Examination-Based Acceleration Mechanisms and Student Outcomes in High School: Investigating Student Attrition from the International Baccalaureate Diploma Program and the Impact of its Introduction on Advanced Placement Course Participation

Thesis Proposal

Submitted by

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Abstract

Acceleration mechanisms are courses that aim to provide challenging material and potentially allow students to attain bachelor's degrees more quickly (mostly through earned college credit). One popular examination-based acceleration mechanism that has surged in growth and gained much national attention is the International Baccalaureate (IB) Diploma Program (Mathews, 2009). Despite its rise in popularity, peer-reviewed scholarly research on the impact of IB on student outcomes is fairly limited; however, understanding these outcomes is critical because of the potential long-term impacts.

Education critics have long asserted that the educational opportunities provided by acceleration mechanisms are not equally distributed among students (Oakes 1995; 2008). Practitioners, researchers and policymakers have expressed concerns that all students do not have equal access to such programs because of prejudices about ability, and the underidentification of particular minority groups for placement into the programs (Brown, 2005; Callahan, 2003; Geiser & Santelices, 2004; Klopfenstein, 2004a; Mayer, 2008). In addition, acceleration mechanisms have replaced most of the other opportunities for students at the secondary level who have been classified as academically gifted; yet, researchers have presented conflicting findings about whether these programs are successfully serving gifted students (Callahan, 2003; Kyburg, Hertberg-Davis, & Callahan, 2007).

This dissertation aims to explore two critical aspects of the IB program. First, I propose to use discrete-time survival analysis to investigate the non-promotional exit of students from an IB program. Second, I propose to use a difference-in-differences approach to estimate the causal impact of the introduction of an IB Diploma Program on students' participation in Advanced Placement courses. Through these two studies, I will determine which students are at greatest risk for non-promotional exit in

an IB program, when they are at greatest risk for exit, and whether the IB and AP programs are indeed substitutes, or potentially complementary, for students in practice.

A descriptive analysis on whether and when students exit an IB program should be valuable information for practitioners because it can help school leaders and teachers identify the points in time when their students will be most at risk for exit; for researchers, it provides specific observations about trends that have been examined qualitatively. Finally, understanding whether the IB and AP programs are complementary or exclusionary, especially for gifted and minority students, will provide important findings about students' course-taking habits that have yet to be explored critically.

Examination-Based Acceleration Mechanisms and Student Outcomes in High School: Investigating Student Attrition from the International Baccalaureate Diploma Program and the Impact of its Introduction on Advanced Placement Course Participation

The 1983 publication of *A Nation at Risk* by the National Commission on Excellence in Education challenged public schools in the United States to improve education through the application of higher standards, quality assessments, better teaching, accountability, and opportunities for all students. As school administrators considered the many ways that they could meet these challenges, many of them turned to existing programs that might be implemented to improve student academic achievement, in addition to accelerating the learning of more students (Rogers & Kimpston, 1992; Gemma 2004; Bunnell, 2008). Among these programs were *acceleration mechanisms*, which aim to provide challenging material and potentially allow students to attain their bachelor's degrees more quickly once they enter college (mostly through the earning of college credit while the student is in high school). They exist mainly in two forms in the United States: college-based programs, through which high school students take college courses, normally for both credits toward their high school diplomas as well as associates and/or baccalaureate degrees, and examination-based programs, whereby high school students take a challenging course and possibly earn college credit after passing a standardized examination successfully.

One of the most popular acceleration mechanisms is the International Baccalaureate (IB) Diploma Program. This is an examination-based program that has gained much national attention and surged in growth in recent years, as it was first available in only 20 schools in 1968, but is offered in nearly 700 American high schools (International Baccalaureate Organization, 2009; Kyburg, Hertberg-Davis & Callahan, 2007; Mathews, 2009). Despite its rise in popularity, peer-reviewed scholarly research on any aspect of IB is fairly limited; however, documenting the nature and effectiveness of the program is important because of its potential long-term impacts on a student's life course. Current research suggests that students who participate in accelerated coursework in high school have better academic outcomes,

such as higher rates of college enrollment and improved performance, better college placement[1], and greater persistence to bachelor's and graduate degrees, than students who do not take the courses (Dougherty, Mellor & Jian, 2006; Duevel, 1999; Geiser & Santelices, 2004; Willingham and Morris, 1986). Such outcomes are important because there are known benefits to higher educational attainment and performance, including greater lifetime earnings, decreased chances of unemployment, and improved social well-being (Baum & Ma, 2007).

However, critics have long asserted that the educational opportunities provided by acceleration mechanisms are not distributed equitably among high school students (Oakes 1995; 2008). Practitioners, researchers and policymakers have expressed concerns that all students do not have equal access to these programs because of prejudices about ability, and the underidentification of particular minority groups for placement into the programs (Brown, 2005; Callahan, 2003; Geiser & Santelices, 2004; Klopfenstein, 2004a; Mayer, 2008). In addition, acceleration programs such as the IB have replaced most of the other opportunities for students at the secondary level who have been classified as academically gifted; yet, researchers have presented conflicting findings about whether these programs serve such students successfully (Callahan, 2003; Kyburg, Hertberg-Davis, & Callahan, 2007).

In my dissertation, I propose to conduct a pair of linked studies to explore critical aspects of the IB program. In one, I propose to focus on an aspect of students' progress through high school; in the other, on course-taking patterns. In both, I will make use of large-scale administrative data on the high school careers of students provided by state officials in Florida. In the first project, I propose to use discrete-time survival analysis to describe *whether* high school students who have chosen to enter an IB program tend to persist in the program, and if not, *when* they are at greatest risk of "non-promotional exit" into regular high school programs. In the second study, I propose to use a "difference-in-differences" approach to estimate the causal impact of the introduction of an IB program on students' participation in Advanced Placement courses, in an attempt to determine whether they are substitutes or complements for each other, in practice.

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[1] For example, students may begin college by taking a higher-level or more challenging course.

In the remainder of this proposal, I describe the background and context of my proposed research, and end the section by stating my specific research questions. Next, I describe my proposed research design, my proposed dataset and measures, my analytic plans, and I comment on the threats to validity and limitations that my proposed study faces.

BACKGROUND AND CONTEXT

What is the International Baccalaureate Program?

The earliest mission of the International Baccalaureate Organization (IBO) was to ensure that children of parents in highly mobile professions had a common pre-university education that would be recognized across geographic boundaries (IBO, 2009; Nugent, 2002). In its present form, the IBO aims to provide students from a variety of racial, economic, social and cultural backgrounds with knowledge, critical thinking skills, and an international awareness within the context of advanced, personalized studies and a rigorous curriculum (Nugent, 2002; Poelzer & Feldhusen, 1997; Tookey, 2000). The IB Diploma Program is designed as a comprehensive two-year curriculum for students in the final two years of their secondary education careers, which is usually eleventh and twelfth grade (IBO, 2009). However, preparation for the IB Diploma Program in U.S. schools usually begins in the ninth grade with students enrolling in Pre-IB courses (Samore, 1992; Shaunessy and Suldo, 2010; Tsukuda, 1998;).

The IB Diploma Program is composed of multiple elements. These include: *Theory of Knowledge*, which is an epistemology course required of all diploma candidates; *Creativity, Action and Service*, which requires candidates to complete a certain number of hours of community service; and the *Extended Essay*, which is an original piece of research on a topic of the student's choosing. Examinations are also administered in six subject areas: *Language A* (the native language), *Language B* (a foreign language), *Individuals and Society* (which includes social studies), *Experimental Sciences*, *Mathematics*, and an elective area called the *Sixth Subject*, which may include art and the performing arts. IB Examinations incorporate multiple assessments; separate oral examinations are required in each of the students' languages, research papers are required in history courses, and laboratory work is assessed in the

sciences, for example. Evaluations of these assessments are combined with the examinations that students take, and together they encompass students' IB scores.

The Appeal of the IB Program

For Gifted Students

Researchers, policymakers and education practitioners have identified critical aspects of the IB program as being particularly beneficial to serving the needs of academically gifted students—those who have superior intellectual development and are capable of high performance (Callahan, 2003; Hertberg-Davis, Kyburg & Callahan, 2006; Florida Office of Program Policy Analysis & Government Accountability, 2008). The opportunities that students have in the IB program for taking demanding coursework across multiple subject areas, as well as for independent investigation via required research projects, are closely aligned with task commitment and creativity, which are critical elements for the education of gifted students (Hertberg-Davis et al, 2006; Renzulli, 2000). Moreover, the social and emotional advantages of working within a peer group with similar academic goals have also been identified as another appeal of the IB program (Foust, Hertberg-Davis & Callahan, 2009; Shaunessy & Suldo, 2010).

For Traditionally Underrepresented Students

Additional research has been conducted on the extent to which the IB program is serving economically underprivileged and minority students, and some have found that it may have a positive impact for these groups. Mayer (2008) for example, described the implementation of an IB program as having the potential to prepare low-income students and students of color for four-year universities and consequently interrupt the cycle of social and educational disadvantage, especially when academic and social support mechanisms are present for these students. Similarly, Kyburg, Hertberg-Davis and Callahan (2007), using in-depth interviews, found that a pervasive and consistent belief from teachers and

administrators that minority students could be successful, alongside scaffolding for academic and social support, created an environment that would make IB an optimal curricular choice for them.

Why Might Students Exit an IB Program?

Much existing research suggests that all students do not remain in IB programs through completion (Hertberg-Davis et al., 2006; Shaunessy & Suldo, 2010). These authors have conjectured that this could be due to the rigor and challenging level of the courses. Moreover, they argue that gifted students may find the rigidity of the structured IB curricula and the reluctance of teachers to deviate from the highly structured IB program as impediments to their learning (Callahan, 2003; Csizszentmihalyi, Rathunde, & Whalen, 1997). Consequently, they may find that the courses are not a good match for their needs. In perhaps the most large-scale and comprehensive study conducted on perceptions of the IB program, Hertberg-Davis, Callahan, and Kyburg (2006) interviewed and observed 200 teachers and 300 students from 23 high schools. While the authors discovered that many of the students participating in the IB program were satisfied with the nature of the curriculum and the standards of instruction within the courses, and perceived them as representing the "best" classes in the school, other students found the IB program to be overwhelming and time consuming. The authors also discovered that teachers thought their students were a homogeneous group of learners, which led them to conclude that they did not need to make modifications to their instructional methods in order to meet the various learning needs and styles of students within the classrooms. On the other hand, those students who dropped out of the IB courses believed that the environment in these courses was inappropriate for their individual needs, and that the way the courses were taught did not allow them to succeed, feel welcome, nor learn in the ways that they preferred to learn. Academically gifted students noted that the rigidity and structure of the IB program made it less than satisfying. Finally, many poor and minority students did not see themselves as part of the IB community because of their generic underrepresentation in the program (Hertberg-Davis et al., 2006).

Other research that has examined student perceptions of the IB program has provided similar findings. Suldo, Shaunessy, and Hardesty (2008) found that high school students in IB programs expressed heightened stress levels as a result of the heavy academic workload and pressure to succeed, which contrasted with their peers in the general education programs. In results from a series of interviews, Taylor, Pogrebin, and Dodge (2003) described how some students taking IB courses often use academically deceitful means to demonstrate success and remain in the competitive program, reflecting the increased pressure that they associated with the program. Foust, Hertberg-Davis, and Callahan (2009) found that students in high schools that provided both general education courses and the IB program perceived that there were negative feelings between IB and non-IB students. The authors further discovered that IB students faced a forced-choice dilemma by having to sacrifice sleep in order to maintain both their academic success and an active social life. The increased levels of stress and demanding academic environment associated with the IB program established in these studies suggest that some students may be at risk for exit, and may choose – at some point -- not to participate in the program (returning to general education courses) rather than endure the increased pressure. So, in my thesis, I propose to investigate exit from the IB program, focusing on *whether* and *when* high school students exit the program, and if the risk of exit differs according to whether students were classified as academically gifted and/or by their race.

The IB Program and Advanced Placement: Substitutes or Complements?

Another popular examination-based acceleration mechanism found in many high schools is the Advanced Placement (AP) program, which is administered by the College Board. Because IB and AP are both examination-based acceleration mechanisms, they have often been presented as a dichotomous choice for high school students, or as rivals (Byrd, Ellington, Gross, Jago & Stern, 2007; Callahan, 2003; Mathews, 2009; Mathews and Hill, 2005). However, other researchers and practitioners explain that since IB and AP are fundamentally different, it may be possible and/or beneficial to offer high school students both programs simultaneously (Casserly, 1986; Dugan, 2005; Savinov, 2006; Willis, 1999). The

similarities and differences between the two programs, and the conflicting viewpoints about whether they are substitutes for each other, or complements, suggest that it is worthwhile to investigate students' participation in these programs empirically, which I propose to do, in the second project in my thesis.

What is Advanced Placement?

The AP program was initially developed out of a necessity to offer students who attended elite private schools the opportunity to earn college credit while still in high school, so that they would not have to enter college early (Callahan, 2003; Hertberg-Davis et al., 2006, Rothschild, 1999). By 1956, the College Board began administering the AP examinations to meet these students' needs, as 1,299 students took 2,199 examinations in that year (Callahan, 2003). Over time, however, the focus of AP has expanded, as has its participation. In its present form, the College Board continues to partner with colleges and universities, and has created assessments that mirror college-level learning in 35 subject areas. Yet, it also supports many secondary schools—not just elite private schools—in the training of teachers to develop syllabi and curricula of high intensity and quality in the AP subjects.

Moreover, in 2009, nearly 2.7 million examinations were administered to over 1.6 million students (College Board, 2009). Consistent with the original intentions of AP, program officials continue to advocate for the awarding of college credit or placement into a higher-level college course for students who perform well on AP examinations (College Board, 2009). However, results from AP exams are also presently being used by many college-admissions administrators in the United States as an indicator of high school students' ability to succeed in rigorous college curricula (Geiser & Santelices, 2004; Mathews, 2009). In fact, students seeking admission to top-tier colleges are generally expected to have taken between four and six AP examinations at a minimum (Casement, 2003).

IB and AP: Comparison and Contrast

The IB and AP programs are each attractive to highly motivated high school students who seek rigorous and advanced coursework. Each of them are also focused largely on student success in end-of-

year examinations. Both are recognized by colleges and universities for college credit and advanced standing. Given this, it is understandable that much of the literature has described the programs as potential substitutes for each other; that is, that students must choose between the two when deciding on their high school course of study. However, there are several noted differences, and also reasons why the programs may be complementary. First, the IB Diploma Program is a comprehensive program that requires students to prepare for examinations in six different areas; by contrast, students may opt to take only a single AP examination (IBO, 2009; College Board, 2009). In addition, the curricular foci of IB and AP courses are often quite dissimilar but complementary.[2] In a final irony, it has also been noted that AP courses can be used to prepare high school students for the IB examinations (Casserly, 1986).

Perspectives on Academically Gifted Students and Underrepresented Groups

High school students who have been identified as academically gifted and are enrolled in an IB program may also benefit from taking AP courses in their areas of academic strength, because they can excel in these areas and move through the material rapidly (Hertberg-Davis et al., 2006). Yet, they might also find the rigidity and structure of AP courses as impediments to pursuing their interests independently, and thus choose not to enroll in AP courses (Callahan, 2003; Csizszentmihalyi, Rathunde, & Whalen, 1997; Hertberg-Davis et al., 2006). Moreover, prior research on participation in AP courses has documented the fact that students from low-income households and certain minority populations have limited access to the courses (Ndura, Robinson, & Ochs, 2003; Klopfenstein, 2004a; Klopfenstein, 2004b). Given the traditional limited access, it is possible that the students with these characteristics who are enrolled in an IB program may have increased access to AP courses if they are indeed complementary. And so, in my study, I propose to investigate whether AP course participation differs for IB students

[2] In articles written about specific subject areas, such as physics and art, authors have noted that separate competencies and skills are emphasized by each of the programs, making it possible or desirable for high school students to take advantage of both courses of study (Willis, 1999; Savinov, 2006).

according to their socioeconomic and racial background, and whether they were identified as academically gifted.

Conclusion: Research Questions

To date, there has been limited investigation of student persistence in the IB Diploma Program, as well as of the possibility that students could take advantage of being enrolled in both the IB program and take AP courses. Moreover, my preliminary review of the literature suggests that much of the research completed has been carried out at a small scale and/or has made use of qualitative methodologies. As a result, I believe that my thesis will offer a unique contribution to the literature, as I propose to use quantitative methodologies to address specific questions that have yet to be investigated thoroughly at a broad scale. In sum, I plan to address the following research questions in my proposed thesis:

RQ 1) When are students who enroll in an IB Program as ninth graders at greatest risk of making non-promotional exits from the program? In addition, is the risk of non-promotional exit greater for racial and ethnic minority students and/or for students who have been identified as academically gifted?

RQ 2) Were high school students who enrolled in an IB program more or less likely to take an AP course than students who did not enroll in the IB program? Does this relationship differ for students of different racial/ethnic backgrounds and/or those classified as academically gifted, or not?

RESEARCH DESIGN

Dataset and Site

I will use data from the Florida K-20 Education Data Warehouse (EDW) to address my research questions. The EDW contains individual-level data on all students who graduated from Florida's public high schools and includes high school transcripts and selected student characteristics, such as gender, race, socioeconomic status (as determined by free- and reduced-price lunch), and student exceptionalities

(such as whether a student has a learning disability or is academically gifted). The richness of this data source makes it optimal for my research questions. Moreover, Florida is the fourth most populated state and home to a large, diverse population. While 62% of its citizens are White, 16% are Black, 2.5% are Asian, and 19.5% are Hispanic (U.S. Census, 2006). The data are provided without personally identifiable information, which ensures confidentiality.

Study #1: Investigating Non-Promotional Exit from the IB Program

Sample.

For my first research question , my proposed sample will contain all students who graduated from a Florida public high school in 2001 and 2002 and were enrolled in an IB program while in high school (to include pre-IB courses beginning in ninth grade), approximately 6,000 students in total, across both cohorts. I focus on these specific exit cohorts because they constitute the most recent set of data to which I have access, and the data have been mined explicitly by the EDW for my proposed analysis.

Measures.

I will create a person-period dataset from these data, in which each high school student will contribute one row of data for each grade-level that he or she was enrolled in an IB program. The ninth-grade year will be the origin of time for my proposed study, consistent with previous research on the IB program (Samore, 1992; Tsukuda, 1998). My dataset will contain the following time-varying and time-invariant variables for each student in each grade in my sample:

Outcome Variable:

EXIT A time-varying dichotomous variable that records whether a student made a non-promotional exit from the IB program in each grade (0 = still enrolled, 1 = exited in that grade), given that they did not exit in an earlier grade.

Question Predictors:

GRADE A vector of time-varying dichotomous variables that distinguish each of the grades in which a student is present in a school, represented by G9-G12: the value of *G9* is set to 1 when the student is in ninth grade (0, otherwise); *G10* = 1 in tenth grade (0, otherwise), etc.

RACE I will code the six race/ethnicity categories as a vector of time-invariant dichotomous variables (named ASIAN, BLACK, HISPANIC, MULTIRACIAL, NATIVE, and WHITE). A student who is Asian, for instance, would have the value of dichotomous predictor ASIAN coded as 1, and be coded 0 for students in the remaining race categories. In my statistical models, I propose to omit predictor WHITE to form the reference category.

GIFTED A time-invariant, dichotomous variable to represent whether a student was classified as academically gifted by his or her school district (=1) or not (=0).

Control Predictors:

COHORT A time-invariant, dichotomous predictor indicating the year in which a student graduated from high school (0=2001, 1=2002).

SCHOOL A vector of time-invariant dichotomous predictors distinguishing schools. I will use these covariates to account for the fixed effects of the clustering of students within each IB school. I will eliminate one school to serve as the reference category.

Data Analysis.

I propose to use discrete-time survival analysis to investigate the relationship between the conditional probability that a student will make a non-promotional exit from the IB program in a

particular grade, given that the student has survived to that grade (the "hazard" probability), and my key predictors (Singer & Willett, 2003). To do so, I will fit logistic regression models of the following form in my person-period dataset:

$$\begin{aligned} logit\ h(EXIT_{ijk}) = &[\alpha_9 G9_{ij} + \alpha_{10} G10_{ij} + \alpha_{11} G11_{ij} + \alpha_{12} G12_{ij}] \\ &+ [\boldsymbol{\beta_1}' \boldsymbol{RACE}_i + \beta_2 GIFTED_i + \gamma' Z + \delta' \boldsymbol{S}_{ik}] \end{aligned} \quad \textbf{(1)}$$

for student *i*, in year *j*, at school *k*, where γ represents the effects of my covariates. In this model, the α coefficients represent the value of the logit-hazard probability (the log-odds of event occurrence) in each time period for individuals in the baseline group (those for whom all substantive predictors are zero) (Singer & Willet, 2003). Parameters $\boldsymbol{\beta_1}$ and β_2 represent the hypothesized main effects of race and gifted status, respectively, on a student's risk of leaving an IB program. So, for instance, if the estimated value of one of the elements on parameter vector $\boldsymbol{\beta_1}$ is negative and statistically significant, I will then know that the risk of non-promotional exit from an IB program for students of that particular race is lower, on average, than the risk for White students. Similarly, if the estimated value of parameter β_2 is negative and statistically significant, I will also know that students who are identified as academically gifted are also, on average, at lower risk of leaving an IB program than students not so designated. I will interpret my findings by plotting fitted hazard and survivor functions for prototypical students, and by estimating the corresponding median lengths of time spent in the IB program to the first non-promotional exit.[3]

Threats to Validity and Limitations.

As stated earlier, this study uses administrative data, and accordingly, my results must be interpreted descriptively, and not causally. In addition, there are shortcomings to my dataset. First, there is no variable that indicates whether a student is enrolled explicitly in an IB program. To make this

[3] During my orals, I will discuss the possibility of including interactions between the substantive predictors (e.g. race, gifted status and socioeconomic status) and modify my interpretations if it is shown that they have a significant impact on the outcome.

determination, I will examine students' transcript data and use the records of whether or not they enrolled in IB courses to ascertain whether and when a student was in, or out, of the program. In collaboration with my readers, I will test the sensitivity of my findings to planned variation in the coding of the transcripts.

Study #2: Examining the Impact of Introducing an IB Program on AP Course Participation

To address my second question, I will use a "difference-in-differences" strategy to attempt to estimate the causal impact of the introduction of an IB program on AP course participation by high school students in my key districts.[4] Under this strategy, I treat the initial introduction of an IB program in these districts as an exogenous policy shift and I will use a before-and-after comparison to estimate the causal impact of the disruption on my outcome, AP course participation. More specifically, in specifying interaction terms in my logistic regression models, I subtract the *first* and *second* difference from each other to obtain an estimate of the causal impact of the policy shift. The "first difference" compares the probability of taking an AP course before and after the introduction of an IB program, by high school students in key districts. If the introduction of an IB program did have an impact on AP course participation, then I would expect to see an increase in the probability of taking AP courses amongst students who were enrolled in an IB program if the programs are viewed as complementary; however, I might also see a decrease in probability on enrolling in an AP course if the programs are regarded as substitutes. There may also be variation in course taking according to a student's racial background or whether s/he was identified as academically gifted, as previously explained in the background and context section.

Yet, because the probability of taking an AP course may differ from year-to-year for other reasons (such as shifting school enrollment trends, and the availability of teachers to teach the courses, for example) this estimated first difference may also include the impact of these "secular" changes. Thus, I will also use a "second difference" to capture such influences, and I will specify my regression models to

[4] A "key" district is one in which an IB program was implemented.

effectively remove this second difference from the first. I will estimate this second difference by taking advantage of a comparison group made up of students who lived in Florida districts where IB programs were not implemented over the same period. Because those students were not in districts where an IB program was implemented, I can attribute changes in AP course participation over the same period to general underlying trends rather than the introduction of an IB program. Then, when – during my fitting of the hypothesized statistical models -- I effectively subtract the second difference from the first difference, I am left with an estimate that is arguably the causal impact of the introduction of an IB program on students' participation in AP courses.

Sample.

My proposed sample will include all students who graduated from a Florida high school in 1996, 1998, and 2000, and will therefore also include those high school students from districts that introduced an IB program. It will also include students who graduated from high school during those years from districts that did not introduce an IB program, which will provide the "second difference" to which I have referred above.

Measures.

I will assemble my data into a person-level dataset, in which each individual contributes a single row of data. It will include the following variables:

Outcome Variable:

APENROLL A dichotomous variable to represent whether a student enrolled in an AP course at any time during high school (=1, 0 otherwise)

Question Predictors:

KEYDISTRICT A dichotomous predictor to indicate whether the student was enrolled in a district that implemented an IB program (=1, 0 otherwise).

AFTER A dichotomous predictor to indicate whether the value of the outcome was taken *after* the implementation of the IB program (=1, 0 otherwise).

RACE I will again code the six race categories as a vector of dummy variables (ASIAN, BLACK, HISPANIC, MULTIRACIAL, NATIVE, and WHITE). In my models, I will omit predictor WHITE to form the reference category.

GIFTED A dichotomous variable to represent whether a student was classified as academically gifted by his or her school district (=1, 0 otherwise).

Control Predictors:

YEAR A set of dummy variables included to represent the years in which an IB program was implemented.

SCHOOL A vector of dichotomous predictors representing school, to account for the clustering of students within each IB school (the "fixed effects" of school). This will be represented in my statistical models by vector $\boldsymbol{S}$, with one school eliminated as a reference category.

Data Analysis.

I will fit the following multilevel statistical model, treating the probability that an individual took an AP course as my outcome:

$$APENROLL = \beta_0 + \beta_1(AFTER_i * KEYDISTRICT_i) + \beta_2 AFTER_i + \beta_3 KEYDISTRICT_i + \boldsymbol{\beta}_4' \boldsymbol{RACE}_i + \beta_5 GIFTED_i + \gamma' z + \delta' \boldsymbol{S}_{ik} \quad \textbf{(2)}$$

for individual i, in year y, at school k, and where γ represents the effects of a vector of selected covariate measures. In this hypothesized model, parameter β_1 is the principle coefficient of interest because it represents the difference-in-differences estimate of the introduction of an IB program on the probability of a student taking an AP course while in high school. If its estimated value is non-zero, positive and

statistically significant, then I will know that on average, across districts, the introduction of an IB program caused the probability that a student took an AP course to increase. During my analyses, I will also test for the impact of further interactions between the key AFTER*KEYDISTRICT interaction with RACE and GIFTED, to assess whether the causal impact of IB program implementation differed according to those characteristics.

Threats to Validity and Limitations.

In my difference-in-differences design, I will make use of a *two-year* gap across which to estimate differences (e.g. the difference-in-differences between the 1998 and 1996 cohorts), because I do not have access to data for adjacent years. Optimally, in a difference-in-differences design, the measured differences would be observed at the time point straddling an immediate exogenous policy change (e.g. the difference-in-differences between the 1998 and 1997 cohorts). Yet, I believe that capitalizing on the two-year shift in policy will still provide a plausible estimate of the causal effect and provide a meaningful contribution to the literature, perhaps a lower bound on the effect.[5]

(Word Count: 4,997)

[5] This analysis relies on an intent-to-treat design, and I will discuss the possibility of using instrumental variables estimation to account for this shortcoming during my orals (see Appendix A).

REFERENCES

Baum, S. and Ma, J. (2007). *Education Pays: The Benefits of Higher Education for Individuals and Society*. Retrieved September 13, 2009 from http://www.hhh.umn.edu/img/assets/10160/PSEO2005.pdf

Brown, R. (2005). *Changes in Advanced Placement Course-Taking in California's High Schools 1998-2003*. Irvine, CA: University of California-Irvine. Online version obtained from http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1009&context=ucaccord.

Bunnell, T. (2008). The global growth of the International Baccalaureate Diploma Programme over the first 40 years: a critical assessment. *Comparative Education, 44*(4), 409-424.

Byrd, S., Ellington, L., Gross, P., Jago, C., & Stern, S. (2007, November). *Advanced Placement and International Baccalaureate: Do they deserve gold star status?* New York: Thomas B. Fordham Institute. Retrieved from http://www.edexcellence.net/detail/news.cfm?news_id=378

Callahan, C. M. (2003). *Advanced Placement and International Baccalaureate programs for talented students in American high schools: A focus on science and math* (RM03176). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut.

Casserly, P. L. (1986). Advanced Placement Revisited. College Board Report 86-2. New York: College Entrance Examination Board.

College Board, The. (2009). *Advanced Placement Report to the Nation.* Online version obtained from: http://www.collegeboard.com/html/aprtn/pdf/ap_report_to_the_nation.pdf.

Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1997). *Talented teenagers*. Cambridge, England: Cambridge University Press.

Dougherty, C., Mellor, L., & Jian, S. (2006). The relationship between Advanced Placement and college graduation. (National Center for Educational Accountability: 2005 AP Study Series, Report 1). Austin, Texas: National Center for Educational Accountability.

Duevel, L. (1999). *The International Baccalaureate experience: University perseverance attainment, and perspectives on the process*. Unpublished doctoral dissertation, Purdue University.

Dugan, T. (2005). Anniversary Reflections: AP and IB at Princeton High School. *Journal of Best Practices (2)*1, 31-33.

Florida Information Note. Retrieved on September 12, 2009 from http://www.myfloridaeducation.com/dps/dpsmemo01/01-056a.pdf

Foust, R. C., Hertberg-Davis, H., & Callahan, C. M. (2009). *Students' perceptions of the social/emotional participation in Advanced Placement and International Baccalaureate programs* (RM09238). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut.

Geiser, P. and Santelices, V. (2004). The role of advanced placement and honors courses in college admissions. University of California, Berkeley: Center for Studies in Higher Education.

Gemma, M.G. (2004). *An analysis of the effectiveness of three dual-credit programs.* Unpublished doctoral dissertation, Arizona State University.

Hertberg-Davis, H., Callahan, C. M., & Kyburg, R. M. (2006). *Advanced Placement and International Baccalaureate Programs: A "Fit" for Gifted Learners?* (RM06222). Storrs, CT: The National Research Center on the Gifted and Talented, University of Connecticut.

International Baccalaureate Organization Website. Retrieved on September 13, 2009 from http://www.ibo.org.

Klopfenstein, K. (2004a). The advanced placement expansion of the 1990s: How did traditionally underserved students fare? Education Policy Analysis Archives, 12(68). Retrieved September 10, 2009 from http://epaa.asu.edu/epaa/v12n68/

Klopfenstein, K. (2004b). Advanced placement: Do minorities have equal opportunity? *Economics of Education Review* (23), 115-131.

Klopfenstein, K. and Thomas, M. K. (2009). "The Link Between Advanced Placement Experience and Early College Success." *The Southern Economic Journal*, *75*(3), 873–891.

Kyburg, R. M., Hertberg-Davis, H., and Callahan, C. M. (2007). "Advanced Placement and International Baccalaureate Programs: Optimal Learning Environments for Talented Minorities?" *Journal of Advanced Academics, 18*(2), 172-215.

Mathews, J. (2009, January 9). New Data on AP's Impact. *The Washington Post.* Online version obtained September 12, 2009 from http://www.washingtonpost.com/wp-dyn/content/article/2009/01/09/AR2009010901085.html

Mathews, J. & Hill, I. (2005). Supertest: How the international baccalaureate can strengthen our schools. Peru, IL: Open Court.

Mayer, A. P. (2008). Expanding Opportunities for High Achievement: An International Baccalaureate Diploma Program in an Urban High School. *Journal of Advanced Academics, 19*(2), 202-235.

National Commission on Excellence in Education. (1983). *A nation at risk: The imperative for educational reform*. Washington, DC: United States Department of Education.

Ndura, E., Robinson, M., & Ochs, G. (2003). Minority students in high school Advanced Placement courses: Opportunity and equity denied. *American Secondary Education, 32*(1), 21-38.

Nugent, S. (2002). *The Advanced Placement Program and the International Baccalaureate Programme.* Gifted Child Today, 25(1), p. 18-23.

Oakes, J. (1995). Two cities' tracking and within-school segregation. *Teachers College Record, 96*(4), 681-690.

Oakes, J. (2008). Keeping Track: Structuring Equality and Inequality in an Era of Accountability. *Teachers College Record, 110*(3), 700-712.

Poelzer, G.H. & Feldhusen, J. F. (1997). *The International Baccalaureate program: A program for gifted secondary students*. Roeper Review, 19, 168-171.

Rogers, K. B., & Kimpston, R. D. (1992). *Acceleration: What we do vs. what we know*. Educational Leadership, *50*(2), 58-61.

Renzulli, J. (2000). Personal communication with Carolyn Callahan.

Rothschild, E. (1999). Four decades of the advanced placement program. *The History Teacher, 32,* 175-206.

Samore, D.C.M. (1992). *Admissions criteria as predictors of success in the International Baccalaureate*. Unpublished doctoral dissertation, Florida Atlantic University.

Savinov, V. (2006). A Comparison of AP and IB (HL) Physics Curricula. Unpublished manuscript, University of Pittsburgh.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* Oxford: Oxford University Press.

Suldo, S. M., Shaunessy, E., Michalowski, J., & Shaffer, E. S. (2008). Coping strategies of high school students in an International Baccalaureate program. *Psychology in the Schools, 45* (10), 960-977.

Shaunessy, E. & Suldo, S.M. (2010). Strategies used by intellectually gifted students to cope with stress during their participation in a high school International Baccalaureate Program. *Gifted Child Quarterly, 54*(2), 127-137.

Taylor, L., Pogrebin, M., & Dodge, M. (2003) "Advanced Placement Advanced Pressures: Academic Dishonesty Among Elite High School Students." *Educational Studies* 33(4):389-421.

Tookey, M. E. (2000). *The International Baccalaureate.* Journal of Secondary Gifted Education, 11, 52-63.

Tsukuda, A. (1998) *A study of indicators discriminating between recipients and non-recipients of the International Baccalaureate Diploma*. Unpublished doctoral dissertation, Florida International University.

Willingham, W. W. & Morris, M. (1986). Four Years Later: A Longitudinal Study of Advanced Placement Students in College. College Board Report 86-2. New York: College Entrance Examination Board.

Willis, S. (1999). *A descriptive analysis of assessment procedures used in the Advanced Placement Studio Art Program and the International Baccalaureate Art and Design Programme*. Unpublished doctoral dissertation, Florida State University.

APPENDIX A

Methodological Details of a Follow-Up Instrumental-Variables Analysis

Because every student in a district that introduced an IB program did not actually enroll in an IB program, my analysis rests on an intent-to-treat design. As a result, during my orals, I propose to discuss the possibility of using instrumental variables estimation to estimate the impact of the introduction of an IB program on AP course taking for students who *actually enrolled* in an IB program, as a sensitivity analysis. In order to accomplish this, I will use whether a student was enrolled in one of the key districts and thus had the *offer* of being in an IB program, as an instrument represented by the variable IBOFFER. For my outcome variable, I will create the variable IBENROLL, to represent whether a student actually enrolled in an IB program. I will then fit the following models:

1st stage model:

$$IBENROLL = \gamma_0 + \gamma_1 IBOFFER_i + \gamma_2 RACE_i + \gamma_3 GIFTED_i + \theta' Z + \lambda' \boldsymbol{S}_{ik} + \delta_i \quad \textbf{(3)}$$

2nd stage model:

$$APENROLL = \beta_0 + \beta_1 \hat{IBENROLL} + \beta_2 RACE_i + \beta_3 GIFTED_i + \theta' Z + \lambda' \boldsymbol{S}_{ik} + \varepsilon_i \quad \textbf{(4)}$$

for student i, in year y, at school k. $\theta' Z$ represents selected covariate measures, $\lambda' \boldsymbol{S}_{ik}$ represents the fixed effects of school, δ_i represents the first-stage residual, and ε_i represents the second-stage residual. In these models, parameter β_1 represents the hypothesized influence of actually being enrolled in an IB program on AP course taking. If the estimated value of the parameter is non-zero, positive, and statistically significant, then I will interpret the result to suggest that on average, across districts, students who enrolled in an IB program were more likely to take AP courses than those who did not. I will conduct a similar analysis with the number of AP courses taken as the primary outcome of interest. In further

exploration, I will include interactions of IBENROLL with RACE and GIFTED to determine if the size of the effects differ according to a students' race and whether s/he was identified as academically gifted.