The Effect of Postsecondary Entry on Wage Income: A Comparison of Community College Transfer and Four-Year Native Graduates

Jeremy B. Tuchmayer

North Carolina State University

This research was supported by a dissertation grant from the Association for Institutional Research, the National Science Foundation, the National Center for Education Statistics, and the National Postsecondary Education Cooperative under Association for Institutional Research Grant Number DG13-53.

Any opinions, findings, and conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the Association for Institutional Research, the National Science Foundation, the National Center for Education Statistics, or the National Postsecondary Education Cooperative.

The Effect of Postsecondary Entry on Wage Income: A Comparison of Community College Transfer and Four-Year Native Graduates

Pathways to the baccalaureate degree are numerous, yet understanding how the choice of postsecondary entry affects post-graduate wage income is complex and not well understood. Economic researchers agree that a college degree is strongly associated with economic mobility through increased wages, lower unemployment rates, and the associated fringe benefits of employment (Autor, 2014; Pierce, 2010). The research on the relationship between earnings and education is well established through human capital models (Becker, 1975, 1993; Mincer, 1974; Schultz, 1961). Postsecondary study builds human capital (Paulsen, 2001) and is strongly correlated with increased earnings (Baum & Ma, 2007; Paulsen, 2001; United States Census Bureau [USCB], 2011; United States Department of Education [USDE], 2010). Indeed, the lifetime earnings premium associated with a college degree is roughly one million dollars more relative to those whose educational pursuits end with the high school diploma (USCB, 2011). Yet an unanswered question remains: are all pathways to the baccalaureate degree associated equally with the baccalaureate earnings premium? Do those whose postsecondary pursuits begin in the community college system and conclude with the four-year degree enjoy the same earnings premium as native four-year graduates?

In 2010, 13 million community college students were enrolled in credit and non-credit programs, representing almost half of the nation's undergraduate students (AACC, 2012). Furthermore, low-income, minority, and first-generation students are more likely to attend community colleges than four-year institutions. Indeed, more than half of the nation's Native American and Hispanic postsecondary students are enrolled in community colleges (AACC, 2012). While approximately 80 percent of all students who begin postsecondary study at a

community college intend to complete a bachelor's degree, less than 25 percent are ultimately successful within six years (Bradburn & Hurst, 2001; Bradburn, Hurst, & Peng, 2001; USDE, 2010). Moreover, only between 23 and 27 percent of all community college students complete the associate's degree within three years (ACT, 2010). Many scholars have explained this discrepancy by suggesting that community colleges dissuade students from their educational goals (Brint & Karabel, 1989) through a process of "cooling-out" (Clark, 1960) or the "diversion effect" (Rouse, 1995). Clark (1960) found that one of the functions of community colleges was to assist marginal students in redefining success; thereby providing a soft denial as educators and academic counselors slowly reoriented these students towards more realistic achievements. This cooling out process slowly redirected these students away from the baccalaureate and into more manageable and realizable pursuits. Similarly, Rouse (1995) argued that close proximity to a community college and cost of attendance diverts some students away from four-year institutions who would have completed more years of schooling had they matriculated to the four-year institution. Others have argued that community colleges have a "democratizing effect" (Brint & Karabel, 1989; Rouse, 19995) in that many students who matriculate at a community college would not have otherwise enrolled in postsecondary study.

The democratizing versus diversion debate has generated much discussion among researchers. Many studies have found a strong diversion effect, or a community college penalty, for students who begin postsecondary study at community colleges in terms of reduced educational attainment or degree completion (Alfonso, 2006; Bowen, Chingos, & McPherson, 2009; Doyle, 2009; Long & Kurlaender, 2009; Reynolds, 2006; Sandy, Gonzalez, & Hilmer, 2006). Yet, less is known about whether or not a similar community college penalty affects post-

college wage income for students who earn their bachelor's degree after having first matriculated at a community college.

Previous Studies

Although little research has been done comparing community college transfer students who obtain the baccalaureate degree with native four-year graduates, a plethora of studies have examined the pathways to the baccalaureate for community college transfer students. This previous research is important to note because barriers to the baccalaureate for community college transfer students may ultimately be reflected in post-college earnings.

Educational attainment. Community college students face a multitude of obstacles on the path towards degree attainment. Several studies have shown that academic ability, college-level preparation, or the differences in campus cultures, demographics and policies between the community college and four-year institution adversely affect transfer rates and baccalaureate degree attainment (Anderson, Alfonso, & Sun, 2006; Alfonso, 2006; Bailey & Weininger, 2002; Bradburn & Hurst, 2001; Brint, 2003; Dougherty, 1992; Dougherty & Kienzl, 2006; Hilmer, 1997; Leigh & Gill, 2003, 2004; Roksa, 2006; Sandy *et al.*, 2006; Shaw & London, 2001; Townsend, 1995; Wassmer, Moore, & Shulock, 2004). Yet others have found that low course-load intensity and credit accumulation reduce transfer rates (Adelman, 1999, 2004, 2006; Doyle, 2011).

Once community college students successfully transfer to a four-year institution, disagreement exists as to how these transfer students perform relative to their native counterparts. Native students are often defined as students who began and subsequently continued their higher education enrollment at the same four-year institution (Carlan, 2001; Glass & Harrington, 2002; Holahan, Green, & Kelley, 1983; Keeley & House, 1993). Some

scholars have found that transfer students do quite well in their new institutions despite being less prepared academically as freshmen at community colleges than many native freshmen (Best & Gehring, 1993; Bogart & Price, 1993; Diaz, 1992; Hollomon & Snowden, 1996; Johnson-Benson, Geltner, & Steinberg, 2001; Owen, 1991; Porter, 1999; Solomon, 2001). However, other studies indicate that community college transfer students are unprepared for the rigorous curriculum at the nation's colleges and universities (Beckenstein, 1992; Dougherty, 1992; National Center for Education Statistics [NCES], 2003; Townsend, 2001). In fact, transfer students often experience transfer shock, a decrease in grade point average between the last semester at their former institution and the end of the first or second semester at their new institution (Anglin, Davis, & Mooradian, 1995; Berger & Malaney, 2001, 2003; Carlan & Byxbe, 2000; Cejda, 1994, 1997; Cejda, Kaylor, & Rewey, 1998; Glass & Harrington, 2002; Hills, 1965; Holahan, *et al*., 1983; Keeley & House, 1993; Laanan, 2001; Rhine, Milligan, & Nelson, 2000; Thurmond, 2007; Whitfield, 2005).

Substantial evidence is accumulating that some form of community college penalty exists which reduces educational attainment and degree completion (Alfonso, 2006; Bowen, Chingos, & McPherson, 2009; Doyle, 2009; Long & Kurlaender, 2009; Reynolds, 2006; Sandy *et al.*, 2006). Yet, little research has been done to extend this line of inquiry beyond the baccalaureate degree. This study intends to address this gap in the literature and examines whether or not students who begin their postsecondary study at a community college prior to obtaining their bachelor's degree enjoy the same earnings premium as four-year native graduates.

Labor market outcomes. Several studies have examined the labor market returns of community college students in general. For example, evidence suggests that the average community college student who never transfers to a four-year institution earns approximately

nine to 13 percent more than the average high school graduate with similar academic ability (Belfield & Bailey, 2011; Leigh & Gill, 1997; Kane & Rouse, 1995, 1999). More importantly, some studies have estimated that each year of credit at a community college is associated with a four to eight percent increase in annual income compared to high school graduates, which roughly approximates the six to nine percent return in income (compared to those with a high school diploma) for one year of education at a four-year institution (Belfield & Bailey, 2011; Kane & Rouse, 1995; Grubb, 1995; Monk-Turner, 1994). For older, more experienced, and displaced workers, researchers found each additional year of community college was associated with a two to five percent increase in annual income. Digging deeper, this study found that quantitatively or technically oriented courses yielded a 15 percent increase in annual earnings, while non-quantitative, non-technical courses such as social sciences and humanities yielded negligible returns to annual income (Jacobson, LaLonde, & Sullivan, 1997, 2005).

Another technique for studying labor-market returns to education is to examine highest degree earned. While the rates of return vary by gender, with women recording higher gains, in general students who earn their associate's degree can expect to earn between 16 and 31 percent more in annual income than those with a high school diploma (Kane & Rouse, 1995, Leigh & Gill, 1997). Conversely, students with bachelor's degrees might expect to earn between 42 and 51 percent more than those with a high school diploma, with women again reporting higher gains than men (Kane & Rouse, 1995).

While scholars have examined the returns to education for community college students (compared only to high school graduates), much less is known about the labor market returns for college graduates who began postsecondary study at a community college. Despite the paucity of research, one study found that students who began postsecondary study at a community

college prior to earning their baccalaureate ultimately attended less selective four-year institutions than their counterparts and were significantly more likely to attend public institutions over private institutions (Kolesnikova, 2009). Moreover, this study found those who earned an associate's degree prior to attaining their baccalaureate were ten percentage-points less likely to pursue graduate education (60% versus 70%) than four-year native graduates and experienced an earnings penalty in the amount of $2,426 per annum. While this earnings gap was smaller for those with bachelor's and master's degrees ($2,269 and $2,117 per year, respectively), the gap increased dramatically for those with doctoral or professional degrees ($6,884 and $7,768 per year, respectively) (Kolesnikova, 2009). Although the results of this analysis seem to confirm that some form of penalty exists both in terms of earnings and postgraduate study, the author made no attempt to control for selection bias. Therefore, it is highly likely that the magnitude of her estimates are inflated given that they likely also reflect inherent differences between those who began postsecondary study at a community college relative to four-year native graduates. As the research has suggested, there is a community college penalty in terms of educational attainment or degree completion for those who initially enroll at a community college; this study seeks to address this gap in the literature and examines if a similar penalty also exists in the labor market.

Theoretical Framework

Using the existing literature and theories on the college student choice process, this study is primarily grounded in the economic framework of human capital theory. Human capital theory is the most widely used method for examining college choice decisions, both at the undergraduate and graduate level (Paulsen & Toutkoushian, 2008). Moreover, human capital

theory is also used extensively in examining labor market outcomes of college graduates (Baum & Ma, 2007; Paulsen, 2001).

Human Capital

The human capital model suggests individuals invest in an array of knowledge, skills, and competencies in order to maximize productivity and earn higher wages (Becker, 1962, 1964). The rise in American high school graduates pursuing postsecondary education can increasingly be attributed to the belief that one accrues considerable economic benefits, in addition to gains in health, nutrition, civic and cultural engagement, and overall quality of life as a direct result of one's investment in postsecondary education (Becker, 1993). Human capital theory assumes that education, job training, and other means of acquiring knowledge and skills are a form of capital investment that benefits both oneself and society. The human capital theory posits that, *ceteris paribus*, wage income is positively correlated with knowledge and ability. Thus, the labor market rewards individuals who invest in additional education or training with greater salaries. Human capital theory relies on the assumption that labor market outcomes are influenced by the level of one's productivity, and that variance in productivity is attributable to the different types of investment individuals make in themselves, as exemplified through both the quantity and quality of their education and job training skills, among other factors (Becker, 1964, 1975, 1993; Mincer, 1958, 1962, 1974; Schultz, 1960, 1961).

Community colleges provide students with open access to postsecondary education and offer an affordable gateway to postsecondary education for students from a variety of economic backgrounds. The human capital model suggests a framework for why students might choose to begin postsecondary study at community colleges rather than four-year institutions. In an attempt to reduce the costs of a college education, some students may wish to first matriculate at

community colleges because they are substantially less expensive than four-year institutions and can significantly reduce the overall cost of the baccalaureate degree. Moreover, community colleges may also provide marginal students an opportunity to better their educational record, improving their odds of transferring to a more selective baccalaureate institution. Indeed, some have suggested transfer students who began postsecondary study at community colleges ultimately matriculated to higher quality universities than they otherwise would have attended had they not begun at a community college, with students from lower income families and those who performed poorly in high school making the largest gains (Hilmer, 1997).

While human capital theory provides the primary lens for examining labor market gains, this theoretical perspective is limited in that it fails to account for additional factors that may influence an individual's pathway to the baccalaureate. The framework for this study is thereby enhanced through the inclusion of additional perspectives informed by the theoretical perspectives of social and cultural capital. Recent scholarship suggests that college choice models are enhanced by the inclusion of social and cultural capital perspectives (Perna, 2004, 2006).

Cultural and Social Capital

Cultural capital is often defined as a complex set of shared attitudes, attributes and values families transmit to their children in an attempt to maintain or improve one's social status. Similarly, social capital includes the connections to knowledge and resources one derives from one's access to various social networks, relationships, and individual associations (Hossler, Schmit & Vesper, 1999; McDonough, 1997; Perna, 2006). This is similar to Bourdieu's (1986) habitus which Hossler, Schmit and Vesper (1999) define as "an internalized set of experiences, outlooks, and beliefs that individuals accumulate from their immediate environment" (p. 152).

Furthermore, these accumulated sets of attitudes, values, and beliefs individuals acquire through social and cultural capital provide a vehicle for creating and preserving class status and social privileges. Indeed, these very "preference[s] for a college education and advanced degrees is one form of cultural capital that enables middle-class and upper-class families to retain their economic status" (Hossler *et al*., 1999, p. 152). Therefore, since a baccalaureate degree is vital to the retention and acquisition of social and cultural capital, it seems only appropriate to examine this study through the lens of the college choice process.

Screening Hypothesis

This study is further enhanced by including in its theoretical framework the principles of screening, signaling, and credentialism (Bills, 2003). Broadly speaking, this theory posits that individuals *signal* to employers in an attempt to highlight certain information to an employer; whereas *screening* is an action undertaken by an employer to filter applicants according to a predetermined set of criteria (Arrow, 1973, Spence, 1973). The screening hypothesis suggests that the positive relationship between education and income may not be based entirely on the increased ability education claims to signify. Rather than adding value in their own right, years of schooling and educational credentials also signal a set of inherent abilities or characteristics preferred by potential employers. Taken together, theories of screening and signaling may help explain variances in wage income between two otherwise equal individuals that simply cannot be explained through the lens of human capital theory alone.

Literature Review

A firm understanding of the college choice process is critical to this study, as the theories of social and cultural capital clearly demonstrate the myriad factors that influence students' choice patterns. These initial choice decisions determine the pathway to the baccalaureate

students will take, which in turn strongly affects their post-college wage income. First, factors associated with the college choice process help explain why some students may initially begin postsecondary study at community college compared to a four-year institution. This initial sorting decision is paramount, since this study seeks to explain how the difference in postsecondary entry affects post-college outcomes. Moreover, even for students who initially matriculate at a four-year institution, or later transfer to a four-year institution, the factors associated with the college choice process directly affect the quality of institution one attends. College quality has been shown to have substantial predictive effects on wage income (Zhang & Thomas, 2005), thus a full accounting of what factors are associated with the choice of pathway students choose in route to the baccalaureate is imperative. The following literature will illuminate why individuals who begin postsecondary entry at a community college may differ substantially from their four-year native peers. These substantial differences in selection of postsecondary entry necessitate the use of a matching or weighting technique (i.e. propensity score matching or inverse probability weighting) to control for or reduce this selection bias inherent in the college choice process, therefore producing truer estimates of the returns to schooling.

College Choice

Building on the social and cultural theories of Bourdieu (1986), sociological theories of status attainment quickly emerged into early conceptions of the college choice process. One of the primary vehicles for attaining or preserving social status is through educational endeavors, including years of schooling and degrees earned. However, an individual's social status is also largely affected by parental factors such as family income, education, and occupation. Within the context of the college choice process, scholars have operationalized status attainment as a

culmination of lived experiences and opportunities derived in large part through an individual's family attitudes, beliefs, and preferences (D. Chapman, 1981; R. Chapman, 1984; Hossler & Gallagher, 1987). These familial and social influences shape a student's behavior and affect one's postsecondary educational decisions, including type of institution and field of study. These early scholars concluded that the factors most heavily associated with one's socioeconomic status (e.g. parental income, education, and occupation) were highly correlated with the type and quality of institution one attended (Hearn, 1991). Specifically, Hearn (1991) found that students from low socioeconomic backgrounds were significantly more likely to attend less selective institutions, irrespective of academic ability, achievement, or expectations.

Initial econometric studies of the college choice process drew heavily from economic theory and were often framed from a human capital perspective. In contrast to the sociological models of status attainment, human capital theory assumes individuals pursue additional levels of education in order to increase their productivity and desirability in the labor market, allowing them to compete for higher wages (Zhang & Thomas, 2005). In the context of college choice, human capital models are predicated upon the notion that high school graduates utilize a rational cost-benefit analysis when deciding whether or not to enter the labor market, seek postsecondary study, or join the military (Hossler *et al*., 1999). These econometric models assume that students are presented with an array of options which are evaluated and eliminated according to a rational decision-making process. Individuals consider both direct (*e.g.* tuition, fees) and indirect costs (*e.g.* forgone earnings) against potential future benefits (*e.g.* higher lifetime earnings) in order to maximize the return on their investment (Chapman, 1979, 1981). Conceptual models later emerged from this research, and often characterized the college going process as comprised of various linear stages (Hossler & Gallagher, 1987; Hossler *et al*., 1999; Kotler & Fox, 1985).

While initial studies using a sociological or econometric approach were informative, critics noted that on their own, these models failed to adequately describe the college going process in sufficient detail (Hossler *et al*., 1999; Perna, 2006). Consequently, researchers began creating combined models of college choice using both human capital theory as well as a sociological framework of social and cultural capital for investigating the college choice practices of high school students. These combined models typically assumed that students made rational decisions based on some form of cost-benefit analysis weighing immediate costs against future benefits. These models varied from earlier econometric models because they also assumed that the college choice process was necessarily too complex to be described in purely human capital terms, and that more importantly college choice patterns varied substantially based on individual characteristics (Hossler, Braxton, & Coopersmith, 1989; Hossler *et* al., 1999; Jackson, 1982; Chapman, 1986).

Deviating from the linear college search process, others sought to incorporate economic and sociological viewpoints into an overall conceptual framework (Paulsen, 1990; Perna, 2006). Shifting from a focus on this linear process essentially comprised of predisposition, search, and choice, other scholars began to examine the role that human, social, and cultural capital played in college choice decisions. Later conceptual frameworks incorporated additional economic factors such as financial aid, tuition or list price, and net price of attendance into their models (Paulsen and St. John, 2002; St. John, Paulsen, & Carter, 2005). From this new line of inquiry emerged an integrated model of college choice that includes the effects of human, social, cultural, and financial capital on students' perceptions, decisions, and behaviors. This combined model comprised of four nested, overlapping contexts that together more fully addressed the college choice process (Perna, 2006). Perna's (2006) model incorporated the various characteristics of

human capital, habitus, social and cultural capital, and institutional contexts together into one unified theoretical model.

Individual Characteristics and Earnings

When estimating the economic returns to education, a bevy of individual attributes such as educational attainment or degree, age, gender and race each affect wage income differently (Belfield & Bailey, 2011; Leigh & Gill, 1997; Kane & Rouse, 1995, 1999; USCB, 2010; U.S. Department of Labor [USDL], 2010, 2011). Previous research has found that, in general, wage income is strongly correlated with age and level of education. The research has consistently shown that those with advanced degrees can expect greater lifetime earnings than their peers with fewer degrees or years of schooling (Leigh & Gill, 1997; Kane & Rouse, 1995). While this study is limited only to those whose highest degree is the baccalaureate, a smaller subset of the population also obtained an associates' degree prior to earning the baccalaureate. Moreover, recent data from the U.S. Census Bureau (2010) continue to illustrate that income rises with age, peaking around age 54 and then decreasing slowly until age 64, before dropping substantially for persons 65 or older. Income also appears strongly correlated with gender and race, with men and white individuals earning more than women and persons of color (USCB, 2010; USDL, 2010).

College Quality and Earnings

Researchers have long sought to link college quality with a return to earnings, thereby directly connecting human capital theory not just to the quantity, but also the quality of one's educational investment (Behrman & Birdsall, 1983; Reed & Miller, 1970; Solmon, 1973, 1975; Weisbrod & Karpoff, 1968; Wise, 1975). Indeed, Behrman and Birdsall (1983) specifically addressed that issue and demonstrated that the quantity of one's education was a necessary but not sufficient condition to estimate the return to schooling, arguing instead that the quality of

one's education must also be included in any Mincerian (1962, 1974) framework that estimates individual earnings. More recently, educational researchers have advanced this line of inquiry and drastically enhanced our understanding of the effect of college quality on earnings (Brewer & Ehrenberg, 1996; Brewer, Eide & Ehrenberg, 1999; Eide *et al*., 1998; Thomas, 2000, 2003).

In one large review of twenty-four "methodologically rigorous studies," which included twelve studies identified in an earlier review (Brewer *et al*., 1999), college quality was found to have a modest yet statistically significant effect on earnings (Zhang & Thomas, 2005, p. 255). While indicators of college quality varied significantly in these studies, common measures included average achievement test scores (*i.e.* SAT/ACT) of the entering class (Dale & Krueger, 1999; Griffin & Alexander, 1978; Morgan & Duncan, 1979; Mueller, 1988; Solmon, 1973, 1975; Thomas 2000, 2003; Wise, 1975), Carnegie Classification (Solmon & Wachtel, 1975), tuition (Smart, 1988), institutional expenditures per full-time equivalent student (Morgan & Duncan, 1979; Wachtel, 1976), and Barron's (Brewer & Ehrenberg, 1996; Brewer *et al*., 1999) or Gourman ratings (Solmon, 1973; 1975; Wales, 1973). While the majority of these studies found a modest earnings premium exists for students who graduated from higher quality institutions, wide discrepancy remained across the studies with conclusions ranging from non-significant or negative effects on earnings relative to college quality to substantial earnings premiums for graduates from elite private institutions (Zhang & Thomas, 2005).

College Major and Earnings

While much attention has been paid to the relationship between college quality and earnings, economists argue that choice of college major has perhaps the greatest impact on post-college earnings, finding that natural science majors earn considerably more than those majoring in the humanities (Arcidiacono, 2004; Berger, 1998; Gill & Leigh, 2000; James, Alsalam,

Conaty, & To, 1989; Rumberber, 1984; Rumberber & Thomas, 1993; Thomas, 2000; Thomas & Zhang, 2005). Answering the hypothetical question posed in the title of their paper, some scholars have concluded that "while sending your child to Harvard appears to be a good investment, sending him to your local state university to major in Engineering, to take lots of math, and preferably to attain a high GPA, is an even better private investment" (James *et al*., 1989, p. 251-2). Thomas (2003, p. 283) countered that "all things being equal, if one desired to maximize postgraduate earnings, she would choose a high quality college or university, major in a lucrative area such as health or engineering, and strive to attain a high grade point average over the course of her studies."

A relatively recent survey of the literature of the economic returns by college major largely confirmed the previous findings, concluding that education, humanities, (*e.g.* liberal arts), psychology and other social science graduates earned less over their lifetime than those majoring in computer science, engineering, health professions, or the natural sciences (Hearn & Bunton, 2001). Recent Census data on the population over the age of 25 also supports previous research that students majoring in the natural science and engineering earn higher wages than their peers who majored in education, the arts, or humanities disciplines (USCB, 2011). For example, graduates who majored in engineering reported the highest annual earnings at roughly $92,000, compared to about $51,000 for those majoring in education or the visual and performing arts. The fields of study associated with the highest median annual earnings for women were the same as for men, with median annual earnings for engineering majors being the highest for both. Consistent with other research, women continued to earn less than men in every field of degree (USCB, 2011).

Methodology

The central purpose of this study sought to explore the extent to which variations in the pathway to the baccalaureate degree affected post-college earnings. Specifically, the pathways to the baccalaureate (*i.e.* treatment conditions) in this study included persons who: (1) *attended* a community college at any point prior to graduating from a baccalaureate degree-granting institution, regardless of credit hour accumulation or associate's degree attainment; (2) *began* postsecondary study at a community college and, regardless of credit hour accumulation or associate's degree attainment, subsequently transferred to and graduated from a baccalaureate degree-granting institution; (3) earned one's *associate's degree* prior to graduating from a baccalaureate degree-granting institution; and (4) began postsecondary study at a community college *and* earned one's associate's degree prior to graduating from a baccalaureate degree-granting institution. In each of these four treatment scenarios, the control group consisted of persons who matriculated to and graduated from the same baccalaureate degree-granting institution (*e.g.* four-year native graduates).

The two outcome measures of interest included wage income one and four years after graduating with a bachelor's degree (*i.e.* 2009 and 2012, respectively). Two different inverse probability of treatment weighting (IPTW) models using the propensity score were used to estimate the average treatment effect of the treated (ATT) across the four aforementioned treatment conditions (*i.e.* pathways to the baccalaureate). Model one defined treatment as having occurred immediately *prior to postsecondary entry*; whereas, model two defined treatment as having occurred at time of *graduation* from the four-year institution. The central difference between these two models was that the latter model included a larger array of covariates accounting for differences in the postsecondary environment (*e.g.* distance and college quality,

academic experiences and major, financial and economic attributes, etc.); whereas, the former only included covariates accounting for differences in the pre-college environment (*e.g.* individual, familial, academic, and high school attributes).

Randomized control trials are considered the gold standard in clinical trials for estimating the effects of a treatment on outcomes of interest. Randomized control trials ensure treatment is not confounded with either observed or unobserved attributes. As a result of this reduction of allocation bias on the treatment condition, the effect of treatment on outcomes of interest may be estimated by directly comparing outcomes between treated and untreated individuals (Greenland, Pearl, & Robins, 1999).

Randomized control trials are impractical in most social science research, yet there is a burgeoning attentiveness to estimating treatment effects on outcomes in observational (*i.e.* nonrandomized) studies. In observational studies such as this, treatment selection is often determined by observed characteristics. Consequently, initial characteristics of individuals under treatment systematically differ from those of untreated individuals. The cumulative effect of these differences on the characteristic variables are included in the estimated coefficient of the treatment variable, creating bias and confounding attempts at causal inference (Winship & Morgan, 1999). Therefore, applied researchers must account for these systematic differences between treated and untreated individuals when estimating the effect of a treatment condition on outcomes of interest. Regression analysis is insufficient for reducing the selection bias inherent in assigning treatment conditions to observational data. Recently, methods based on propensity score analysis have been used to reduce or eliminate the effects of confounding when using observational data.

The Propensity Score

To address the issue of selection bias and provide for causal inference, scholars developed the counterfactual model of causal inference (Heckman & Hotz, 1989; Heckman, Ichimura, Smith, & Todd, 1998; Rosenbaum & Rubin, 1983, 1985). This statistical approach attempts to replicate an experimental design with randomized assignment by assigning matched students to treatment and control groups. In a true randomized experiment, the random assignment of subjects to treatment and control groups guarantees that both groups have equal background characteristics. This assurance that the two groups are equal allows for any differences observed between the two groups on the dependent measure to be attributable to the treatment alone and not caused by any baseline characteristics.

The counterfactual model replicates this process by first building a logistic regression model that predicts the dichotomous outcome of the treatment variable. This model includes as predictor variables the measured baseline characteristics that might otherwise distinguish students from one another related to the treatment condition. The result of this logistic regression model estimates the probability or likelihood of that student being assigned to the treatment group. This estimate is known as the propensity score, and ranges from 0 to 1 (Rosenbaum & Rubin, 1983, 1985).

Propensity score matching requires creating matched pairs of treated and untreated individuals who share a similar value of the propensity score (Rosenbaum & Rubin, 1983, 1985). Propensity score matching allows researchers to estimate the ATT, the average effect of treatment on those individuals who ultimately underwent the treatment (Imbens, 2004). In order to create these matched pairs for propensity score analysis applied researchers are confronted with a dizzying array of decisions (Austin, 2011). First, one must choose between matching with

or without replacement (Rosenbaum, 2002). Matching with replacement allows a single untreated individual to be included in more than one matched set with treated individuals. Matching without replacement removes that untreated individual from further analysis once he or she has been matched with a treated individual. Next, researchers must decide between greedy and optimal matching (Rosenbaum, 2002). In so called greedy matching (*i.e.* nearest neighbor), a treated individual is first selected at random and then matched with the nearest untreated individual whose propensity scores closely resemble one another. This process is referred to as greedy because the closely identified match occurs without considering whether or not that untreated individual would be a better match with a subsequent treated individual. The alternative, optimal matching (*i.e.* nearest neighbor with a specified caliper distance), identifies matches that minimize the total within-pair difference of the propensity score. Finally, if selecting the nearest neighbor with a specified caliper distance, the researcher must then determine what the caliper distance should be (Rosenbaum & Rubin, 1985). Aside from the researcher being confronted with multiple decisions, another disadvantage to propensity score matching techniques is that once all available matched pairs are created, often times sample size is reduced as observations without clear matches are removed from analysis. Without complete case analysis, threats to external validity arise.

Inverse Probability of Treatment Weighting

Instead, inverse probability of treatment weighting (IPTW) using the propensity score uses weights based on the propensity score to create a synthetic sample in which the distribution of measured baseline covariates is independent of treatment assignment. The use of IPTW is similar to the use of survey sampling weights that are used to weigh survey samples so that they are representative of specific populations (Morgan & Todd, 2008). Inverse probability of

treatment weighting using the propensity score allows for complete case analysis and is doubly robust since after weighting the data to simulate matched pairs, covariates are included in the model to further identify the true effect of treatment. When estimating the ATT, individuals who underwent treatment received a weight of one. Untreated individuals received a weight of $\frac{p}{1-p}$, where *p* represents the propensity score (Porter, 2015). When estimating the ATT is goal is to estimate the effect of treatment for those who underwent treatment; therefore no adjustment needs to be made to weights of the treated group. However, untreated individuals look different from treated individuals, thus they are weighted such that they will look similar to treated individuals. After calculating the propensity scores for each of the four treatment conditions across both conceptual models, and applying the inverse probability of treatment weights using the aforementioned formulas, the synthetic samples produced roughly equal means across the 83 covariates used to predict the treatment conditions.

Data

The data come from the 2008 Baccalaureate and Beyond Longitudinal Study with the 2012 follow-up data (B&B:08/12) which was obtained from the National Center for Education Statistics under a restricted use license. Of the 17,110[1] observations in the dataset, only 15,050 completed their bachelor's degree in 2007-08. The sample was further reduced to 13,140 after removing observations with a prior undergraduate certificate (*n* = 920), and those with prior bachelor's (*n* = 920), master's (*n* = 30), and doctoral (*n* = 40) degrees. Table 1 describes the number of observations for each of the four treatment conditions. All analysis was conducted using STATA 13, a statistical software package commonly used among social science researchers.

[1] National Center for Education Statistics (NCES) requires all sample sizes to be rounded to the nearest 10.

Missing Data

Missing data frequently present complications for empirical researchers. These complications result from the fact that in statistical analysis, every case is presumed to have information on all other variables included in the analysis (Allison, 2001). Given this vexing issue, it is nevertheless difficult to properly handle missing values.

Even when several methods of dealing with missing data are available, those techniques often assume that observations are *missing at random* (MAR). MAR suggests that a variable's missing value is not related to the observed value of that variable, controlling for all other variables (Allison, 2001; Cohen, Cohen, West & Aiken, 2003). A slightly more robust assumption, *missing completely at random* (MCAR), suggests that a variable's missing value is not related to the value of the variable itself or to the values of any other variable (Allison, 2001).

There are three generally recognized approaches to resolving the issue with missing values: dummy variable adjustment, listwise deletion, and imputation. Dummy variable adjustment is one of the most direct approaches, and is often used by researches as a quick or convenient way to account for missingness. The limitation with this approach is that heterogeneous groups of students are combined into one missing group, ignoring the differences across these group members. Listwise deletion, on the other hand, is a common method used by researchers and is available in nearly all statistical packages. Listwise deletion excludes cases that have missing values for any variables included in the regression equation. The central limitation of this approach is that it reduces the size of the analytic sample. The problem with this approach is since all cases with missing values are excluded from the sample, a significant number of observations may be omitted from the analysis, potentially reducing the analytic

sample to a size too small for meaningful and precise inference. Moreover, the estimates obtained using listwise deletion may be biased due to selection issues (Allison, 2001).

Multiple imputation. The more accepted approach to resolve the issue of missing values is multiple imputation. Multiple imputation is a comparatively recent methodological development that generates values to replace missing data through a variety of statistical methods. Developed by Rubin (1978), the approach has become the more accepted method of choice for handling missing data, provided certain assumptions are met. Multiple imputation procedures involve directly introducing a random component into the generation of multiple *imputed* datasets that calculate the predicted value of missing data from the other complete data contained in the dataset. The random component encompasses capturing random draws from the Bayesian posterior distribution of the model parameters (Allison, 2001).

While there are several methods to conduct multiple imputation using a variety of statistical packages, this study employed the *mi impute* command in Stata 13 (Multiple Imputation, 2012). As is similar with most multiple imputation packages, *mi impute* creates multiple copies of imputed datasets by using predicted equations for each variable (Multiple Imputation, 2012). Of the 89 variables used in this study (four treatment variables, two dependent variables, 28 pre-college covariates, and 55 postsecondary covariates), 21 variables contained missing data. While twenty of these variables were missing in about 15 percent or fewer of their cases, one binary variable indicating whether or not the individual could afford college without working was missing in 38 percent of its cases. While no agreement exists on the number of imputations required to ensure high efficiency, low loss of power, and stable standard error and *p*-values, some researchers have begun recommending the number of imputations should roughly approximate the proportion of missingness in your data (Bodner,

2008; White, Royston, & Wood, 2011). Consequently, given one case with almost 40 percent missingness, I created 50 imputations to ensure proper standard errors were calculated.

Analysis

In an attempt to chart a few of the myriad pathways students may take to the baccalaureate, this study devised four treatment conditions under which the analysis would be conducted. In all analyses, the outcome of interest is wage income after completion of the baccalaureate. Given the longitudinal nature of this data, the effect of each of these four treatment conditions on wage income could be estimated twice: once one year after completion of the bachelor's degree, and again three years later (2009 and 2012 wage income, respectively). Creating the four treatment conditions was largely intuitive, but was also aided by the available data. Although an untold number of pathways to the baccalaureate exist, this study focused exclusively on the role of the community college as a conduit to the baccalaureate. As such, the following four treatment conditions were created: (1) persons who *attended* a community college at any point prior in their postsecondary career; (2) individuals who *began* postsecondary study at a community college; (3) those who earned an *associate's degree* prior to graduating with their bachelor's degree; and finally (4) individuals who began postsecondary study at a community college *and* earned an associate's degree prior to graduating from a baccalaureate degree-granting institution. In each of these four treatment scenarios the control group consisted of persons who matriculated to and graduated from the same baccalaureate degree-granting institution (*e.g.* four-year native graduates); therefore allowing the effect of community college experience on wage income after completion of the baccalaureate to be examined.

In addition to the four treatment conditions, a second crucial choice in study design also needed to be decided. As the literature clearly demonstrates, those who began their

postsecondary career in a community college are systematically different from those who do not (Chapman, 1981; Hearn, 1991; Hossler & Gallagher, 1987; Hossler *et al*., 1999). Properly accounting for these differences prior to postsecondary entry allowed this study to estimate the effect the choice of postsecondary entry had on wage income after baccalaureate degree attainment. Conversely, with regards to the returns on schooling, the literature unmistakably demonstrated the effects college quality (Zhang & Thomas, 2005), college major (Berger, 1998; Gill & Leigh, 2000; Hearn & Bunton, 2001; James *et al*., 1989; USCB, 2011; Zhang, 2003), and financial aid (St. John *et al.*, 1996; St. John, 2002; St. John *et al.*, 2005) had on wage income. Failing to account for these and other collegiate factors would bias any results. Consequently, two models were created: the first only accounted for factors before postsecondary entry; the second included the previous model in addition to factors associated with the collegiate experience. In both instances, the covariates for each of these models were included in the logit regression to calculate the propensity score (later used in the inverse probability of treatment weighting), as well as the final regression model estimating the effect of treatment on wage income.

Any Community College Experience

The first treatment condition explored the relationship between those individuals who ever attended a community college at any point in their educational career and those who did not. This treatment condition effectively serves as a baseline determination of the differences that exist between persons who have any experience at the community college level and those whose only experiences were at a four-year institution.

Pre-college model. In order to chart the effect of the confoundedness inherent in the choice of postsecondary entry, naïve multivariate regressions were conducted on wage income

with 28 pre-college covariates including the treatment condition. These so-called naïve estimates simply reflect the association between the treatment condition and wage income without balancing the observations on the propensity score (*i.e.* the bias in the treatment condition has not yet been accounted for). Naïve estimates demonstrated that individuals with any community college experience earned \$1811 ($p < .001$) more in annual income one year after graduation and \$2246 ($p < .001$) four years after graduation than did native college graduates without any community college experience. However, once the data were balanced on the propensity score and those who experienced the treatment condition now looked similar to those who did not on all covariates, these differences increased. After inclusion of the IPTW using the propensity score, individuals with community college experience earned \$2232 ($p < .001$) more in their first year and \$2734 ($p < .001$) more four years after college graduation than did native college graduates.

Postsecondary model. With the inclusion of the full model (83 covariates plus the treatment condition), the magnitude of the differences in income were reduced. Naïve estimates without the propensity weighting showed no differences in wage income one year ($M = 768$, $p = .108$) or four years ($M = 1088$, $p = .124$) after receipt of the baccalaureate degree between those with any community college experience and four-year native graduates. Nonetheless, after eliminating the bias and including the IPTW using the propensity score, differences in wage income emerged. With the inclusion of the full model, differences in wage income decreased from the pre-college model yet remained statistically significant. Individuals with some community college experience earned \$1157 ($p = .003$) more in their first year and \$1733 ($p = .003$) more four years after graduation than did four-year native graduates.

Postsecondary Entry

The second treatment condition explored the relationship between individuals who began their postsecondary career at a community college, regardless of credit hour accumulation or associate's degree attainment, before graduating with their bachelor's degree relative to their peers who matriculated to and graduated from the same four-year institution. This treatment condition is designed to typify the traditional difference between community college transfer students and four-year native graduates. More than anything else, this treatment condition illuminates how college choice effects wage income after graduation.

Pre-college model. Naïve estimates demonstrated that students who began their postsecondary career at a community college earned \$1544 (p = .001) more in their first year and \$2333 (p < .001) more four years after receipt of their baccalaureate compared to native four-year graduates. After balancing the data on the propensity score through the IPTW technique, individuals who began their postsecondary career at a community college earned \$2021 (p < .001) more in their first year and \$3002 (p < .001) more four years after graduation than their four-year native peers.

Postsecondary model. With inclusion of the full model, the effects of the naïve estimates were mixed. Although no difference in wage income was observed one year after college graduation (M = 786, p = .096), four years later those who began their postsecondary career at a community college earned \$1513 (p = .031) more than native four-year graduates. Nonetheless, after implementation of the IPTW using the propensity score, individuals who started in the community college system earned \$1101 (p = .004) in their first year and \$2077 (p < .001) more four years after college graduation than their four-year native peers.

Associates Degree

Informed by the theories of signaling, screening, and credentialism (Arrow, 1973; Bills, 2003; Spence, 1973), the third treatment condition tests whether or not students who earn an associate's degree prior to the baccalaureate experience an earnings premium relative to their four-year native peers without an associate's degree. Not entirely unlike the work of others who have researched the relationship between highest degree and earnings, this treatment condition attempts to parse out the effect of an associate's degree on wage income when everyone in the sample has a bachelor's degree.

Pre-college model. Naïve estimates showed that individuals with both an associate's and bachelor's degree earned \$2584 ($p < .001$) more in their first year and \$2035 ($p = .011$) more four years after graduation than their peers who only held a bachelor's degree. After accounting for the bias inherent in the selection process through the IPTW using the propensity score, the earnings premium increased for those with an associate's degree. One year after college graduation, the effect of an associate's degree on wage income was estimated at \$4249 ($p < .001$); whereas four years after graduation the earnings premium stood at \$3564 ($p < .001$).

Postsecondary model. With the implementation of the full model, no differences in wage income were observed in the naïve estimates either one year ($M = 550$, $p = .327$) or four years ($M = 170$, $p = .837$) after college graduation. However, after removing bias in the estimates through the implementation of the IPTW using the propensity score, the average treatment effect on the treated was significantly positive. One year after college graduation, the effect of an associate's degree on wage income was \$1115 ($p = .005$). Four years after college graduation no significant differences in wage income were observed ($M = 905$, $p = .126$)

between those who earned an associate's degree in addition to the baccalaureate and those with only the bachelor's degree.

Postsecondary Entry with Associate's

The final treatment condition explored the relationship between initial postsecondary entry and an earned associate's degree on wage income after completion of the baccalaureate. Also informed through the theories of credentialism (in addition to social, cultural, and human capital theories), this treatment condition epitomizes the classical view of the community college: certain individuals begin their postsecondary career in the community college system, earn their associate's degree, and then transfer to and graduate from a four-year institution.

Pre-college model. Naïve estimates indicated the classical community college student with an associate's degree earned \$1610 (p = .010) more one year after graduation and \$2633 (p = .004) more four years after graduation than native four-year graduates. Once bias in the estimates was removed through application of the IPTW using the propensity score, the earnings premium for the classical community college transfer student increased. One year after college graduation, individuals who began postsecondary study in the community college system and received an associate's degree prior to their bachelor's degree earned \$3159 (p < .001) more than four-year native graduates. Four years after college graduation their earning premium increased to \$4356 (p < .001) more than their four-year native peers.

Postsecondary model. Without removing bias from the models, naïve estimations revealed no significant differences in earnings for classical community college graduates one year (M = -80, p = .898) or four years (M = 949, p = .307) after college graduation relative to native four-year graduates. Nevertheless, after removing the bias through implementation of the IPTW using the propensity score, an earnings premium emerged for the classical community

college graduate. One year after college graduation, individuals who began postsecondary study at a community college and received their associate's earned $793 ($p$ = .043) more than four-year native graduates. Four years after college graduation, those same individuals realized an earnings premium of $2042 ($p$ = .001) over their peers with only a bachelor's degree.

Discussion

The purpose of this study was to explore the extent to which variations in the pathway to the baccalaureate degree affected post-college earnings. Four pathways to the baccalaureate were defined as treatment conditions, and the effect of each of these conditions was tested on wage income after graduation using inverse probability of treatment weighting using the propensity score. Results were analyzed using two measures of wage income over time for each of the four treatment conditions, across two separate matching models resulting in sixteen models for analysis. In reviewing these results, four major themes appear: the results are somewhat surprising, a longitudinal trend appears, model specificity improves precision, and the pathway to the baccalaureate appears to matter.

Community College Earnings Premium

At first blush, the results are somewhat surprising. The literature on the college choice process (Chapman, 1981; Hearn, 1991; Hossler & Gallagher, 1987; Hossler *et al*., 1999) suggests that students who enter the community college system (*i.e.* open access, non-selective, relatively inexpensive institutions) are much more likely to be from a minority background, with lower incomes, are less academically prepared, and ultimately have less social, cultural, and human capital than their peers who matriculate at four-year institutions. We know from the literature that these deficits clearly make it more difficult for individuals from these backgrounds to succeed academically, particularly those who matriculate at community colleges with high hopes

of graduating with a bachelor's degree (*e.g.* 80% of them are unsuccessful). By extending this line of inquiry to wage income, some might hypothesize similar disadvantages for students with community college experience in terms of an earnings deficit. The theories on screening, signaling, and credentialism (Arrow, 1973; Bills, 2003; Spence, 1973) are a little less clear. On the one hand, employers could be screening for employees who appear to have higher levels of social, cultural, and human capital; believing them to be more productive than their less equipped peers and rewarding them with higher salaries. This reading of the theory suggests that native four-year graduates might be more likely than those from community colleges to enjoy the earnings premium. On the other hand, the credentialism aspect of this theory suggests that, all else being equal, employers may prefer and therefore reward through higher salaries, individuals with an extra credential—the associate's degree—over their peers with only the baccalaureate.

In fifteen of the sixteen models analyzed in this study, individuals with community college experience received the earnings premium over their four-year native graduate peers. In no case were four-year native graduates observed with higher earnings. The only study that failed to find an earnings premium for community college students resulted in no differences in income being observed between these two groups.

Some community college. The earnings premium was generally lower in the pre-college models exploring the effects of ever having attended a community college than it was in subsequent models for the other three treatment conditions with only one exception (the 2009 income for those who began postsecondary study at a community college in the pre-college model; *c.f.* Tables 2-5). Using the more precise postsecondary models, students with some community college experience enjoyed a greater earnings premium than students in the other

three treatment conditions one year after college, but enjoyed the smallest earnings premium four years after college.

One possible explanation for these confusing results lies in the composition of this treatment group. Of the four treatment conditions, this category had the highest percentage of observations (*e.g.* 36%; *c.f.* Table 1). Also, it isn't clear when in their postsecondary career some of these students attended a community college. The six percentage point difference between those with some community college experience and those who began their postsecondary career in a community college could include students who took college-level courses during high school, or four-year native graduates who took summer school courses at their local community college. These anomalies are difficult to disentangle, which make drawing conclusions from this treatment condition difficult. The incongruities in this treatment condition likely includes observations with very little community college experience and those with a great deal of community college experience, confounding attempts to model accurate estimates.

Postsecondary entry. The earnings premium for students who began their postsecondary career in the community college system is generally lower than the other treatment conditions on the pre-college model, but is among the highest for both years under the more precise postsecondary model. This higher earnings premium in the postsecondary model suggests that grit and resiliency may play a role (Umbach, Tuchmayer, & Clayton, n.d.) in estimating wage income, confounding attempts at causal inference. Given the particularly high obstacles many who begin postsecondary study in the community college system face, those that are able to succeed—to transfer to a four-year institution and earn a four-year degree—may be inherently different than other community college students. This intense motivation to succeed

where others have failed likely biases these results and might help explain the observed earnings premium.

Associate's degree. In both of the treatment conditions which included an associate's degree, the pre-college models returned some of the largest earnings premiums for individuals with an associate's degree (see discussion on model precision). However, after controlling for postsecondary factors in the more complete model, the return for those with an associate's degree is relatively small one year out of college and becomes insignificant four years after graduation. This suggests that receipt of an associate's degree may make college graduates more marketable immediately out of college, but the effects of an additional degree dissipate a few years after graduation. Furthermore, the positive earnings premium experienced by those in the fourth treatment condition (*e.g.* began postsecondary education at a community college and earned an associate's degree) may be more a reflection of the grit and resiliency observed in the second treatment condition (*e.g.* began postsecondary study at a community college) than it is a pure reflection of the credential, given the insignificant findings four years after college graduation for all individuals with an associate's degree (*e.g.* the third treatment condition). Although somewhat confusing, it appears from the results that receipt of the associate's degree independent of anything else, is less predictive of an earnings premium than initial enrollment in the community college system (with or without the associate's degree).

Longitudinal Trend

In seven of the eight models that reflect change in income from 2009 to 2012, the earnings premium increased (the other model indicated no significant difference in income). Given that the magnitude of the earnings premium increased from one year after college graduation to four years after college graduation in each of the four treatment conditions suggests

there is something unique about individuals with community college experience. Individual motivation, grit or resiliency (Umbach *et al.*, n.d.), an unobserved variable in these models, may partially explain these results, confounding any attempts at causal inference. Nonetheless, implementing the IPTW using the propensity score at the very least removed a large portion of the bias in the estimates, allowing for a strong association between community college experience and wage income to emerge, even if causality cannot be claimed.

As demonstrated in the literature, students who enroll in the community college system face tremendous hurdles in their educational pursuits, with large majorities of them failing to graduate with either an associate's or bachelor's degree. For those that are successful; however, motivation to succeed may explain the results. In an earlier study of community college transfer students using statewide administrative date, community college transfer students who were successfully remediated at the community college level demonstrated higher rates of persistence and degree completion at the four-year institution than their fellow transfers who were not remediated (Umbach, *et al.*, n.d.). Something similar may be occurring in this study—all else being equal, students who faced adversity in the community college system and persevered to graduate from a four-year institution may simply have more levels of motivation, grit, or resiliency to persist and succeed, and these increased levels of motivation (*i.e.* more productive individuals) may be rewarded in the labor market in the form of higher salaries.

Model Precision

Across all of the models, the magnitude of the earnings premium was reduced when the postsecondary covariates were introduced into the models. Given the review of the literature, this is not an unexpected finding. Studies have demonstrated the positive relationship between college quality (*e.g.* Zhang & Thomas, 2005), and college major (*e.g.* Hearn & Bunton, 2001;

Zhang, 2003) on earnings. Once these factors, among other collegiate experiences (*e.g.* dean's list versus academic probation, etc.) as well as a host of additional familial factors that could not be included in the pre-college model because they were only observed once enrolled in postsecondary institutions (*e.g.* family income, number of dependents, etc.) were included in the postsecondary model, the magnitude of the earnings premium decreased. Given that a causal relationship is unlikely to have been demonstrated in these studies given the unobserved nature of motivation, the postsecondary model likely represents an increase in model precision, reducing the bias in the estimates on wage income after graduation for each of the four treatment conditions.

Pathway to the Baccalaureate

Given the immense hurdles community college students face in their pathways to the baccalaureate, it would seem impractical to suggest that matriculation to a community college will lead to higher earnings. However, the evidence from this study demonstrates that for individuals who find themselves enrolled in the community college system, hope is not lost. If they persevere, transfer to and graduate from a four-year institution, community college transfer students may be just as successful, if not more so, in the labor market and may even experience higher earnings as a result of their grit, resiliency, and determination to succeed than four-year native graduates. The point here is that there are multiple pathways to the baccalaureate. Individuals should discover their own conduit to that degree and strive to achieve it. In the end, all that extra hard work and motivation to succeed where others have failed may be rewarded in the labor market in the form of higher earnings, as evidenced in this study.

Conclusions

Although this study hoped to demonstrate a causal relationship between community college experience and wage income after graduation, it appears that unobserved factors confounded the estimates and have biased the results. Nevertheless, despite the lack of causality, this study illustrates a strong positive relationship between community college experience for those who also earn a bachelor's degree and wage income after graduation. Further research should be conducted to determine if the inclusion of additional covariates in the models substantiates these findings, or are there other explanatory relationships driving the observed wage premium for individuals with community college experience? In all but one of the models, the earnings premium for community college individuals increased from one year after college graduation to four years later. Further study should be conducted to examine if this trend continues over the lifecycle of one's career. If the earnings premium continues to increase as distance from college graduation increases, this might be additional evidence that some other important unobserved factors are at play in this relationship (motivation, or perhaps another factor) that are driving increased earnings. What conclusions should be drawn from the seemingly contradictory evidence of the relationship between the earnings premium and an associate's degree? Is this further evidence of credentialism, where employers may reward individuals who possess additional degrees with greater earnings (as observed in three of the four models), or are there other factors that might explain the positive relationship between an associate's degree and earnings? Finally, what makes community college transfer students so unique? Above all else, this study confirms a strong positive relationship between post college earnings and community college experience. Is the relationship the result of motivation, determination, resiliency and grit, or are there other factors at play? Further research should be

conducted on community college transfer students who persevere to the baccalaureate to determine what, if anything, makes them different from even traditional college students. Although no causal relationship may have been discovered in this study, the strong positive findings still suggest that those with community college experience earn higher wages than similar college graduates without such experience. Motivation may explain some of the difference, but it seems unlikely that all else being equal, community college students possess substantially higher levels of motivation than four-year native graduates.

Table 1: Composition of each treatment condition

	n	%
Every Attended 2-Year Institution		
Yes	8440	64%
No	4700	36%
First Postsecondary Institution		
4-Year	9210	70%
2-Year	3930	30%
Earned Associate's Degree Prior to BA		
Yes	2610	20%
No	10530	80%
Began at 2-Year & Earned AA Prior to BA		
Yes	1770	13%
No	11370	87%

Table 2: Attended a Community College Prior to Baccalaureate

	2009			2012		
	ATT	(SE)	p	ATT	(SE)	p
Pre-College Match	$2232	(428)	.000	$2734	(603)	.000
Postsecondary Match	$1157	(385)	.003	$1733	(586)	.003

Table 3: Postsecondary Entry at a Community College

	2009			2012		
	ATT	(SE)	p	ATT	(SE)	p
Pre-College Match	$2021	(400)	.000	$3002	(572)	.000
Postsecondary Match	$1101	(379)	.004	$2077	(566)	.000

Table 4: Earned an Associate's Degree Prior to Baccalaureate

	2009			2012		
	ATT	(SE)	p	ATT	(SE)	p
Pre-College Match	$4249	(454)	.000	$3564	(659)	.000
Postsecondary Match	$1115	(399)	.005	$905	(591)	.126

Table 5: Postsecondary Entry at a Community College and Earned Associate's

	2009			2012		
	ATT	(SE)	p	ATT	(SE)	p
Pre-College Match	$3159	(421)	.000	$4356	(641)	.000
Postsecondary Match	$793	(391)	.043	$2042	(632)	.001

References

ACT (2010). What works in student retention? Fourth national survey report for all colleges and universities. Retrieved from: http://www.act.org/research/policymakers/pdf/droptables/AllInstitutions.pdf.

Adelman, C. (1999). Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment. *Technical report*. Washington, DC: United States Department of Education.

Adelman, C. (2004). Principal indicators of student academic histories in postsecondary education. *Technical report*. Washington, DC: United States Department of Education.

Adelman, C. (2006). The toolbox revisited: Paths to degree completion from high school through college. *Technical report*. Washington, DC: United States Department of Education.

Alfonso, M. (2006). The impact of community college attendance on baccalaureate attainment. *Research in Higher Education, 47*, 873-903.

Allison, P. D. (2001). *Missing data*. Thousand Oaks, Calif.: Sage Publications.

American Association of Community Colleges (2012). Reclaiming the American dream: Community colleges and the nation's future. Washington, D.C.: American Association of Community Colleges.

Anderson, G. M., Alfonso, M., & Sun, J. C. (2006). Rethinking cooling out at public community colleges: An examination of fiscal and demographic trends in higher education and the rise of statewide articulation agreements. *Teachers College Record, 108*(3), 422–451.

Anglin, L. W., Davis, J. W., & Mooradin, P. W. (1995). Do transfer students graduate? A comparative study of transfer students and native university students. *Community College Journal of Research and Practice, 19,* 321-330.

Arcidiacono, P. (2004). Ability sorting and the returns to college major. *Journal of Econometrics*, *121*, 343–375.

Arrow, K. J. (1973). Higher education as a filter. *Journal of Public Economics, 2*(3), 193-216.

Austin, P. C. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research, 46,* 399-424.

Autor, D. H. (2014). Skills, education and the rise of earnings inequality among the "other 99 percent." *Science, 344,* 843-851.

Bailey, T., & Weininger, E. B. (2002). Performance, graduation, and transfer of immigrants and natives in City University of New York community colleges. *Educational Evaluation and Policy Analysis*, *24*(4), 359–377.

Baum, S., & Ma, J. (2007). Education pays: The benefits of higher education for individuals and society. Washington, D.C.: College Board.

Beckenstein, L. (1992). Success rate of transfer students enrolled in a program for the underprepared at a senior college. *Journal of College Student Development*, *33,* 56-60.

Becker, G.S. (1962). Investment in human capital: A theoretical analysis. *Journal of Political Economy* 70(Suppl. 5): 9–49.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education.* New York: National Bureau of Economic Research.

Becker, G. S. (1975). *Human capital: A theoretical and empirical analysis, with special reference to education* (2nd ed). New York: National Bureau of Economic Research.

Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis with special reference to education*. (3rd ed.). Chicago: University of Chicago Press.

Behrman, J.R., & Birdsall, N. (1983). The quality of schooling: Quantity alone is misleading. *The American Economic Review* 73(5): 928–947.

Belfield, C. R., & Bailey, T. (2011). The benefits of attending community college: A review of the evidence. *Community College Review, 39*(1), 46-68.

Berger, M. (1988). Predicted future earnings and choice of college major. *Industrial and Labor Relations Review, 41*, 418-429.

Berger, J. B., & Malaney, G. D. (2001). Assessing the transition of transfer students from community colleges to a university. Paper presented at the NASPA annual conference on March 20, 2001. (ERIC Document Reproduction Service No. ED 453 489).

Berger, J. B., & Malaney, G. D. (2003). Assessing the transition of transfer students from community colleges to a university. *NASPA Journal, 40*(4), 1-23.

Best, G. A., & Gehring, D. D. (1993). The academic performance of community college transfer students at a major state university in Kentucky. *Community College Review, 21*(2), 32-41.

Bills, D. B. (2003). Credentials, signals, and screens: Explaining the relationship between schooling and job assignment. *Review of Educational Research, 73*(4), 441-469.

Bodner, T. (2008). What improves with increased missing data imputations? *Structural Equation Modeling: A Multidisciplinary Journal, 15*, 651-675.

Bowen, W. G., Chingos, M. M., & McPherson, M. S. (2009). *Crossing the finish line: Completing college at America's public universities*. Princeton, NJ: Princeton University Press.

Bradburn, E. M., & Hurst, D. G. (2001). Community college transfer rates to 4-year institutions using alternative definitions of transfer. *Education Statistics Quarterly, 3*(3), 119-125.

Bradburn, E. M., Hurst, D. G., & Peng, S. (2001). Community college transfer rates to 4-year institutions using alternative definitions of transfer. U.S. Department of Education, National Center for Education Statistics. Available: http://nces.ed.gov/pubs2001/2001197.pdf

Brewer, D., & Ehrenberg, R. (1996). Does it pay to attend an elite private college? Evidence from the senior class of 1980. *Research in Labor Economics* 15: 239–272.

Brewer, D., Eide, E., & Ehrenberg, R. (1999). Does it pay to attend an elite private college? Cross cohort evidence on the effects of college type on earnings. *Journal of Human Resources* 34(1): 104–123.

Brint, S. (2003). Few remaining dreams: Community colleges since 1985. *Annals of the American Academy of Political and Social Science, 586,* 16–37.

Brint, S., & Karabel, J. (1989). *The diverted dream*. Oxford: Oxford University Press.

Bogart, Q. J., & Price, M. J. (1993). Arizona student success: A comparative study of community college transfer, four-year college transfer, and native university students. A final report to the state, its leadership, and its citizens. Phoenix, AZ: Arizona State Board of Directors for Community Colleges. (ERIC Document Reproduction Service No. ED 361 048).

Bourdieu, P. (1986). The forms of capital. In J.G. Richardson (ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241–258). New York: Greenwood Press.

Bowen, W. G., Chingos, M. M., & McPherson, M. S. (2009). *Crossing the finish line: Completing college at America's public universities*. Princeton, NJ: Princeton University Press.

Carlan, P. E. (2001). Adult students and community college beginnings: Examining the efficacy of performance stereotypes on a university campus. *College Student Journal, 35*, 169-181.

Carlan, P. E., & Byxbe, F. R. (2000). Community colleges under the microscope: An analysis of performance predictors for native and transfer students. *Community College Review, 28*, 27-42.

Cejda, B. D. (1994). Reducing transfer shock through faculty collaboration: A case study. *Community College Journal of Research and Practice, 18*, 189-199.

Cejda, B. D. (1997). An examination of transfer shock in academic disciplines. *Community College Journal of Research and Practice, 21*(3), 279-288.

Cejda, B. D., Kaylor, A. J., & Rewey, K. L. (1998). Transfer shock in an academic discipline: The relationship between students' majors and their academic performance. *Community College Review, 26*(3), 1-13.

Chapman, D. W. (1981). A model of student college choice. *Journal of Higher Education, 52*(2), 490-505.

Chapman, R. G. (1984). Toward a theory of college choice: A model of college search and choice behavior. Alberta, Canada: University of Alberta.

Chapman, R. G. (1986). Toward a theory of college selection: A model of college search and choice behavior. *Advances in Consumer Research, 13*, 246-250.

Clark, B. A. (1960). The "cooling-out" function in higher education. *The American Journal of Sociology, 65*(6), 569-576.

Dale, S., & Krueger, A. (1999). *Estimating the Payoff to Attending a More Selective College.* (NBER Working Paper Series No. 7322). Cambridge, MA: National Bureau of Economic Research.

Diaz, P. (1992). Effects of transfer on academic performance of community college students at the four-year institution. *Community/Junior College Quarterly, 16*(3), 279-291.

Dougherty, K. J. (1992). Community colleges and baccalaureate attainment. *Journal of Higher Education, 63*(2), 188-214.

Dougherty, K. J., & Kienzl, G. S. (2006). It's not enough to get through the open door: Inequalities by social background in transfer from community colleges to four-year colleges. *Teachers College Record, 108*(3), 452–487.

Doyle, W. R. (2009). The effect of community college enrollment on bachelor's degree completion. *Economics of Education Review, 28,* 199–206.

Doyle, W. R. (2011). Effect of increased academic momentum on transfer rates: An application of the generalized propensity score. *Economics of Education Review, 30,* 191–200.

Eide, E., Brewer, D.J., & Ehrenberg, R.G. (1998). Does it pay to attend an elite private college? Evidence on the effects of undergraduate college quality on graduate school attendance. *Economics of Education Review, 17*(4), 371–376.

Gill, A. M. & Leigh, D. E. (2000). Community college enrollment, college major, and the gender wage gap. *Industrial and Labor Relations Review, 54*(1), 163-181.

Glass, J. C., & Harrington, A. (2002). Academic performance of community college transfer students and native students at a large state university. *Community College Journal of Research, 26,* 415-430.

Greenland, S., Pearl, J., & Robins, J. M. (1999). Causal diagrams for epidemiologic research. *Epidemiology, 10,* 37-48.

Griffin, L., & Alexander, K. (1978). Schooling and socioeconomic attainments: High school and college influences. *American Journal of Sociology 84*(2): 319–347.

Grubb, W. N. (1995). Postsecondary education and the sub-baccalaureate labor market: Corrections and extensions. *Economics of Education Review. 14*(3), 285-299.

Hearn, J. C. (1991). Academic and nonacademic influences on the college destinations of 1980 high school graduates. *Sociology of Education, 64*(3), 158-171.

Hearn, J.C., & Bunton, S.A. (2001). The effects of students' fields of study on their earnings and other outcomes of postsecondary education. *PEPSC Policy Brief 01-02*. Postsecondary Education Policy Studies Center, University of Minnesota, Minneapolis, MN.

Heckman, J. J., & Hotz, V. J. (1989). Choosing among alternative nonexperimental methods for estimating the impact of social programs: The case of manpower training. *Journal of the American Statistical Association, 84,* 862–875.

Heckman, J. J., Ichimura, H., Smith, J., & Todd, P. (1998). Characterizing selection bias using experimental data. *Econometrica, 66,* 1017–1098.

Hilmer, M. J. (1997). Does community college attendance provide a strategic path to a higher quality education? *Economics of Education Review, 16*(1), 59–68.

Hills, J. R. (1965). Transfer shock: The academic performance of the junior college transfer. *Journal of Experimental Education, 33,* 201-215.

Holahan, C. K., Green, J. L., & Kelley, H. P. (1983). A 6-year longitudinal analysis of transfer student performance and retention. *Journal of College Student Personnel, 24,* 305-310.

Hollomon, C. A., & Snowden, M. (1996). Comparing performance of two-year community college students to four-year native students. (ERIC Document Reproduction Service No. ED 403 005).

Hossler, D., Braxton, J., & Coopersmith, G. (1989). Understanding student college choice. In J. C. Smart (Ed). *Higher Education: Handbook of Theory and Research* (pp.231-288). New York: Agathon Press.

Hossler, D., & Gallagher, K. S. (1987). Studying student college choice: A three-phase model and the implications for policymakers. *College and University, 62*(3), 207-221.

Hossler, D., Schmit, J., & Vesper, N. (1999). *Going to College: How Social, Economic, and Educational Factors Influence the Decisions Students Make.* Baltimore: The John's Hopkins University Press.

Imbens, G. W. (2004). Nonparametric estimation of average treatment effects under exogeneity: A review. *The Review of Economics and Statistics, 86,* 4-29.

Jacobson, L. S., LaLonde, R. J., & Sullivan, D. G. (1997). The Returns from community college schooling for displaced workers. Federal Reserve Bank of Chicago, WP-97-16.

Jacobson, L. S., LaLonde, R. J., & Sullivan, D. G. (2005). Estimating the returns to community college schooling for displaced workers. *Journal of Econometrics, 125*(1-2), 271-304.

James, E., Alsalam, N., Conaty, J., and To, D. (1989). College quality and future earnings: where should you send your child to college? *American Economic Review, 79*, 247-252.

Johnson-Benson, B., Geltner, P. B., & Steinberg, S. K. (2001). Transfer readiness: A case study of former Santa Monica college students. *New Directions for Community Colleges, 114*, 77-85.

Kane, T. J., & Rouse, C. E. (1995). Labor-market returns to two- and four-year college. *American Economic Review, 85*:3, 600-614.

Kane, T. J., & Rouse, C. E. (1999). The community college: educating students at the margin between college and work. *Journal of Economic Perspectives, 13*(1), 63-84.

Keeley, E. J., III, & House, J. D. (1993). *Transfer shock revisited: A longitudinal study of transfer academic performance*. (ERIC Document Reproduction Service No. ED 357 774).

Kolesnikova, N. (2009). Community colleges: A route of upward economic mobility. *NBER Working Paper*. Federal Reserve Bank of St. Louis. Available at: http://www.stlouisfed.org/community_development/assets/pdf/CommunityColleges.pdf.

Kotler, P. & Fox, K. (1985). *Strategic marketing for educational institutions*. Englewood Cliffs, NJ: Prentice-Hall.

Laanan, F. S. (2001). Transfer student adjustment. *New Directions for Community Colleges, 114*, 5-13.

Leigh, D. E., & Gill, A. M. (1997). Labor market returns to community colleges: Evidence for returning adults. *Journal of Human Resources, 32*(2), 334-353.

Leigh, D. E., & Gill, A. M. (2003). Do community colleges really divert students from earning bachelor's degrees? *Economics of Education Review*, *22*(1), 23–30.

Leigh, D. E., & Gill, A. M. (2004). The effect of community colleges on changing students' educational aspirations. *Economics of Education Review*, *23*(1), 95–102.

Long, B. T., & Kurlaender, M. (2009). Do community colleges provide a viable pathway to a baccalaureate degree? *Educational Evaluation and Policy Analysis, 31*(1), 30-53.

McDonough, P. M. (1997). *Choosing colleges: How social class and schools structure opportunity*. Albany: State University of New York Press.

Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy, 66*, 282-302.

Mincer, J. (1962). On-the-job training: Costs, returns, and some implications. *Journal of Political Economy, 70*(5): 50–79.

Mincer, J. (1974). *Schooling, Experience, and Earnings*. New York: National Bureau of Economic Research.

Monk-Turner, E. (1994). Economic returns to community and four-year college education. *Journal of Socio-Economics, 23*(4): 441-447.

Morgan, J.N., & Duncan, G. (1979). College quality and earnings. *Research in Human Capital and Development* 1: 103–121.

Morgan, S. L., & Todd, J. L. (2008). A diagnostic routine for the detection of consequential heterogeneity of causal effects. *Sociological Methodology, 38*, 231-281.

Mueller, R. (1988). The impact of college selectivity on income for men and women. *Research in Higher Education 29*(2): 175–191.

Multiple Imputation in Stata, Part 1. (2012). UCLA: Statistical Consulting Group. Retrieved from http://www.ats.ucla.edu/stat/stata/seminars/missing_data/mi_in_stata_pt1.htm .

National Center for Education Statistics. (2003). Postsecondary attainment, attendance, curriculum, and performance. Report prepared by C. Adelman, B. Daniel, I. Berkovits,

& J. Owings. NCES 2003-294. Washington, D.C.: U.S. Department of Education, National Center for Education Statistics.

Owen, J. A. (1991). A comparative analysis of the academic performance and graduation rates of freshmen and transfer students. Paper presented at the Association for Institutional Research 1991 Annual Forum. (ERIC Document Reproduction Services No. ED 336 022).

Paulsen, M. B. (1990). *College choice: Understanding student enrollment behavior*. Washington, D.C.: School of Education and Human Development, George Washington University.

Paulsen, M. B. (2001). The economics of human capital and investment in higher education. In Paulsen, M. B., & Smart, J. C. (Eds). *The finance of higher education: Theory, research, policy, and practice.* New York: Agathon Press.

Paulsen, M. B., & St. John, E. P. (2002). Social class and college costs: Examining the financial nexus between college choice and persistence. *Journal of Higher Education, 73,* 189–236.

Paulsen, M. B. & Toutkoushian, R. K. (2008). Economic models and policy analysis in higher education: A diagrammatic exposition. In J. C. Smart (Ed.), *Higher Education: Handbook of Theory and Research, 23,* 1-48. The Netherlands: Springer.

Perna, L. W. (2004). Understanding the decision to enroll in graduate school: Sex and racial/ethnic group differences. *The Journal of Higher Education, 75*(5), 487-527.

Perna, L. W. (2006). Studying college access and choice: A proposed conceptual model. *Higher Education: Handbook of Theory and Research, XXI*, 99-157.

Pierce, B. (2010). Recent trends in compensation inequality. In K. G. Abraham, J. R. Spletzer, and M. Harper (Eds), *Labor in the New Economy* (pp. 63-98). Chicago: The University of Chicago Press.

Porter, S. R. (1999). Assessing transfer and native student performance at four-year institutions. Paper presented at the Association of Institutional Research 1999 Annual Forum, Seattle, Washington.

Porter, S. R. (2015). Lecture: Introduction to propensity score analysis: Nearest neighbor matching and inverse propensity weights [PowerPoint slides]. Retrieved from North Carolina State University, Causal Inference with Observational Data.

Reed, R., & Miller, H. (1970). Some determinants of the variation in earnings for college men. *Journal of Human Resources* 2: 537–587.

Reynolds, C. L. (2006). *Where to attend? Estimates of the effects of beginning at a two-year college* (Working Paper). Ann Arbor: University of Michigan.

Rhine, T. J., Milligan, D. M. & Nelson, L. R. (2000). Alleviating transfer shock: Creating an environment for more successful transfer students. *Community College Journal of Research & Practice, 24*, 443-453.

Roksa, J. (2006). Does the vocational focus of community colleges hinder students' educational attainment? *Review of Higher Education, 29*(4), 499-526.

Rosenbaum, P. R. (2002). *Observational studies* (2nd ed.). New York, NY: Springer-Verlag.

Rosenbaum, P. R., & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika, 70*, 41–55.

Rosenbaum, P. R., & Rubin, D. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician,39,* 33–38.

Rouse, C. E. (1995). Democratization or diversion—the effect of community-colleges on educational-attainment. *Journal of Business and Economic Statistics*, *13*(2), 217–224.

Rubin, D. B. (1978). Multiple imputations in sample surveys—A phenomenological Bayesian approach to nonresponse, in *Proceedings of the Survey Research Methods Section, American Statistical Association*, 20- 34. Also in *Imputation and Editing of Faulty or Missing Survey Data.* U.S. Department of Commerce,1-23.

Rumberger, R. (1984). The changing economic benefits of college graduates. *Economics of Education Review*, *3,* 3-11.

Rumberger R., and Thomas, S. (1993). The economic returns to college quality, major, and performance. *Economics of Education Review*, *12,* 1-19.

Sandy, J., Gonzalez, A., & Hilmer, M. J. (2006). Alternative paths to college completion: Effect of attending a two-year school on the probability of completing a four-year degree. *Economics of Education Review*, *25,* 463-471.

Schultz, T.W. (1961). Investment in human capital. *American Economic Review, 51*(2), 1-17.

Shaw, K. M., & London, H. B. (2001). Culture and ideology in keeping transfer commitment: Three community colleges. *Review of Higher Education*, *25*(1), 91.

Smart, J. (1988). College influences on graduates' income levels. *Research in Higher Education 29*(1): 41–59.

Solmon, L. (1973). The definition and impact of college quality. In L. Solmon and P. Taubman (Eds.), *Does College Matter?* New York: Academic Press.

Solmon, L. (1975). The Definition of College quality and its impact on earnings. *Explorations in Economic Research* 2: 537–588.

Solmon, L., & Wachtel, P. (1975). The effect on income of type of college attended. *Sociology of Education* 48: 75–90.

Spence, A. M. (1974). *Market Signaling.* Cambridge, MA: Harvard University Press.

St. John, E. P., Paulsen, M. B., & Carter, D. E. (2005). Diversity, college costs, and postsecondary opportunity: An examination of the financial nexus between college choice and persistence for African Americans and Whites. *The Journal of Higher Education, 76*(5), 545-569.

St. John, E. P., Paulsen, M. B., & Starkey, J. B. (1996). The nexus between college choice and persistence. *Research in Higher Education, 37*(2), 175-220.

Townsend, B. K. (1995). Community-college transfer students—A case-study of survival. *Review of Higher Education, 18*(2), 175–193.

Townsend, B. K. (2001, Fall). Redefining the community college transfer mission. *Community College Review*, *29*(2), 29-42.

Thomas, S. (2000). Deferred costs and economic returns to college quality, major and academic performance: An analysis of recent graduates in Baccalaureate and Beyond. *Research in Higher Education, 41*(3): 281–313.

Thomas, S. (2003). Longer-term economic effects of college selectivity and control. *Research in Higher Education* 44(3): 263–299.

Thomas, S., & Zhang, L. (2005). Post-baccalaureate wage growth within four years of graduation: The effects of college quality and college major. *Research in Higher Education, 46*(4), 437-459.

Thurmond, K. C. (2007). Transfer shock: Why is a term forty years old still relevant? National Academic Advising Association. Retrieved from NACADA Clearinghouse of Academic Advising Resources: http://www.nacada.ksu.edu/Clearinghouse/AdvisingIssues/Transfer-Shock.

Umbach, P. D., Tuchmayer, J. B., & Clayton, A. B. (Forthcoming, n.d.). Community college transfer student success: Using a cross-classified random effects model to explore individual, community college, and university effects. *Community College Review*.

U.S. Census Bureau (2011). American Community Survey. Retrieved: https://www.census.gov/acs/www/.

U.S. Department of Education (2010). *Digest of education statistics 2009*. Technical report, National Center for Education Statistics.

Wachtel, P. (1976). The effect on earnings of school and college investment expenditures. *Review of Economics and Statistics* 58: 326–331.

Wales, T. (1973). The effects of college quality on earnings: Results from the NBER-Thorndike data. *Journal of Human Resources* 8(3): 306–317.

Wassmer, R., Moore, C., & Shulock, N. (2004). Effect of racial/ethnic composition on transfer rates in community colleges: Implications for policy and practice. *Research in Higher Education*, *45*(6), 651–672.

Weisbrod, B., & Karpoff, P. (1968). Monetary returns to college education, student ability, and college quality. *Review of Economics and Statistics, 50,* 491–497.

White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine, 30,* 377-399.

Whitfield, M. (2005). Transfer-student performance in upper-division chemistry courses: Implications for curricular reform and alignment. *Community College Journal of Research and Practice, 29*, 531-545.

Winship, C., & Morgan, S. L. (1999). The estimation of causal effects from observational data. *Annual Review of Sociology, 25*, 659–707.

Wise, D. (1975). Academic achievement and job performance. *American Economics Review* 65(3): 350–366.

Zhang, L. (2005). Advance to graduate education: The effect of college quality and undergraduate majors. *The Review of Higher Education, 28*(3), 313-338.

Zhang, L. & Thomas, S. L. (2005). Investments in human capital: Sources of variation in the return to college quality. In J. C. Smart (*Ed.), Higher education: Handbook of theory and research, XX*, 241-306.