-9.

Intention

In terms of intention, individuals who claimed to attain a degree have a higher risk of achieving an Associates or higher degree in any given year compared to their peers who claimed to enroll due to personal interests. The effect is statically significant at .05 level ($p < .01$.) Furthermore, for those students who claimed to have job skill, to transfer, and to earn a certificate, they are at a lower risk of degree completion in each year from 2003 to 2009 compared to their peers who claimed to enroll for interests. Overall, the variables denoting intention in this present study may not be good predictors on degree completion expect the intention to attain a degree.

Placement test scores

Table 4.1 suggests that the higher of membership in the quartile of math, the more likely individuals attained an Associates or higher degree in any given year. Yet the test scores in language do not show the same pattern. Moreover, the effects of membership in the quartile of language are not statistically significant, indicating that test scores in language fail to be an effective explanatory factor on student success.

Specifically, an individual in the fourth quartile of math is almost 1.7 times as likely to achieve an Associates or higher degree as an individual in the first, also the lowest quartile of math. The advantage of being the higher membership in the quartile of math exists for the third one with 1.3 times and second one with 1.2 times of likelihood of completing a degree compared to individuals in the lowest quartile of math.

Environmental factors

Two environmental factors are included. They are variables indicating poverty and if students enrolled in either Sinclair or Owens Community College, accounting for over a half of the total sample size of this study. The effects of both variables are statistically significant, referring to the power of environmental factors in predicting students' degree completion. Specifically, students whose quarterly wages are lower than the federal index of 2002 ($2215) are more likely to achieve a degree at any given year than those individuals whose quarterly wages above the index of poverty. Instead, students enrolled in either one of the two big colleges are less likely to graduate with a degree compared to their counterpart who enrolled in other smaller size of schools.

Enrollment pattern, GPA, & change of major

As Table 4.1 indicates, full-time enrollment and better performance in GPA are powerful determinant of degree completion. Moreover, the coefficients show that when changing the major in any given year before graduation, individuals are less likely to

complete a degree. Noticeably, all these three variables are allowed to change with time, indicating different values in the event period 2003-2009.

Specifically, in periods when students enroll full-time or have a higher GPA, they are more likely to graduate with a degree by almost four times and two times separately as compared to periods when they enroll part-time or have a lower GPA. The behavior of changing major in any year has a negative effect on degree completion. Namely, students' changing major before graduation will lower the likelihood of achieving a degree in any given year even though the impact is marginal (13 percent) compared to the impacts of enrollment pattern and GPA.

Achieving the Dream (AtD) measures

Among the five variables functioning as benchmarks for student performance in the first three years, all measurements are proven to benefit degree completion with statistical significant effect at the .01 level except the fall to spring persistence in the first year. Measures such as passing eighty percent of courses taking, the persistence till the second fall quarter (1^{st} fall to 2^{nd} fall), the completion of 24 hours or more by the second year, and the completion of remediation by year 3 successfully increase the likelihood of achieving a degree in any given year.

However, the behavior of short-term persistence (from fall to spring in the first year) decreases the likelihood to attain a degree, indicating that this short-term persistence in the very first year is not a good predictor of degree completion. Logically, behaviors like persistence until a later time should be more helpful to predict students'

degree completion. Meanwhile, the findings verify the value of applying longitudinal data sets instead of one-term or one-year studies, which are often found in prior research.

The final hazard model replicates the findings of prior research, revealing that characteristics such as being female, White, a better preparation in college readiness (especially math), students' enrolling full-time and a better performance in college are beneficial factors contributing to student success, defined as degree completion in this present paper. Furthermore, the final hazard model estimates the impact of various factors over time.

It is expected to see more students graduate with a degree after year 3 compared to earlier periods. Equally important is certain behaviors that increase the likelihood of degree completion in any given period, to enroll as full-timers and to earn a higher GPA in particular. Finally, it is no surprise to learn that the behavior of changing a major decreases the risk of degree completion in any given period. The hazard models of event history analysis allow researchers to differentiate the impacts of various factors over time, especially the changeable behaviors. Conventionally, the characteristics of individuals are fixed over time, not to mention the possibility to point out the importance of timing.

Following this logic, hazard models will yield more accurate estimates of factors since the changing nature of higher education process is the fact. Therefore, findings revealed in this present study are constructive since different interventions can be implemented from the institutional perspective during the period students enroll.

4.2 Responses to research questions

Based on the final model reported in Table 4.1, this section goes through the previous research questions in sequence. The hazard model allows variables to take different values in any given period. With a focus on time, these questions were examined by revealing the impact of participation in remediation, enrollment patterns, varying GPA performance and the overall time-varying variables on degree completion. Noticeably, the relationship between the participation in developmental education and the timing of students' declaration of major will be further explored in the later section.

4.2.1 Does developmental education affect the timing of declaring a major?

Before testing the statement that developmental education has a negative effect on the timing of declaring a major, we have to determine if there is a relationship between participation in remediation and the declaration of major. Once the relationship is confirmed, we can further investigate if the participation in developmental education raise or lower the hazard of initial declaration of major.

However, the application of EHAs is not applicable, given around 90% of the studied group (emerging adults who attained an Associates degree or still enrolled with 30 credits or above by 2009) have claimed a major in the first year. Therefore, we are not allowed to apply EHAs to test if developmental education negatively affects the timing of

students' declaration of major. Namely, participation in developmental education and its effect on the timing of students' declaration of major cannot be verified.

Instead, we tried logistic regression to examine the relationship between participation in remediation and major declaration in the first year. To clarify, the difference between EHAs and conventional regression models is the capability to deal with time. In this case, regression models can only be used to learn the relationship between participation in developmental education and students' declaring a major limiting to the first year

Technically, a continuous variable was created to denote the total remediated hours in the first year, which is the explanatory variable. The purpose of choosing a continuous variable is to show the intensity of remediation and its impact on the issue of declaring a major. As for the dependent variable, students' declaration of a major in the first year was coded 1, otherwise 0. Given the outcome coded as 1 and 0, logistic regression analyses were used in predicting the relationship between participation in remediation and major declaration in the first year (Allison, 1999).

Surprisingly, the logistic model in Table D.1 revealed that participation in remediation slightly "increases" the probability of declaring a major in the first year, holding other situations constant. Furthermore, the same results held still after testing the total sample in 23 schools as shown in Table D.2. Based on the similar results of two different samples sizes, participation in remediation actually increases the probability of declaring a major. The result is significant statistically even though the effect is marginal (5%).

The outcomes conflict with the conventional knowledge indicated in prior research (Bettinger & Long, 2009; Gordon, 1994; Pascarella & Terenzini, 2005). That is, the statement that participation in remediation unavoidably postpones students' declaration of major is not confirmed by our findings. With such conflictory results, further inquiry is needed and we will revisit the relationship between participation in remediation and declaration of major in chapter 5.

4.2.2 The effects of varying participation in developmental education

As Table 4.1 suggests, the participation in developmental education in each year (2003-9) collectively denoted a coefficient of .428, referring to a relatively lower rate of degree completion due to the participation in remediation. The six-year duration, collectively, any year in which students take developmental education are .428 times as likely to graduate with a degree as the period when students don't enroll in remediation. The result reflects the necessity of participating in remediation in any give period decreases the risk of completing an Associates or higher degree by 57 percent.

Participation in remediation actually lowers the risk of degree completion compared to treating the remediated experience as a simple dummy. To compare the difference between remediation treated as time-varying and time-invariant variables, each of them is incorporated in the final model separately. Namely, variables denoting changing participation in remediation and if students have the experience of remediation as dummy variables are compared as shown in Table 4.2. As Table 4.2 suggests, the odds ratio differs by .018, meaning only 4 percent of change in comparison between time-varying and time-invariant remediated experiences. Logically, the changing participation in remediation is expected to estimate the true effect of remediation better by capturing its change over time even though the discrepancy is small in this case.

Therefore, the impact of remediation grows larger as its change over time is calculated, indicating that the participation in developmental education causes a worse negative effect on students' degree completion in any given year compare to the duration

of no remediation. However, it is necessary to take other factors into account in order to more accurately learn the impacts of remediation.

4.2.3 The effects of varying enrollment pattern (full-time vs. part-time)

The factor of full-time enrollment, defined as taking 24 credit hours or more each year, is the most powerful predictor of whether students graduate with a degree. As Table 4.1 indicates, the odds ratio for full-time is up to 3.625, meaning that full-timers in any given year are 3.625 times as likely to graduate with a degree compared to those who enrolled part-time. Understandably, students who enrolled full-time advance at a faster pace compared to their part-time counterparts.

As a result, the behavior of full-time enrollment should inform students and encourage them to do so. Namely, the effect of full-time enrollment during the six years causes the graduation with a degree almost four times more than part-time enrollment. The effect is the most powerful one as we compared to other factors in the models. In light of this, both administrators and policy makers should be alert to this result and develop corresponding strategies to enhance degree completion in college.

4.2.4 The effects of varying yearly GPA

The intensity of GPA reflects its true value, obtaining by total yearly credit points dividing by yearly total credit hours. The range goes from 0 to 4, which is treated as a continuous variable providing changes over in any given year. As Table 4.1 shows, the coefficient is 1.911 and the effect is statically significant at the .001 level, revealing the power of GPA in predicting degree completion.

Specifically, the higher GPA students obtain each year, the more possible that students will graduate with a degree. The likelihood goes up twice as students perform better than those who have lower performance. In fact, a higher GPA is one of the most powerful indicators, only next to a full-time enrollment. In this sense, both factors correspond to the importance of Astin's (1984) student involvement theory in quantitative and qualitative forms separately.

4.2.5 The effects over time

With the employment of EHAs, the mechanism of time-varying variables distinguishes themselves from other fixed-time ones. In this study, three main time-varying variables are the full-time enrollment each year, yearly college GPA and the necessity of taking developmental education each year. In order, the power of indicators is ranked as a full-time status, college GPA and the necessity of taking developmental education. Namely, a full-term status in any given year plays a decisive role in degree completion. Besides, students' changes of major yearly lower the likelihood of degree completion in any given year but with a relatively low statistical power ($p <. 05$).

Therefore, the behavior of enrolling full-time per term could be achieved by youths who strive to complete a degree, showing the possible efforts from individuals. Instead, the necessity of taking developmental education has a relatively small negative impact on degree completion compared with a higher GPA as well as the full-time status. More or less, the negative impact of taking developmental education fainted as time passes, particularly after year 3. Understandably, students completed the necessity of taking developmental education gradually so the impact of developmental education decreases.

Table 4.1 Estimated Odds Ratios for Hazard Models, Outcome is Associates +

	Odds Ratio	*Std. Err.*	*Z-test*	*P-Value*
Remediation (vs. none)	.428	.017	-21.61	.000***
Year1_2 (vs. Year0_1)	.580	.064	-4.94	.000***
Year2_3 (vs. Year0_1)	.758	.069	-3.05	.002**
Year3_4 (vs. Year0_1)	1.425	.111	4.53	.000***
Year4_5 (vs. Year0_1)	1.638	.128	6.30	.000***
Year5_6 (vs. Year0_1)	1.751	.137	7.14	.000***
Year6_7 (vs. Year0_1)	1.828	.144	7.67	.000***
Age 18-19 (vs. Age 20-29)	1.011	.021	0.50	.616
Female (vs. Male)	1.361	.028	15.00	.000***
Black (vs. White)	.598	.024	-12.95	.000***
Hispanic (vs. White)	.709	.054	-4.47	.000***
Raceother (vs. White)	.807	.064	-2.70	.007**
Intention				
Job skill (vs. Interest)	.808	.046	-3.71	.000***
Transfer (vs. Interest)	.949	.044	-1.12	.263
Certificate (vs. Interest)	.711	.045	-5.34	.000***
Attainment of Degree (vs. Interest)	1.087	.042	2.13	.033*
Placement test scores				
Lang Test (2 Q)	.887	.029	-3.61	.000***
Lang Test (3 Q)	1.006	.032	0.17	.862
Lang Test (4Q)	.997	.033	-0.09	.928
Math (2Q)	1.239	.038	6.94	.000***
Math (3Q)	1.301	.041	8.37	.000***
Math (4Q)	1.689	.054	16.26	.000***
Poverty Index of 2002	1.128	.024	5.57	.000***
Big college	.703	.014	-17.12	.000***
full-time (vs. part-time)	3.625	.100	46.62	.000***
GPA	1.911	.021	59.43	.000***
Change of major	.869	.050	-2.46	.014*
Fall to spring (Year 1)	.759	.058	-3.59	.000***
Pass eighty of courses taken (Year 1)	1.590	.104	7.10	.000***
Fall to fall (Year 1 and 2)	1.344	.134	2.97	.003**
24 hours or more (Year 2)	1.344	.140	2.83	.005**
Completion of Remediation (Year 3)	1.893	.123	9.83	.000***
Number of person period=51632	Pseudo R-squared=.129		LR chi2 (32)= 8837.33	
	Prob >chi2 = .000		Log likelihood = -29909.529	
***P<.001 ** P<.01 *P<.05				

Table 4.2 Odds Ratios for developmental education treated differently

	Remediation odds ratio: Odds (SE)		
Specification	Time-varying	Time-invariant	Difference
Final model (Table 4)	.428*** (.017)	.446*** (.010)	.018

5. Discussions and recommendations

This chapter consists of three sections. First of all, a further exploration into the issue of college major was conducted primarily from a sociological point of view. Next, it concludes suggestions and recommendations for practitioners and policymakers to enhance student completion rates in the future. The last section is a reflection from the author to conclude what has been learned from this study.

This study revealed several findings based on the final model. First of all, participation in developmental education is related to a lower likelihood of degree completion. This negative impact even gets worse as developmental education can be treated to vary over time, which is supported by Table 4.2. Unsurprisingly, remediated students are those students who fail to pass placement tests tend to perform worse than their non-remediated counterparts. Moreover, the necessity of taking developmental education unavoidably prolongs the speed of academic progress since usually no college credits will be accumulated. Noticeably, this negative effect of developmental education will be greatly released after the third year given that most students have completed remediation by year 3 as shown in Table 3.2.

Second, the third year is a threshold year for students' degree completion both for remediated and non-remediated students, which is partly because most students have completed remediation. During the period of the beginning three years, persistence longer than one year (instead of short-term) as well as the accumulation of credit hours toward a degree is beneficial to college degree completion.

Finally, students' changing behaviors such as full-time enrollment and the attainment of a higher GPA have more power than remediation in deciding degree completion. Based on the final model in Table 4.1, either full-time enrollment or a higher GPA can dilute the negative impact of developmental education since their odd ratios are far greater than the one of remediation.

However, we are not naïve enough to believe that individuals can go against the forces of institutions providing that the benefits of full-time enrollment and the attainment of a higher GPA outweigh the negative impact of remediation. In fact, the structure connecting individuals and institutions could interfere with the relationship. Namely, the design of educational system could mislead individuals in the wrong way, inducing behaviors that do not contribute to degree completion.

Therefore, there is a continuous necessity to examine policy implementation and to evaluate its impact. Specifically, the issue of students' declaration of major is an example given that the relationship between remediation and individual declaration of major cannot be obtained by empirical studies. The following discussions enhance our understanding about how systematic designs are related to individuals.

5.1 The malfunction of students' declaration of major driven by financial aid

The explanation of why students' declaration of major does not reflect the impact of developmental education is financial aid, which attenuates the assumed relationship among the participation in developmental education, students' declaration of major, and degree completion. In practice, students' declaration of major is the prerequisite of financial support; therefore, students' declaration of major is driven by the need for financial aid. Namely, financial aid interferes with a relationship between developmental education and the timing of students' declaration of major supposedly.

Based on our data, the timing of declaring a major is not postponed as assumed, since around 90% of the studied group declared a major in the first term. The fact not only reveals the connectedness between the application for financial aid and students' declaration of major, but also exposes the malfunction of students' choices of major in community colleges.

Realizing the procedure of applying for financial aid as the key, the author had conversations with seven practitioners to further understand the issue. We interviewed three executive administrators, two counselors and two financial aid officials in four different schools. Gradually, the problem of bureaucratic dysfunctions emerged during the process of exploration, providing that student affairs are managed in a hierarchical authority distributed by officials correspondingly. To fully realize the issue, the theory of bureaucracy and the potential causes of its dysfunctions should be recognized.

Weber's analysis of bureaucracy

Weber's work focuses on the prototype of bureaucracy, reflecting a lens of sociology to study organization. In brief, Weber articulated the characteristics of bureaucracy such as fixed-duties in hierarchy, consistent formality as well as impersonality and technical practices, which aim to achieve an ideal effectiveness and efficiency of organizations (Blau & Mayer, 1987). However, the emphasis of adherence to rules and regulations also brings about the drawbacks of bureaucracy, including monopolized information resulting in secret decision-making, a tendency of nonresponsive to public opinions, and the construction of a hard-to-destroy organization (Blau & Mayer, 1987). It is worth noting that Weber's analysis weighted advantages of bureaucracy over its disadvantages (Merton, 1940).

In essence, Weber's analysis about bureaucracy mixes of positive and negative discussions. The division of labor and skill assures a technical enterprise enhancing the coordination and control of organizations. Namely, it is predictable action based on technical expertise that makes bureaucratic organization such a powerful institution of centralization. Meanwhile, the technical expertise acts as protection, allowing bureaucracies to resist external forces asking for changes (Blau & Mayer, 1987). As a result, several forms of bureaucratic dysfunction have been proposed.

Criticisms of bureaucratic dysfunctions

Critics proposed several forms of bureaucratic dysfunction leading to inefficiency and ineffectiveness of organizations, which differentiate Weber's analysis specifying the advantages of bureaucracy. In general, there are three forms of dysfunction including inefficient rigidity, conservatism and resistance to innovation, and a potential to perpetrate inequality in society by maintaining the discrepancy of social-class (Blau & Mayer, 1987). Guided by discussions pertaining to the dysfunction of bureaucracy, we came to realize that the inertia expressed by the staff in community college is understandable. Specifically, excessive rigidity leads to inefficiency of bureaucracy as revealed in Merton (1940), which helps us to understand the responses of practitioners.

According to Merton (1940), bureaucratic dysfunction is mainly a characteristic of detachment from personality in organizations, reflecting extreme rigidity to rules in a systematic approach. In the case, counselors of community colleges know it well that some students may declare a major randomly since it is required to apply for financial support. Ironically, they do not plan to do anything to change the status quo. Like one of the counselors told us: "Yes. Cases of students with random declaration of major increase my burden. Yet they are part of my job." In this sense, the purpose of assisting students to explore the potential is neglected; for counselors, the importance of students' educational choices is transformed into a routine-like of job instead. Namely, once students declare their majors, some counselors naively think their duties are completed.

The form of means becoming ends in themselves may incur the process of "displacement of goal" (p.563), representing an insightful observation from Merton (1940). It is often identified as a characteristic dysfunction of bureaucratic form of organization. Basically, Merton's discussion of bureaucracy extended Weber's analysis and pointed out the perspective of dysfunction. Merton revealed that the practices to conform the rules, in certain cases, will yield extreme rigid behaviors that interfere with the supposed goal of organizations, detracting from efficiency and effectiveness (Blau & Mayer, 1987).

Furthermore, the requirement assures the implementation of rules making no difference for all, causing the "trained incapability" (Merton, 1940). That is, the conformity to rules was transformed into self-protective behaviors by officials, whose over-conformity to rules leaves no room for them to make judgments. For instance, one of the financial aid officers shared her ways of dealing with students. She treats each student who applies for support fairly, because she does not want to be accused of discrimination by pointing someone out. In this sense, the conformity is partly because of the fear that behaviors to judge the need of certain customers will be accused of favoritism (Blau & Mayer, 1987). As a result, no proper judgment will be given, not to mention a further initiative action against the dysfunction of bureaucracy.

Inertia in community college

Undoubtedly, the phenomenon of inertia in the public sector is often the target of criticism. The operation of bureaucracy in community colleges is no exception. Namely, behaviors of employees consistent to rules and regulations are conducted even with disagreement underneath. Opinions about improper policies were expressed by one of the executive managers. In the presence of her other colleagues, she addressed: "To be honest, I am not satisfied with lots of policies from above." Ironically, even though disagreement is found as practitioners see the gap between policy and practice, the conformity to regulation seems the primary response.

Moreover, some bureaucrats believe that something wrong will be corrected eventually. By sharing the course of work, one of the financial officials told me that "word of mouth" is often the way students learn how to take the utmost advantage from federal support. According to her, these students walk in and speak bluntly, "I know John got the money and can afford a car. Why can't I have the same offer? " Without the intention to make further action, she told me that these students will be caught eventually and she just does not know when and who will catch them. Learning from the responses, the dilemma between impersonality and personal discretion reveals a struggle for a street-level bureaucrat like her.

As Lipsky (1980) proposed, individuals serving in public administration even as entry-level officials have a wide-range of discretion to perform their jobs. In this sense, street-level bureaucrats are actually making policy choices instead of merely

implementing the policy. In this sense, street-level bureaucrats are important players in the policy process since they interpret and implement policy within some latitude (Oberfield, 2010). By definition, the street-level bureaucrats are those who interact with citizens directly during their course of work, such as teachers, policemen and officials dealing with social aid (Lipsky, 1980). In light of this, individual officials can hardly been considered totally detached from their own sentiments, indicating the possibility to perform their duties differently.

Sentimental devotion to one's duty is needed as Merton (1940) revealed: Discipline can be effective only if the ideal patterns are buttressed by strong sentiments which entail devotion to one's duties..... (p.562). Therefore, the strategies that can be used to induce proper attitudes and sentiments are needed to make successful management of bureaucracy. To some extent, these strong sentiments can result from the spirit of loyalty as expressed by one of the officials. The official showed his unwillingness to contradict federal policy: "The interest of the school as a whole is my concern," given the fact that he considered some regulations improper.

In sum, self-discretion and a need of sentimental devotion to one's duty play an important role in shaping the way how these school personnel perform their daily job. More importantly, the way they deal with their duties actually affect students greatly, even their stay or leaving college. Realizing this, it is valuable to understand the behaviors of bureaucrats before we intend to develop a strategy to deal with this problem.

Drone-like behaviors of street-level bureaucrats

The habitual inertia expressed by most bureaucrats could be a mixture of conformality and autonomy, reflecting their policy choices to some extent. Lipsky's (1980) analysis of the work context of street-level bureaucrats demonstrates how their drone-like behavior patterns are formed. In Lipsky (1980), street-level bureaucrats find the goal expectations for the agencies where they work tend to be ambiguous or conflicting.

In fact, conflicting tasks have existed in community college over the course of its history. The conflicting tasks include but not limit to: "To extend opportunity and to serve as an agent of social and educational selection, to respond to the demands of subordinate groups for equal education and to answer the pressures of employers and state planners for differentiated education" (Brint & Karabel, 1989: 9). Therefore, the condition of work forces employers in community college to define their jobs in such a way that reduces the conflicts and strike a balance on the mission.

This kind of struggle can be found in some officials. One of the executives expressed this kind of thought during the conversation. He said that he is not going do something initially against the procedure of applying for financial support. However, he will do it collectively once if there are some actions arising from other schools.

By and large, the inertia but alert attitude of certain officials expresses the preference to wait for changes from external forces but not within. In this sense, there is something in common with those who pessimistically believe that policy will be

modified, which indicates initiative is a critical and needing characteristic in the public sectors. Arguably, it is the officials with different degree of consciousness mixing with their own sentiments that play an important role if a further reform is to be taken.

Evidence from empirical studies

Discussions about bureaucracy are often established on conceptual statements without much support from empirical studies. There are more and more effort to meet the gap between theory and practice, especially in the field of public administration. In this sense, the theory of Public Service Motivation (PSM) has been studied with an aim to enhance the effectiveness of bureaucracy.

With a mail survey conducted in four cities of a mid-western state, Feeney & DeHart-Davis (2009) tested the relationship between reduced bureaucratic control and incurred creativity of public-sector service employees. Their findings reveal mixed results, confirming that formalization is not significantly related to perceived productivity and creativity. Instead, centralization was proven to connect to lower perceived productivity and creativity. Based on Feeney & DeHart-Davis (2009), it is intriguing to learn the characteristics of bureaucracy may not necessarily lead to employees' perception of lower perceived productivity and creativity. Yet there is still difference between perception and behavior. Namely, it is difficult to assure whether employees' perception will induce corresponding behaviors.

Moreover, the theory of PSM has been developed to promote productivity and to improve management practices recently. Unsurprisingly, the investigation of PSM has become one of the most important topics in public administration (Moynihan & Pandey, 2007). Originally, the definition of PSM can be traced back to Perry & Wise's (1990: 368): "An individual's predisposition to respond to motives grounded primarily or uniquely in public institutions and organizations."

Moynihan & Pandey (2007) extended the application of PSM into organizational institutions. They claimed that both administrative behaviors and the basic attitudes about the value of public services shape servants' work-related rules and norms. Therefore, once public servants have higher level of PSM, they will work harder since they believe their job is important.

With a national data set during 2002-3, Moynihan & Pandey (2007) found the most powerful predictors of PSM are higher levels of education and professional identification. Interestingly, their findings reveal the perception that the active implementation of reforms by organizations is a positive and significant predictor of PSM. As a result, organizations play an active and important role to make a reform successful.

Function vs. malfunction? The counseling system and students' declaration of major

So far our discussion focuses on officers in the bureaucracy, neglecting the fact that students' declaration of major fail to represent the potential in which students explore their interests. That is, students' declaration of major loses its function, which should indicate a decisive choice after exploration; or at least, a tentative decision implying their ideal program. What makes it worse comes from the dysfunction of school counseling system. In reality, counselors might be confused in the routine-like of duties. Like one of the counselors told me that the procedure of declaring a major is good for students even though they do so mainly because of the requirement for financial aid.

Alternatively, different opinions came from the other counselor, who sees the issue in a clear view. After revealing the necessity to connect financial aid and students' declaration of a major, she suggested a practical way to deal with the issue. Personally, she thinks that some extra time like one or two terms allowing students to delay their declaration of major is necessary and that these students should be still eligible to apply for financial aid.

Furthermore, the same counselor stated that the design of associate degree of general or science can be problematic. Ideally, students who choose associate degree of general or science are determined to make a transfer to four-year colleges. Ironically, the majors in general may actually act like a leeway for undecided students. The group of students still has no idea where to go afterwards. In light of this, there are challenges to be solved before the function of counseling in community college can be fulfilled.

At this point, we cannot help but wonder what kind of purpose that the school counseling system should fulfill. Which direction should we go to strengthen the effectiveness and efficiency of bureaucracy operated in community college? Undoubtedly, the issue of stubbornly low degree completion rates can be improved only if students' declaration of major acts as a good proxy of their educational goals.

First of all, the drone-like behaviors of school counselors and administrators need to be informed and changed. As Lipsky (1980) suggests, the structure or context of the work must be reformed to produce expected results. Equally important is the active role of institutions (Moynihan & Pandey, 2007). Without knowing the aim of policy, most bureaucrats may try to meet the new performance criteria but disregard policy objectives. To assure reforms implemented effectively, several suggestions are provided.

5.2 Recommendations and suggestions

Based on the findings of this present study, this section provides recommendations and suggestions for anyone who is concerned about the issue of college degree completion. Specifically, discussions specifying on the counseling system and the persistence issue are separated. Policy-makers and practitioners in community college are the focal audiences, who should be informed, given the stubbornly low degree completion rates in community colleges.

5.2.1 The malfunction of counseling system revisited

Arguably, the necessity of declaring a major to be eligible for financial aid leads to the malfunction of the counseling system. Besides the potential to influence students' declaration of major, financial aid fraud has been problematic. As one of the executives addressed, the issue of financial aid has existed since she began her career working for community college, which can be traced for more than twenty years. In spite of the notorious "Pell runners"[10], the adjustment of improper policy is difficult catching up the fraud cases. Like the statement she made: "People tend to do something cynically to get around the policy," which provides an insightful comment as we try to realize what leads to the malfunction of counseling system in community college.

[10] Pell runners refer to scam students who bounce from college to college, enrolling in certain programs merely long enough to receive the Pell grant refund (Field, 2011 August 28).

A survey could be conducted to clarify the impact of developmental education on students' declaration of major

Technically, the relationship between participation in developmental education and the timing of students' declaration of major cannot be reflected in conventional statistical models that answers how a majority of students have declared a major in the first term. In light of this, future research can be done by giving surveys to learn whether the device of financial aid makes some students declare a major haphazardly, especially in the cases of undecided students.[11] To describe the responses accurately, a relationship between researchers and participants is helpful. So counselors can be good candidates to collect the information. Once the survey is conducted successfully, the effect of developmental education on students' declaration of major can be better informed.

Students' declaration of major should express their will honestly, free from the influence of other factors. Ideally, the declaration of major could present individual free will once it is released from the role of prerequisite of applying for financial aid. Failing to present individual educational choices, previous studies pertaining to the issue of major are problematic. The issue gets even worse as the number of student-aid fraud increases gradually.

According to one of the financial officials, not only community colleges but also four-year universities should alert the legitimacy of students' declaration of major. To clarify, students in four-year universities are likely to declare a major randomly providing

[11] Undecided students refer to whose individuals who are "unwilling, unable, or not prepared to make educational choices." (Gordon, 1994: 6)

that a declaration of major as the prerequisite to apply for financial aid. Obviously, the requirement does not follow the logical sequence since a choice of major often occurs in the sophomore year.

Correspondingly, ways to strengthen the function of students' declaration of major can be achieved only if students declare a major, which he or she intends to pursue. Moreover, counselors should be alert to the existence of emerging adulthood theory, which can provide an insightful perspective to advise youth in this unique stage of life.

Workshops as a means to provide education and to strengthen sentiments

Workshops ensure officials to recognize their work with certain knowledge of the policy aim. Bureaucrats have to be equipped with knowledge embedded in their routine. Without learning opportunities, policy cannot be implemented because officials have a range of discretion as performing their duties.

For instance, counselors should keep in mind that their practices should help youths exert the potential to reach their educational goals or career goals in the end. With the same goal, the discrepancy in practice will decrease. For example, as we learned from the discussions with the two counselors: One of them does not see students' declaration of major as a prerequisite of applying for financial aid problematic; the other one sensed it as a troublesome controversy. Indeed, their perception of how important a counselor can be is the key (Moynihan & Pandey, 2007).

In practice, workshops should be held to further facilitate the education or the opinion exchanges of bureaucrats. By doing so, the system of bureaucracy can be integrated with sentiments in general, which is constructive to the implementation of policy in the end. Moreover, the opportunities to discuss the implementation of policy may contribute to some initiate activities collectively. Understandably, to strengthen a counseling system should begin from well-functioned bureaucracy with policy informed and agreed by all parties.

A proper ratio of counselors to students

Inaccurate ratios of counselors to students are problematic for advising at the postsecondary level. One counselor has to deal with hundreds or even up to thousands of students. As a result, a better counseling system can be achieved if a high load of responsibilities can be lessened.

In effect, more intensive care and time is needed as a majority of undergrads take more time to complete their college degrees (Horn & Berger, 2004). The findings of this present study reiterate this statement by showing that students finish Associates degrees at different times. Moreover, students in lower levels of college readiness usually require more attention to achieve success (Visher, Butcher, & Cerna, 2010), reflecting a desperate need of counselors. Similarly, emerging adulthood theory implies that youth aged 18-29 devoted themselves to explore the purpose of life, confirming the need for guidance from counselors.

Efforts to define a proper ratio are critical to balance the need and supply. Studies should seek a trade-off between cost and a ratio of counselors to college students; thereby, to strengthen the rational goal of counseling is expected to enhance degree completion rates in community colleges. Moreover, efforts to find the appropriate ratio of counselors to students can be meaningful since the context of work for counselors can be improved, implying the possibility to stop the drone-like behaviors.

5.2.2 Recommendations pertaining to the persistence issue

The distinct advantage of applying EHAs is to reveal the factor of time, indicating a potential of timely interventions from institutions. Given that, several factors are particularly important in increasing persistence as shown in the final hazard model of table 4.1. In particular, time-varying indicators like the participation in developmental education, enrollment pattern and GPA are the main focus of this present study. Overall, several lessons are learned as follows:

The participation in developmental education does have a negative effect on student success. Yet the impact of full-time enrollment or a higher GPA is even powerful.

.

The effect of developmental education on persistence has been examined extensively but results have not yielded a consistent conclusion. This present study provides a different angle to investigate the impact of remediation by reflecting on the factor of time, confirming that remediation does harm student success. Moreover, the negative effect goes even downward as change over time is estimated. The difference is around 4 percent as indicated in Table 4.2, holding other factors constant. To clarify, the 4 percent is equal to the odds ratio of difference divided the odds ratio of remediation treated as a time-varying variable.

This study reflects the momentum of higher education process by treating participation in developmental education as a time-varying indicator. Meanwhile, the

findings are expected to be practical since the 18-29 age range accounts for the majority at the postsecondary level. As the final hazard model reveals, holding all other factors constant, the participation in developmental education decrease the likelihood of completing a degree by 57 percent in any given year compared with non-remediated emerging adults. This effect is statistically significant.

However, such a negative impact of developmental education may lessen if we see the hazard model in a holistic way. Namely, full-time enrollment and a higher GPA can mitigate the negative effect caused by developmental education since each of their influence is in excess of the impact of developmental education. In other words, full-time enrollment and a higher GPA will greatly increase the likelihood of earning an Associates or higher degree, holding other factors constant. Full-time enrollment, especially, acts as the most powerful indicator to contribute to degree completion for either remediated or non-remediated students.

Specifically, a full-time status pushes up the likelihood of attaining a degree as high as three times in any given period. Therefore, the hazard model indicates the characteristics and behaviors needed for student success, informing institutions to incentivize such behaviors. Overall, findings of this present study reveal: The impact of developmental education may not so destructive since a full-time status or a higher GPA can play a more important role contributing to degree completion.

Programs should be tailored to enhance an invaluable persistence after year 3

This study replicates the findings of previous studies, confirming early interventions like the first year experience in college are valuable to enhance degree completion rates (Calcagno, Crosta, Bailey, & Jenkins, 2007b; Hawley & Chiang, 2011a). Moreover, this present study extends the necessity of early intervention to Year 3, suggesting continuous interventions are the key to graduate more college students. Namely, keeping students enrolling till Year 3 will greatly push up their likelihood of achieving an Associates or higher degree, everything else held constant.

The ability to point out timely intervention is one of the best advantages of applying EHAs. The hazard model is duration-dependence, which is capable to capture the relationship between factors and event occurrences over certain period of time. In light of this, policy-makers and institutions can be informed to develop timely strategies or incentives to enrich college experiences with an aim to keep students at school.

Programs to help students orientate campuses should not only limit to the first-year experiences as they are conducted prevailingly; instead, the length of programs have to go beyond the first year given the fact that most college students need more than one year to complete a degree. It is understandable to learn a higher likelihood of completing a degree occurring in a later year since there is a trend that college students postpone their graduation gradually (Horn & Berger, 2004). Moreover, this extent study further confirms that assistance lasting for one year only is not enough to enhance student success.

Noticeably, this present study doesn't include older adults defined above age 30. It is reasonable to assume that the kind of first-year experience programs have to be tailored to meet the needs of older adults given that the environmental factors outweigh other perspectives of factors greatly (Bean & Metzner, 1985). Therefore, the difference in age highlights the tasks in emerging adulthood, providing guidance for practitioners and policy makers about what should be taught in these programs.

For example, issues such as work and love are crucial for emerging adults (Arnett, 2004, 2006); related support and mentoring should be integrated into the process of orientation. As a result, programs like the design of first-year college experience should be restructured differently, especially for the majority of undergrads in the emerging adulthood.

The age range 18-29 of emerging adults should be considered an integrated group to target on their degree completions

Applying emerging adulthood theory as a way to refine research sample for this study, we investigate the college persistence issue based on a theoretical lens of emerging adulthood. The intention of dividing the whole emerging adults into two groups is to examine the difference by age, reflecting that age is a dispensable factor which is associated with life issues correspondently. For example, Bean & Metzner (1985) suggests older adults are more affected by environmental factors since most of them are bread-earners in the families. Interestingly, the age difference in emerging adulthood is

not statistically significant with odds ratio close to 1 (1.011) as indicated in Table 4.1, suggesting there is no difference between these two age groups (age 18-19 vs. 20-29) in emerging adulthood.

Arguably, the finding does not correspond to either Bean & Metzner (1985) or Adelman (2006) providing that these two groups make no difference in student outcomes. A tentative explanation could be that the age range 18-29 stands for a unique stage in life—the emerging adulthood. Namely, the finding assures us that this particular age range actually presents a homogeneous group from a theoretical perspective, suggesting that policymakers and practitioners develop proper strategies targeting this specific age group.

Placement test score, especially math, is important

As discussed in the methodology section, placement test scores in this study stand for college readiness, which is often presented by high school grades in some reports with national-scale samples. In comparison with their counterparts in the lowest quartile, students who have a membership in the other three quartiles perform better. And there is a trend of increasing likelihood in degree completion with a membership of higher quartiles in each year. Overall, the effects of memberships in quartiles of math tests are statistically significant.

Language tests do not show the pattern that memberships in a higher quartile are more likely to attain an Associate or higher degree in any given period of time.

Moreover, the p-value indicates that the coefficient denoting a membership in quartile of language tests is not statistically significant except a membership in the second quartile of language tests. For the youth in emerging adulthood, the ability of math skills is a better indicator of degree completion than the ones in language.

The findings correspond to prior studies with a focus on older learners such as Hawley & Chiang (2011a). Namely, a better performance in math plays a salient role in predicting student success than students do so in language. In light of this, it is worth noting that good performance in math is a sure key to contribute to degree completion either for the young group in emerging adulthood or for the older adults.

Either poverty line or the size of college may make a difference in youth degree completion

Based on the final hazard model, individuals who are below the index of poverty slightly increase the likelihood of degree completion at any given term, holding other factors constant. Instead, students enrolling in either one of the two big-sized colleges will decrease the likelihood by around 30 percent.

Supposedly, the membership in poverty may result from the varieties of part-time jobs. Namely, the results can be interpreted as the low-skilled jobs with less pay. Or there is possibility that some emerging adults engage in school activities more; therefore, making less money. Given this, the indicator of poverty denoting how emerging adults make use of their time– a combination of work and study.

Notably, the size of colleges with different number of enrollment influences the final outcomes of students, indicating that the size of enrollment should be concerned to some extent. Namely, policy-makers should pay more attention on institutional performance since the findings present partial facts that the size of enrollment has something to do with student success.

Besides the difference in size, other aspects such as efficiency in administration, the methods of instructions, and the interaction between faculty and students should be examined accordingly. As indicated in Moynihan & Pandey's (2007) study, institutions should play an active role in implementing reforms, which will benefit to employees' perception and behaviors related to reforms. Given the findings of this study, further efforts are needed to clarify what leads to the inefficiency of big colleges.

Students should be incentivized to express the behaviors contributing to degree completion

Due to the ability to reveal the nature of time-varying factors, the technique EHAs distinguishes itself from conventional regression in showing certain behaviors helpful for degree completion. As this present study shown, these behaviors include enrolling full-time and attaining a higher GPA in any given period. Namely, a continuous enrollment with twelve credit hours or more in each term greatly enhances the likelihood of degree completion. So does the attainment of a higher GPA.

Similarly, except fall to spring persistence in the first year, all Atd measurements function as advantageous benchmarks, denoting various promising benchmarks in the first three years. Besides the effort of keeping students informed, institutions should further provide incentives to induce more students perform these behaviors in any given period. In sum, the characteristic of capturing a changing nature with time for event history analysis is persuasive to encourage more positive behaviors leading to degree completion.

Better connectedness between high school and basic skills for college success

As more and more states restricting the provision of developmental education to certain section such as community colleges or even abolish it, high schools are usually the primary institutions to be blamed (Parker, 2007). Arguably, students' poor preparation is rooted in high schools' disabilities to equip graduates with college-level skills and knowledge.

Interventions intended to strengthen youths' transition from high school to college are found in California. With the offer of early assessment tests in math and English for California 11th graders, students, parents, administrators of both secondary and postsecondary level can be informed of students' readiness for college (Howell, Kurlaender & Grodsky, 2010). Namely, the provision of early assessment program does not only signal students the readiness of college skills but also allow them to make effort at their 12th grade. In light of this, a better connectedness between high school and

college is expected since the co-operation from both parties is critically needed to contribute to early assessment program.

Howell and his colleagues' study provides evidence that the early assessment programs successfully reduce potential participants in developmental education by about 5000 students in the California State University system (Howell, Kurlaender & Grodsky, 2010). Logically, their results confirm that students with better performance in high school are prone to succeed than their counterparts (Pascarella & Terenzini, 2005; Tinto, 1993; Voelkle & Sander, 2008). More importantly, an early intervention made in the secondary level can be seen a means to deal with the college degree completion issue by reducing the necessity of taking developmental education.

Not one size fits all. Community college deserves more attention to target on the need of its enrollees, both from research and policy perspectives.

Community colleges have been situated in a relatively obscure position compared with their four-year counterparts, accompanying with conflict objects (Brint & Karabel, 1989). The situation is improving gradually but it still far from a comprehensive view to examine the degree completion issue in community colleges. Namely, merely transplant is not applicable. Researchers and policymakers should recognize the discrepancy between two-year and four-year institutions.

The obscurity of community college students is particularly problematic as we intend to learn the process of declaring a major. As revealed, a large body of research has

been established on the undergrads enrolling in four-year universities as subjects. It is the case for the development of emerging adulthood theory in Arnett (2000, 2004). Also it makes no exception in the issue of students' declaration of major, which is primarily studied and developed in the four-year university section (Gordon, 1994). Understandably, methods and strategies targeted on four-year universities do not fit students in community colleges providing a totally different student body.

More importantly, the trend of changing asks for continuous updates with the time. For example, the existence of emerging adulthood acts as a reminder for anyone who concerned the youth group, reflecting a timely update from a view of socio-psychology. In light of this, an extended and update of study on community college students is particularly crucial. Bearing different tasks to accommodate various students with college aspiration, community colleges deserve more attention both from researchers and policy-makers to graduate more students.

As revealed in the limitation section, the main weakness of this study is its disability to reveal students' intention accurately. In specific, psychological measurements such as educational expectation and personal intention cannot be obtained preciously over time. This insufficiency explains the reason why it is difficult applying primary theories such as Tinto's (1993) student integration model or Bean's (1982) student attrition model to gain support empirically for this present study. The source of this study is a one-time measurement of personal intention as students enrolled. Therefore, it is not a good predictor of whether students graduate with a degree.

Furthermore, parental approval or also named parental expectation on educational attainment is proposed to be an important indicator of student success (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). For example, challenging parents can be a source of motive for emerging adults given they are in the process of re-centering (Arnett & Tanner, 2006; Cooper, 2011). In fact, family support is revealed in Bean's model but it is a pity that this study cannot validate its impact on emerging adults' college success.

In terms of the strategies to improve college persistence issue, both practitioners and police-makers should seek for more opportunities to collaborate, as ways to examine and test the results from research. More importantly, the relationship between policy and the function of bureaucracy could be improved gradually if a means of communication is well established.

5.3 Reflection: The role of higher education for youths

As an English teacher in the middle school, I used to share with my students about how they should see the opportunity of learning English. “Pretty much like the window which you can see the world through it” I said. True, then I come to realize that the role of higher education do the same function. Namely, a smooth transition from school to today’s work needs to be equipped with higher education for youths. This kind of realization is confirmed with a high school dropout in his age of 20. To my best memory, this is what he told me:

It just took me years working this job, understanding the need about the education stuff. You know...this rotted off my body—tiring. It is a dead-end job. When I was young, it did not matter to me. Then I realize that I will have a family. You cannot work at this place forever; you have to get a decent job.”

Interesting enough, his statement indicated the necessity of education; to clarify, he means the role of higher education will be helpful for his future career. On the other hand, his personal experiences highlight the factor of time as well. Namely, individuals need time to deal with their own life situations even after they decide to enroll in higher education. In light of this, a fixed and usually short window of observation period may bias the way we examine the persistence issue.

With this belief, I see the technique of event history analysis a fit as I investigate the persistence issue with a state wide longitudinal data set. Given the principle assumption of event history analysis—everyone fails eventually, I made an arbitrary benchmark. Namely, only students who are still enrolled and obtain thirty credit hours or more are kept as right-censored cases in the final hazard model.

Results as presented in earlier chapters, participation in developmental education does negatively affect the likelihood of degree completion for students in emerging adulthood. Yet after including other time-varying variables like enrollment patterns and college GPA, I surprisingly learned that my findings echo that statement from Adelman (2006) as seeing students as active and responsible agent in their higher education process. Even though Adelman's statement particularly focuses on traditional-aged students who attend a four-year college at any time, it is still held true for emerging adults enrolling in community colleges. Namely, individual performance in each term plays a greater role than the necessity of taking developmental education.

However, as I naively believe power of individuals can combat the force of top-down, the design of system could blur the aim of policy eventually, such as the case of students' declaration of major. To clarify, I simply consider the prerequisite to take developmental education the force from policy or institution against individual endeavor to earn a degree, given both forces could have the same goal—students complete degrees in the end. Ironically, the way the education system functions in bureaucracy may miss the point in effect. Namely, the issue of students' declaring a major is complicated as

individual behaviors may be driven by financial aid, instead of a proxy expressing career choices.

Efforts and alternative methods to fix the issue are critically needed and I see the power of individuals as the key either to improve the counseling system or to enhance college degree completion rates in the end. Informed by the study, I can be confident to tell youths about the college persistence issue, especially for those who are identified as college underprepared." Even with the challenge to take numerous remedial courses, you still have the opportunity to complete a degree with success. First of all, there are some behaviors assuring you on the right track, such as enrolling full-time each term and earning better GPA. Most important of all, you have to keep in mind that the higher education process takes TIME for you to persist to achieve the final success—degree completion."

Reference

Adelman, C. (2006). *The Toolbox Revisited: Paths to Degree Completion from High School Through College.* Washington D. C.: U.S. Department of Education.

Allen, J., & Robbins, S. (2010). Effects of interest--Major congruence, motivation, and academic performance on timely degree attainment. *Journal of Counseling Psychology 57*, 23-35.

Allison, P. D. (1982). Discrete-time methods for the analysis of event histories. *Sociological Methodology, 13*, 61-99.

Allison, P. D. (1999). *Multiple Regression: A Primer*. Thousand Oaks, California: Pine Forge Press.

Arnett, J. J. (2000). Emerging Adulthood. *American Psychologist, 55*(5), 479-481.

Arnett, J. J. (2004). *The Winding Road from the Late Teens through the Twenties*. New York: Oxford University Press.

Arnett, J. J. (2006). Emerging adulthood: Understanding the new way of coming of age. In J. J. Arnett & J. L. Tanner (Eds.), *Emerging Adults in America: Coming of Age in the 21st Century* (pp. 3-19). Washington, DC: American Psychological Association.

Arnett, J. J. (2009). *Adolescence and Emerging Adulthood: A Culture Approach* (3rd ed.). New Jersey: Pearson.

Astin, A. W. (1975). *Preventing Students from Dropping Out*. San Francisco: Jossey-Bass.

Astin, A. W. (1984). Student involvement: A developmental theory for higher education In P. G. Altbach (Ed.), *Contempotary Higher Education* (pp. 13). New York: Garland Publishing.

Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *The Journal of Higher Education, 77*(5), 886-924.

Bahr, P. R. (2010). Revisiting the efficacy of postsecondary remediation: The moderating effects of depth/breadth of deficiency. *The Review of Higher Education, 33*(2), 177-206.

Bailey, T. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community college. *New Directions for Community Colleges, 2009*(145), 11-30.

Bailey, T., Alfonso, M., Calcagno, J. C., Jenkins, D., Kienzl, G., & Leinbach, T. (2004). *Improving Student Attainment in Community Colleges: Institutional Characteristics And Policies.* New York: Community College Research Center.

Bailey, T., Jeong, D. W., & Cho, S.-W. (2010). Referral, enrollment, and completion in developmental education sequences in community colleges. *Economics of Education Review, 29*, 255-270.

Barak, A., & Rabbi, B.-Z. (1982). Predicting Persistence, Stability, and Achievement in College by Major Choice Consistency: A Test of Holland's Consistency Hypothesis. *Journal of Vocational Behavior, 20*(2), 235-243.

Bean, J. P. (1982). Student attrition, intentions, and confidence: Interaction effects in a path model. *Research in Higher Education, 17*(4), 291-319.

Bean, J. P., & Metzner, B. S. (1985). Nontraditional student attrition. *Review of Educational Research, 55*(4), 485-540.

Bettinger, E. P., & Long, B. T. (2005). Remediation at the Community College: Student Participation and Outcomes. *New Directions for Student Services, 129*, 17-26.

Bettinger, E. P., & Long, B. T. (2009). Addressing the needs of underprepared students in higher education: Does college remediation work? *Journal of Human Resources, 44*(3), 736-771.

Biswas, R. R. (2007). *Accelerating Remedial Math Education: How Institutional Innovation and State Policy Interact*. Boston, MA: Job for the Future.

Blau, P. M., & Meyer, M. W. (1987). *Bureaucracy in Modern Society* (3rd ed.). New York: McGraw-Hill.

Boatman, A., & Long, B. T. (2010). *Does Remediation Work for All Students? How the Effects of Postsecondary Remedial and Developmental Courses Vary by Level of Academic Preparation* (No. NCPR Working Paper). Cambridge, MA.: National Bureau of Economic Research.

BOR. (2006a). Costs and Consequences of Remedial Course Enrollment in Ohio Public Higher Education: Six-Year Outcomes for Fall 1998 Cohort (pp. 12). Columbus, OH: Ohio Board of Regents.

BOR. (2006b). Degree Production by Level, Sector, and Major (pp. 19). Columbus, OH: Ohio Board of Regents.

Bowen, W. G., Chingos, M. M., & McPherson, M. S. (2009). *Crossing the Finish Line: Completing College at America's Public Universities*. Scottsdale, Arizona: Princeton Editorial Associates.

Brint, S. & Karabel, J. (1989). *The Diverted Dream: Community Colleges and the Promise of Educational Opportunity in America, 1900-1985.* New York: Oxford University Press.

Budden, M. C., Hsing, Y., Budden, & Hall, M. (2010). Heads or tails (success or failure)? Using logit modeling to predict student retention and progression. *Contemporary Issues in Education Research, 3*(5), 35-42.

Cabrera, A. F., Castaneda, M. B., Nora, A., & Hengstler, D. (1992). The convergence between two theories of college persistence. *Journal of Higher Education, 63*(2), 143-160.

Calcagno, J. C., Bailey, T., Jenkins, D., Kienzl, G., & Leinbach, T. (2008). Community college student success: What institutional characteristics make a difference? *Economics of Education Review, 27*, 632-645.

Calcagno, J. C., Crosta, P., Bailey, T. R., & Jenkins, D. (2007a). Does age of entrance affect community college completion probabilities? Evidence from a discrete-time hazard model. *Educational Evaluation and Policy Analysis, 29*(3), 218-235.

Calcagno, J. C., Crosta, P., Bailey, T., & Jenkins, D. (2007b). Stepping Stones to a Degree: The Impact of Enrollment Pathways and Milestones on Community College Student Outcomes. *Research in Higher Education, 48*(7), 775-801.

Calcagno, J. C., & Long, B. T. (2008). *The Impact of Postsecondary Remediation Using a Regression Discontinuity Approach: Addressing Endogenous Sorting and Noncompliance* (No. NCPR Working Paper. No. 14194). Cambridge, MA.: National Bureau of Economic Research.

Carnevale, A. P. (2008). Employment policy at the crossroads [Electronic Version]. *Workforce Narrative Project*, 20. Retrieved 03/08/2009 from http://www.aecf.org/news/fes/dec2008/pdf/Carnavale.pdf.

Chen, X. (2007). *Part-time undergraduates in postsecondary education: 2003-04* (NCES 2007-165). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Cleves, M. A., Gould, W. W., Gutierrez, R. G., & Marchenko, Y. U. (2008). *An Introduction to Survival Analysis Using Stata* (2nd edition ed.). College Station, Texas: Stata Press.

Collins, R. (1971). Functional and conflict theories of education stratification. *American Sociological Review, 36*(6), 1002-1019.

Cooper, C. R. (2011). *Bridging Multiple Worlds: Cultures, Identities, and Pathway to College.* New York: Oxford University Press.

Crockem, R.S. (2008). *An Analysis of Variables Affecting First-time Freshmen's One-year Persistence at a Texas Open Admissions University*. Unpublished doctoral dissertation, Texas Southern University, Houston.

Csikszentminalyi, M. & Schneider, B. (2000). *Becoming Adult: How Teenagers Prepare for The World of Work.* New York: Basic Books.

DesJardins, S. L. (2003). Event history methods: Conceptual issues and an application to student departure from college In J. Smart (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 18, pp. 421-471).

DesJardins, S. L., Ahlburg, D. A., & McCall, B. P. (2002). A temporal investigation of factors related to timely degree completion. *The Journal of Higher Education, 73(5)*, 555-581.

DesJardins, S. L., McCall, B. P., Ahlburg D. A. & Moye, M. J. (2002). Adding a timing light to the Tool Box. *Research in Higher Education, 43* (1), 83-114.

Erikson, E. H. (1994). *Identity: Youth and Crisis.* New York: Norton & Company.

Feeney, M. K. & Dehart-Davis, L. (2009) Bureaucracy and public employee behaviors: A case of local government. *Review of Public Personnel Administration, 29*(4), 311-326.

Field, K. (2011, August 28). Education department chases "Pell runners" who threaten aid program. *Chronicle of Higher Education*.

Gordon, J. N. (1994). *Issues in Advising the Undecided College Student*. Columbia: National Resource Center for the Freshman Year Experience, University of South California

Graunke, S. S., Woosley, S. A., & Graunke, S. S. (2005). An exploration of the factors that affect the academic success of college sophomores. *College Student Journal, 39*(2), 367-376.

Grubb, W. N., Worthen, H., Byrd, B., Webb, E., Badway, N., Case, C, & et al. (1999). *Honored But Invisible: An Inside Look at Teaching in Community Colleges.* New York and London: Routledge.

Hawley, J. D., & Chiang, S.-C. (2011a). Does Developmental Education Help? Manuscript submitted for publication.

Hawley, J. D., & Chiang, S.-C. (2011b). *Initial Survey of Assessment and Placement Tests Used for Placement into Developmental Education in Ohio.* Unpublished manuscript, The Ohio State University, Columbus.

Hawley, J. D., Chiang, S.-C., & Lechman, K. (2011). *The Organization and Operation of Developmental Education in Ohio: Survey Results for the Developmental Education Initiative.* Unpublished manuscript, The Ohio State University, Columbus.

Howell, J. S., Kurlaender, M., & Grodsky, E. (2010) Postsecondary preparation and remediation: Examining the effect of the early assessment program at California State University. *Journal of Policy Analysis and Management, 29 (4)*, 726-748.

Horn, L., & Berger, R. (2004). *College Persistence on the Rise?* Washington D.C.: National Center for Education Statistics.

Jacobs, J., & Tolbert-Bynum, P. (2009). *Shifting Gears: Community Colleges and Adult Basic Education*. U.S. Department of Education. Office of Vocational and Adult Education.

Jenkins, D., Jaggars, S. S., & Roka, J. (2009). *Promoting Gatekeeper Course Success Among College Student Needing Remediation: Findings and Recommendations from a Virginia Study* (Summary Report). New York: Community College Research Center.

Kerckhoff, A. C. (2001). Education and social stratification process in comparative perspective. *Sociology of Education, 74* (Extra Issue: Current of Thought: Sociology of Education at the Dawn of the 21st Century), 3-18.

Kuh, G. D., Kinzie, J., Buckley, J. A., Bridges, B. K., & Hayek, J. C. (2006). *Commissioned Report for the National Symposium on Postsecondary Student Success: Spearheading a Dialog on Student Success.* Washington, DC: National Postsecondary Education Cooperative.

Laird, T. F. N. & Cruce, T. M. (2009). Individual and Environmental Effects of Part-Time Enrollment Status on Student-Faculty Interaction and Self-Reported Gains. *Journal of Higher Education, 38*(3), 290-314.

Lipsky, M. (1980). *Street-level Bureaucracy: Dilemmas of the Individual in Public Services.* New York: Russell Sage Foundation.

Martorell, P., & McFarlin, I. (2011). Help or hindrance? The effects of college remediation on academic and labor market outcomes. *Review of Economic & Statistics, 93*(2), 436-467.

Melguizo, T., Bos, J., Prather, G., & Melguizo, T. (2011). Is developmental education helping community college students persist? A critical review of the literature. *American Behavioral Scientist, 55*(2), 173-184.

Merton, R. K. (1940). Bureaucratic structure and personality. *Social Forces, 18*(4), 560-568.

Moynihan, M. P. & Pandey, S. K. (2007). The role of organization in fostering public service motivation. *Public Administration Review, 67*(1), 40-53.
National Research Council. (2005). *Growing Up Global: The Changing Transitions to Adulthood in Developing Countries.* Washington, D. C.: The National Academies Press.
Neeley, S. J., & Paredes, R. A. (2007). *Texas P-16 Council Developmental Education Report: A report on Recommendations Produced FY 2005-2006*. Austin, Texas: P-16 Council.
Neumark, D., & Wascher, W. (2001). Minimum Wages and Training Revisited. *Journal of Labor Economics, 19*(3), 563-595.
Newman, K. S. (2006). *Chutes and Ladders: Navigating the Low-wage Labor Market*. Cambridge: Harvard University Press.
Oberfield, Z. W. (2010). Rule following and discretion at government's frontlines: Continuity and change during organization socialization. *Journal of Public Administration Research and Theory, 20*(4), 735-755.
Parker, T. L. (2007). Ending college remediation: Consequences for access and opportunity [Electronic Version]. *Policy Brief*, 2.
Pascarella, E. T., & Terenzini, P. T. (2005). *How College Affects Students* (2nd ed.). New Jersey: Jossey-Bass.
Perdue, D. A. (2008). *Reach Higher, AMERICA: Overcome Crisis in the U.S. Workforce.* Washington, D.C.: National Commission on Adult Literacy.
Perry, J. L. & Wise, L. R. (1990). The motivational bases of public service. *Public Administration Review, 50*(3), 367-373.
Porfeli, E. J., & Vondracek, F. W. (2009). Career development, work, and occupational success In M. C. Smith & N. DeFrates-Densch (Eds.), *Handbook of Research on Adult Learning and Development* New York and London: Routledge.
Reitzle, M., Vondracek, F. W., & Silbereisen, R. K. (1998). Timing of school-to-work transition: A developmental-contextual perspective *International Journal of Behavioral Development, 22*(1), 7-28.
Rosenbaum, J. E., Deil-amen, P., & Person, A. E. (2006). *After Admission: From College Access to College Success.* New York: Russell Sage Foundation.
Schneider, B., Carnoy, M., Kilpatrick, J., Schmidt, W. H.,& Shavelson, R. J. (2007). *Estimating Causal Effects: Using Experimental and Observational Designs.* American Educational Research Association.
Shanahan, M. J., Mortimer, J. T., & Kruger, H. (2002). Adolescence and adult work in the twenty -first century. *Journal of Research on Adolescence, 12*(1), 99-120.
Singer, J. D., & Willett, J. B. (2003). *Applied Longitudinal Data Analysis: Modeling change and event occurrence*. Oxford: University Press.
St. John, E. P., Hu, S., Simmons, A., Carter, D. F., & Weber, J. (2004). What difference does a major make? The influence of college major field on persistence by African American and white students. *Research in Higher Education, 45*(3), 209-232.

Stein, D. S., & Wanstreet, C. E. (2006). Beyond yes or no: Factors in adult's decisions to enroll in higher education *The Journal of Continuing Higher Education 54*(2), 2-12.

Tanner, J. L. (2006). Recentering during emerging adulthood: A critical turning point in life span human development. In J. J. Arnett & J. L. Tanner (Eds.), *Emerging Adults in America: Coming of Age in the 21st Century* (pp. 21-55). Washington, D.C.: American Psychological Association.

Tanner, J. L., Arnett, J. J., & Leis, J. A. (2009). Emerging adulthood: Learning and development during the first stage of adulthood. In M. C. Smith & N. DeFrates-Densch (Eds.), *Handbook of Research on Adult Learning and Development* (pp. 34-67). New York and London: Routledge.

Tinto, V. (1993). *Leaving College: Rethinking the Causes and Cures of Student Attrition* (2nd. ed.). Chicago and London: The University of Chicago Press.

Tinto, V. (1997). Classrooms as communities. *Journal of Higher Education, 68*(6), 599-623.

van Aalst, J. (2010). Using Google Scholar to Estimate the Impact of Journal Articles in Education. *Educational Researcher, 39*(5), 387-400.

Visher, M. G., Butcher, K. F., & Cerna, O. S. (2010). *Guiding Developmental Math Students to Campus Services.* New York: MDRC.

Voelkle, M. C., & Sander, N. (2008). University dropout: A structural equation approach to discrete-time survival analysis. *Journal of Individual Differences, 29*(3), 134-147.

Wang, X. (2009). Baccalaureate attainment and college persistence of community college transfer students at four-year institutions. *Research in Higher Education, 50*(6), 570-588.

Yeats, J. A. (2005). The transition from school to work. *Monthly Labor Review 128*(2), 21-33.

U.S. Department of Education, National Center for Education Statistics. (2009). *Digest of Education Statistics, 2008* (NCES 2009-020), Table 190. Retrieved September 15, 2010, from http://nces.ed.gov/programs/digest/d08/tables/dt08_190.asp

Compare the general specification of time (Model 1) vs. time as categorical dummy (Model 2)

(Model 1)

```
logistic aa deved year

Logistic regression                             Number of obs   = 51632
LR chi2(2)      =629.12                         Prob > chi2     = 0.0000
Log likelihood = -34013.634                     Pseudo R2       = 0.0092


aa    Odds Ratio Std. Err.     z         P>z     [95% Conf.
      Interval]

deved   .4601602 .0147367    -24.24      0.000     .4321646
      .4899693
year    .9539615 .0047095    -9.55       0.000     .9447755
      .9632368
```

(Model 2)

```
logistic aa deved year1_2 year2_3 year3_4 year4_5 year5_6 year6_7

Logistic regression                             Number of obs   = 51632
LR chi2(7)      =723.16                         Prob > chi2     =
      0.0000
Log likelihood = -33966.617                     Pseudo R2       =
      0.0105


aa       Odds Ratio   Std. Err.      z    P>z     [95% Conf.
      Interval]

deved      .4083961   .0141484   -25.85   0.000     .3815862
      .4370895
year1_2    .7220173   .0264676    -8.89   0.000     .6719615
      .7758018
year2_3    .6721849   .0251756   -10.61   0.000     .6246091
      .7233844
year3_4    .6601383   .0248641   -11.03   0.000      .613161
      .7107148
year4_5    .6537599   .0246989   -11.25   0.000     .6070997
      .7040062
year5_6     .651222   .0246332   -11.34   0.000     .6046882
      .7013369
year6_7     .647885   .0245467   -11.46   0.000     .6015173
      .6978269
```

Ho: there is no difference. Ha: Ho is not true.
Chi-square test:
Model 1: LR chi2(7) = 723.16 Model 2: LR chi2(2) = 629.12

→ Model (2–1): LR ch2(5)=94.04 > the critical value of chi2(5)=16.81(.01)

Likelihood Ratio= -2 ((-33966.617)- (-34013.634)=94.034

Both results conclude that two models are different and the test is statistical significantly at P<.01

So the results confirm that time treated as categorical variables (model 2) is better than model 1.

Appendix B: The test of proportionality assumption

```
stphplot, by (devflag) title(Unadjusted)
```

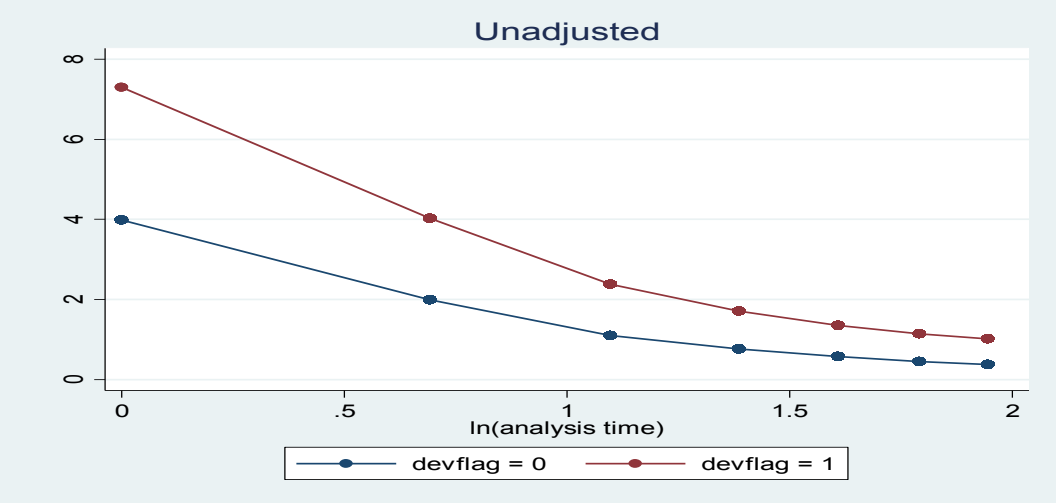


Figure B.1 The unadjusted graph by developmental education

```
stphplot, by (devflag) adjust ( deved2003 deved2004 deved2005 deved2006 deved2007
deved2008 deved2009  falltospringyear12003 falltofallyear22004 comp_dev_year22005)
title(Adjusted by aca performance)
```

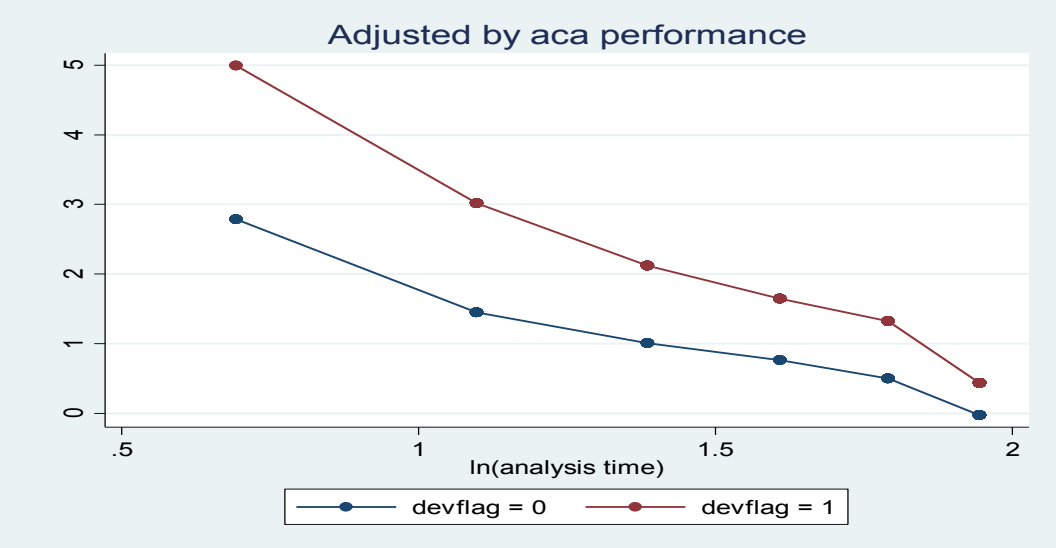


Figure B.2 The unadjusted graph by developmental education

Appendix C: Comparisons of models

Table C.1 Comparisons of models

Estimated Odds Ratios for Hazard Models, Outcome is Achieving Associates+ Higher				
Remediation (vs. none)	.411***	.459***	.401***	.428***
Year1_2 (vs. Year0_1)	.721***	.751***	.845***	.580***
Year2_3 (vs. Year0_1)	.673***	.707***	1.063	.758**
Year3_4 (vs. Year0_1)	.661***	.696***	1.306***	1.425***
Year4_5 (vs. Year0_1)	.655***	.691***	1.528***	1.638***
Year5_6 (vs. Year0_1)	.652***	.689***	1.651***	1.751***
Year6_7 (vs. Year0_1)	.649***	.686***	1.734***	1.828***
Age 18-19 (vs. Age 20-29)	1.215***	1.174***	1.017	1.011
Female (vs. Male)	1.305***	1.380***	1.357***	1.361***
Black (vs. White)	.437***	.504***	.592***	.598***
Hispanic (vs. White)	.619***	.663***	.709***	.709***
Raceother (vs. White)	.796**	.825**	.801**	.807**
Intention				
Job skill (vs. Interest)	.810**	.803***	.809***	.808***
Transfer (vs. Interest)	1.031	.948	.952	.949
Certificate (vs. Interest)	.682***	.672***	.708**	.711***
Attainment of Degree (vs. Interest)	1.150***	1.111***	1.090*	1.087*
Placement test scores				
Lang Test (2 Q)		.913**	.886***	.887***
Lang Test (3 Q)		1.081*	1.001	1.006
Lang Test (4Q)		1.122***	.989	.997
Math (2Q)		1.221***	1.243***	1.239***
Math (3Q)		1.322***	1.306***	1.301***
Math (4Q)		1.767***	1.687***	1.689***
Environmental factor				
Poverty Index of 2002			1.132***	1.128***
Big college			.708***	.703***
full-time (vs. part-time)			3.636***	3.625***
GPA			1.999***	1.911***
Change of major			.869*	.869*
ATD measurements				
Fall to spring (Year 1)				.759***
Pass eighty of courses taken (Year 1)				1.590***
Fall to fall (Year 1 and 2)				1.344**
24 hours or more (Year 2)				1.344**
Completion of Remediation (Year 3)				1.893***
No. of observations=	51632	51632	51632	51632
***P<.001 ** P<.01 *P<.05				

Appendix D: Effects of developmental education on the declaration of major

Developmental education treated as continuous variable "totaldevc2003"

logistic claimajor2003 totaldevc2003 female black hispanic raceother normalaged quartlang1 quartlang2 quartlang3 quartmath1 quartmath2 quartmath3 povertylevelin2002 jobskill transfer certificate AAorBA

Logistic regression Number of obs = 7376

LR chi2(17) = 409.51 Prob > chi2 = 0.0000

Log likelihood = -2129.5911 Pseudo R2 = 0.0877

claimaj~2003	Odds Ratio	Std. Err.	Z	P>z	[95% Conf.	Interval]
totalde~2003	1.048803	.0111752	4.47	0.000	1.027127	1.070937
Female	.5860539	.0511286	-6.12	0.000	.4939432	.6953415
Black	1.023389	.157238	0.15	0.880	.7572833	1.383003
Hispanic	2.069827	.8811577	1.71	0.087	.8985953	4.767644
Raceother	1.129001	.3547206	0.39	0.699	.609896	2.089937
Normalaged	1.491022	.129483	4.60	0.000	1.257662	1.767681
quartlang1	1.19046	.1814481	1.14	0.253	.8830308	1.604921
quartlang2	1.146566	.1423326	1.10	0.271	.8989437	1.462398
quartlang3	1.363549	.1471279	2.87	0.004	1.103635	1.684674
quartmath1	1.666054	.248244	3.43	0.001	1.244111	2.2311
quartmath2	1.429452	.1781619	2.87	0.004	1.119641	1.82499
quartmath3	1.149604	.1251479	1.28	0.200	.9287202	1.423022
poverty~2002	1.299307	.111549	3.05	0.002	1.098079	1.53741
Jobskill	3.270301	.5884279	6.59	0.000	2.298425	4.653129
Transfer	3.814466	.5521091	9.25	0.000	2.872302	5.065676
Certificate	3.049756	.608119	5.59	0.000	2.063175	4.508105
AAorBA	5.905128	.6654367	15.76	0.000	4.734882	7.364605

Table D.1 Results limited to the sample of this study

With the whole sample 44962 individuals to test the effect of remediation on the declaration of major in the first quarter instead of yearly measurement. Similarly, remediation was treated as continuous variable.

logistic claimajor_au2003 fall_dev2003 female black hispanic raceother EA jobskill transfer certificate AAorBA (continuous remediation " fall_dev2003")

Logistic regression Number of obs= 44960

LR chi2(10) = 3454.72 Prob > chi2= 0.0000

Log likelihood = -19357.226 Pseudo R2 = 0.0819

claimaj~2003	Odds	Std. Err.	Z	P>z	[95%	Interval]
fall_dev2003	1.066316	.0053667	12.76	0.000	1.055849	1.076887
female	.902018	.0235326	-3.95	0.000	.8570544	.9493406
black	1.244535	.0513294	5.30	0.000	1.14789	1.349317
hispanic	.9987562	.0879679	-0.01	0.989	.8404035	1.186946
raceother	.8916359	.0588777	-1.74	0.082	.7833933	1.014835
EA	1.247909	.0368383	7.50	0.000	1.177756	1.32224
jobskill	2.221446	.0933298	19.00	0.000	2.045852	2.412112
transfer	1.662645	.0732249	11.54	0.000	1.525147	1.81254
certificate	3.824284	.2277283	22.53	0.000	3.403007	4.297713
AAorBA	5.125293	.172757	48.48	0.000	4.797637	5.475325

Table D.2 Results of the whole sample available

Appendix E: Calculations of hazard rates

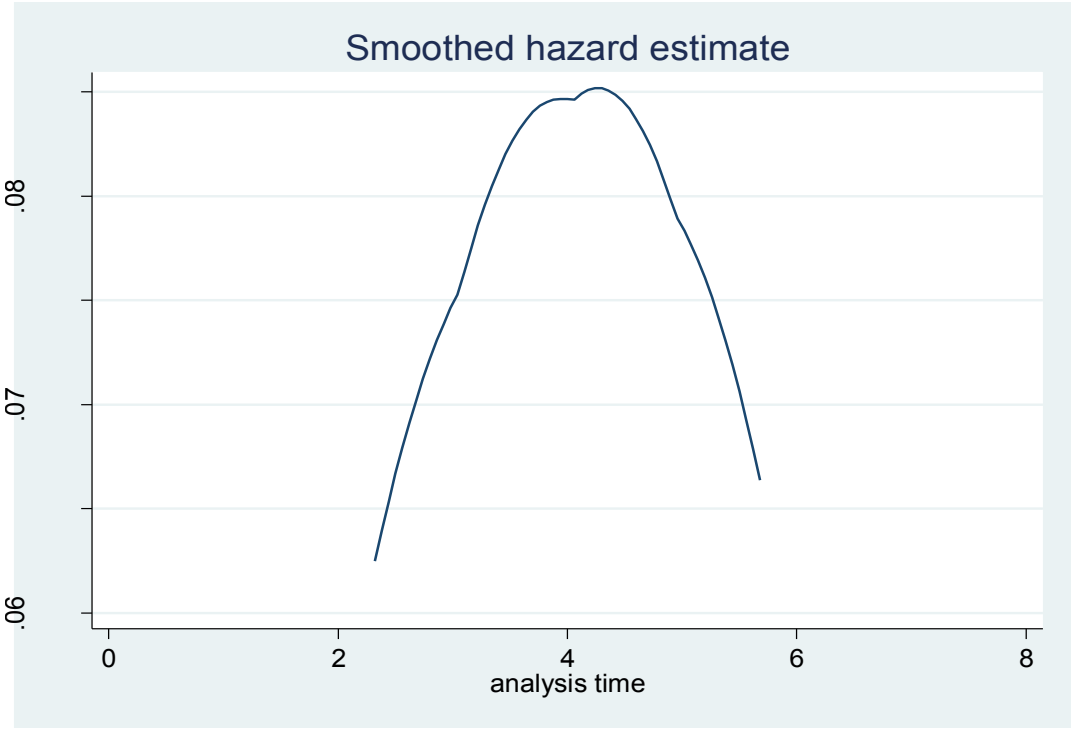


Figure E.1 The trend of hazard rates for the whole group

Term	Year	Total number of episode	Event occurred (Associates or higher)	Degree Completion rates
1	0-1	51632	399	.00773
2	1-2	51233	2786	.05438
3	2-3	48447	5397	.11140
4	3-4	43050	4221	.09805
5	4-5	38829	3136	.08076
6	5-6	35693	2324	.06511
7	6-7	33369	1442	.04321

Table E.1 Degree completion rates in each year for the whole sample