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Exploring the Iron Triangle:

Predicting Student Success

At A Large Rural Community College

By
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B.A. History, University of Notre Dame, 1988
M.M. Finance, Operations and Organizational Behavior, Northwestern University, 1995

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Education
Educational Leadership

The University of New Mexico
Albuquerque, New Mexico

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DEDICATION

This is dedicated to all of the hardworking people who make the world a better place, one student at a time.

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I would like to acknowledge the many researchers upon whose work this piece is built. In particular, I would like to thank Baum and Ma (CollegeBoard: price and value of higher education), Baumol and Bowen (cost disease), Bowen (higher education costs), Brown and Gamber (higher education costs), Clotfelter (beautiful cost case study), Desrochers, Lenihan and Wellman (cost-shifting), Dickeson (setting institutional priorities), Eagan and Jaeger (effects of adjunct faculty), Ehrenberg (cost drivers), James (cross subsidies), Ewell (challenging the folklore), Kuh, Kinzie, Schuh, and Whitt (resources at DEEP schools), Harvey and Green (defining quality in higher education), Kelly (costs and outputs), Leinbach and Jenkins (milestones), Massy (costs and quality), Massy and Zemsky (academic ratchet—the multiproduct firm), Middaugh (understanding instructional costs), Tinto (student persistence), Twigg (fighting cost disease), Wellman (fighting cost disease), and Winston (higher education economics: differentiating between price and cost).

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Exploring the Iron Triangle:

Predicting Student Success

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ABSTRACT

The Iron Triangle is the belief that Access, Cost, and Quality are linked in such a way that to change one, we must change one or both of the others. For example, to expand Access, some leaders in higher education believe that they must, by definition, either increase Costs or decrease Quality.

Winston has proposed an economic model for higher education which states that Price = Costs - Subsidies. In this model, Price is what students pay to colleges to attend classes, while costs are the expenses incurred by colleges to provide those classes. Subsidies come from a variety of sources, primarily state appropriations, local property taxes and endowments.

Over the past 15 years, there has been a steady decline in state appropriations to higher education. Using Winston's formula, leaders in higher education therefore have two choices to balance their budgets: increase Price or decrease Costs. Based on the fact that higher education

Price increases in tuition and fees have tripled the rate of inflation over the past twenty years, it is evident that leaders have chosen to increase Price, rather than decrease Costs. Some believe that price is a proxy measure of college accessibility. If so, we are limiting Access to college.

I believe the decisions to raise price rather than to cut costs are based in an unexamined faith in the Iron Triangle belief system—the belief that lowering Cost will lower Quality. This study defined instructional Costs and instructional Quality, then explored the relationship between the two at a large, urban, multi-campus community college using logistical regression analysis.

Based on the results of this study, instructional cost variables can impact the predicted probability of student success. The implications for higher education policy makers and for leadership skills within higher education are discussed.

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CHAPTER 1: INTRODUCTION

Community Colleges

Most community college missions are focused on providing open access to a comprehensive set of educational programs and related services (American Association of Community Colleges, 2011). Traditional categories of programs and services include: 1) Academic Transfer programs leading to an associate degree or further study at a baccalaureate institution, 2) Vocational-Technical programs designed to lead directly to employment, 3) Continuing Education programs including Adult Basic Education, General Education Degree, cultural/ personal enrichment, and economic development, 4) Developmental programs to prepare students for college-level programs, and 5) Community Service including non-credit instruction and spectator events (Cohen & Brawer, 2008, pp. 22-25).

In the fall of 2007, 76% of post-secondary students enrolled in public, not-for-profit institutions of higher education. Another 15% enrolled at private not-for-profit colleges and universities. The remainder of students entered for-profit schools (Baum & Ma, 2010).

Public community colleges are typically the lowest price option available in the higher education market, costing on average half the price of private community colleges (Mupinga, Wagner, & Wilcosz, 2009), roughly 33% of public four year universities, 20% of the for-profit four year college, or as little as 10% of the average private four year school (Baum & Ma, 2010; Morey, 2004). With 40% of the total enrollments, public community colleges represent the largest single segment of the higher education market—and over half of the undergraduate market. As such, the costs and quality of these institutions are of great importance, both to the students who pay to attend them, as well as to the local, state and federal governments that subsidize them.

Global Competition

In the United States, approximately 39% of the adult population aged 25-64 earn a college degree, a proportion that has been relatively constant for 40 years (Lumina, 2010). While governmental policies and institutional processes provided the United States with the third highest proportion of college-educated population as recently as 10 years ago (Lumina, 2010), the Organisation for Economic Co-operation and Development (OECD) data for 2005 indicated that the United States fell to the 10th ranked country as measured by the proportion of 25-34 year olds with college degrees (OECD, 2008). In other words, nine other countries' higher education systems are preparing a larger proportion of their citizens to be active members of both their society and their workforce, potentially putting the United States at a competitive disadvantage. Similarly, while India and China are not in the top ten countries by proportion, they still produce more college graduates than the United States due to their large populations.

Several policy-influencing organizations have taken note of this set of circumstances including the Spellings Commission Report (Secretary of Education's Commission on the Future of Higher Education (SECFHE), 2006), the National Center for Higher Education Management Systems (Callan, Ewell, Finney, & Jones, 2007), The National Center for Public Policy and Higher Education and Public Agenda (Immerwahr, Johnson, & Gasbarra, 2008). Ultimately, policymakers influenced President Obama who, in July of 2009, set a goal for the United States of America to have the highest proportion of college graduates in the world by 2020 (Obama, 2009). This completion goal is now formally reflected as part of the strategic vision of the Arizona community colleges (Arizona Community College Presidents' Council (ACCPC), 2012). Yet this goal comes at a time when many believe the price of attending college is spiraling out of control, making higher education unattainable for many.

Higher Education Economics: The Relationship Between Access and Cost

In January of 1998, the National Commission on the Costs of Higher Education produced its final report, "Straight Talk About College Costs and Prices" (Harvey, Williams, Kirshstein, O'Malley, & Wellman, 1998). One of the contributions the report made to the national dialogue was its clarification of the difference between and relationships of costs and prices in higher education. Higher education pricing is based on Winston's (1997) economic model: Price = Costs – Subsidies (P = C - S). Price is what students pay to attend college; whereas cost is what the colleges spend in order to provide classes and related services (Winston, 1996; Winston & Yen, 1995). Figure 1 demonstrates the Winston Model using 2008 Integrated Postsecondary Education Data System (IPEDS) data. At community colleges, the price students paid in tuition and fees (T&F) was 31% of the total Education and General costs of providing those classes—the rest of the costs were subsidized.

If we assume that price is a valid proxy for access (Sheldon, 2003), then access to higher education is diminished when price increases due to an increase in cost or a decrease in subsidy, as fewer people would be able to afford to attend.

Higher education is rife with subsidies, both internal and external. There are many examples of internal subsidies: large, lower division lectures often subsidize small, graduate level seminars. Similarly, affluent students pay full tuition price, whereas less affluent students may be offered institutionally funded scholarships—in effect, the affluent students subsidize the costs of offering coursework to the less affluent students. Finally, many general education courses like philosophy are less expensive to provide than allied health or engineering courses, which often require specialized equipment and faculty who command higher market-based

salaries (Brown & Gamber, 2002; Clotfelter, 1996; Derochers, Lenihan, & Wellman, 2010; Ehrenberg, 2000; James, 1978; Maury, 2004). Yet most colleges continue to have

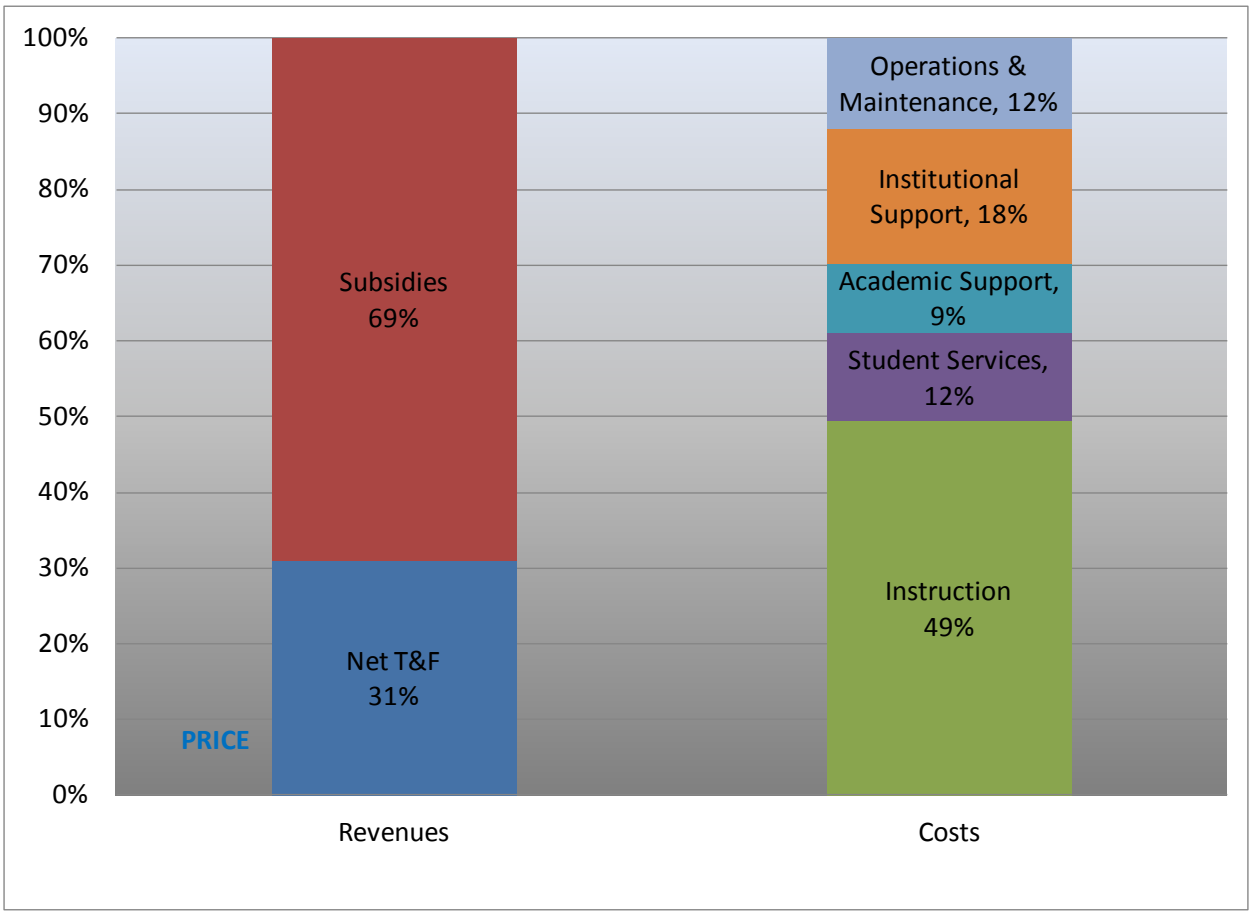

Figure 1. Winston Model of Higher Education Economics: Price = Costs - Subsidies Revenue and Cost at community colleges based on 2008 data from Derochers, Lenihan and Wellman (2010).

"smorgasbord" tuition policies: one price gets you anything on the menu. In essence, the students enrolled in the lower-cost programs are subsidizing the students in the higher-cost programs (James, 1978, p. 182).

External subsidies exist as well. Private universities often enjoy subsidies from endowment gifts, while many public colleges receive additional subsidies in the form of state appropriations or local tax revenues (Clotfelter, Ehrenberg, Getz, & Siegfried, 1991; Wellman, 2008; Winston, 1997). Public and private education provide a general subsidy to all students,

where the advertised price of tuition for a course is less than the cost of providing that course. These general subsidies are significant: private university endowments and state allocations to public universities make it possible to offer coursework at 45% and 12%, respectively, of the actual costs incurred by the college (Winston, 1997). While external subsidies are shrinking, they still represent as much as 30% of the private school costs and 69% of the public school costs (Wellman, 2008). In effect, these external subsidies increase access by lowering price (Carnegie Commission on Higher Education, 1973; Gillen, 2008).

Diminishing Access: The Rapid Rise in the Price of Tuition and Fees

Many people believe that a college degree is required to have a successful career and a good quality of life (Immerwahr, Johnson, & Gasbarra, 2008). For well over a decade, there have been concerns at the federal level about the rapidly escalating price of attending college. In establishing the context for their report, the National Commission on the Costs of Higher Education (Harvey et al. 1998, p. 1) indicated, "Financing a college education is a serious and troublesome matter for the American people."

According to CollegeBoard (Baum & Ma, 2010), the rate of tuition and fee increases has increased at approximately three times the rate of inflation increases over the past 30 years. These steady increases in price—at rates well beyond the inflation-adjusted gains in personal income—threaten to make college unaffordable for those most in need. The National Center for Public Policy and Higher Education (Immerwahr, Johnson & Gasbarra, 2008, p. 3) reported, for the lowest quintile of wage earners, tuition consumed 27% of family income in 2000 compared to 13% of income in 1980. The final report from the Spellings Commission (SECFHE, 2006) found similar problems with the price of post-secondary education: "The Commission notes with concern the seemingly inexorable increase in college costs, which have outpaced inflation for the

past two decades and made affordability an ever-growing worry for students, families, and policymakers" (p. 2).

The Lumina Foundation sponsored the Delta Cost Project (Desrochers, Lenihan, & Wellman, 2010; Desrochers & Wellman, 2010) to better understand these price increases. Contrary to the assertions made by Congress (Boehner & McKeon, 2003), this seminal study showed that increasing prices were not indicative of increasing costs, "Although public sector institutions have seen the greatest increases in tuition rates in percentage terms, these new revenues have not translated to growth in spending, as tuition revenues primarily replaced state appropriations" (pp. 31-32). In other words, public policy decisions have resulted in lowering the state subsidy per full-time equivalent student. Using Winston's higher education economic pricing model, P = C – S, institutional leaders have chosen to raise prices rather than lower costs. Though the public perception is that the higher education sector has out-of-control prices and costs, the cost per student has been relatively constant for roughly 20 years (McPherson & Shulenberger, 2010).

Cost Expenditures by College Budget Type

There are several different budgets used to manage community college expenses. Starting broadly, there is a capital budget and an operating budget (Goldstein, 2005).

The capital budget focuses on new buildings, renovations to existing buildings, expensive equipment (typically over $5,000), and debt service. Winston (2000) argued that a meaningful exploration of college costs must include capital expenses, as different programs have vastly differences in the quantity of space, type of space, and type of equipment required.

The operating budget has two primary components: the Auxiliary Budget and the Education and General Budget. The Auxiliary Budget is primarily comprised of "self-supporting

campus-based activities that provide services to students, faculty and staff" (Goldstein, 2005, p. 157). At most colleges, these typically include food services, the bookstore, and the residence halls, though only 3 in 10 community colleges have residence halls (American Association of Community Colleges, 2010).

The Education and General (E&G) Budget is the largest budget at community colleges, (Wellman, Desrochers, & Lenihan, 2008). As one might expect, all colleges are structured somewhat differently from one another. Yet the IPEDS requires all colleges and universities to report summary level financial information in a similar fashion. According to the IPEDS guidelines, colleges report the E&G Budget in five functional categories: Instruction, Academic Support, Student Services, Institutional Support, and Plant and Operations Maintenance (See Figures 1 and 2).

The instruction functional budget is the largest single functional budget comprising almost half of the E&G budget. Instruction captures expenses that are directly related to the educational activities of the college, typically those in the classroom such as faculty salaries and class supplies. Academic Support captures those costs that directly support Instruction such as libraries, audio-visual support services, and the deans who manage Instruction. Student Services include costs associated with services for students that are typically non-instructional in nature such as registration, financial aid, counseling and career services. Institutional Support budgets account for those functions that many would consider administrative overhead, such as campus executives, purchasing, accounting, human resources, and information technology. Plant and Operations Maintenance are referred to as the Facilities Department on many campuses, and include grounds keeping, custodial, and (non-capital) maintenance services (Dyke, 2000). See

Appendix A for a complete list of relevant IPEDS terminology, as well as other key terms discussed in this paper.

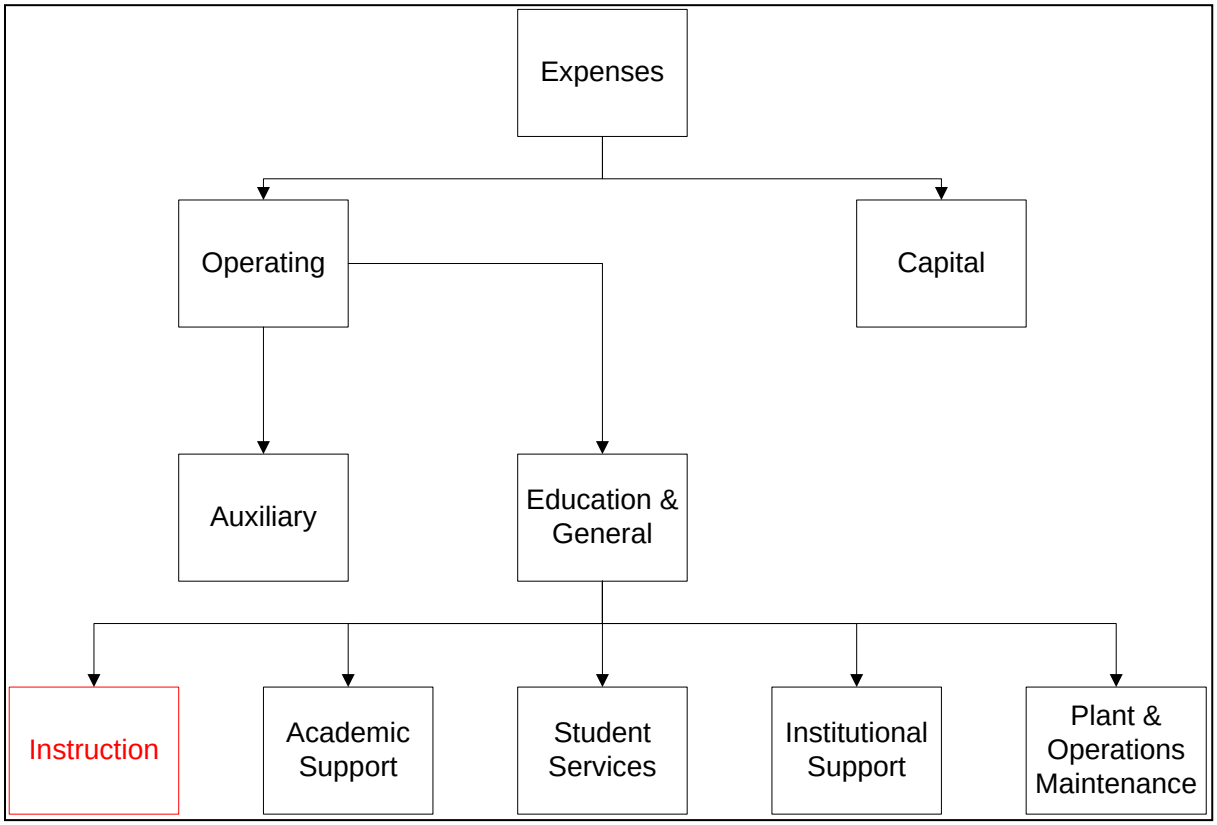

Figure 2. Cost Expenditures by Budget Type

For reasons that I provide and expand upon in Chapter Two, this study only included Instructional Cost variables.

A Brief History of Quality

In the earliest markets, quality was governed by the term "caveat emptor"—let the buyer beware. Sellers were responsible for producing or at least providing goods, but buyers had to ensure the goods met their specifications (Juran, 1995).

Over time, societies became more complicated, as did the skills required to support those societies. Different trades required the development of skilled craftsmen to perform specific sets

of tasks to provide unique products. "A craftsman, by definition, is responsible for the quality of his or her own work, and the origins of modern quality have their roots in the work of the early craftsmen such as the carpenter… cooper, tanner, blacksmith, iron smelter, potter and so on" (Hutchins, 1995, p. 459). The livelihood of these people was determined by the quality of the goods and services they produced. Initially, these people lived in small villages where they could develop a reputation based on personal relationships. Quality was defined by the artisans—the producers (American Society for Quality, 2010; Juran, 1995; Seymour, 1993).

However, as European societies became more complex during the Middle Ages, similar tradesmen formed associations called Guild Halls (Juran, 1995). These Guilds assured the quality of their products by overseeing the admission and training of their membership as well as inspecting the quality of their products. The product quality was assured with a hallmark, trademark or seal of approval. By assuring quality, the Guilds allowed for commerce to expand beyond personal relationships to the next village or the next neighborhood in larger cities (American Society for Quality, 2010; Cotter & Seymour, 1993; Juran, 1995; Seymour, 1993).

The Industrial Revolution, which occurred throughout the 18th and 19th centuries, brought about the end of Guild dominance in the market and brought in the next phase of quality (American Society for Quality, 2010; Juran, 1995). By using different processes and technology (i.e. machines), mass-producers were able to produce higher volumes of standardized products with fewer, lower-skilled, lower-paid workers. Smith (1776) described a pin factory where the holistic set of craftsmen skills was separated into a series of limited-skill tasks. Instead of each craftsman performing every step in the pin-making process, each worker would become proficient at performing one step of the pin-making process. This new mass-production model allowed workers to become more specialized and more productive (Smith, 1776). The

productivity gains of mass-production led to lower prices, which in turn ultimately led to the triumph of the factories over the craftsmen, and consequently the demise of the Guilds. Yet this task orientation limited workers' understanding to a very narrow sliver of the operations, and led to the need for a separate inspection process as the primary form of quality control during the Industrial Revolution (Juran, 1995).

The 20th century ushered in the era of Statistical Quality Control (SQC). During the 1920s, Shewhart developed SQC techniques at the Bell Laboratories (American Society for Quality, 2010; Cotter & Seymour, 1993; Juran, 1995; Rinehart, 1993; Seymour, 1993). One of Shewhart's (Rinehart, 1993) primary contributions was the development of the control chart, which was used to help manufacturers understand when their processes were in control, and when their processes were out of control. Compared to the inspection method, SQC improved manufacturers' ability to ensure that their products were meeting customer specifications. SQC became a major factor in improving the United States' economic productivity during World War II —so much so that some of the techniques remained classified until after the war had ended (Rinehart, 1993).

After World War II, the demand for products in the United States and abroad was very high. Most of the world's production facilities had been ravaged by the war, and those that remained were geared to military production, not civilian consumers (Juran, 1995; Nonaka, 1995; Rinehart, 1993). Over the next several years, quality languished as demand far surpassed supply (Juran, 1995). At that point, SQC had all but been forgotten by American manufacturers (Deming, 1982).

Japan was one of the post-World War II countries in dire straits, with more people than it could feed, limited natural resources, and a reputation for poor quality. When Deming went to

Japan in 1950 to consult with General MacArthur, the Union of Japanese Scientists and Engineers (JUSE) invited him to give a seminar on SQC (Juran, 1995; Nonaka, 1995; Rinehart, 1993). In Japan and in the United States, Deming advocated a change from the traditional management philosophy that had evolved as part of the Industrial Revolution. In this traditional management system, workers focused narrowly on one part of the process and relied on down-line inspectors to monitor the quality of their work. Deming (1982, pp. 23-24) first summarized his quality management philosophy in 14 points and then a decade later, synthesized the 14 points into his "system of profound knowledge." Profound knowledge went beyond the basic statistics emphasized in SQC, consisting of knowledge of four basic topics: systems thinking, variation, learning theory, and psychology (Deming, 1994, p. 92). More specifically, leaders must understand the system they are trying to manage; leaders must understand systemic variation and special cause variation; leaders must build their knowledge on theories; and leaders must understand individual behavior in order to effectively motivate and manage people.

A brief time after Deming's initial speech in Japan, Juran spoke to JUSE about the systemic application of quality techniques throughout the organization. Over the next decade, both Juran and Deming espoused a philosophy of quality, which became known as Total Quality Control and ultimately as Total Quality Management (TQM) (Nonaka, 1995).

Juran also advocated that quality go beyond statistical quality control and include quality planning, and quality improvement. Juran's first visit to Japan in 1954 "marked the beginning of a gradual transition from statistical quality control to total quality control… in which all departments and all employees participated…" (Nonaka, 2005, p. 541).

The philosophies espoused by Deming and Juran led to Total Quality Control in the 1950s, which evolved into Total Quality Management (TQM). In stark contrast to quality

through only inspection or SQC, TQM became a guiding set of principles and tools by which everyone in the organization became focused on continuously improving the processes used to meet or exceed the customers' needs (American Society of Quality, 2010; Cotter & Seymour, 1993; Juran, 1995; Seymour, 1993).

Though TQM may have its roots in the United States, the philosophy did not become prevalent in this country until 1980, when NBC aired "If Japan Can, Why can't We?" on NBC Whitepaper, a news program outlining how the Japanese adopted SQC and TQM to revitalize their economy (Dobyns, 1980). Many believe this television show led to the renaissance of the quality movement in America, and popularized the TQM principles of Deming and Juran (American Society for Quality, 2010; Bonstingl, 1992).

In the 1980s, some of the problem-solving tools associated with TQM were further refined into the Six Sigma movement (American Society for Quality, 2010; Pande, Neuman & Cavanaugh, 2002), which aspires to have processes robust enough to produce only 3.4 defects per million opportunities in which a defect could occur. In addition, the 1990s saw the quality systems and tools from TQM begin to expand beyond the manufacturing floor into the administrative side of organizations, and into the service sector as a whole (Juran & Gryna, 1993).

Modern-day Guilds: Accreditation Agencies and Quality in US Higher Education

Accreditation is "a process of external quality review used by higher education to scrutinize colleges, universities, and educational programs for quality assurance and quality improvement" (Council for Higher Education Accreditation, 2011) and "ensures quality control" (Kirp, 2003, p. 200).

There are six regional accreditation bodies authorized by the United States Department of Education (USDOE) and the Council for Higher Education Accreditation (CHEA) to accredit colleges and universities in the United States (CHEA, 2002): the Middle States Association of Colleges and Schools, the New England Association of Colleges and Schools, the North Central Association of Colleges and Schools (NCA), the Northwest Commission on Colleges and Universities, the Southern Association of Colleges and Schools, and the Western Association of Schools and Colleges (CHEA, 2011).

The four primary purposes for accreditation (Council for Higher Education Accreditation, 2011, p. 2) include: assuring quality to students and the public, assuring quality to the federal government to ensure federal resources are only disbursed to legitimate institutions, assuring quality to fellow institutions to encourage them to accept transfer credits, and assuring quality to employers who ultimately consume the "product" of higher education.

In 1987, the National Institute for Standards and Technology, a division of the United States Department of Commerce, established a national quality award, the Malcolm Baldrige Award, based on a set of criteria designed to create performance excellence. While there is not one agreed upon definition of TQM, the Baldrige criteria engender the principles common to most definitions of TQM (Juran, 1995). Originally established for the manufacturing sector, since 1989 the criteria have since been expanded to cover healthcare, government, small business, services, and education (National Institute for Science and Technology, 2011). Regardless of whether or not they have ever applied for the award, many primary, secondary, and post-secondary schools have adopted the TQM principles as they try to improve the quality of education in their organizations (Bonstingl, 1992; Cotter & Seymour, 1993; Fields, 1993; Rinehart, 1993; Schargel, 1994; Sorensen, Furst-Bowe, & Moen, 2004; Spanbauer, 1992).

In 1999, the Higher Learning Commission division of the North Central Association of Colleges and Schools established a new accreditation process based on the Malcolm Baldrige Criteria for performance excellence: the Academic Quality Improvement Program (AQIP). The AQIP criteria further customized the Malcolm Baldrige criteria, focusing on applying TQM principles, including process improvement and a focus on measurable outputs, to colleges and universities.

The AQIP accreditation model has 9 core criteria: Helping Students Learn, Accomplishing Other Distinctive Objectives, Understanding Students' Needs, Valuing People, Leading and Communicating, Supporting Institutional Operations, Measuring Effectiveness, Planning Continuous Improvement, and Building Collaborative Relationships (Higher Learning Commission, 2008). Though based in the Total Quality Management body of knowledge, these criteria are broad enough to allow colleges and universities with diverse missions, from divinity to engineering schools, to explain how their school's processes uniquely address the criteria.

Definitions of Quality

There are many definitions of quality, "a subjective term for which each person or sector has its own definition" (American Society for Quality, 2010). Harvey and Green (1993) have concurred, stating, "Quality is relative to the user of the term and the circumstances in which it is invoked. It means different things to different people, indeed the same person may adopt different conceptualizations at different moments" (p. 10). They further expanded this notion, "We all have an intuitive understanding of what quality means but it is often hard to articulate. Quality, like 'liberty', 'equality', 'freedom' or 'justice', is a slippery concept" (Harvey & Green, 1993, p. 10). In the rest of this section, I explore several traditional notions of quality identified

by Harvey and Green (1993), including inputs, process, outputs, value for money, and transformational.

Quality as Exceptional: Inputs.

Within exceptional quality, there are three sub-categories including distinctive, excellence as demonstrated through exceeding high standards, and conformance to minimum standards (Harvey & Green, 1993, p. 11). The distinctive quality approach confers status on the consumer such as by attending Harvard University. The scarcity of the product combined with the product's reputation creates distinctive quality (Harvey & Green, 1993, p.11).

The excellence definition is focused on inputs and unattainably-high standards. "In the education context, if you are lectured by Nobel prizewinners, have a well-equipped laboratory with the most up-to-date scientific apparatus and a well-stocked library, then you may well produce excellent results" (Harvey & Green, 1993, p. 12). Another example of this definition is when the University of Southern California strove to increase its quality by reducing the size of its freshmen class through raising admission standards (Kirp, 2003, p. 122).

The conformance to minimum standards approach is a means by which a product is measured against attainable criteria to weed out defective products. I provided an example of the minimum standards approach where I discussed accrediting body standards in the *Brief History of Quality* section. Consumers of higher education, students seeking education and employers seeking graduates, search for regionally accredited schools as a form of quality of assurance. On a more practical basis, the federal government lends credence to the accreditation process by only awarding Pell Grants and Stafford subsidized loans to students who attend accredited schools.

Quality as Consistency: Process.

Quality as consistency focuses on processes, seeking to minimize variation and avoid producing defective products—defects as defined by the customer. Reliability and prevention are the hallmarks of consistent quality. While Harvey and Green (1993, p. 16) argued that this focus on consistent processes does not fit most people's idea of quality in higher education, their article was written only a couple of years after the Malcolm Baldrige Criteria for Education first appeared in 1989 and almost a decade before the Higher Learning Commission established the AQIP accreditation criteria.

Today, many K-12 schools and hundreds of colleges (Higher Learning Commission, 2012) have attempted to improve the quality of their processes by adopting TQM principles developed by Juran and Deming (Bonstingl, 1992; Cotter & Seymour, 1993; Fields, 1993; Rinehart, 1993; Schargel, 1994; Sorensen, Furst-Bowe, & Moen, 2004; Spanbauer, 1992). Some K-12 schools have gone a step further by teaching a subset of the TQM principles, the continuous quality improvement tools, to students in their classrooms (Byrnes, Cornesky, & Byrnes, 1992; Duncan, Raines, & Woodburn, 1999; McClanahan & Wicks, 1994).

Notably, three institutions of higher education have been awarded the Malcolm Baldrige Award: the University of Wisconsin-Stout in 2001, the Kenneth W. Monfort College of Business at the University of Northern Colorado in 2004, and Richland College within the Dallas Community College System in 2005 (NIST, 2011). In summary, with roughly 10% of public colleges and universities adopting the AQIP and/or the Malcolm Baldrige criteria, quality as consistency of processes has gained a modest, but not inconsequential, foothold in the higher education sector.

The ultimate output or purpose of education is learning (Bok, 2003, 2006). Former Harvard University professor Derek Bok (2006) spent considerable effort demonstrating some of the systemic process problems in higher education that impede learning such as using part-time instructors or graduate assistants to teach Freshmen in their foundational coursework (p. 337); the lack of pedagogical training for professors (p. 314); an irrational curriculum requiring too many courses in the major and too many elective choices (pp. 311, 323), lack of continuous quality improvement processes related to teaching and learning (p. 316), budget processes which do not align resources with quality improvement initiatives (p. 337), and too many silos of seemingly unrelated disciplines (p. 309).

The National Survey of Student Engagement and the Community College Survey of Student Engagement are process-based measures of quality. The surveys assess the institutions' ability to engage students both in and out of class, which in turn has been shown to increase student retention and achievement (Pascarella & Terenzini, 1991; Tinto, 1993). Over 600 4-year schools and over 400 community colleges choose to gather these quality data to help them improve their processes.

Quality as Fitness for Purpose: Outputs.

Schools demonstrate fitness for purpose quality either by meeting students' specifications or by fulfilling the unique mission of the school (Harvey & Green, 1993). In either case, quality is judged on the outputs, not on the inputs, or on the processes. Using the student specification definition, the quality outputs are defined by the student. In the latter scenario, the quality outputs are defined by the institution as evidence that it is fulfilling its mission. "The problem with any fitness for purpose definition of quality in higher education is that it is difficult to be

clear what the purposes of higher education should be….Different stakeholders…may have different views about the purpose" (Harvey & Green, 1993, p. 21).

Though there is a myriad of definitions of quality, the most common theme appears to be a product's ability to meet the customer's requirements (American Society for Quality, 2010; Clotfelter, Ehrenberg, Getz & Siegfried, 1991; Crosby, 1979; Deming, 1982; Juran & Gryna, 1993). Juran and Gryna (1988, p. 22) defined quality as consisting "of those product features which meet the needs of the customers." According to this definition, products may mean goods or services. Also customers may mean anyone who is impacted by the product, in other words, all stakeholders (Juran & Gryna, 1988, p. 22). In the case of this analysis, I have defined "needs" or "requirements" as student completion, student transfer and student persistence.

Deming (1982, p. 169) tried to narrow his definition of stakeholder by focusing on the consumer: "The quality of any product, or service has many scales. A product may get a high mark, in the judgment of the consumer on one scale, and a low mark on another." Deming (1982, p. 175) further suggested that the consumer or customer is "the man that pays the bill," "the one to be satisfied," or "the man or company that will use the product is the one to be satisfied." Yet in higher education, many stakeholders might "pay the bill" including the student, the student's parents, the current or future employer through professional development or taxes, the state through appropriations, the federal government through Pell grants and subsidized loans, the foundation through scholarships, and the community at large through property and income taxes. Deming's (1982, p. 175) other description of the consumer as the "man or company that will use the product" is also complex: who consumes higher education's services: students? employers? society?

A decade later, Burrows and Harvey (1992) articulated the unique circumstances of higher education, noting, “There are many ‘stakeholders’ in higher education, including students, employers, teaching and non-teaching staff, government and its funding agencies, accreditors, auditors” (as cited in Harvey and Green, 1993, p. 10) where each will have “a different perspective on quality” (Harvey & Green, 1993, p. 10).

Sirvanci (1996) expanded on the complexity of defining the “customer” of education, noting that students are the customer of the course material as well as other on-campus services; however they are also an input to the learning process, and ultimately an output of the college system.

Some institutions have tried to reconcile these differing and often conflicting stakeholder definitions of quality by creating their own set of measures to demonstrate that they are fulfilling their mission (Harvey & Green, 1993). This is similar in concept to the Balanced Scorecard approach advocated by Kaplan and Norton (2001), where organizations develop a comprehensive set of success measures. Organizations should not focus on only one measure; rather, they should take a more holistic view, which generally encompasses a variety of quality measures including financial, customer satisfaction, internal processes, and employee learning and growth (Kaplan & Norton, 2001, p. 23). This more comprehensive approach, including some “leading indicators” (measures of input and process quality) and “lagging indicators” (measures of output quality), would allow organizational leaders and stakeholder to better triangulate the true performance of the organization (Kaplan & Norton, 2001, p. 3). Those seeking accountability for fulfilling institutional mission have advocated the adoption of the Balanced Scorecard concept in higher education (Dickeson, 2010; Ruben, 1999).

Yet many would argue that higher education has been reluctant to create this transparent, mission-driven set of accountability (output) measures—three separate federal commissions spanning three decades have repeatedly requested increased transparency regarding the costs and/or the quality of higher education (National Commission on Excellence in Education, 1983; Harvey et al. 1998; SECFHE, 2006). Bloom (1987) might argue this is due to academia's liberal view that all world views (i.e. measures) have value. But whatever the reason, some would argue that higher education's reluctance to provide transparency has led to third party ranking systems, such as the one produced by U.S. News and World Report. These rankings, in turn, have helped to create the "spending arms race" in order to be the best at everything (Ehrenberg, 2000; Zemsky, Wegner, & Massy, 2006). Likewise, in response to the seeming unwillingness by higher education to self-regulate costs and quality, the National Governors Association has announced a comprehensive set of measures of college and university effectiveness as measured by outputs (Reyna, 2010). As of 2006, forty or more states had at least some portion of their appropriations to higher education based on output performance measures (Bok, 2006).

Colleges and universities have made some progress toward providing more cost transparency, beginning with participation in instructional cost and productivity studies (Malo & Weed, 2006; Middaugh, 2001; Seybert & Rossol, 2010; Sumner & Brewer, 2006), yet this information is not publicly available to consumers. Similarly, the National Community College Benchmark Project (NCCBP) collects a wide variety of performance information annually from over 100 community colleges that volunteer to participate. The purpose is to help member colleges improve and demonstrate their effectiveness to accreditors and legislators. This information could be useful to faculty, administrators, and potential students alike, because community colleges, like four year colleges, have complex missions (see Chapter 1) that should

be measured by more than simply graduation rates, prices and costs. However, these NCCBP benchmark measures are not publicly available to consumers either (National Community College Benchmark Project, 2011).

More recently, the American Association of State Colleges and Universities and the Association of Public Land-grant Universities created the CollegePortraits.org website where over 300 of their member schools voluntarily provide basic information about prices and student success (outputs). While the site is a huge step forward for consumers, it provides information for less than 15% of the public and private four-year colleges and universities in the United States, with no information on over 3600 public and private two year colleges.

Recently, the American Association of Community Colleges (AACC), in conjunction with the American Community College Trustees and Collegeboard, completed a draft of output measures for community colleges called the Voluntary Framework for Accountability. The measures were to be piloted in early 2011, with the short term intent of finalizing the measures by the fall of 2011, and the long term intent of developing transparency in outcomes, much like the public four year college website described above, so that consumers (students, parents, legislators, and others) can make better informed choices (AACC, 2011).

Even after the customer(s) have been identified, one of the issues troubling many organizations is how to determine customer requirements. If bookstore retailers had surveyed customers in 1995 about how to improve their shopping experience, it is doubtful that the customer would have indicated that they would like to buy almost any product without having to leave their living room. In other words, customers would not likely have identified their desire for e-commerce. Similarly, while the vast majority of students are happy with their college

experience, they may not be in the best position to judge the quality of their learning experience (Bok, 2006).

Quality as Value for Money: The Relationship of Cost and Quality.

Harvey and Green (1993) have advocated that quality has come to be defined by governmental funding agencies as the balance between the effectiveness (outputs) of education and the efficiency (cost) of education. Bok (2006, p. 326) would concur: "Facing the mounting appropriations for higher education and anxious to reap the benefits of a well-trained workforce, state officials have started to ask whether they are getting adequate value for the money they give to colleges and universities."

As may be inferred from the *Quality as Exceptional* definition of quality, some equate quality with costs: the more resources consumed, the higher the quality (Clotfelter, 1996; Clotfelter, Ehrenberg, Getz & Siegfried, 1991; James, 1978; McPherson & Gordon, 1991; Zeithaml, 1988). The US News and World Report rankings are a prime example. Their methodology bases 27% of the quality ranking on financially related criteria, including the expenditures per full-time student, class size, faculty salary, student-faculty ratio, and the proportion of full-time faculty (Morse, 2011). In essence, US News tells its readers that higher costs equate to higher quality.

In stark contrast, Crosby (1979) advocated, "Quality is free." Crosby (1979) described five misperceptions of quality, including the "erroneous assumption" that there is an economics of quality that requires higher costs for higher quality (p. 16). In fact, Crosby argued, low-quality costs more than high-quality. The cost of poor quality in a manufacturing setting, including the costs associated with quality assurance (institutional research), losing a customer (course withdrawal rates, fall to fall retention), rework (retaking a course, developmental

education, adult basic education), poor design (associates degrees requiring more that 60 credits, credits taken in excess of curriculum requirements, inefficient scheduling), and scrap (incompletes, general education course credits that do not articulate) (Crosby, 1979, p.106). However, all of these are applicable to the higher education sector and to community colleges in particular, and are examples of how poor quality adds costs to the education system (Spanbauer, 1992).

There is a small but growing number of studies that challenge the notion that higher costs are required to achieve higher quality in education (Ewell, 2008; Gansemer-Topf, Saunders, Schuh, & Shelley, 2004; Gansemer-Topf & Schuh, 2006; Kelly & Jones 2007; Kelly, 2009; Grubb, 2009; Twigg, 2003; Twigg, 2003a; Twigg, 2005). These studies seem to indicate that while a certain amount of resources is required to achieve desired outcomes, *how* resources are spent is more important than the simple quantity of resources available.

Zemsky and Finney (2010) suggested that there could be a relationship between higher costs and *lower* quality. In particular, they assert that the proliferation of the curriculum drives higher costs and lower completion rates. Similarly, Jones and Wellman (2010) had several suggestions for fundamentally changing the cost structure of higher education, including the elimination or consolidation of high-cost low-demand programs, improving teaching and learning productivity, and limiting electives.

Quality as Transformational: Learning Outputs.

Harvey and Green (1993) noted that some schools view education as a value-added process, where the quality can be assessed through summative evaluation. Examples include RAND's College Learning Assessment tool (CLA), ACT's Measure of Academic Proficiency and Progress (MAPP), and State Licensure tests. For example, to demonstrate its quality, the

largest for-profit university, the University of Phoenix, publishes its MAPP results annually on its website, showing that its students improve as much as students at not-for-profit schools (Berg, 2005; Blumenstyk, 2008). Of course the "learning" demonstrated by these tools is fairly low. In a recent study (Arum and Roksa, 2010), only 64% of four-year college graduates demonstrated a statistically significant improvement in learning—those who did improve, averaged only .47 standard deviations of improvement—18%.

Rankings.

Partially in response to the lack of information on institutional quality, there have been numerous methodologies devised to rank the quality of educational institutions (Myers & Robe, 2009). These ranking systems tend to focus on one or more quadrants of the following matrix: on the x-axis, the methodology is designed to assess either an academic program or an institution; on the y axis, the methodology focuses on either the undergraduate or the graduate level. Within each of these quadrants, the methodology will use one or more of the aforementioned definitions of quality. The problem is "… every ranking system makes a subjective value judgment about which criteria represent 'quality' in higher education. The choice of which measures to use in a ranking implicitly and somewhat arbitrarily defines the meaning of 'quality'" (Myers & Robe, 2009, p. 23).

For example, U.S. News and World Report, arguably one of the most popular ranking systems, provides institution-level rankings using a variety of Quality as Exceptional (via reputational surveys) and input measures such as applicant SAT scores and expenditures per student.

Yet there are many methodologies: Money Magazine uses the Value for Money definition, the Princeton Review uses the Fitness for Purpose definition by surveying students,

and Forbes uses a blended definition by using a variety of Outputs and Value (as measured in student debt) (Myers & Robe, 2009). Likewise, the Washington Monthly provides an annual ranking of Community Colleges using a blended definition: Process Consistency (via Community College Survey of Student Engagement scores) and Outputs (via Integrated Postsecondary Educational Data System 3-year graduation rates) (Carey, 2010).

Yet for those who believe that student learning is at least part of the definition of "quality" in higher education, it is important to note that many of the popular rankings do not correlate well with studies seeking to understand what factors positively impact student learning (Bok, 2003; Bok, 2006).

The Iron Triangle

In the view of many college and university presidents, the three main factors in higher education—cost, quality, and access–exist in what is called an iron triangle (see Figure 3). These factors are linked in an unbreakable direct relationship, such that any change in one will inevitably impact the others (Immerwahr, Johnson, & Gasbarra, 2008, p. 4).

There are several theories that may have given rise to the Iron Triangle belief system, which necessitates a trade-off between quality and costs. I will briefly review three, including Baumol and W. Bowen's Cost Disease theory (1966), H. Bowen's Revenue theory (1980), and the Resource Dependency theory introduced by Pfeffer and Salancik (1978).

Cost Disease Theory.

In 1966, Baumol and Bowen introduced the Cost Disease theory in the context of examining the performing arts. In this theory, the nature of the work limits the ability to improve productivity. In other words, "for all practical purposes the labor is itself the end product"

(Baumol, 1967, p. 164). As an example, a one hour quartet concert requires 4 man hours of effort.

Moreover, as the manufacturing sector becomes more productive through the utilization of technology, manufacturers share some of these productivity gains in the form of salary increase. To remain competitive in the labor market, according to the cost disease theory, service providers must offer raises, too. Yet without a corresponding increase in productivity, the cost per unit increases and the "cost disease" begins.

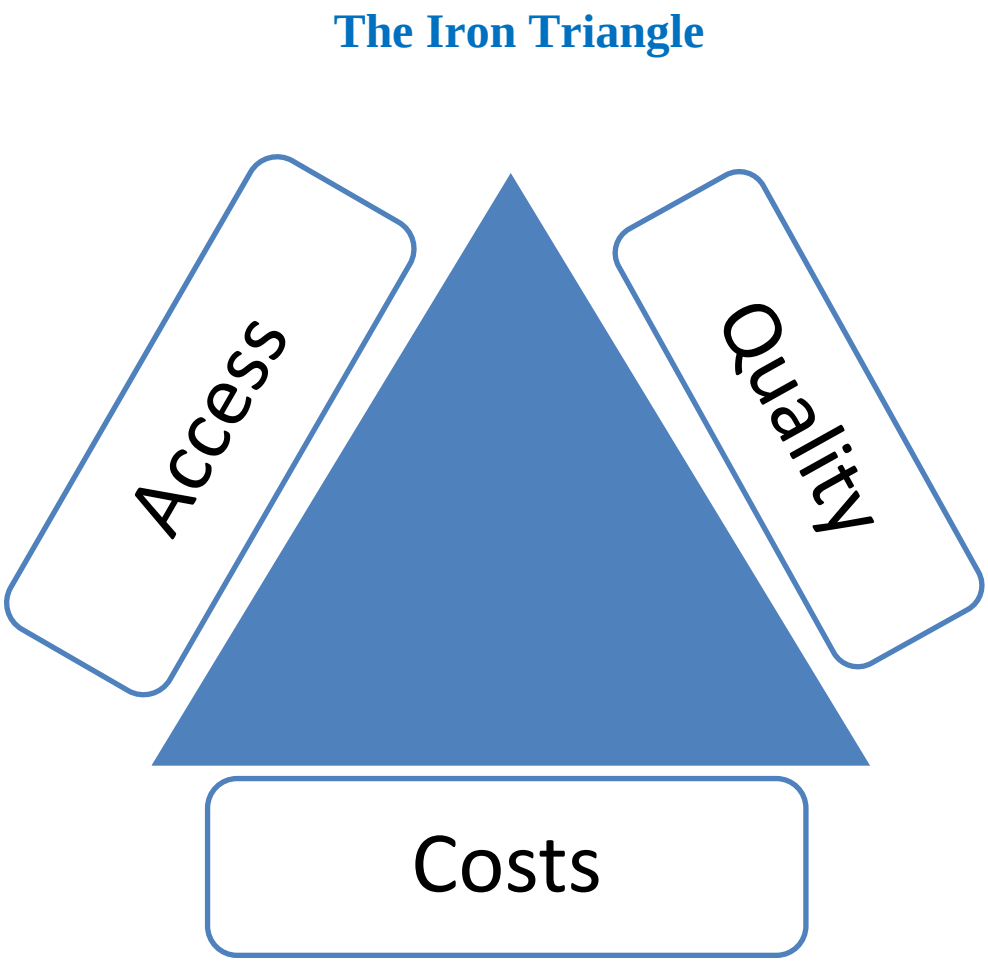

Figure 3. The Interdependency of Access, Cost and Quality (Daniel, Kanwar, & Uvalic-Trumbic, 2009).

This example ignores the fact that technology can be used to enhance the productivity of services as well. The quartet may have originally performed for the king and the relatively few members of his court, but improvements in architectural design led to audiences of hundreds; electronic speakers and amplifiers magnified the sound such that halls could be enlarged to accommodate thousands; television allows the broadcast of live musical events to millions; likewise digital recordings can make the one-hour quartet performance available to millions more.

Baumol spoke specifically about the application of the cost disease theory to higher education saying "as productivity in the remainder of the economy continues to increase, costs of running educational organizations will mount correspondingly, so that whatever the magnitude of the funds they need today, we can be reasonably certain they will require more tomorrow…" (1967, p. 421). Later, Baumol expressed his concern "… that we will deny ourselves education… or [any of] the products whose costs are determined by the cost disease…." (Krueger, 2001).

There is another issue in higher education related to the cost disease theory. Many four year colleges and universities are multi-product firms, "producing" not only teaching, but institutionally-funded research and public services as well. The "academic ratchet" theory asserts that faculty discretionary time becomes devoted to research, which in turn lowers their teaching workload (Massy & Zemsky, 1990; Zemsky, Wegner, & Massy, 2006). The second part of this theory is the "administrative lattice" which refers to the expansion of college staff. As senior college executives search for ways to allow faculty to optimize their productivity (teaching and research), the executives hire additional lower-cost staff members to assume some of the administrative duties, which had previously been performed by faculty. In combination,

these practices lead to higher costs per class and senior executives respond by increasing prices and requesting more subsidies (Green, Kisida, & Mills, 2010; Massy & Wilger, 1995; Massy & Zemsky, 1990). Moreover, while research is valued and rewarded by the academy (Fairweather, 1993, 2002), some studies would indicate that it is not essential for effective teaching skills (Marsh & Hattie, 2002).

As an example of how priorities vary for different stakeholders, low tuition rates and degree production are becoming increasingly valued by various stakeholders, including students and legislators. According to Public Agenda (Immerwahr, Johnson, Gasbarra, Ott, & Rochkind, 2008, p. 5), over half of the general public believes that colleges could spend a lot less and serve a lot more students without affecting quality or price. This study focused on community colleges, whose mission, while still complex, focuses on teaching and learning—with little or no institutional expenses related to research and public service.

Archibald and Feldman (2008, 2008a, 2011) studied the higher education sector costs using Baumol and Bowen's (1966) Cost Disease theory. They compared fifty years of inflation-adjusted *cost* increases for higher education to *price* increases in other product and service categories during the same time frame. They (Archibald & Feldman, 2008) found what Baumol and Bowen (1967) had asserted: pricing for services tended to increase at higher rates than inflation, while prices for goods tended to decrease relative to inflation. Presumably, these differences are attributable to the increases in productivity enjoyed by the manufacturing sector, which are only experienced to a much lesser degree by the service sector. Based on the capital-skill complementary theory of Griliches (1969), Archibald and Feldman (2008) then went on to assert that the cost disease is further exacerbated by the use of technology, rather than controlled by it. High technology equipment requires highly skilled labor, which in turn commands higher

salaries. Archibald and Feldman (2008) theorized that technology is used in higher education to enhance quality rather than control costs, though they offer no evidence of quality enhancement. This supported Baumol and Batey-Blackman who in 1995 asserted that the application of technology to improve higher education productivity was limited, and that the relative price of higher education would continue to increase.

Yet not everyone subscribes to the validity of the Cost Disease Theory. Twigg (2003, 2003a, 2005) countered both the cost disease theory and the capital-skill complementary theory in her work with the National Center for Academic Transformation (NCAT). She directly challenged the Iron Triangle when she worked with 30 institutions to redesign large-enrollment introductory courses using technology to increase quality *and* lower costs. Nineteen of the 30 projects demonstrated improved student learning, with the remainder showing no statistically significant difference. Yet all 30 projects generated cost savings ranging from 20 to 86%, with an average of 40% (Twigg, 2003). The techniques developed by NCAT continue to yield similar results for colleges and universities outside of the original test group (Roach, 2009).

Massy asserted the cost-quality linkage of the Iron Triangle is based on the premise that higher education operates on the "'efficient frontier' (the upper limit of quality achievable at a given spending level)" (2003, p. 245). Massy (2003) has stated that in order to break the Iron Triangle, higher education needs to avail itself of cost analysis tools such as activities based costing models in order to see which activities inside the "black box" of the education process cost the most money and which of those could be automated with technology to lower costs while maintaining or improving educational quality (p. 279).

Jones and Wellman (2010) agreed:

> To begin with, both [institutions and state government] need to revisit unexamined assumptions about higher education finance that are impeding new thinking about resource use. Our top candidate for the funeral pyre of old ideas is the assumption that higher education costs must increase each year in order to maintain quality. This conventional wisdom is rooted in economic theory about non-profit "cost-disease," which holds that the cost of the service sectors inevitably rise because they are driven by labor costs that go up each year and cannot be reduced without harming the service.
>
> In higher education, this view of costs equates all spending with expenditures on faculty, which is actually less than half of that across the sector. It also ignores the potential for expanding the scope of services through technology; not all teaching and learning has to be done in a classroom. (p. 9)

Wellman (2010) asserted that the cost disease gained prominence, in part, because of "unexamined assumptions about the relationship between spending [cost] and quality" (p. 26). Sullivan (2008) advocates defining success carefully at open admissions institutions. As such, his paper seeks to examine those assumptions by building a logistic regression model designed to predict student success (completion, transfer, or persistence), using variables which the literature has linked to student success or to instructional costs.

Revenue Theory.

In 1980, Howard Bowen discussed the Revenue Theory of higher educational costs. He asserted that the college mission was, generally, to be excellent in all things. Colleges seek to optimize educational quality within the constraint of their available resources. Consequently, colleges raise the money they can and then spend all the money they raise. In other words, the

institutions continually strive to improve quality—at any and all costs. This theory aligns well with the Iron Triangle. As more Revenues (resources) become available, one or more sides of the Iron Triangle can lengthen.

To test Bowen's theory, Seybert and Rossol (2010) conducted a study of community college instructional costs, but did not find a statistically significant relationship between resources and costs. In another study, Archibald and Feldman (2011) did not find evidence of the Revenue Theory.

In contrast, Robst (2001) found that total revenue was a positive, statistically significant predictor of cost inefficiency.

Resource Dependency Theory.

Simply stated, Resource Dependency Theory (RDT) asserts that in order to fulfill their missions, organizations will seek new revenues as old revenues disappear. Whoever controls and provides the resources will influence the organization receiving those resources. To maximize their power, organizations should seek to minimize their dependence on other organizations (Pfeffer & Salancik, 2003). This theory may be of greatest importance as non-profits often produce services that would be unaffordable if the non-profit had to recover its full costs (Massy, 2003). In other words, non-profits, including higher education, are often subsidized, and are consequently dependent on and influenced by those external entities providing the subsidies.

There is evidence of cost shifting from the state to the student, as higher education is increasingly viewed by lawmakers as a private good, rather than a public good (Kenton, Huba, Schuh & Shelley, 2005; Desrochers & Wellman, 2010). RDT suggests that as colleges receive fewer of their resources from the states and more from their students, colleges will likely become more market driven, and responsive to their students' needs. The state policy implications of

RDT are less clear. If we follow the "college is a private good to individual citizens, not a public good to society as a whole" rationale to its logical conclusion, how much influence and control will the state have over higher education? In practical terms, if "state" colleges receive few, if any, of their resources from the state, how likely is it that these state institutions will allocate time, effort, and money to pursue the policy objectives of the state?

Research Questions

The goal of the Lumina Foundation is to increase the proportion of college graduates from 40% to 60% over the next 15 years, a 50% increase. The United States already spends a larger proportion of its Gross Domestic Product (2.9%) on higher education than any other OECD country (National Science Foundation, 2005). The Iron Triangle theory would seem to suggest that the U.S. may need to spend up to 4.4% of GDP on higher education—which may not be affordable, or even desirable given that other countries are spending a lower proportion of their GDP in this area while already achieving better graduation results.

There has been a public policy change—by accident or by design—shifting the costs of higher education from public subsidies to the student. As with any large organization, state governments have many competing priorities including K-12 education, corrections, transportation, and Medicaid. In the 10 years from 1998 to 2008, states have decreased the proportion of their budget dedicated to higher education from 10.8% to 10.2%, primarily to support Medicaid and "Other" priorities (National Association of State Budget Officers, 1999, 2009).

Moreover, it is important to note that state budgets are cyclical, with budgets rising and falling in sync with the general economy. It is noteworthy that state tax revenues took five years to recover after each of the past three recessions (Boyd, 2009). Given that the 2008 recession

has been the deepest recession in 40 years, the Rockefeller Institute of Government (Boyd, 2009) is projecting a longer time for state revenues (and budgets) to recover. Given this outlook, state agencies, including public higher education, will likely endure more cuts before they see larger state subsidies (i.e. appropriations).

Yet the result of this *cost-shifting* is that the price of higher education has become less affordable for everyone, and perhaps even inaccessible to those who could most benefit from attaining a college degree.

I have used Winston's higher education economic pricing model (P = C – S) to describe and better understand the basic choices available to institutional, state and federal policymakers: change price (i.e. decrease access), change costs or change subsidies. As subsidies have decreased over the past decade, institutional decision makers have, on average, chosen to increase Price, rather than decrease Costs as is evident from the Collegeboard tuition data (Baum & Ma, 2010) This may be due to the belief that decreases in the costs of education must lead to decreases in quality of education.

The purpose of this study was to examine the relationship between costs and quality at a large rural community college. I wanted to test the relationships represented by the Iron Triangle via these research questions:

1. Which variables from Tinto's model of institutional departure have a statistically significant relationship with student success?

2. Based on the literature, do any of the variables which typically impact Instructional costs have a statistically significant impact on Student Success at Yavapai College? If so, to what extent?

For the purposes of this study, I have limited my definition of quality to the output category, specifically persistence, transfer, and completion.

Significance

The primary purpose of this study was to examine the possibility that public institutions could adapt to low subsidies by lowering costs while maintaining quality. If so, this likely will necessitate changes to institutional policy and practice, including the further development of fiscal stewardship skills as part of the desired community college leadership skill set. If not, institutions will need to continue their current practice of revenue optimization. Moreover, state policy makers would need to better understand the short term and long term interactions between state resource allocation decisions, educational goals (such as completion rates), and economic development goals.

Delimitations

The strength of the study is also its weakness: By limiting the sample to one community college, I was able to conduct more complex analyses than if I were to use publicly available datasets like IPEDS. "By organizing [Student Unit record] data into term-by-term student transcript records over several years and incorporating individual student demographic data, colleges and states can create a powerful resource for understanding patterns of student progression and achievement over time…. [which is] essential in developing strategies and choosing appropriate interventions to improve student outcomes" (Leinbach & Jenkins, 2008, p. 1). At the same time, the sample of one limits my ability to generalize to other community colleges.

CHAPTER 2: LITERATURE REVIEW

Few studies examine higher education quality (output, value and consistency) *and* costs. Those investigating quality and *instructional* costs are rare. The National Center for Higher Education Management Systems (NCHEMS) (Kelly & Jones, 2007) conducted a comprehensive study in which they analyzed the output quality (measured as degrees produced per 100 full-time-equivalent (FTE) undergraduate, three year graduation rate, and degrees awarded per 1000 adults aged 25-64) and the available resources per FTE student of all 50 states educational systems. They evaluated not only the state as a whole, but the higher education sectors including the community college sector. They found that states with similar expenses per FTE had differing output quality results, and conversely, states with similar output quality incurred different amounts of expenses to achieve those outputs. NCHEMS concluded, "Not all institutions need more resources, some can perform better with what they have, and some can maintain or improve performance with fewer resources" (Kelly & Jones, 2007, p. 37).

Using the output and value definitions of quality, Kelly (2009) built on this work by evaluating the credentials awarded as a percent of students enrolled, the market value (earnings potential) of the degree or certificate awarded, and the total cost of producing the completion. Like the earlier study, "This analysis also refutes the argument that more funding always leads to better performance" (Kelly, 2009, p. 5).

Kuh, Kinzie, Schuh, and Whitt (2005) of Indiana University identified four-year colleges and universities that had high graduation and student engagement levels when compared to their respective peers. The study sought to describe the methods used by these high-performing colleges, methods the authors called "DEEP" (Documenting Effective Educational Practice).

In a related study by Gansemer-Topf, Saunders, Schuh, and Shelley (2004), the spending patterns at twenty DEEP schools were evaluated to determine if they spent more to achieve this high level of quality outputs. The investigators concluded that the public DEEP Doctoral and Masters schools did not spend more than their lower performing peers, and the Baccalaureate schools spent more in Instruction and Academic Support in only one of the three years studied. The findings questioned "the assumption that simply putting more money in functions will pay off in terms of student engagement and learning" (Gansemer-Topf et al., 2004, p. 17). In other words, DEEP schools did not spend more; rather, they used resources differently than their lower quality peers.

In a study of student engagement, Ryan (2005) found that Institutional Support (administrative overhead) expenditures per student were negatively related to engagement (as measured by the National Survey of Student Engagement) but that Instructional expenditures per full-time equivalent student were not statistically significant. And while Webber and Ehrenberg (2010) found that Instruction and Student Services expenditures were both statistically significant, they concluded that increasing Student Services expenditures would have the greatest positive impact on completion.

In contrast, Hamrick, Schuh, and Shelley (2004) evaluated 444 four-year public institutions and found that Instruction costs were the largest significant predictor of graduation rates in their model. A ten percent increase in Instructional costs led to a 1.99% increase in graduation rates. Likewise, a study of the Tennessee community college system by Thompson and Riggs (2000) found that schools that spent higher proportions of their budgets in Instruction and Academic Support produced better Output measures.

Yet another study found mixed results: Instructional expenditures did not have a statistically significant impact on the achievement of high student engagement scores with Freshmen (as measured by the National Survey of Student Engagement), but that instructional expenditures were statistically significant in three of the five engagement measures by the time students were Seniors in college (Pike, Smart, Kuh, & Hayek, 2006).

Conceptual Framework of Student Success

Though there are many measures of student success (i.e. output, value and transformational quality) in the literature, for the purpose of this study, I defined student success in terms of persistence, completion, and transfer (Callan, Ewell, Finney & Jones, 2007; Durkin & Kirchner, 2010; Jenkins, 2006; Leinbach & Jenkins, 2008).

Tinto (1993) is one of the seminal researchers of *student attrition*, that is, students who leave college prior to completion of their goals. Student attrition is the inverse of *student persistence*, that is, students who stay in college through completion of their goals. Intuitively, we understand that students cannot achieve their longer-term educational goals of completing, transferring or learning unless they remain in the educational process—in other words, unless they persist. As will be discussed thoroughly in Chapter 3, my research model is based heavily on Tinto's longitudinal model of institutional departure (see Figure 4), which seeks to explain the variables that contribute to students leaving college. In my study, I define success as completion, transfer, or persistence—persistence being the opposite of Tinto's "Departure Decision".

In addition, my research model is informed by a study of Washington state's community college system by Leinbach and Jenkins (2008). Their study took student intent (i.e. completion level and major) and student preparedness into account. In essence, they argued that student intent alone is not a satisfactory method of dividing students into cohorts; evaluating students

who enter the community college system at different points of the preparedness pipeline confounds completion results. Simply stated, not all entering freshmen are college-ready,

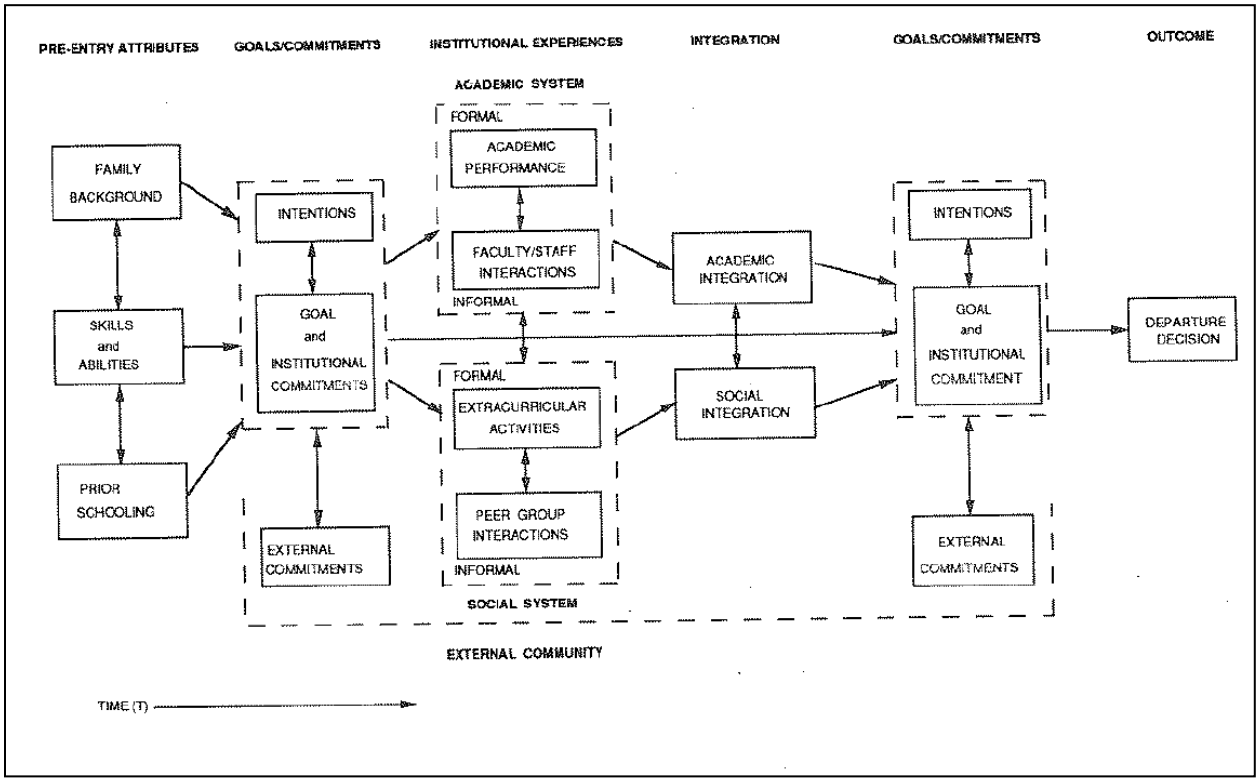

Figure 4. Tinto's longitudinal model of institutional departure (Tinto, 1993, p. 114)

whether or not they have completed high school. Some have not mastered the English language, and require English as a Second Language (ESL) coursework. Some have not earned a high school diploma and need to earn a General Equivalency Degree (GED) through Adult Basic Education (ABE) coursework prior to pursuing a college degree. Finally, many students with a high school diploma still do not have the fundamental reading, writing, and arithmetic skills needed to be successful in college-level coursework, and must further develop these skills through Developmental Education.

The study (Leinbach & Jenkins, 2008) determined a number of *momentum points* (such as successful completion of college level English or math, 15 credits earned, 30 credits earned) to be good predictors of traditional completion measures. Leinbach and Jenkins (2008) argued

that due to the complexities of the various populations served by community colleges, these momentum points may even be appropriate measures of attainment for certain cohorts of community college students.

As can be inferred from Figure 5, not all first time freshmen are "college ready." For the measures of quality outlined in Chapter 1 to be meaningful, studies must carefully select which students are appropriate to include in the measure. For example, including full-time first-time freshmen that require significant developmental coursework may be misleading, as they are really at a different starting point than those students who truly come academically ready to pursue college-level coursework. Many students may require at least two courses of developmental coursework, while others may require more than s full semester's worth.

Student Intent

The student's intention (i.e. goal) is important. From a persistence and completion standpoint, the higher the student's goals, the higher the likelihood of completion (Tinto, 1993). Thus, helping students to clarify and articulate their educational goals could enhance completion. Yet many students, perhaps especially those attending community colleges, never intend to complete. Many intend to transfer to a four year school after the completion of some developmental or general education coursework. Others seek to enhance a skill for work, while some take a class simply because they are interested in the subject. Intention is also important for those seeking to measure the quality of college outputs. For example, students who are not seeking a degree or certificate should not be included in the completion performance measure.

Most schools try to assess student intent in one fashion or another. Some universities require students to apply not only to the university, but to be accepted by a specific program or to

at least declare a major. Some community colleges ask students about their educational goals as part of the admissions process—yet many students understandably change their minds after the first semester.

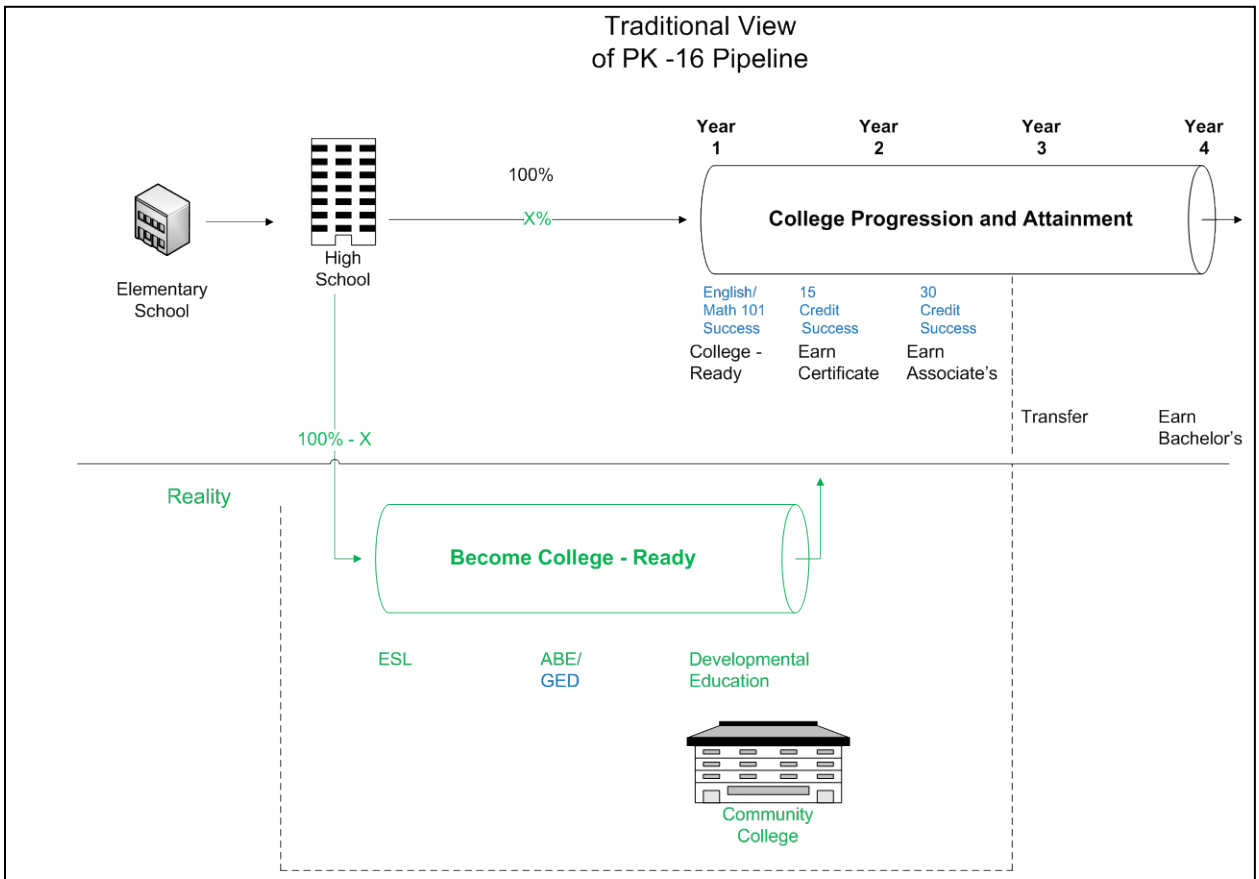

Figure 5: **PK-16 Pipeline**, modified from Ewell's "Milestone Events" model (2007), and Leinbach & Jenkins (2008).

San Juan College in Farmington, NM developed a method of assessing student intent. They judged students' intentions based on the students' actions, rather than on the students' words at the initial step of their college experience. San Juan evaluated each student's course-taking pattern during their first semester enrolled: Students taking 9 or more liberal arts credits were Transfer students, while students taking 9 or more vocational credits were Career students seeking to earn a degree. Students taking less than 9 credits of liberal arts were considered lifelong learners, and students taking less than 9 vocational credits were considered Skill-

Seekers. In order to more accurately reflect whether or not San Juan was meeting its students' (i.e. customers') needs, neither of these two groups, lifelong learners and skill-seekers, was considered in San Juan's state performance measured of completion rates and transfer rates. At this point, all of the community colleges in New Mexico have adopted this same student intent model for their state performance measure of quality outputs (Moore, 2000).

Yet some researchers (Pace, 1980) might assert that the San Juan model is a measure of student effort ("Commitment" in the Tinto model), rather than Intent. The higher the number of credits attempted in a semester, the stronger the student's commitment to achieve their intent.

As an alternative solution, Pima Community College developed a process where students must update their intention (i.e. goal) each semester when they register for classes. This allows Pima to more accurately measure their quality output performance based on what their students (i.e. customers) desire. This practice fits well with the Tinto model, wherein Intent is defined in both the second column (prior to having "Institutional Experiences" in column 3) and in the fifth column. This method was adopted by Yavapai College in the summer of 2011, and as such, the data are not available for the cohort in this study.

Persistence

In the IPEDS Glossary (2010), retention is "the percentage of first-time degree/ certificate-seeking students from the previous fall who either re-enrolled or successfully completed their program by the current fall." There are alternative measures of retention (American Association of Community Colleges, 2011; Cohen & Ibrahim, 2008; National Community College Benchmark Project, 2011; Reyna, 2010). The IPEDS definition, one of the more popular measures used by colleges to create benchmarks, uses first time, full-time freshmen who enroll in the fall as the measured cohort (i.e. the denominator of the measure).

IPEDS shows how many of these students return the following spring or the following fall. IPEDS only requires one year of tracking, so multi-year benchmark data on retention is not readily available. Yet this method excludes many students including transfer students, returning students who took a multi-year break from college, students starting in the spring and summer terms, and part-time students. Unlike four year college and university students, roughly 60% of community college students attend part-time (fewer than 12 student credit hours per semester), and more than a third are older than traditional age (18-24 years) students (Baum and Ma, 2010). This part-time status may indicate that community college students are more likely to be working adults and/ or have family commitments that compete with their graduation goal. Likewise, some students may enroll in a class simply because they are interested in the topic or need to acquire one skill to apply in their workplace—these students may already have a degree, and not desire another. In any event, the IPEDS measure may be of limited value in assessing community college output quality as it represents only a small portion of the population being serviced.

Studies relating costs to retention are relatively scarce, and many of those that do exist evaluate the impact of part-time faculty on outcomes. A few studies of the impact of part-time faculty on retention demonstrate a statistically significant relationship, yet with a relatively modest effect (Harrington & Schibik, 2001; Jaeger & Hinz, 2008). Bettinger and Long (2005) studied freshmen retention rates at four year public colleges in Ohio, and determined a 1% point increase in freshmen exposure to part-time faculty led to a statistically significant .6% point decrease in freshmen retention rates. On the other hand, Ehrenberg and Zhang (2005) did not find a statistically significant relationship between the proportion of part-time faculty and retention rates at 2-year colleges. Finally, some results are more nuanced: Eagan and Jaeger

(2008) found that while non-tenure track full-time faculty and graduate assistant-led courses did not negatively impact student persistence, other types of part-time faculty did. In another study, Ronco and Cahill (2004) found that only those freshmen who took less than 25% of their freshmen coursework from full-time faculty had significantly lower retention rates.

Completion

Graduation rate is one of the most intuitive measures of success for both students and colleges. Arguably, most traditional college students (full-time attendance, beginning directly after high school completion) attend a college to earn a degree or a certificate—not to "be retained" or to transfer to another college. However, this is not always the case for community college attendees. The list price differential between community college and four-year college tuition and general fees is large; four-year public college in-state rates are roughly three times the community college rate and private college prices are roughly ten times the community college rate of $2713 per year (Baum & Ma, 2010). As a cost-savings strategy, many students may choose to complete their general education requirements at a community college before transferring to the more-expensive college or university where they intend to earn their degree.

There are many ways to measure graduation rates (American Association of Community Colleges, 2011; National Community College Benchmark Project, 2011; Reyna, 2010). The most common method of comparison was developed by IPEDS, where all colleges and universities must report a variety of data if they want their students to remain eligible for federal grants and loans. The IPEDS method limits the measure to "the number of full-time, first-time, degree/certificate-seeking undergraduate students in a particular year (cohort) who complete their program within 150 percent of normal time to completion" (IPEDS, 2011). For a typical associate's degree, the time limit would be three years. This measure has the same limitations as

described in the IPEDS Retention measure: some students are inappropriately included in the denominator, while over half are inappropriately excluded from the measure altogether.

As with retention, the few studies indirectly evaluating the costs of instruction and the quality of output are related to part-time faculty. There have been studies evaluating the effect of part-time faculty on graduation rates and several have shown a statistically significant relationship, but the effect has been small. For example, Jacoby (2006) examined the effect of part-time faculty on graduation rates at community colleges using IPEDS data. His model, which had a R^2 of .34, found a .158% decrease in graduation rates for every 1% increase in part-time faculty headcount. For example, if a community college had a 3-year graduation rate of 50%, and increased its usage of part-time faculty by 10%, that community college would decrease its graduation rate to 49.21% (50% - 50%*.158% * 10). Jacoby concluded that less part-time faculty should be used, yet he did not evaluate the premium costs associated with maintaining that .79% graduation rate enhancement. Jaeger and Eagan (2009) obtained similar results; however, Ehrenberg and Zhang (2005) did not find a statistically significant relationship between the proportion of part-time faculty and graduation rates at two-year colleges. Finally, college grades and major are consistent indicators of both persistence and graduation (Pascarella & Terenzini, 2005).

Transfer

Transfer is a measure of "the total number of students who are known to have transferred out of the reporting institution [to another institution] within 150% of normal time to completion divided by the adjusted cohort" (IPEDS, 2011). The IPEDS definition, the gold standard of college benchmarking, uses the same cohort as described in the retention and graduation measures: first time, full-time freshmen who enroll in the Fall. IPEDS shows how many of these

students enroll at another college the following spring or the following fall. Once again, the applicability of this standard IPEDS measure has limited validity at community colleges, for the reasons I described in the Persistence and Graduation sections.

There are alternative measures of retention, which differ in terms of the numerator, the denominator, and the timeframe allowed (American Association of Community Colleges, 2011; Berger & Malaney, 2001; National Community College Benchmark Project, 2011; Reyna, 2010).

Several studies indicate that college grade point average is a good predictor of transfer rate and success (grades) after transfer (Eagan & Jaeger, 2008a; Laanan, 2007; Lee & Frank, 1989). Jaeger and Eagan (2009) indicated that younger age leads to higher transfer rates, while vocational studies, part-time student status, low socio-economic status (as measured by receiving financial aid) and exposure to part-time faculty all negatively impacted transfer rates.

Learning

As discussed in Chapter 1, the generic higher education mission has three primary objectives: teaching and learning, research, and public service. Some would argue that learning is the central mission for all of higher education (Bok, 2006), but this is certainly the case at community colleges which allocate few resources to research or public service (Desrochers, Lenihan, & Wellman, 2010). Many methods have been used to assess learning. The most prevalent is grades in the class (Pascarella & Terenzini, 2005); however, grades in the subsequent class (Burgess & Samuels, 1999), pass rates on licensure tests, and scores on standardized tests such as departmental finals (Landrum, 2009), the Collegiate Learning Assessment and the Graduate Record Examination (Bok, 2006) have been used as well.

Some studies try to measure the effect of part-time faculty on learning. Some studies found no relationship between student learning and faculty status (Iadevaia, 1991; Landrum,

2008; Ronco & Cahill, 2004; Wheland, Konet, & Butler, 2003). Other studies found higher grades associated with part-time faculty (MacFarland, 1997; McArthur, 1999) where the authors hypothesized that the higher grades reflected grade inflation due to concerns for continuing employment, rather than better teaching.

Other studies of part-time faculty gauge student learning in a sequence of two related courses (Burgess & Samuels, 1999). The researchers compared the second course grades of students who had part-time faculty in the first course to the second course grades of students who had full-time faculty in the first course. The premise of this method is that it helps to eliminate instructor bias, and perhaps measures the students' ability to apply what they learned in the first course. In this particular study (Burgess & Samuels, 1999), the students who had full-time faculty in the first course significantly outperformed the students who had part-time faculty in the first course; however, there were no control variables for the students or the faculty.

Budget Allocation and Management Tools

There are many methods by which colleges allocate their resources (revenues) into the capital, auxiliary, and E&G budgets, and ultimately into the National Association of College and University Business Officers (NACUBO) functional budgets and the departmental budgets. The following four budget allocation tools are described in increasing order of complexity and sophistication: incremental, strategic, zero-based, and responsibility-centered budgeting.

Incremental budgeting is one of the most prevalent budget allocation techniques wherein across the board decreases or increases are made to existing budgets. Organizations using strategic budgeting make allocation decisions based on which activities are deemed to best support the mission, vision and strategic plan of the organization. Zero-based budgeting is a rigorous approach, one rarely used in higher education, requiring each department to justify its

entire budget every year, starting from zero. Finally, responsibility centered budgeting (RCB) essentially turns instructional departments into “profit-centers,” where the departmental budget must be equal to or less than the departmental revenues (Goldstein, 2005).

RCB was pioneered by the University of Pennsylvania in response to the recession of the 1970s (Kirp, 2003). It has come to be known by many names including Responsibility Center Management, Revenue Center Management, Value Center management, and Incentive Based Budgeting (Hanover, 2008). Relatively few, yet prominent, private and public universities including Indiana University, Harvard University, UCLA, Ohio State University, and the University of Michigan have adopted the RCB model. This model acknowledges the Instructional function as the center of the institution, both in terms of mission and as the driver of variable revenue (Hearn, Lewis, Kallsen, Holdsworth, & Jones, 2006; Lang, 2001). As discussed in Chapter 1, non-profit higher education operates on a subsidy model, where price does not reflect total costs of operations. RCB seeks to make the financials more transparent and the departments more cost-effective by linking revenues to expenses (Whalen, 1991). Supporters suggest it drives cost efficiency and programmatic effectiveness, while critics suggest that it may detract from the strategic plan, shared governance (in this case meaning interdepartmental cooperation, and quality (Hanover, 2008; Strauss & Curry, 2002).

It is worth noting that many assumptions must be made in allocating revenues and non-instructional costs (including capital). Including these costs as part of a budgeting tool like RCB could create misleading results (Middaugh, 2001; Whalen, 1991).

Kissler (1997) surveyed 483 schools and found that most budgeting activities tended to be led by central administration and faculty were satisfied with this approach as long as there was enough money to continue their focus on research and teaching. Yet Iowa State University

found that people throughout the university were spending more time developing and using budgeting tools, which was natural, given that higher education "is transitioning away from a reliance on a relatively straightforward and predictable level of state support and moving toward an increased dependence on a variety of revenue and funding sources" (Hanover, 2008, p. 27).

Instructional Cost Drivers

Colleges and universities provide a wide variety of products and services with varying costs associated with each. The disciplines taught, the level of education provided (lower division, upper division, or graduate), teaching workloads (the number of sections and class sizes) as well as the proportion of workload allocated to research and public service all impact costs (Middaugh, 2000).

Institutional size (economies of scale) was found to impact institutional costs (de Groot, McMahon, & Volkwein, 1991; Laband & Lentz, 2004), but not between departments in a single institution (Nelson & Hevert, 1992).

Several researchers have tried to identify variables which determine Instructional costs. Faculty compensation, fringe benefits, the number of employees, number of programs, number of different courses, full-time faculty workload (number of classes taught and class size), number of part-time faculty, and number of new courses have all been explored (Berg, 2005; Brown & Gamber, 2002; Clotfelter, 1996; Ehrenberg, 2002; Jordan & Layzell, 1992; Levin, 1991; Middaugh, Graham, & Shadhid, 2003).

Many of these studies described four-year institutions, where faculty teaching productivity has given way to faculty research productivity. At many four-year schools, research is required to achieve promotion and tenure, whereas teaching productivity is less valued (Fairweather, 2002). In an earlier study, Fairweather explored the premise that extensive

research is needed for effective teaching (1993). In fact, Fairweather (1993) found low correlations between teaching effectiveness and research productivity. These issues are of less concern at community colleges, which have virtually no research activities, but it does demonstrate what happens to instruction costs as faculty are "released" from teaching duties to pursue other activities such as research, committee participation, and curriculum development.

IPEDS data (2005) indicate that labor and benefits represent over 76% of I&G costs, and over 90% of Instruction costs, at community colleges. There are many types of faculty including tenured faculty, lecturers, and part-time faculty, each with varying responsibilities and costs. In addition to potentially impacting the quality of higher education outputs as discussed above, part-time faculty do impact instructional costs. The relative cost of using a part-time faculty member to teach a course is typically from 1/3 to 1/2 the cost of utilizing a full-time tenured professor (Advisory Committee on Part-Time Faculty (ACPTF), 2003; California Postsecondary Education Commission (CPEC), 2001; New Mexico Higher Education Department (NMHED), 2007). Changing the proportion of part-time faculty used to deliver coursework can have a significant impact on Instructional and Institutional costs.

Using several variables, Watkins (1998) explored the cost drivers of instructional costs at 563 public community colleges. He found full-time faculty salaries, class size, and institutional size to be statistically significant predictors of instructional costs. In addition, he (Watkins, 1998) found the ratio of program completers to full-time equivalent enrollments to be statistically significant for some vocational-technical and allied health programs.

Sharp (2007) evaluated education and general cost drivers at all community colleges using IPEDS data. Though he did not focus on instructional expenses specifically, he did find several statistically significant instructional variables at rural community colleges including

institutional size, number of FTE students, proportion of budget spent on Instruction, proportion of full-time faculty, average faculty salary, and average class size (p. 83).

Efficiency and Productivity

As state appropriations to institutions of higher education continue to decrease, there are many tools available to assess productivity and efficiency (National Council for Continuing Education & Training (NCCET), n.d.). Like RCB, some tools use revenues and expenditures when assessing efficiency (Gaither, 2002; Redlinger & Valcik, 2008; Simon & Ranchero, 2010; Richards & Dayar, 2007; Ewell, 2009). One school, Mohave Community College, developed a model plotting their academic programs in a four-quadrant matrix, with the axes representing efficiency (profit) and effectiveness (quality of outputs) (Henry, 2007).

One methodology gaining prominence is to measure instructional cost per credit hour and faculty productivity as measured in student credit hours taught and research papers presented or published (Dellow & Losinger, 2004; Malo & Weed, 2006; Middaugh, Graham, & Shahid, 2003; Seybert & Rossol, 2010; Sumner & Brewer, 2006). The two most widespread techniques of this nature were developed for the Delaware Study (Middaugh, 2001) and then replicated in the Kansas Study (Seybert & Rossol, 2010) Since its inception in 1996 as a federally funded project, the Delaware Study was designed to assess the instructional productivity at four years colleges and universities. Led by the Institutional Research Department of the University of Delaware, the study designed a methodology for measuring instructional costs per student credit hour for each discipline. The methodology enables the instructional cost drivers of faculty salary, faculty load, faculty status (full-time or adjunct), and class size to become more apparent. The study also assessed the productivity of faculty members in terms of student credit hours generated as well as of research presented or published (Middaugh, 2001). Over 170 private and public 4-

year schools participated in the 2009 fiscal year study on a voluntary basis. Modeled after the Delaware Study, the Kansas Study (Seybert & Rossol, 2010) assessed instructional costs and productivity by discipline at over 130 community colleges in 2009.

Less-well-known measures of college productivity exist. The Center for College Affordability and Productivity suggests the number of degrees earned as a proportion of full-time equivalent employees (Bennett, 2009). This is likely to address the "academic ratchet" and "administrative lattice" described in Chapter 1 (Zemsky, Wegner, & Massy, 2006).

In a similar vein, Kelly (2009) suggested measuring productivity using total E&G costs per degree produced. He rightly pointed out that much of the true costs of increasing the number of college graduates is associated with issues regarding students withdrawing from classes, students retaking classes, and students taking more classes than their degree or certificate requires. All of these costs are captured in his proposed productivity measure (Kelly, 2009); however, for community colleges, it would overstate the costs per degree or certificate. As discussed previously, many students attend community colleges for reasons other than receiving an Associate's degree: some take developmental classes to become "college-ready"; some take some classes then transfer; some need a class or two to upgrade specific skills; and some students simply take a low-price class for personal enrichment.

Class Size

By tradition, community colleges typically offer small class sizes. In 2010, the median class size was 18.9, with the 90th percentile at 23.1 (National Community College Benchmark Project, 2010). This is in stark contrast to the large average class sizes of introductory survey courses for freshmen and sophomores at four-year institutions that can have over 200 students in them. Class size is another variable that researchers use as an indirect means to link instructional

costs to outputs. As mentioned previously, Watkins (1998) and Sharp (2007) both found class size to be statistically significant indicators of costs, yet both used the proxy of student-faculty ratio to approximate class size. Likewise, Koshal and Koshal (1999) found that class size impacted costs at a variety of schools.

Yet the quality output results are mixed, perhaps in part because many of the studies were methodologically weak overall, failing to control for other confounding variables (Toth & Montagna, 2002). One study indicated that class size had a statistically significant positive impact on effort, which should increase persistence (Fenollar, Roman, & Cuestas, 2007). The same study indicated no impact on student learning as measured by grades. Likewise, Wetstein and Mora (2007) found that class sizes ranging from 20 to 80 had no significant impact on student grades. Machado and Vera-Hernandez (2008) studied the impact of class sizes from 60 to 82 on college freshman grades and found no statistically significant impact.

As class size increases, some students perceive that their instructors are less effective (Bedard & Kuhn, 2008). Some students believe they learn less in large classes (Chapman & Ludlow, 2010), while others are satisfied with the instructional quality regardless of class size (Lesser & Ferrand, 2000).

It seems that without valid measures of quality, consumers tend to create their own measures. For example, Kramer and Pier (1999) determined that instructor pedagogical and communication style mattered more than class size to student ratings and concluded that many instructors used the same pedagogy regardless of class size.

However the effects of class size do not appear to be linear. In one well-designed study, the negative impact of class size on college student grades was largest for class sizes under twenty, and diminished as class sizes become larger. For classes with over 20 students, the

impact of adding one student was a .1% reduction in GPA (Kokkelenberg, Dillon, & Christy, 2008). This study may show how class size is related to Tinto's Departure Decision model (1993). In Tinto's model, class size could impact students' academic and social integration, as small classes become larger, the students' ability to interact with the instructor and with their peers in a meaningful way may decrease; yet at some point the change becomes negligible.

Faculty.

Full-time faculty are "Those members of the instruction/research staff who are employed full-time and whose major regular assignment is instruction, including those with released time for research" (IPEDS, 2010). Gappa (1984) defined a part-time faculty member as "anyone who (1) teaches less than the average full-time teaching load, or (2) has less than a full-time faculty assignment and range of duties, or (3) may have a temporary full-time assignment"; furthermore, part-time faculty are "non-tenured and non-permanent and have little or no job security" (p. 5).

At community colleges, part-time faculty are compensated roughly one-half to one-third of the rate of full-time faculty to teach a class (ACPTF, 2003; Anderson, 2002; Banachowsky, 1996; Cohen & Brawer, 2008; CPEC, 2001; Halcrow & Olson, 2008; JBL, 2009; Liu & Zhang, 2007; NMHED, 2007). This variance in compensation is in part due to the fact that many schools provide limited if any benefits to part-time faculty; yet the salary differential may be justifiable as full-time faculty tend to have more education, more teaching experience, and additional duties such as institutional service (ACPTF, 2003; CPEC, 2001; Halcrow & Olson, 2008; JBL, 2008; NMHED, 2007). The proportion of credits taught by part-time faculty varies by discipline (CPEC, 2001; JBL, 2008; NMHED, 2007), which can dramatically change Instructional costs.

Supporters of using part-time faculty advocate several reasons to hire part-time faculty including greater flexibility in course offerings to meet the needs of the community, greater access to students through lower tuition, applied knowledge of a particular subject, and coverage for sabbaticals and/ or research (ACPTF, 2003; Banachowski, 1996; CPEC, 2001; Haeger, 1998, Halcrow & Olson, 2008; Jordan & Layzell (1992); Levin, 2007; NMHED, 2007; Smith, 2007).

Critics of using part-time faculty assert that the use of part-time faculty is driven almost exclusively by college financials, and theorize that the use of part-time faculty lowers quality in a variety of ways including: outdated pedagogy, less quality control due to fewer instances of student and/ or administrative evaluation of part-time faculty; less time made available by part-time faculty to interact with students outside of class; part-time faculty tend to be less educated and less experienced; part-time faculty's concerns about re-appointment lead to less rigorous grading; and part-time faculty are less supported by the institution with many faculty having limited access to office space, computers, office supplies, email, the internet, administrative support, professional development, and to engage in departmental decisions (ACPTF, 2003; Gappa, 1984; Haeger, 1998; Halcrow & Olson, 2008; Levin, 2007; NMHED, 2007; Umbach, 2008).

The Research Model

Based on the review of the literature, the research model attempted to control for many of the variables that are known to impact student persistence and success, as well as those variables that are research question predictors, namely those which affect costs and quality.

CHAPTER 3: METHODS

The purpose of this study was to better understand the relationship between the cost of Instruction and the quality of Instruction, which is defined as persistence, transfer, and completion. To accomplish this, I designed a research model based on Tinto's Departure Decision Model (see Figure 4).

Research Model

Tinto ascribed the roots of his college student Departure Decision model to Van Gennep's Rites of Passage theory (1960) and Durkheim's Theory of Suicide (1951). Yet the Departure Decision model appeared to reflect some aspects of Astin's Input-Environment-Outcome model (1963) and Chickering's seven vectors of student development (1969) as well. Tinto's research-informed model built on prior studies demonstrating the known effects of variables in the categories of Family Background (such as socio-economic status, first generation student, gender, ethnicity, age), Skills and Abilities (including high school grades and college placement scores), Prior Schooling (e.g. Advanced Placement classes, concurrent enrollment credits, and dual enrollment credits), Intentions (the student's initial goals), Goal and Institutional Commitments (the amount of effort the student will exert to attain the goal), External Commitments (the amount of time and energy spent on non-educational priorities such as family and/ or work), Academic Performance (college grades), Faculty/ Staff Interactions (the degree to which the student is actively engaged in the learning process), and Social Integration (the degree to which the student is actively engaged in the social aspects of school).

As seen in the blue text and outlines in Figure 6, my model made only a few changes to the Tinto model. Virtually all of the aforementioned categories were considered control categories (C1-C11). In the Institutional Experiences column, the scope was limited to

Instructional Faculty and Staff, and I tested a variety of Independent variables that likely impacted Academic Integration (I1). The Outcomes column changed as well. Departure Decision was renamed Persistence (D1). As mentioned above, for the purpose of this study, student success has three components: Persistence (D1), Completion (D3), and Transfer (D4). Persistence, Completion and Transfer were combined into 1 dependent variable: Success. In other words, a student was considered successful if he/ she completed, persisted, or transferred.

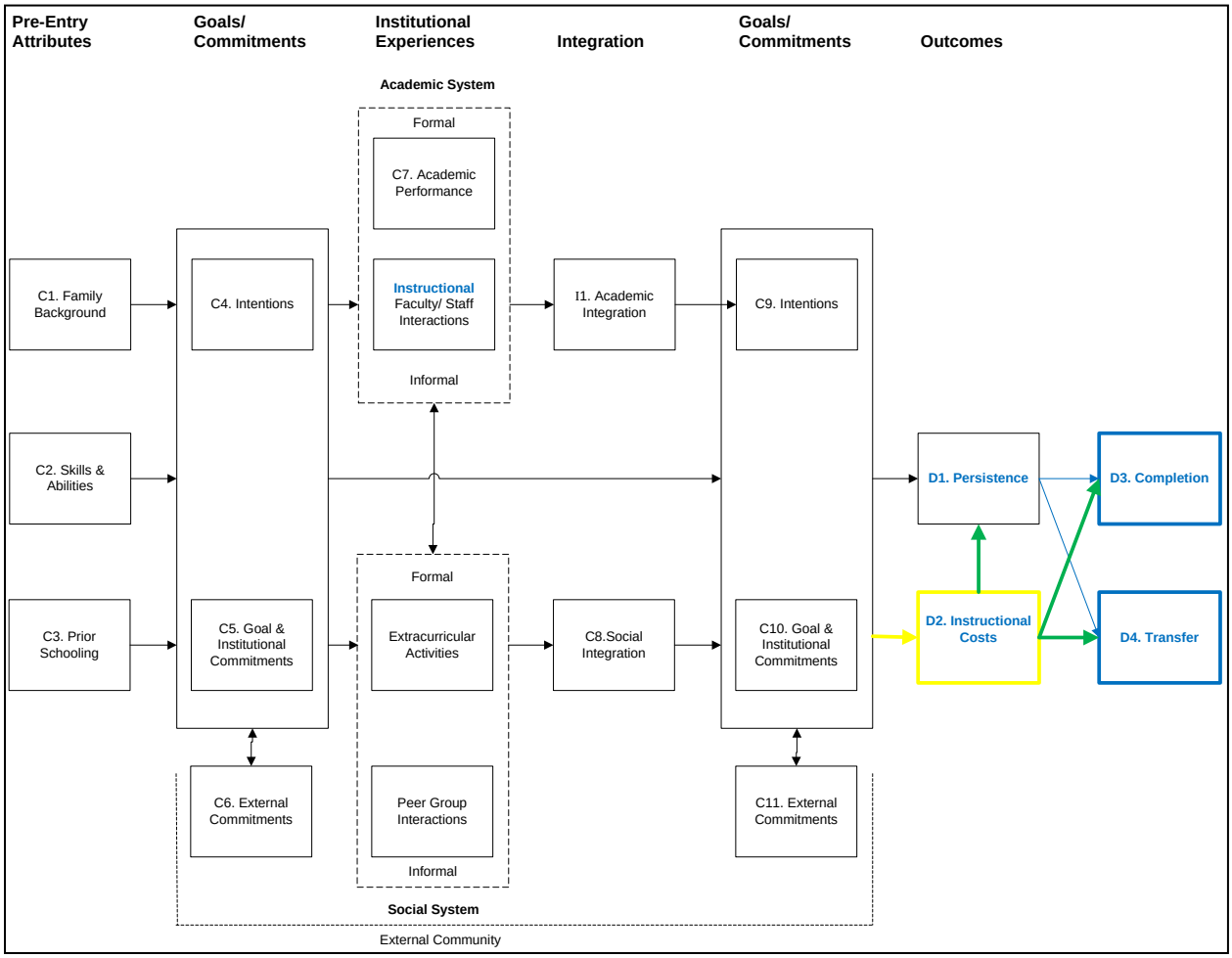

Figure 6. Hypothesized model based on Tinto's Departure Decision Model

As discussed in Chapter 1, the Iron Triangle (Figure 3) is based on the premise that Access, Costs, and Quality are positively correlated—to increase Access or Quality, a college must increase its costs. As was seen in Figure 1, the relationship between Cost and Price does

not have to be directly correlated due to the ability of colleges to offset a portion of costs with subsidies.

As discussed in Chapter 1, there are many different notions of Quality. In higher education, or at least in the rankings, the Quality as Excellence definition still dominates with its focus on the various inputs (including financial resources) needed to provide an education. This definition supports the Iron Triangle: to increase quality, measured in this study as "success" (persistence, completion, transfer), colleges must increase costs.

The modified Tinto model relates the costs of quality inputs (seen in column 3, Institutional Experiences) to the Quality as Fitness for Purpose (Outputs) definition (seen in columns 6 and 7). In other words, I used the modified Tinto model to test the Quality-Cost leg of the Iron Triangle.

Setting: Yavapai College (YC)

YC is a large, rural community college with 2 campuses and four sites throughout Yavapai County in Northern Arizona. Established in 1965, YC held its first classes in 1969. YC services over 200,000 people throughout the 8100 square miles of Yavapai County. Altogether, YC served over 16,000 different students in Fiscal Year 2010. Although YC is fiscally sound, having recently received Moody's AA2 and Standard & Poor's AA- ratings, the institution faces the challenge of decreasing state revenues while enrollments are growing.

YC is a comprehensive community college, providing transfer, occupational and continuing education college programs. Additionally, YC provides ESL, ABE, and Developmental coursework.

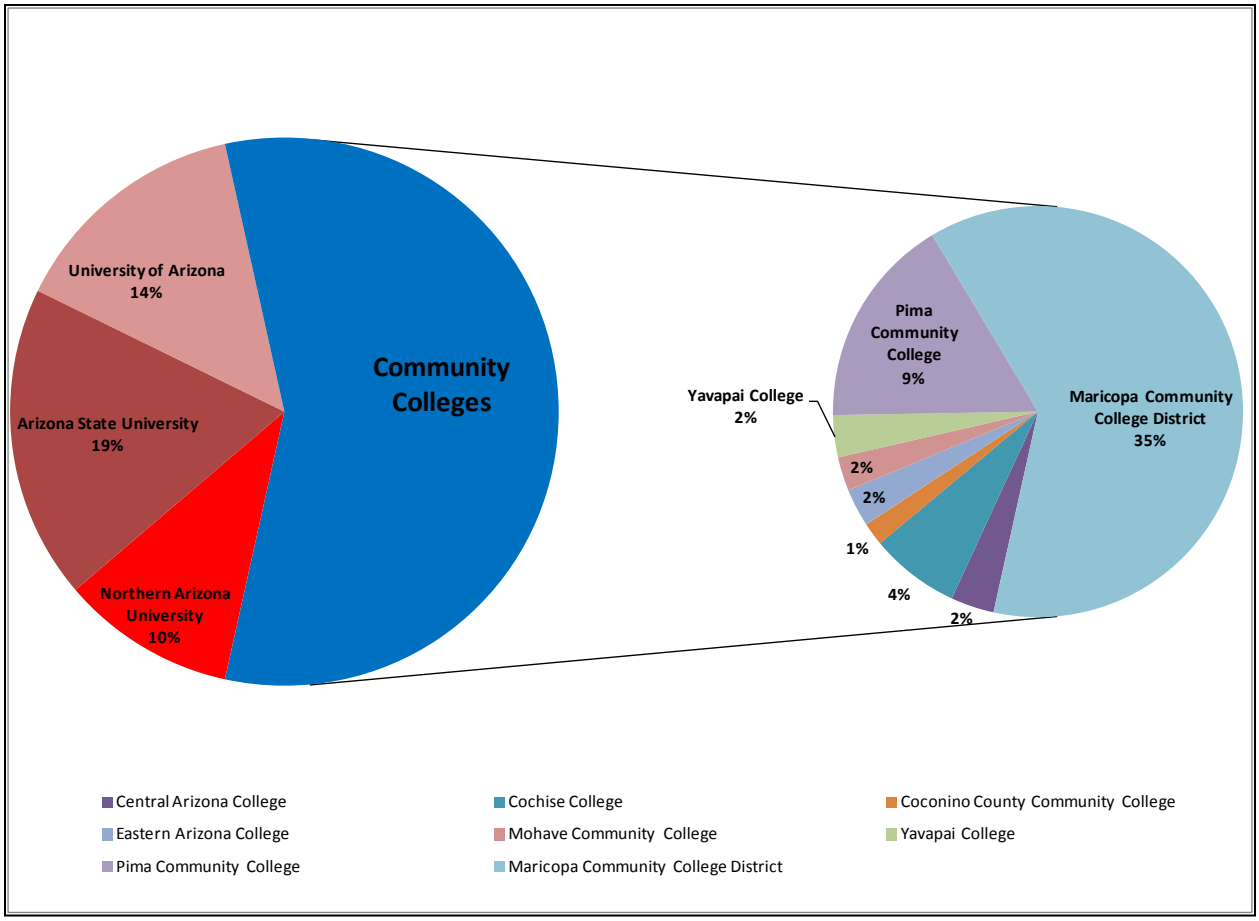

Figure 7. Full-Time Student Equivalent Enrollments at Arizona Community Colleges and Universities in 2007. (Data from Nicodemus, 2010)

The State of Arizona has three public research institutions and twelve community colleges, but is not a formal system. Over half of the student full-time equivalent enrollments are at community colleges (see Figure 7). Maricopa and Pima are two of the largest community colleges in the country. Yavapai College (YC) is the 6th largest community college in the state.

The State of Arizona had one of the hardest hit economies during the ongoing recession of 2008 (National Association of State Budget Officers, 2009), causing it to reduce its budget by over $4B (roughly 33%) in just two years. As can be seen in Figure 8, higher education appropriations were continually reduced over the past decade: while appropriations for the four-year institutions were reduced by only 16% per student full-time equivalent (FTE), the

community college appropriations were reduced by 42% per student FTE (Joint Legislative Budget Committee, 2010). The Fiscal Year 2012 budget reduced community college appropriations by an average of an additional 55%. Moreover, though constitutionally bound to provide higher education instruction "as nearly free as possible" (Arizona Constitution, 2009), the state has made a formal or informal policy decision to support four year colleges at substantially higher levels than community colleges.

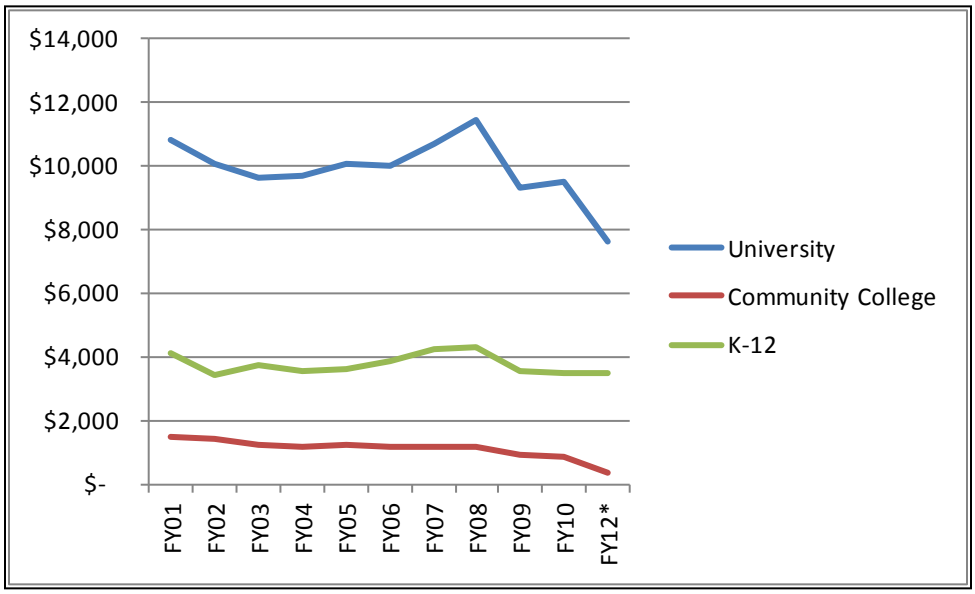

Figure 8. Educational Appropriations per Full-Time Equivalent Student in Arizona

Community Colleges are governed by Title 15 of the Arizona Revised Statutes (ARS), chapters 12 and 14. Community colleges are designated as political subdivisions of the state, which gives them limited taxing authority; however tax increases are limited to 2% of the existing levy amount and require the local governing board approval. Property taxes are the primary source of revenue for most Arizona community colleges comprising an average of just over 60% of total revenues (Nicodemus, 2010). As part of ARS chapter 14, some community college districts in less affluent counties receive additional equalization funds to allow for the provision of higher education.

Figure 9 demonstrates the primary revenue streams for community colleges in Arizona. Please note that YC has the highest revenues (resources) per student credit hour in the State of Arizona—using the Exceptional definition of Quality, we might expect YC to be one of the best-performing institutions in the state. Yet out of the 12 Arizona community colleges, YC was 6th in retention rate, 5th in transfer rate, 5th in graduation rate, and 10th in College course success rate (achieving a grade of "C" or better).

Figure 9. Arizona Community Colleges: Revenue Sources by Student Credit Hour, FY12 Arizona Community College State Aid Request

As political subdivisions, community colleges are also governed by Article IX, sections 19 and 21 of the Arizona Constitution, which limits the increase of expenditures related to tax revenues. As such, Arizona community colleges are only allowed to increase basic expenditures to offset increases in inflation or student enrollments. If a school's expenditures rise more that the growth in inflation and FTE, the state will decrease its appropriation to that school by an offsetting amount. This may likely explain why the Arizona Community Colleges, as a whole, have prices almost 25% below the national average (see Figure 10) and costs over 30% below the national average (see Figure 11). In fact, Arizona Community Colleges are consistently

some of the lowest priced community colleges in the nation (Baum & Ma, 2010; Shaffer, 2009). Please note that the four purple bars represent schools that receive state equalization funds, and that YC is the second lowest priced of those colleges that do not receive state equalization funds. YC likely has the ability to raise price and remain market competitive, yet chooses to operate with fewer financial resources.

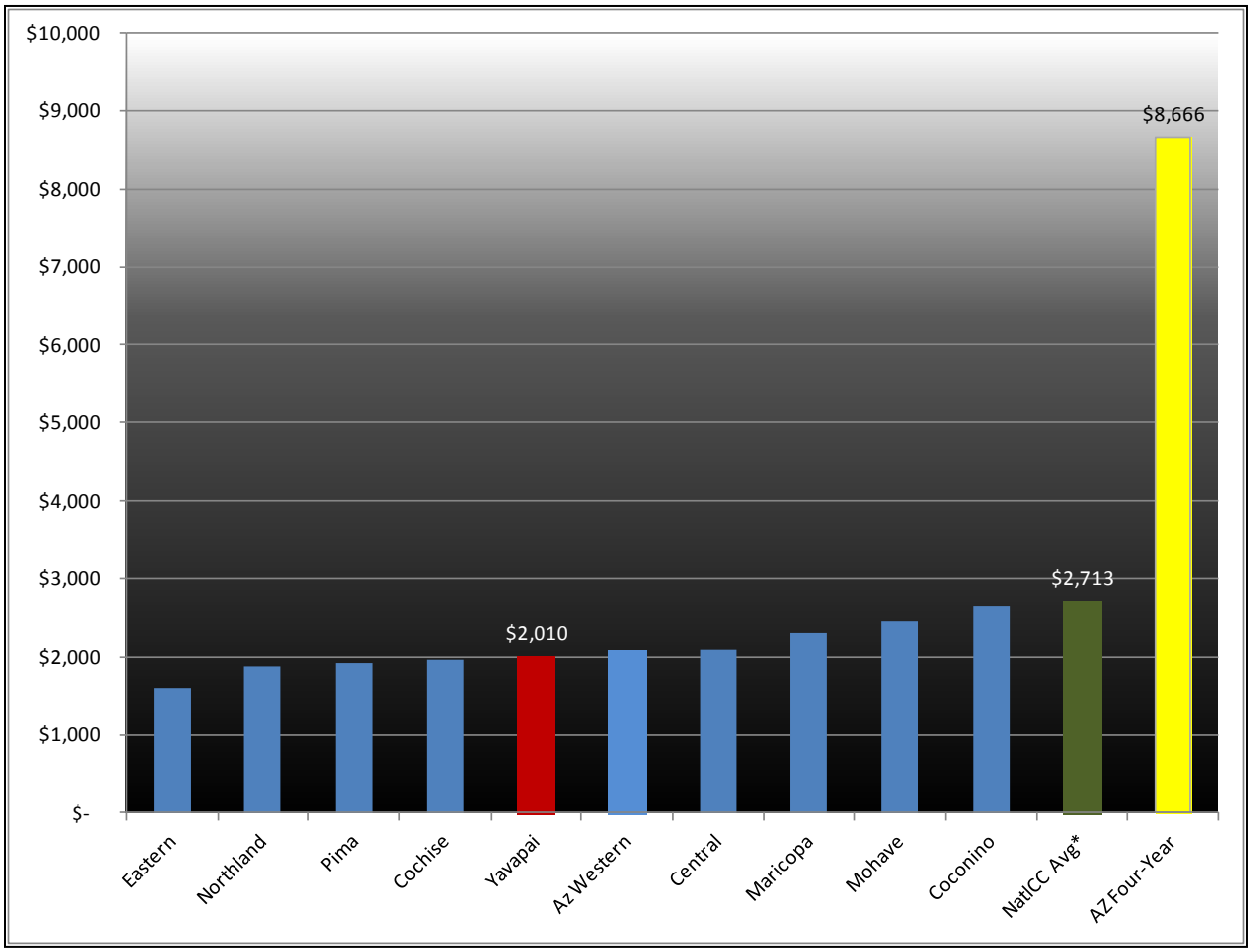

Figure 10. FY12 Annual Tuition and Fees of Arizona Community Colleges with Benchmark data

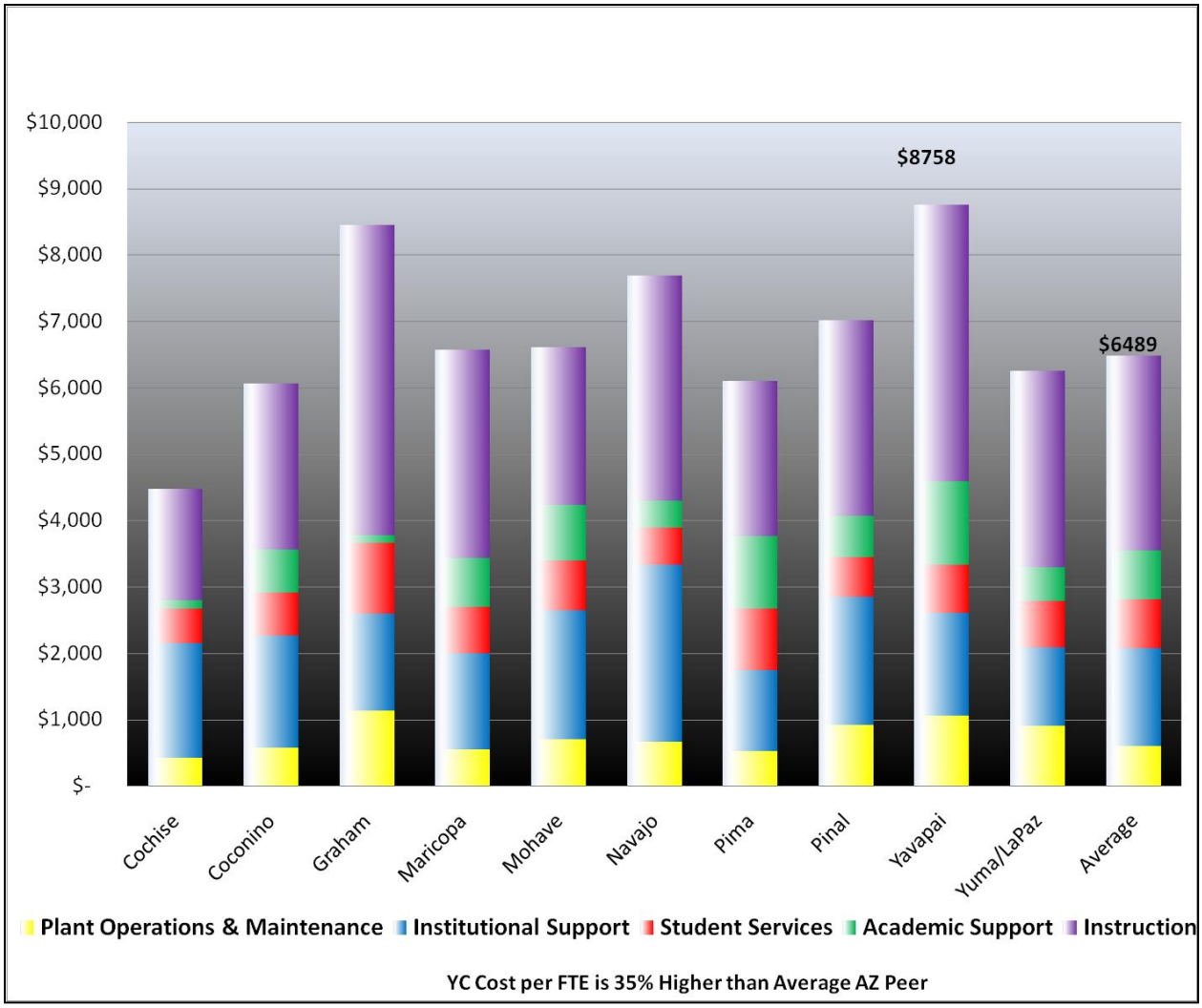

Figure 11. Educational & General Expenditures per Student FTE, FY2009-10

Data

I requested data from the Institutional Research Department at Yavapai College. Four full years of quality data from Summer 2007 through Summer 2011 were collected for the cohort (See Appendix B), to allow part-time students attending at a half-time rate to complete. Based on Institutional Research enrollment data, there were 814 student students in this cohort. In addition to a variety of demographic data, class data for each student was provided, 8550 data points in total, representing 4,225 sections. The quality of instruction was recorded for each

student (persistence, transfer, and completion). In addition, I needed information about the 601 faculty (347 part-time and 264 full-time) that taught these students to serve as control variables.

Because of the way financial data are collected, I requested financial data for all of the courses offered during the four years of the study—not just the courses taken by the cohort. Only Instructional operating costs were considered for these 12,775 courses—neither capital, nor any of the other operating costs were considered. Per my request, Institutional Research categorized these data into instructor salary and benefits, non-faculty salary and benefits, and non-labor expenditures.

The College used an Enterprise Resource Planning software tool called Banner, which is used at over 800 colleges and universities in the United States. There are multiple modules within Banner including Finance, Human Resources, and Student. Each module has a variety of tables and fields. Appendix B provides the list of requested data, with Description and Banner Table location where appropriate.

In order to perform my analyses, it was necessary for data from different tables to be combined into two databases. Per my request, Institutional Research used Term code, Year, Class prefix and number, Section number to link information from the Student, Human Resources and Financial modules for both databases. The first database focused on the cohort being studied, with both its control variables and a section-level cost per student credit hour variable, which was derived from the second database. For the first database, each case (row) is a class taken by one of the students in the cohort, along with all of the control variables associated with that student (e.g. ethnicity, age, gender, etc.), and the dependent variables associated with that student (Success, Grade, and GPA).

The second database focused on the financial variables needed to derive a cost per student credit hour for each section of each course. In the second database, each case (row) is a class section. Class sections became the common variable by which I was able to compare student quality and instructional costs. Students enroll in class sections. Individual class sections create grades. Certain combinations of class sections become completions. Similarly, certain combinations of class sections facilitate successful transfer to another institution. Continuing to enroll in class sections is retention. On the financial side, all instructional costs are either directly associated with a class section (e.g. instructor costs) or were allocated to a class section (e.g. departmental secretary) based on student credit hours. Appendix C presents the variables for each of these datasets and the methodology used for derived variables and allocated costs.

Research Design

This study treated student success (i.e. the sum of those students who completed, transferred or persisted) as the dependent variable, which as a categorical variable required logistic regression analysis. The analysis used a set of dependent variables supported by the literature (see Table 1) and independent variables (see Table 2).

Table 1

Literature support for dependent variables

Variable	Coding ID	Type	Description	Literature Support
Y_1'	Success	Dependent	(# Completers + # Transfers + # Persisters)/ Initial Cohort	Bailey, Calagno, Jenkins, Kienzl, & Leinbach, 2005; Jenkins, 2006.
	Complete	Dependent	(# people who earned degree or certificate within 200% of normal time)/ (#	Ehrenberg & Zhang, 2005; Jacoby, 2006; Jaeger & Eagan, 2009; Moore, 2000; Pascarella & Terenzini, 2005; Eagan & Jaeger, 2008a; Kelly &

			people who wanted to complete, as of final term)	Jones, 2005; Hamrick, Schuh & Shelley, 2004; Jenkins, 2006
	Transfer	Dependent	(# Students who Transferred to another school within 1 year departure)/ (# people who wanted to Transfer as of final term)	Berger & Malaney, 2001; Eagan & Jaeger,2008; Laanan, 2007; Lee & Frank, 1989; Moore, 2000
	Persist	Dependent	(# Students in attendance During final semester)/ (Initial cohort – Completers – Transfers)	Bettinger & Long, 2005; Cohen & Ibrahim, 2008; Eagan & Jaeger, 2008; Ehrenberg & Zhang, 2005; Harrington & Schibik, 2001; Jaeger & Hinz, 2009; Moore, 2000 ; Ronco & Cahill, 2004; Burgess & Samuels, 1999
	Learn	Dependent	Difference in Freshmen and Completer scores on ETS Academic Profile Scores	Bok, 2006; Burgess & Samuels, 1999; Dessrochers, Lenihan & Wellman, 2010; Iadevaia, 1991; Landrum, 2009; MacFarland, 1998; McArthur, 1999; Pascarella & Terenzini, 2005; Ronco & Cahill, 2004; Wheland, Konet & Butler, 2003; Berger & Malaney, 2001; Fenollar, Roman & Cuestas, 2007; Wetstein & Mora, 2003; Machado & Vera-Hernandez, 2008; Kokkelenberg, Dillon & Christy, 2006; Chapman & Ludlow, 2010; Lesser & Ferrrand, 2000

Table 2

Literature support for control variables

Variable	Coding ID	Type	Description	Literature Support
X_1	LOWSES	Control	Pell Grant awarded (Y=1)	Jacoby, 2006; Jaeger & Eagan, 2009; Ehrenberg & Zhang, 2005; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Ronco & Cahill, 2004; Jenkins, 2006; Lee & Frank, 1989; Laanan, 2007; Pascarella & Terrenzini, 1991, 2005; Tinto, 1993

X_2	ETHNIC	Control	Categorical for Minority =1 or Other =1	Jacoby. 2006; Jaeger & Eagan, 2009; Harrington & Schibik, 2001; Ehrenberg & Zhang, 2005; Bettinger & Long, 2005; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Ronco & Cahill, 2004; Kelly & Jones, 2005; Jenkins, 2006; Lee & Frank, 1989; Laanan, 2007; Berger & Malaney, 2001; Wetstein & Mora, 2003; Kokkelenberg, Dillon & Christy, 2008; Pascarella & Terranzini, 1991, 2005; Tinto, 1993
X_3	AGE	Control	18-24 (0), >24 (1) (<18 removed)	Jaeger & Eagan, 2009 Harrington & Schibik, 2001; Ehrenberg & Zhang, 2005; Bettinger & Long, 2005; Eagan & Jaeger, 2008a; Iadevaia, 1991; Laanan, 2007; Berger & Malaney, 2001; Pascarella & Terrenzini, 1991, 2005; Tinto, 1993
X_4	FIRST	Control	First generation college (Y=1)	Laanan, 2007; Pascarella & Terrenzini, 1995;
X_5	GENDER	Control	Female (Y=1) (unknown removed)	Jaeger & Hinz, 2009; Harrington & Schibik, 2001; Bettinger & Long, 2005; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Iadevaia, 1991; Ronco & Cahill, 2004; Jenkins, 2006; Lee & Frank, 1989; Laanan, 2007; Berger & Malaney, 2001; Wetstein & Mora, 2003; Machado & Vera-Hernandez, 2008; Kokkelenberg, Dillon & Christy, 2006; Pascarella & Terrenzini, 1991, 2005; Tinto, 1993
X_6	ESL	Control	English as 2nd Language coursework taken (Y=1)	Leinbach & Jenkins, 2008
X_7	GPA	Control	Grade Point Average:	

			1st semester	Jaeger & Eagan, 2009; Jaeger & Hinz, 2009; Harrington & Schibik, 2001; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Ronco & Cahill, 2004; Lee & Frank, 1989; Kokkelenberg, Dillon & Christy, 2006; Pascarella & Terrenzini, 1991, 2005; Tinto, 2003
X_8	READ	Control	Developmental reading Not required and not taken	Iadevaia, 1991; Jenkins, 2006 Wetstein & Mora, 2003 Leinbach & Jenkins, 2008; Tinto, 1993; Sharp, 2007
X_9	MATH	Control	Developmental math Not required and not taken	Jenkins, 2006; Tinto, 1993 Leinbach & Jenkins, 2008 Sharp, 2007
X_{10}	WRITE	Control	Developmental writing Not required and not taken	Jenkins, 2006; Tinto, 1993; Leinbach & Jenkins, 2008 Sharp, 2007
X_{11}	READY	Control	Dev ed courses not required and not taken (Y=1)	Jenkins, 2006; Tinto, 1993; Leinbach & Jenkins, 2008; Sharp, 2007
X_{12}	AP	Control	# Advanced Placement credits awarded	None
X_{13}	CD	Control	# Concurrent or dual credits awarded	None
X_{14}	GED	Control	General Equivalency Degree (Y=1)	None
X_{15}	INTENT	Control	Complete (0) or Transfer (1)	Jacoby, 2006; Laanan, 2007; Pascarella & Terrenzini, 1991, 2005; Tinto, 1993
X_{16}	FOCUS	Control	# withdrawals first semester	None
X_{17}	MAJOR	Control	None, Business or Allied Health, Other (2)	Jaeger & Eagan, 2009; Harrington & Schibik, 2001; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Ronco & Cahill, 2004; Kelly & Jones, 2005; Jenkins, 2006; Lee & Frank, 1989; Lesser & Ferrand, 2000; Pascarella & Terrenzini, 1991, 2005; Sharp, 2007; Watkins, 1998
X_{18}	MAJFOC	Control	Major is same in first and last Semester of attendance (Y=1)	None
X_{19}	CS	Control	Attended college success	None

			course (Y=1)	
X_{20}	EFFORT15	Control	Earned 15 credits in first year (Y=1)	Jaeger & Hinz, 2008; Harrington & Schibik, 2001; Eagan & Jaeger, 2008; Lee & Frank, 1989; Pascarella & Terrenzini, 1991, 2005
X_{21}	EFFORT30	Control	Earned 30 credits in first year (Y=1)	Jaeger & Hinz, 2008; Harrington & Schibik, 2001; Eagan & Jaeger, 2008; Pascarella & Terrenzini, 1991, 2005
X_{22}	STUDPT	Control	Student attempted <12 credits first semester (Y=1)	Jacoby, 2006; Jaeger & Eagan, 2009; Eagan & Jaeger, 2008a; Jenkins, 2006; Lee & Frank, 1989; Pascarella & Terrenzini, 1991, 2005; Tinto, 1993
X_{23}	FACED	Control	Average faculty ed based on courses taken	Fairweather, 1993
X_{24}	FACEXP	Control	ave # credits taught at YC based on courses taken	None
X_{25}	FACPED	Control	Ave. hours pedagogy training based on courses taken	Smith, 2007; Bok, 2003, 2006
X_{26}	SCHOOL	Control	proportion of courses taken in each school	Harrington & Schibik, 2001
X_{27}	DISCSIZE	Control	ave. size of disc. based on # Student credit hours of Discipline in first term Then average for each student based on courses taken	Watkins, 1998; Sharp, 2007
X_{28}	CULTEVAL	Control	ave. student evaluation score for School first term, then ave. for each student based on courses taken	Landrum, 2009; Ronco & Cahill, 2004; Lesser & Ferrand, 2000; Bedard & Kuhn, 2008
X_{29}	CULTGPA	Control	average GPA for courses offered by that discipline in first term, then average for each student based on courses taken	MacFarland, 1998
X_{30}	HONORS	Control	participate in college honors (Y=1)	Laanan, 2007; Berger & Malaney, 2001
X_{31}	PUB	Control	participate in school pubs (Y=1)	Laanan, 2007; Berger & Malaney, 2001
X_{32}	ROTC	Control	participate in ROTC (Y=1)	Laanan, 2007; Berger & Malaney;
X_{33}	PERF	Control	participate in choir, band,	Laanan, 2007; Berger &

			theatre (Y=1)	Malaney
X_{34}	LEAD	Control	participate in student leadership (Y=1)	Laanan, 2007; Berger & Malaney
X_{35}	ATH	Control	student athlete (Y=1)	Laanan, 2007; Berger & Malaney
X_{36}	RH	Control	Did student live in Residence Hall during study (Y=1)	None

Table 3

Literature support for question predictors

Variable	Coding ID	Type	Description	Literature Support
X_{37}	SCHPAY	Question	Aver. faculty pay per SCH Based on courses taken	Bennett, 2009; Middaugh, Graham & Shahid, 2003; Sumner & Brewer, 2006; Malo & Weed, 2006; Hamrick, Schuh & Shelley, 2004; Sharp, 2007
X_{38}	CRPAY	Question	Aver. faculty pay per credit For each student Based on courses taken	Bennett, 2009; Middaugh, Graham, Shahid, 2003; Sumner & Brewer, 2006; Malo & Weed, 2006; Kelly & Jones, 2005; Hamrick, Schuh & Shelley, 2004; Sharp, 2007
X_{39}	OTHER	Question	Aver. Other instructional labor $ per student credit hour Based on courses taken	Bennett, 2009; Middaugh, Graham & Shahid, 2003; Malo & Weed, 2006; Sumner & Brewer, 2006; Kelly & Jones, 2005; Hamrick, Schuh & Shelley, 2004
X_{40}	NONLAB	Question	Instructional non-labor cost per student credit hour based on courses taken	Middaugh, Graham & Shahid, 2003, Sumner & Brewer, 2006; Malo & Weed, 2006; Hamrick, Schuh & Shelley, 2004
X_{41}	CLASSIZE	Question	Aver. # students in class Based on courses taken	Middaugh, Graham & Shahid, 2003; Malo & Weed, 2006; Eagan & Jaeger, 2008; Fenollar, Roman & Cuestas, 2007; Wetstein & Mora, 2003; Machado & Vera-Hernandez, 2008;

				Kokkolenberg, Dillon & Christy, 2006; Kelly & Peter, 2008; Chapman & Ludlow, 2010; Lesser & Ferrand, 2000; Kramer & Pier, 1999; Bedard & Kuhn, 2008; Zemsky, Massy & Oedel, 1993; Sharp, 2007; Zemsky & Finney, 2010
X_{42}	FACSTAT	Question	Aver. proportion of classes From FT faculty based on Courses taken	Jordan & Layzell, 1992; Seybert & Rossol, 2010; Malo & Weed, 2006; Sumner & Brewer, 2006; Jacoby, 2006; Jaeger & Eagan, 2009; Jaeger & Hinz, 2009; Harrington & Schibik, 2001; Ehrenberg & Zhang, 2005; Bettinger & Long, 2005; Burgess & Samuels, 1999; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Levin, 2007; MacFarland, 1998; McArthur, 1999; Iadevaia, 1991; Ronco & Cahill, 2004; Wheland, Konet & Butler, 2003; Sharp, 2007
X_{43}	MODE	Question	Proportion of fully online courses based on courses taken	Levin, 1991; Twigg, 2003, 2003a;
X_{44}	LOAD	Question	Aver. annual SCH per FT Based on courses taken	Bennett, 2009; Fairweather, 2002; Middaugh, Graham & Shahid, 2003; Seybert & Rossol, 2010; Sumner & Brewer, 2006; Malo & Weed, 2006; Zemsky & Finney, 2010

Control variables $X_1 – X_{14}$ represent the first column of the research model, Pre-Entry Attributes. Control variables $X_{15} – X_{22}$ represent the second column of the model, Goals/ Commitments. Control Variables $X_{23} – X_{29}$ represent Column 3, Institutional Experiences. Control variables $X_{30} – X_{36}$, represent the Social Integration box in the Integration column, while

the question predictors ($X_{37} – X_{44}$) represent the Academic Integration box in the Integration column.

Data Analysis

Descriptive Statistics.

To help summarize the data set, I calculated descriptive statistics for all the variables of interest. Descriptive statistics "are necessary to help spot problems with the data that require changes in the inferential and advanced techniques the researcher employs" (Vogt, 2007, p. 57).

Logistic Regression Model

I built a taxonomy of logistic regression models, adding blocks of variables based on Tinto's model, and entering the question predictors last.

Here are the research questions with the associated model. Note that the question predictors for costs are bolded:

1. Which variables from Tinto's model of institutional departure have a statistically significant relationship with student success?

2. Based on the literature, do any of the variables which typically impact Instructional costs have a statistically significant impact on Student Success at Yavapai College? If so, to what extent?

$Y_2' = f(X_1 \ldots X_{44})$

SUCCESS = f (LOWSES, ETHNIC, AGE, FIRST, GENDER, ESL, GPA, READ, MATH, WRITE, READY, AP, CD, GED, INTENT, FOCUS, MAJOR, MAJFOC, CS, EFFORT15, EFFORT30, STUDPT, FACEXP, FACPED, SCHOOL, DISCSIZE, CULTEVAL, CULTGPA, HONORS, PUB, ROTC, PERF, LEAD, ATH, RH, **PAYSCH, PAYCREDIT, OTHER, NONLAB, CLASSIZE, FACSTAT, MODE, LOAD)**

Chapter 4: FINDINGS

The purpose of this study was to ascertain whether or not there is a relationship between the costs and quality of instruction. More specifically, I accomplished this by choosing variables from the literature that had a statistically significant impact on student success (persistence, transfer, or completion), then examined whether adding variables, which the literature indicated have a statistically significant impact on instructional costs, improved the student success model.

Descriptive Statistics

There were 814 students in the cohort. This represents all of the students, both full- and part-time, who had a high school diploma or equivalent (i.e., dual and concurrent enrollment students are excluded); entered college for the first time since receipt of the diploma or equivalent during the 2007 Summer, 2007 Fall or 2008 Spring term; enrolled in credit or developmental education courses; and entered college with a declared intent of completing an award or transferring. Lifelong Learners and Skill Seekers were excluded from the cohort.

Pre-Entry Attributes (X_1-X_{14})

As we can see in Table 2, slightly more than half the cohort (51.6%) were women (GENDER). The vast majority of the cohort was White (71.5% WHITE), with Hispanic (11.4% HISPANIC), American Indian (4.3% NATIVEAM), Black (2.6% BLACK), and Asian (1.8% ASIAN) making up the balance. Some 8.4% of the cohort did not identify their ethnicity. Though the cohort was predominantly White, this matches the demographics of the College's service district (Yavapai County). None of the cohort took English as a Second Language (ESL) coursework, so this variable was removed from the analysis. Because of the relatively small numbers associated with each of the non-white ethnicities, they were combined into a variable called Minority, which represented 20.1% of the population.

Table 2
Categorical variable names, descriptions, and descriptive statistics for Pre-Entry Control Variables, n = 814

Variable Name	Description	Count	Percentage
LOWSES	Student received Pell Grant		
	1 = Yes	194	23.8
	0 = No	620	76.2
OTHERETHNIC	Is student not white and not Minority?		
	1 = Yes	68	8.4
	0 = 0	746	91.6
MINORITY	Is student Asian, Black, Hispanic, Native American?		
	1 = Yes	164	20.1
	0 = No	650	79.9
AGE	Is student over 24?		
	1 = Yes	334	41
	0 = No	480	59
GENDER	Is Student Female?		
	1=Yes	420	51.6
	0=No	394	48.4
READ	Was student college-ready in reading and did not take Dev. Read?		
	1=Yes	751	92.3
	0=No	63	7.7
MATH	Was student college-ready in math and did not take Dev. Math?		
	1=Yes	469	42.4
	0=No	345	57.6
WRITE	Was student college-ready in Writing and did not take Dev. Writing?		
	1=Yes	755	92.8
	0=No	59	7.2
GED	Did student earn GED?		
	1=Yes	59	7.2
	0=No	755	92.8

Fifty-nine percent of the cohort was of traditional age (24 or younger) when they entered college, with the balance being older (AGE). Students under 18 were excluded from the study. There were 23.8% of students that received Pell grants (proxy for low socio-economic status-LOWSES), well above the county demographic of people at or below the poverty level (13.7%). The vast majority (78%) of the cohort did not identify whether or not they were a first generation (FIRST) college student. Of those that did, 12.3% were first generation, and the balance of the students was not. Because so many students did not report this information, this variable was removed from the analysis.

Almost all (92%) of the cohort placed into college level reading (READ) and writing (WRITE) or was not required to take the placement test. In contrast, only 58% of the cohort tested into college level math (MATH) or was not required to take the test. In all, 44% of the cohort was considered not "college" ready based on entrance criteria, a notable difference from the average AZ community college which enrolls 58.8% of its students in developmental coursework (completecollege.org).

Only 6 of the 814 students came to Yavapai College with AP (AP) credits, while 21 came to college with earned college credits through either dual-credit or concurrent-credit (CD) courses. Because of this small number, these two variables were removed from the study.

Fifty-nine students came to YC with a General Equivalency Diploma (GED), with the balance of the cohort bringing a traditional high school diploma. As is shown in Table 3, the average GPA for the cohort during its first semester was 3.0.

Table 3

Continuous Variable name, description, and descriptive statistics for Pre-Entry Control Variables, n=814

Variable Name	Description	Mean	Std. Dev.	Min.	Max.
GPA	Actual first semester GPA	3.0001	1.1085	0	4

Goals/ Commitments (X_{15}-X_{22})

Most (63%) of the cohort came to earn a degree or a certificate, while the balance of the cohort wanted to earn some coursework before transferring (TRANSFER). Most students (37%) did not come with a clear idea of what they wanted to major in (MAJORNONE). Thirty-four percent entered as Allied Health or Business majors (MAJORBUSAH), with the balance of students declaring another major (MAJOROTHER). A large majority (66%) of students stayed with their same major throughout the period of the study (MAJFOC). The descriptive statistics for the Goals/ Commitments variables are shown in Table 4.

Table 4

Categorical variable names, descriptions, and descriptive statistics for Goals/ Commitments Control Variables, n = 814

Variable Name	Description	Count	Percentage
INTENT	Does student intend to transfer?		
	1=Yes	300	36.9
	0=No	514	63.1
MAJORAHBS	Is student majoring in Allied Health or Business upon entry?		
	1 = Yes	276	33.9
	0 = No	513	66.1
MAJOROTHER	Has student declared another major?		
	1 = Yes	237	29.1
	0 = No	577	70.9

MAJORFOCUS	Did student have same major in first and last semester?		
	1 = Yes	533	65.5
	0 = No	281	34.5
CS	Did student take college success course?		
	1 = Yes	78	9.6
	0 = No	736	90.4
EFFORT15	Did student complete 15 or more credits in first year?		
	1=Yes	308	37.8
	0=No	506	62.2
EFFORT30	Did student complete 30 or more credits during first year?		
	1=Yes	69	8.5
	0=No	745	91.5
STUDENTPT	Did student take less than 12 credits in first semester?		
	1=Yes	497	61.1
	0=No	317	38.9

Less than 10% of the cohort took the elective College Success (CS) course to improve their study habits. Twenty-nine percent of the cohort earned at least 15 credits during their first year of study (a half-time rate— EFFORT15), while an additional 8.4% earned at least 30 credits during their first year (a full-time rate—EFFORT30). Of note, 61% of the students were classified as part-time (STUDPT), earning less than 12 credits during their first semester. Only 15.7% of the cohort withdrew from a class during their first semester (FOCUS). The descriptive statistics for Focus are shown in Table 5.

Table 5

Continuous Variable names, descriptions, and descriptive statistics for Goals/ Commitments Control Variables, n=814

Variable Name	Description	Mean	Std. Dev.	Min.	Max.
FOCUS	Number of withdrawals in first semester	0.22	0.626	0	5

Institutional Experiences (X_{23}-X_{29})

As can be seen in Table 6, thirteen percent of the courses were taken from faculty that had earned a terminal degree, 45% from faculty who had earned a Master's degree, 13% from faculty who had earned a Bachelor's degree, 3% from faculty who earned an Associate's Degree, and 3% from faculty who had earned a technical certificate (FACED). Actual student experience ranged from all coursework being taught by a high school graduate to all coursework being taught by a faculty with a terminal degree, and averaged 5.8 years of post-secondary education (roughly a Master's degree). Several faculty credentials were not available through Banner (23%), and these cases were excluded when calculating the average faculty education experienced by students through their unique course portfolio.

The students were taught by faculty with an average of 60 courses worth of teaching experience (FACEXP) at Yavapai College— 6 years, assuming a 10-course per year load. Actual student experience ranged from a faculty average of 0 courses (all courses from brand new hires) to a faculty average of 179 courses.

Faculty have opportunities to participate in free pedagogical training twice per year (FACPED), focused on applying technology to classroom and online environments. About half of the faculty participated in the training, and those that participated averaged 24 hours of

training. Actual student experience ranged from having all coursework from faculty with no pedagogical training to faculty averaging 95 hours of training, and averaged 18.2 hours.

Table 6

Continuous Variable names, descriptions, and descriptive statistics for Institutional Experiences Control Variables, n=814

Variable Name	Description	Mean	Std. Dev.	Min.	Max.
FACED	Average faculty post secondary education based on student course portfolio	5.80	1.48	1.00	9.00
FACEXP	Average number of courses taught by the faculty based on student course portfolio	60.33	32.42	0.00	179.00
FACPED	Average number of faculty on-site training hours based on student course portfolio	18.24	15.07	0.00	95.05
SSHL	Proportion of courses taken in Science, Allied Health and Phys Ed School	0.15	0.21	0.00	1.00
TECH	Proportion of courses taken in Career and Technical School	0.20	0.35	0.00	1.00
BCBS	Proportion of courses taken in Business School	0.13	0.24	0.00	1.00
VPLA	Proportion of courses taken in Visual, Performing, and Liberal Arts School	0.26	0.30	0.00	1.00
DISCSIZE	Average size of disciplines based on student course portfolio	2220.47	1282.44	25.00	6456.25
CULTEVAL	Average student course evaluation based on student course portfolio	4.34	0.56	0.00	4.80
CULTGPA	Average GPA awarded by disciplines based on student course portfolio	3.15	0.32	0.00	4.00

The Instruction Division of Yavapai College is organized into 5 schools: Of the 8550 courses taken by students in the cohort during the 4 year study, 15% were in Allied Health, Science and Physical Education (SSHL), 26% were in Foundation Studies (English, Math,

Developmental) (FNDT), 20% in Career & Technical (TECH), 13% in Business (BSCS), and 26% in Visual, Performing and Liberal Arts (includes all social sciences) (VPLA). These schools teach 61 disciplines which ranged in size (DISCSIZE) during the first semester of the study from 1 student credit hours (Military Science) to 7504 student credit hours (Math).

Student course evaluations are collected every semester, and the average was calculated for each discipline (CULTEVAL). They ranged from 3.41 (Machine Pneumatics) to 5 (Industrial Plant Technology) on a five point scale. Grade point averages were also calculated for each discipline (CULTGPA). They ranged from 2.0 (Military Science) to 4.0 (Police Academy) on a four point scale.

Social Integration (X_{30}-X_{36})

Table 7 presents the descriptive statistics for the Social Integration block of control variables.

Table 7

Categorical variable names, descriptions, and descriptive statistics for Social Integration Control Variables, n = 814

Variable Name	Description	Count	Percentage
SOCIAL	Did student participate in college honors program, athletic team, student leadership council, school newspaper, music program, or ROTC?		
	1=Yes	55	6.8
	0=No	759	93.2
RESHALL	Did student live in residence halls at any point during the study?		
	1 = Yes	145	17.8
	0=0	669	82.2

Ten of the students (1.2%) were in the college honors program (HONORS). One student was involved with the school newspaper (PUB) and 3 were involved in the Reserve Officer Training Corps (ROTC) program. Nine students joined the chorus or band (PERF), and three served on the Student Leadership Committee (LEAD). Of the cohort, 4.3 % played on the college athletic teams (ATH). Again, because these numbers were so small, they were combined into a categorical variable called SOCIAL and 6.8% of the population was part of the group represented by this variable. In this sample, 17.8% lived in the Residence Halls (RH) for one or more semesters of their tenure at the college.

Academic Integration/ Question Predictors (X_{37}-X_{44})

Students' primary interaction with the institution is through the faculty. Fifty-one percent of the courses taken by this cohort were from Part-time faculty (FACSTAT), 39% were from full-time faculty, and 10% were unknown. Courses with Unknown faculty status were excluded from the average proportion of classes taken from full-time faculty calculation, which was 47%. Actual student experience ranged from not having any classes taught by part-time faculty to having all of their classes taught by part-time faculty. Full-time faculty load was measured in student credit hours (SCH) taught; however, this would have cut the sample size by roughly one third, so this variable was not used in the analysis.

Similarly, the faculty's ability to interact with students may be affected by the class delivery mode. Nineteen percent of the courses offered during the period of the study were fully online (MODE). The balance was some other delivery mode (face to face, hybrid); however, 327 sections had no delivery code and were excluded from the calculation of the proportion of classes taken in on-line courses. Actual student experience ranged from having none of their

classes online to having all of their classes online. Table 8 shows the descriptive statistics for Academic Integration.

Table 8

Continuous Variable names, descriptions, and descriptive statistics for Academic Integration Predictor Variables, n=814

Variable Name	Description	Mean	Std. Dev.	Min.	Max.
PAYCREDIT	Average faculty pay per credit taught based on the student course portfolio	2272.31	1091.56	0.00	7844.75
OTHERLABOR	Average non-faculty instructional labor costs based on the student course portfolio	20.49	32.65	0.00	237.52
NONLABOR	Average amount of instructional expense that is not labor based on the student portfolio	11.56	25.20	0.00	140.58
CLASSSIZE	Average class size at Day 45 census based on student class portfolio	22.06	10.27	0.00	104.33
STATUS	Proportion of courses taken from full-time faculty based on student course portfolio	0.47	0.34	0.00	1.00
MODE	Proportion of courses taken fully online	0.19	0.28	0.00	1.00
LOAD	Average student credit hours taught by full-time faculty based on the student course portfolio	630.11	203.53	48.00	1461.00

Different instructional departments had various structures designed to support students, including instructional technicians, administrative assistants, lab technicians, and program managers. These labor costs were captured for each fiscal year and allocated by student credit hour within that department (OTHER). Likewise, different disciplines had provided a variety of non-labor (supplies, services, etc.) resources to their students. These non-labor costs were calculated for each discipline and allocated by student credit hours each fiscal year (NONLABOR).

Class size (CLASSIZE) was measured at census for each section. Class size averaged 22.06 for all the sections taken by students during the period of the study.

Even though the cohort took a combined 8550 classes over the period of the study, cohort members often were in the same class with one another. The result is that the cohort took 4,225 of the 11,688 courses offered during the period of the study. After accounting for course "stacking" (teaching multiple sections in the same room at the same time—such as Pottery 1 and Pottery 2), and co-teaching (multiple instructors for the same section), 12,738 cases were examined to calculate instruction cost variables. This is because cost data are only available in aggregate by department and on an annual basis, so it was necessary to collect similar course level information on the courses that were not taken by cohort members. Of note, Other labor, Non-labor, Class Size, Faculty Status, and class delivery Mode were collected for every section offered during the four year study.

In addition, using payroll data, cost per credit taught (PAYCREDIT) and cost per student credit hour taught (SCHPAY) were calculated for every faculty member, regardless of status. SCHPAY was excluded from the study as it essentially measured the same thing as PAYCREDIT (i.e. faculty costs).

Dependent Variable

Student Success (SUCCESS) was measured for all 814 cases (students). In this cohort, 20.8% of the students completed a certificate or degree during the time period of the study. Some 14.4% of the cohort transferred during the period of the study, and 14.5% of the cohort was still persisting (i.e. still enrolled) during the last term of the study. In total, 40.9% of the cohort was successful using the success definitions and timeframe of this study. Note that some students meet more than one definition of success, but are only counted as one successful case.

MultiCollinearity

For the logistic regression, I performed correlation analysis, looking for statistically significant correlations with high (r = .7 to .9) estimated correlation coefficients. There were only two issues that arose based on these criteria: Proportion of courses taken in Foundation division (math, English and developmental) vs. Discipline Size (r = .773), and Ready for College Level Math (MATH) vs. Ready for College (Read, Write, and Math) (READY) (r = .972).

I chose to eliminate Foundation Studies, as I would have all of the other divisions represented. I also decided to keep the Math variable, as this provided more precision than keeping the aggregated variable (College Ready).

Outliers

For the logistic regression, I evaluated all continuous variables to look for outliers. Cases with values that were more than 3 standard deviations from the mean were found for several variables including: the number of First Semester Withdrawals, average Discipline Size, faculty education, Faculty Experience, Faculty Pedagogical training, average grade awarded by discipline, Compensation per credit taught, Other Labor compensation per student credit hour, Non-Labor costs per student credit hour, average Class Size, the proportion of student credit hours taken in the Science and Allied Health school, and the proportion of classes taken in the Business school. After cases with outliers on one or more of these variables were removed, the analytic dataset contained 639 cases. The logistic regression model and analysis of the results are based on this subset of the data.

Model Building Strategy

The model building strategy I used follows the hypothesized research Model introduced in Chapter 3, which was based on Tinto's Departure Decision model (Figure 6). Each column

became a block of the logistic regression model building process: Block One represents Pre-Entry Attributes, Block Two represents Goals & Commitments, Block Three represents (Academic) Institutional Experiences, Block Four represents Social Integration and Block Five represents Academic Integration. Block Five contained the question predictors and the rest of the blocks contained control predictors.

Once all of the variables were in the model, I removed the control variables from each block that did not reach the p =/<.05 level of statistical significance, while leaving the question predictors in the model until it was clear they would not attain the p =/< .05 level of statistical significance. Table 9 represents a nested taxonomy of fitted logistical regression models in which the probability of student success (P) is predicted by costs or variables that influence costs (PAYCREDIT, OTHERLABOR, NONLABOR, CLASSSIZE, STATUS, MODE).

I chose to move forward with Model 9 instead of Model 8 because of the improved predictive accuracy (from 74.2 to 74.8).

Interactions

I tested interactions between several pairs of the independent variables to see if they were statistically significant predictors of the probability of student success, including: LowSES*Gender, LowSES*Age, LowSES*Minority, Minority*Age, Minority*Gender, NotReadyMath*Age, Age*Intent, Grade*(6-Focus), Focus*(Not Ready), Reshall*LowSES, NotReadyMath*Gender, MajorBusAH*SSHL, Majfoc*MajorBusAH, Ready*CS, Social*Reshall, Ath*Reshall, Status*Facexp, Status*Facped, and Mode*Facped. Only Gender*LowSES was statistically significant and added to the final model (Model 10).

Table 9

Taxonomy of fitted logistic regression models in which student success (SUCCESS) is predicted by instructional cost variables or variables that influence instructional costs (CRPAY, OTHER, NONLABOR, CLASSSIZE, FACSTA, MODE)(n=639)

	MODELS					
Predictors	Baseline M0	Pre-Entry M1	Goals M2	Inst. Exp. M3	Social Int. M4	Acad. Int. M5
Constant	-0.422***	-1.039*				1.997
Pre-Entry Controls						
LOWSES			-.446*	-.53*	-.493*	-.497*
OTHERETHNIC						-0.141
MINORITY						0.463
AGE		-.645**				-0.423
GENDER			-.426*	-.438*	-.436*	-.467*
GPA		.239**				0.096
READ						0.377
MATH		-.5**				-.509*
WRITE						0.126
GED						-0.116
Goals/ Commitments Controls						
INTENT						0.11
FOCUS						-0.052
MAJORAHBS			.597**	.601*	.632*	.557*
MAJOROTHER						-0.082
MAJORFOCUS			-1.035***	-.693**	-.751**	-.643**
CS						-0.64
EFFORT15			1.065***	1.018***	.978***	.87***
EFFORT30			1.121*	1.213**		1.003

STUDENTPT		-0.27
Institutional Experiences Controls		
FACED		-0.083
FACEXP	-.025***	-.032***
FACPED	.029**	.024*
SSHL		1.409
TECH		1.124
BSCSS		-0.012
VPLA		0.663
DISCSIZE		-.000357*
CULTEVAL		0.722
CULTGPA		-1.669*
Social Integration Controls		
RESHALL		0.612
SOCIAL		
Academic Integration/ Question Predictors		
PAYCREDIT		0
OTHERLABOR		0.012
NONLABOR		1.701
CLASSSIZE		0.012
STATUS		1.701*
MODE		0.002
Interactions		
pell*gender		

*p<.05, **p<.01, ***p<.000

Results

Omnibus Chi square		34.162	134.444	187.198	196.41	210.931
-2 Log Likelihood	857.956	823.795	723.512	670.759	661.545	647.026
Cox & Snell R Square		0.052	0.19	0.254	0.265	0.281
Nagelkerke R Square		0.07	0.257	0.344	0.358	0.381
Percent Correct	60.4	62.9	71.4	74.8	75.1	75.9
Degrees of Freedom	1	10	19	29	32	38

Table 9 Continued

Taxonomy of fitted logistic regression models in which student success (SUCCESS) is predicted by instructional cost variables or variables which influence instructional costs (CRPAY, OTHER, NONLABOR, CLASSSIZE, FACSTA, MODE)(n=639)

	MODELS					
Predictors	Acad. Int. M5	Removing Noise M6	M7	M8	Without Interactions M9	With Interactions M10
Constant	1.997	4.888*	5.648**	6.021**	6.003**	5.818**
Pre-Entry Controls						
LOWSES	-.497*	-.489*	-.492*	-.493*	-.525*	0.199
OTHERETHNIC	-0.141					
MINORITY	0.463	0.42	0.444			
AGE	-0.423	-0.381	-.439		-.454*	-.463*
GENDER	-.467*	-0.488*	-.516*	-.404*		-.143
GPA	0.096					
READ	0.377	0.418				
MATH	-.509*	-.459*	-0.404			
WRITE	0.126					
GED	-0.116					

Goals/ Commitments Controls						
INTENT	0.11					
FOCUS	-0.052					
MAJORAHBS	.557*	.607**	.54*	.519*	.513*	.607**
MAJOROTHER	-0.082					
MAJORFOCUS	-.643**	-.672**	-.591**	-.698**	-.656**	-.66**
CS	-0.64	-0.593				
EFFORT15	.87***	.933***	1.032***	1.04***	.971***	.99***
EFFORT30	1.003	1.114	1.304*	1.322*	1.339*	1.344*
STUDENTPT	-0.27	-0.272				
Institutional Experiences Controls						
FACED	-0.083					
FACEXP	-.032***	-.032***	-.031***	-.031***	-.031***	-.033***
FACPED	.024*	.025**	.02*	.022**	.023**	.024**
SSHL	1.409	1.554*	1.106			
TECH	1.124	1.208				
BSCSS	-0.012					
VPLA	0.663	0.657				
DISCSIZE	-.000357*	-.000348*	-.000359**	-.000299**	-.000359**	-.000348**
CULTEVAL	0.722					
CULTGPA	-1.669*	-1.503*	-1.501*	-1.749**	-1.71**	-1.641**
Social Integration Controls						
RESHALL	0.612	0.354				
SOCIAL		.823*	1.055*	.91**	.831*	.808*

Academic Integration/ Question Predictors						
PAYCREDIT	0					
OTHERLABOR	0.012	.017*	.016*	.015*	.016**	.016*
NONLABOR	1.701	-0.029				
CLASSSIZE	0.012					
STATUS	1.701*	1.662**	1.567**	1.526**	1.469**	1.559**
MODE	0.002					
Interactions						
pell*gender						-1.025*
*p<.05, **p<.01, ***p<.000						
Results						
Omnibus Chi square	210.931	206.246	197.492	182.099	182.017	190.844
-2 Log Likelihood	647.026	651.71	660.464	675.857	675.94	667.112
Cox & Snell R Square	0.281	0.276	0.266	0.248	0.248	0.258
Nagelkerke R Square	0.381	0.373	0.36	0.336	0.335	0.349
Percent Correct	75.9	75.6	76.1	74.2	74.8	74.8
Degrees of Freedom	38	24	18	13	13	15

Model with Probability of Student Success as the outcome

I selected Model 10 as my final model because it has a set of statistically significant control variables that are supported by the literature. Model 10 has a Cox-Snell value of.258 and a Nagelkerke value of .349. Its Omnibus Chi Square is 190.844 and it accurately predicts student success 74.0% of the time. Its -2 log likelihood is 667.112.

The equation for Model 10 where student success is the outcome:

$\hat{p}$[SUCCESS = 1] = 1/(1+e^-(B0 +B1*(LOWSES) + B2*(AGE) +B3*(GENDER) + B4*(MAJORBUSAH) + B5*(MAJORFOCUS) + B6*(EFFORT15) + B7*(EFFORT30) + B8*(FACEXP) + B9*(FACPED) + B10*(DISCSIZE) + B11*(CULTGPA) + B12*(SOCIAL) + B13*(OTHER) + B14*(FACSTAT) + B15*(PELL*GENDER)))

$\hat{p}$[SUCCESS = 1] = 1/(1+e^-(5.818 +.199(LOWSES) - .463*(AGE) - .143*(GENDER) + .607*(MAJORBUSAH) - .66*(MAJORFOCUS) + .99*(EFFORT15) + 1.344*(EFFORT30) - .033*(FACEXP) + .024*(FACPED) - .000348*(DISCSIZE) – 1.641*(CULTGPA) + .808*(SOCIAL) + .016*(OTHER) + 1.559*(FACSTAT) - 1.025*(PELL*GENDER)))

Interpreting Model 10

There are 9 categorical and 6 continuous variables in Model 10. Assuming all continuous variables are held to their mean, there are still 512 (2^9) combinations to explore. Moreover, if continuous variables were allowed to have high-medium-low values, this would raise the number of combinations to 1241 (2^9+3^6).

For this reason, a limited number of meaningful combinations should be chosen to explore and discuss. For the purposes of the remainder of Chapter 4 and all of Chapter 5, I have chosen to hold the continuous variables at their mean value, and the categorical variables at their mode value (using the descriptive statistics from the analytic sample and not the full sample). A quick description of the categorical variable modes would be helpful: LOWSES=0, meaning that a Pell grant was not awarded; AGE=0, meaning that the student was under 25 when they attended Yavapai College during the first term of the study; GENDER=1, meaning that most students are female; MAJORBUSAH=0, meaning that most students do not major in Business or Allied Health; EFFORT15=0, meaning that most students do not successfully complete at least 15 credits during their first year of study; EFFORT30=0, meaning that most students do not successfully complete 30 credits during their first year of study; SOCIAL=0, meaning that most students do not participate in campus activities (such as play on an athletic team or join a choir) which can create social integration; and PELLGENDER=0, meaning that most students are not females who have received a Pell grant.

When all other variables are held constant (at their average or mode), the predicted probability of success for a male student receiving a Pell Grant (LOWSES) is 3.71 percentage points higher than the predicted probability for a male student that did not receive a Pell Grant. Interestingly, an interaction was found for females who received Pell Grants such that their probability of success decreased by 10.41 percentage points when compared to women who did not receive Pell Grants.

When all other variables are held constant (at their average or mode), the predicted probability of success for non-traditional age students (>24 years old) is 6.57 percentage points lower than for traditional age students.

When all other variables are held constant (at the average or mode), the predicted probability of success for female students is 2.44 percentage points lower than for male students.

When all other variables are held constant (at their average or mode), the predicted probability of success for students majoring in Allied Health or Business (MAJORAHBS) is 11.65 percentage points higher than for students majoring in other areas.

When all other variables are held constant (at their average or mode), the predicted probability of success when a student has the same major when s/he finishes as when s/he began is 12.82 percentage points lower than when a student changes majors.

When all other variables are held constant (at their average or mode), the predicted probability of success for students completing 15 credits (EFFORT15) in the first year is 20.52 percentage points higher when compared to those that completed fewer credits. Again, when all other factors are held constant, the predicted probability of success for students completing 30 credits in the first year (EFFORT30) is 52.21 percentage points higher than for those that did not complete at least 30 credits in the first year.

When all other variables are held constant (at their average or mode), as the average experience level of faculty (FACEXP, measured by courses taught at this college) decreases by 10 (a year's workload for most faculty at this college, and roughly

one third of a standard deviation), the probability of student success is predicted to decrease by 4.88 percentage points.

When all other variables are held constant (at their average or mode), completing 5 hours of training (roughly one third of a standard deviation) on how to effectively use technology in the classroom and/ or to conduct online classes (FACPED) increases the predicted probability of student success by 2.03 percentage points.

When all other variables are held constant (at their average or mode), increasing discipline size by 420 student credit hours (14 FTE, or roughly one third of a standard deviation) decreases the predicted probability of success by 2.29 percentage points.

When holding all other variables constant (at their average or mode), taking a portfolio of classes in disciplines which award higher grades (CULTGPA) hurts student success—the predicted probability of student success in disciplines with a .086 higher average GPA (roughly one third of a standard deviation) is 2.22 percentage points lower than for students in disciplines with lower average GPAs.

When holding all other variables constant (at their average or mode), participating in one or more social activities on campus (SOCIAL) improves the predicted probability of student success by 16.19 percentage points.

When holding all other variables constant (at their average or mode), increasing the average proportion of credits taught by full-time faculty (FACSTAT) from its current average of 52% to an average of 62% (roughly one third of a standard deviation) improves the predicted probability of success by 2.71%. Likewise, when holding all variables constant (at their average or mode), increasing the amount of money spent on

other instructional labor per student credit hour (OTHER) by $6.07 (roughly one third of a standard deviation) increases the predicted probability of success by 1.63%.

The effects of varying each of the two question predictors (FTSTAT and OTHER) can be seen in Figures 12 and 13.

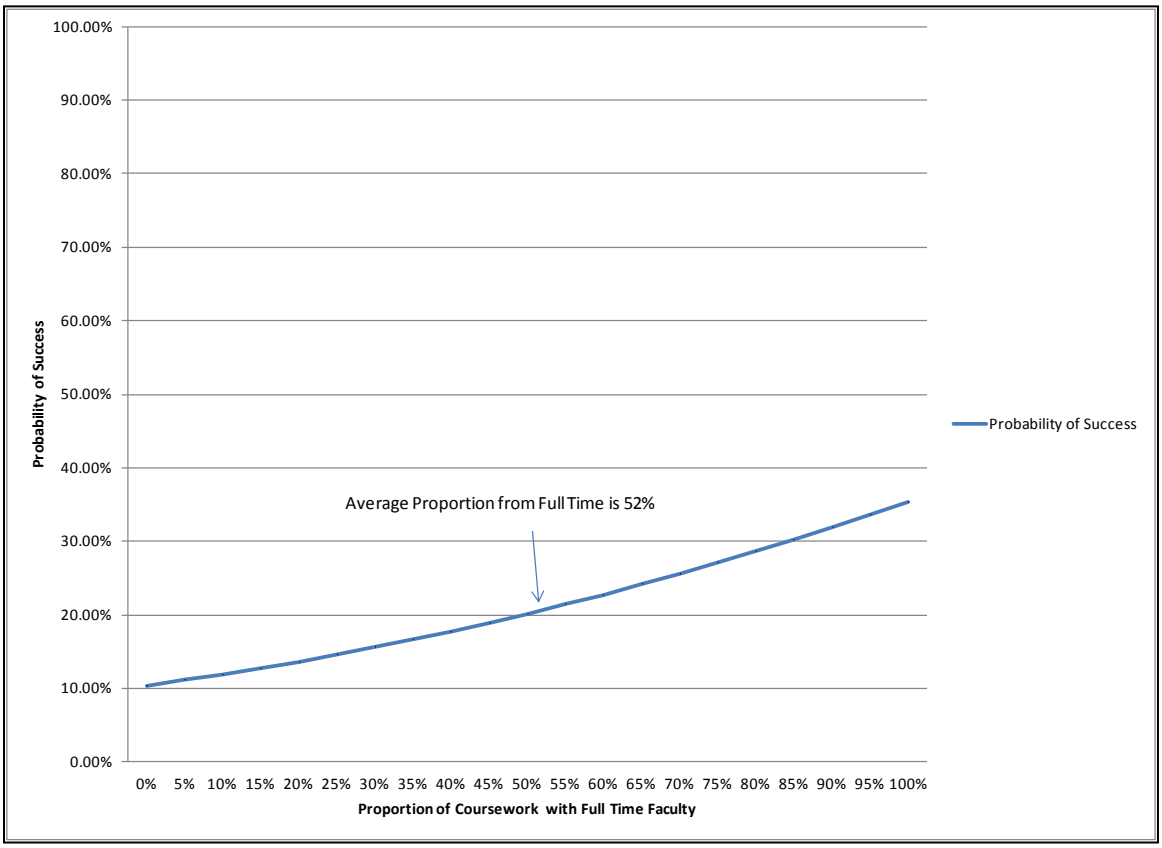

Figure 12. The effect that increasing the proportion of classes taught by full-time faculty has on the predicted probability of student success, controlling for all other predictors in the model, such that continuous variables are held at their means and categorical variables are set to their mode values as follows: LOWSES=0 (no pell grant), AGE =0 (under 25 years old upon entry), GENDER=1 (female), MAJORBUSAH=0 (not business or allied health), MAJORFOCUS=1 (same major first and last semesters), EFFORT15=0 (took less than 15 credits during first year), EFFORT30=0 (took less than 30 credits during first year), SOCIAL=0 (student did not participate in common extra-curricular activities), and PELLGENDER=0 (this was not a female who received a Pell grant)

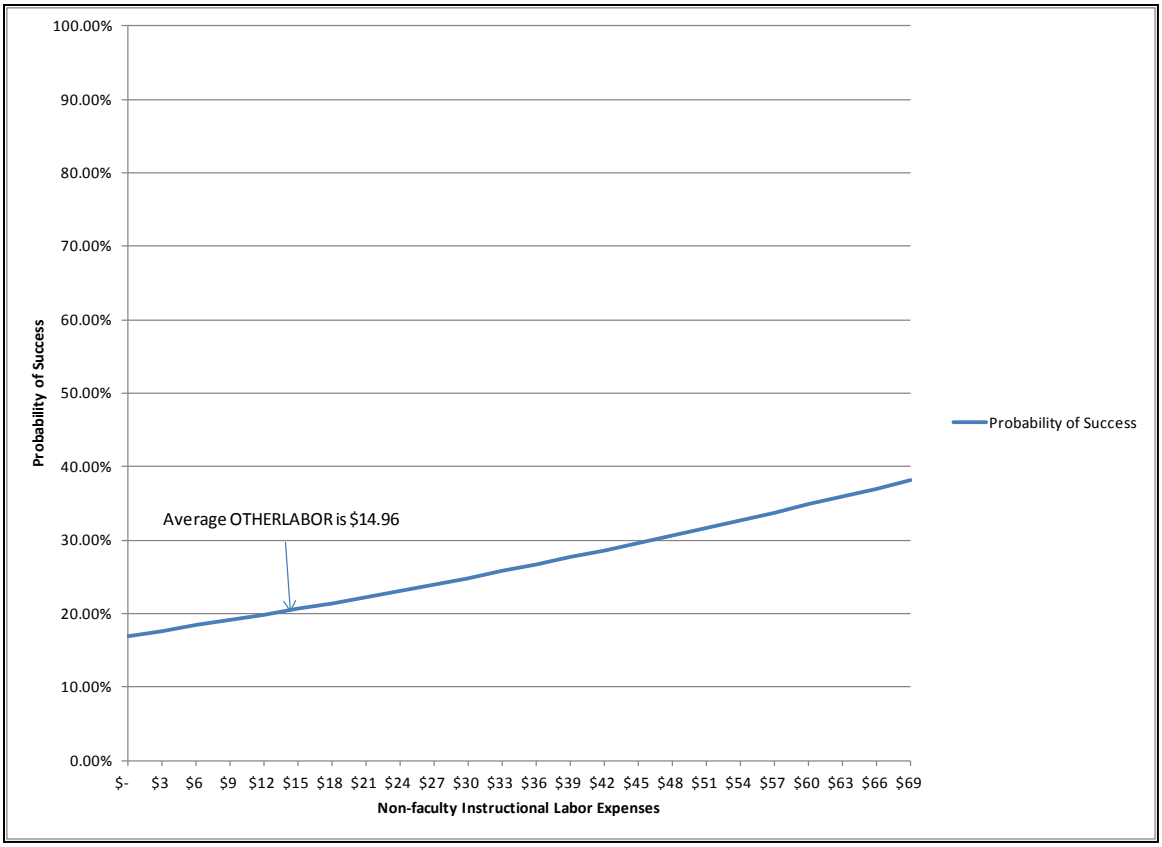

Figure 13. The effect that increasing the amount spent on non-faculty instructional labor has on the predicted probability of student success, controlling for all other predictors in the model such that continuous variables are held at their means and categorical variables are set to their mode values as follows: LOWSES=0 (no pell grant), AGE =0 (under 25 years old upon entry), GENDER=1 (female), MAJORBUSAH=0 (not business or allied health), MAJORFOCUS=1 (same major first and last semesters), EFFORT15=0 (took less than 15 credits during first year), EFFORT30=0 (took less than 30 credits during first year), SOCIAL=0 (student did not participate in common extra-curricular activities), and PELLGENDER=0 (this was not a female who received a Pell grant)

CHAPTER 5: DISCUSSION

Restatement of the problem

State and Federal policy makers have begun to explicitly state that the primary quality measure of higher education is Output quality (i.e. productivity) that can be assessed through simple, commonly defined measures such as completion rates, transfer rates and persistence (ACCPC, 2010; Immerwahr, Johnson, & Gasbarra, 2008; NCHEMS, 2007; Obama, 2009; Reyna, 2010; SECFHE, 2006). Moreover, they have implicitly supported the notion that higher education is a private, not public, good; as such, they have steadily decreased the public subsidy for higher education over the past decade. In response, college and university leaders have raised prices, implicitly supporting the idea that the assumptions of the Iron Triangle (Immerwahr, Johnson, & Gasbarra, 2008) are valid, and that lowering costs will, by definition, lower quality. This study quantitatively examined the assumption of the Iron Triangle that there is a direct relationship between lower costs and lower quality.

Limitations of the study

As mentioned previously in Chapter 1, the strength of this study is also its weakness. By examining one college the study was able to achieve depth (student unit record data) that is not available in IPEDS or most state databases. However, the findings cannot be generalized to other schools. Having said that, my hope is that, in addition to being of benefit to Yavapai College, the study may serve as a starting point of discussion for research at other schools.

Discussion of findings

Student Success.

There are 9 categorical and 6 continuous variables in Model 10. Assuming all continuous variables are held to their mean, there are still 512 (2^9) combinations to explore. Moreover, if continuous variables were allowed to have high-medium-low values, this would raise the number of combinations to 1241 (2^9+3^6).

For this reason, a limited number of meaningful combinations should be chosen to explore and discuss. For the rest of Chapter 5, I have chosen to hold the continuous variables at their mean value, and the categorical variables at their mode value. A quick description of the categorical variable modes would be helpful: LOWSES=0, meaning that a Pell grant was not awarded; AGE=0, meaning that the student was under 25 when they attended Yavapai College during the first term of the study; GENDER=1, meaning that most students are female; MAJORBUSAH=0, meaning that most students do not major in Business or Allied Health; EFFORT15=0, meaning that most students do not successfully complete at least 15 credits during their first year of study; EFFORT30=0, meaning that most students do not successfully complete 30 credits during their first year of study; SOCIAL=0, meaning that most students do not participate in campus activities (such as play on an athletic team or join a choir) which can create social integration; and LOWSESGENDER=0, meaning that most students are not females who have received a Pell grant.

Pre-entry attributes.

For the purposes of this study, federal Pell grants were used as a proxy for low socio-economic status (LOWSES). There was a statistically significant and positive

relationship between low SES and student success, when controlling for all other variables in Model 10. This is contrary to the work of Jaeger and Eagan (2009) which found a negative relationship; however, this study also shows a negative interaction for low-SES and females. In other words, men who receive Pell grants do better than men who don't, while women who receive Pell grants do worse than women who do not.

Interestingly, Yavapai College, unlike many community colleges, has predominantly white students (79.9%). Though 20.1% minorities is fairly small for a typical community college, it almost doubles the county-wide minority demographic of 10.7%. Because of the relatively small size of each ethnic group, the non-white ethnicities were combined into a single variable (MINORITY). There were no statistically significant differences between white and non-white students when controlling the other variables in the study. The researcher believes this may be because in rural communities, most people—of all ethnic backgrounds—attend the public primary and secondary schools because there are not many private school choices. In effect, the quality of preparation is similar for all K -12 students. This finding does not support the literature (Bailey, Calcagno, Jenkins, Kienzl & Leinbach, 2005; Driscoll, 2007; Jaeger & Eagan, 2009).

Students were grouped into two age groups (AGE): traditional and non-traditional (24 or older) upon admittance. The non-traditional students are predicted to be less successful using the definitions of this study. This supports the work of Durkin and Kircher (2010), but is contrary to other research (Calcagno, Crosta, Bailey & Jenkins, 2006). Further study is needed to understand what may be the root causes of this phenomenon. Yavapai College does not have good data on job placement for its

students, but it would be interesting to see if older students are not “successful” because they are getting jobs prior to transfer or completion. This is a particularly important question in light of the timing of the data collected for this study, which began at the depth of the worst national economic recession since the Great Depression and continued during the first years of the slow economic recovery.

The study found that females were predicted to be less likely to be successful than males (GENDER) when controlling for the other variables in the study. Again, this was especially true for poor females (LOWSES*GENDER). This may suggest the need for Student Services intervention, requiring extra counseling, advising, and support for females receiving Pell grants. In the Jaeger and Eagan (2009) study, females had a higher probability of success than males.

First semester grade point average was not a statistically significant indicator of student success. These results conflict with the work of Driscoll (2007) who found that the first semester academic performance played a key role in students’ decision to persist and/ or transfer and of Lee and Frank (1989) who found college grades to be the strongest predictor of transfer. This study also contradicts the works of Laanan (2007) and Jaeger and Eagan (2009), which also found college GPA to be a statistically significant predictor of success (transfer).

Interestingly, being “college ready” in reading (READ), writing (WRITE) or math (MATH) were not statistically significant indicators. The implication could be that our developmental coursework in these areas prepares students for success in college, or that the methodology for identifying students who are not “college ready” is flawed. It may also indicate that the methodology of the researcher influenced the results—students who

tested as “college ready” but chose to take the developmental coursework were not considered “college ready” in this study.

First semester grade point average (GPA) was not statistically significant, contrary to the literature (Driscoll, 2007; Jaeger & Eagan, 2009).

GED students were as likely to succeed as traditional high school graduates.

Goals/ Commitments.

Student intent (INTENT) upon admission was not a statistically significant variable. Students who indicated either completion or transfer were equally likely to succeed (personal enrichment students were excluded from the sample). As a reminder, during the timeframe of the study (2007-2011), Yavapai College only measured intent as students entered the college; however, experience and research (Driscoll, 2007), has shown that students may change their minds. In 2011, Yavapai College adopted the Pima Community College model of measuring intent every semester as students register. Intent should be re-examined as an indicator of the likelihood of student success in a few years when these improved data are available. Likewise, the number of first semester withdrawals (FOCUS) was not a statistically significant indicator.

Confirming the literature (Watkins, 1998), majoring in Business or Allied Health program (MAJOR) increased the likelihood of student success.

Having the same major when you finish as when you started (MAJORFOCUS) was a statistically significant variable; however, its estimated coefficient was negative. Accordingly, holding all other predictors constant, when solving the equation for MAJORFOCUS=1, the predicted probability for student success was lower than when solving the equation for MAJORFOCUS=0 by 12.82 percentage points. In other words,

students who change majors during their tenure at Yavapai College are more likely to be successful than those students who do not. The researcher had hypothesized that a clear goal would enhance the probability of success, when in fact the opposite occurred in this study. However, the results may imply that better student assessment tools (Strong Interest, Workkeys, etc.) and processes may be needed to help students find the right major, or intervention strategies to help students know when it is time to try something new. It is also interesting to note that majors at Yavapai College are most meaningful within an A.A.S. degree, and that majors are not recorded when earning an A.A. or A.S. degree. Further study, with more precise measures of changing majors, is recommended.

Contrary to the findings of another study, taking the optional college success course (CS) did not have a statistically significant impact on the predicted probability of student success at the $p<.05$ level of significance (Zeidenberg, Jenkins, & Calcagno, 2007). This could indicate that the course is not effective or that the random nature of who chooses to take the course does not allow us to accurately judge the effectiveness of the course. Further research is recommended to test the effectiveness of the College Success course.

All else being equal, students who took 15 or more credits during their first year (EFFORT15) were predicted to be more likely to succeed than students who took fewer than 15 credits during their first year; and students who took 30 credits or more (EFFORT30) were predicted to be much more likely to succeed than students who took fewer than 15 credits. Given the subset of students evaluated, as described at the beginning of this chapter, the full-time students (taking 30 or more credits in the first year) were 52.21 percentage points more probable to be successful – by far the largest

impact within the study. This is consistent with the literature (Durkin & Kircher, 2010), which indicates that full-time students have higher completion rates than part-time students. Moreover, this study confirmed that certain momentum points, such as passing 15 or 30 course credits, are good leading indicators of student success (Leinbach & Jenkins, 2008). Finally, though using a different measure, this study confirms that student effort is one of the best predictors of student success (Strauss & Volkwein, 2002).

Per IPEDS guidelines, a part-time student is one that takes fewer than 12 credits in a semester. Using the IPEDS definition, each student was identified as a part-time or full-time student during their first semester. Part-time student status was not a statistically significant predictor of student success. This is contrary to the Jaeger and Eagan (2009) study in which part-time students were less likely to be successful. However, it is worth noting that student course loads often change from semester to semester, and students in this cohort could have been classified differently in each semester of the study.

Institutional Experiences.

Faculty education level (FACED) was not a statistically significant indicator of predicted student success; however, it is important to remember that many of the faculty educational records were not available in Banner, and these sections were excluded from calculations.

Faculty experience, as measured by the number of courses taught at Yavapai College (FACEXP), was statistically significant. Interestingly, the estimated effect was negative such that as tenure increased, the predicted probability of student success decreased, when all other variables were held constant. To the researcher, this was

counter-intuitive. The researcher can only posit the following: with limited course proliferation within a discipline at community colleges (at least compared to a university), many faculty teach the same course numerous times per semester throughout their career. This may lead to boredom and a “stale” course.

Conversely, participation in the voluntary pedagogical training (FACPED) was found to have a statistically significant positive impact on predicted student success, and is consistent with the literature (Smith, 2007). This could indicate that the courses are effective, or it could indicate that the more engaged faculty are self-selecting to participate in the pedagogical training.

The proportion of courses taken in each of the College’s schools was measured based on each individual student’s course choices (SCHOOL). Given the assumptions outlined at the beginning of this chapter, students are equally likely to succeed regardless of the portfolio of classes from the various schools chosen.

Similarly, the size of each discipline (DISCSIZE) was measured during the first semester of the study. Then the average discipline size was calculated for each student depending on the portfolio of classes they chose. Holding all other variables in the model constant, DISCSIZE was found to be a statistically significant variable, with larger disciplines having a negative impact on the predicted probability of student success. The researcher had hypothesized that students would be more successful in smaller disciplines due to more academic and social interaction, though more research is needed to truly understand this phenomenon. These results support the literature (Bailey, Calcagno, Jenkins, Kienzl & Leinbach, 2005). Moreover, contrary to economy of scale economic theory, in at least one study, smaller disciplines have been found to be more cost effective

than large disciplines (Gimenez & Martinez, 2006), likely due to the increased use of adjunct faculty.

The student course evaluation scores (CULTEVAL) were not a statistically significant indicator of student success; however, the grade point average of each discipline (CULTGPA) was a statistically significant variable in predicting the probability of student success. The researcher had hypothesized that higher grades would encourage student success; however, the relationship was negative for the students with the characteristics outlined at the beginning of this chapter. More research is needed to understand these results.

Social Integration.

Many variables were collected to assess social integration including participation in College Honors, ROTC, school newspaper, music groups, student leadership, athletic teams and residence halls. Because each of these were a very small portion of the sample they were combined into a SOCIAL variable, except residence halls which remained a separate variable due to its larger size. Supporting the literature (Pascarella & Terrenzini, 1991, 2005; Tinto, 1993), all else being equal, social integration played a statistically significant role in improving the predicted probability of student success by 16.19 percentage points.

On the other hand, living in the residence halls did not have a statistically significant effect on the predicted probability of student success, all other variables considered. The lack of significance is an important finding as the college is approaching a decision point as to whether or not to re-invest in its residence halls. This study would indicate that the current programming is not effective and does not improve the predicted

probability of student success. Residence hall programming should be evaluated to see if it can be improved. Another alternative to not replacing the halls might be for the college to investigate a private partnership with a company that provides on-campus apartments, but merely as a service, not as a tool for student success.

Academic Integration (question predictors).

Taking a higher proportion of classes from full-time faculty (STATUS) had a statistically significant positive impact on predicted student success. It is worth noting that the impact was relatively small: a 10% increase in courses taught by full-time faculty is predicted to improve the probability of student success by 2.71 percentage points, all else being equal. As mentioned in Chapter 2, the literature is divided on this issue, but the majority of researchers indicated that having more classes taught by full-time faculty enhanced the likelihood of student success (Bailey, Calcagno, Jenkins, Kienzl & Leinbach, 2005; Bettinger & Long, 2005; Burgess & Samuels, 1999; Durkin & Kircher, 2010; Eagan & Jaeger, 2008; Eagan & Jaeger, 2008a; Harrington & Schibik, 2001; Jacoby, 2006; Jaeger & Eagan, 2009).

Similarly, increasing the amount of non-faculty instructional labor (OTHERLABOR) has a statistically significant positive impact on student success as well. Evidently, faculty support such as Administrative Assistants, Lab Technicians, Program Managers, and Instructional Technicians allow students to be more effective, perhaps by freeing faculty time to focus on teaching and learning. This appears to be evidence that the administrative lattice (Massy & Zemsky, 1990) not only increases costs as theorized, but also improves the probability of student success, presumably by freeing faculty to focus on teaching and learning.

Class size (CLASSSIZE), delivery mode (MODE), faculty pay per credit (CRPAY) and non-labor instructional costs (NONLABOR) did not have a statistically significant impact on predicted student success. This confirms the literature on the lack of effect that class size has on quality (Machado & Vera-Hernandez, 2010; Wetstein & Mora, 2007), at least within the range explored in this study (up to 55 students at census).

Throughout this Chapter, only one subset of students has been discussed—those with the characteristics laid out at the beginning of the Chapter, as this is the largest single subgroup of students. Table 10 presents the predicted probability of success for several subgroups of students.

Table 10

The predicted probability of success for eight subgroups of students, with all continuous variables set to their means, and categorical variables set to their mode except as otherwise specified.

	Male		Female	
	<=24	>=25	<=24	>=25
Pell	26.8	18.7	10.2	6.7
No Pell	23.1	15.9	20.6*	14

- This subset is graphed at various costs in Figures 12 and 13

Table 11 presents the fitted odds of the event versus the non-event for differing subsets of students.

Table 11

The fitted odds for differing subsets of students

Traditional-Age Male vs. Traditional-Age Female	1.12
Poor Traditional-Age Male vs. Poor Traditional-Age Female	2.62
Poor Non-Traditional-Age Male vs. Poor Non-Traditional-Age Female	2.79

Examining the results presented in Table 11, we can see, for example, that the fitted odds that a traditional-age male will be successful (versus not) are 1.12 times the fitted odds that a traditional-age female will be successful (versus not). This suggests

that, based on this model at least, that the fitted odds slightly favor males aged 24 years or younger over females from the same age group. However, we can also see that poor, non-traditional aged males have much higher estimated odds of success than their female counterparts (2.79), all else being equal.

Table 12 presents the fitted probability of success and the estimated odds for those students at two extremes, those with a combination of the most favorable characteristics and those with a combination of the least favorable characteristics. Notice that predicted odds of success for a student with the most favorable combination of characteristics are 14 times the predicted odds of success for a student with the least favorable combination of characteristics.

Table 12

The predicted probability of success and fitted odds for the subset of students with the most favorable categorical characteristics (Traditional-aged male who received Pell, changed major to Allied Health or Business, took 30 or more credits during first year and participated in social activities) compared to the students with the least favorable categorical characteristics (Non-traditional-aged female who received Pell, did not change majors, majored in anything except Allied Health or Business, took fewer than 15 credits during 1st year and did not participate in any social activities) with all continuous variables set to their means.

	Predicted Probability of Success	Fitted Odds
Most favorable	91.51%	14.12
Least favorable	6.48%	

Implications and Recommendations

As mentioned in Chapter 1, an NCHEMS report (Kelly & Jones, 2007) found that schools with the same amount of Education and General resources have different quality levels of output as measured by graduation rate, and likewise that schools with similar output (graduation rate) require different amounts of financial resources to achieve these results. A cursory review of FY2008 IPEDS data confirms that this holds true not only at

the Education and General (Operating) budget level, but at the Instructional budget level as well. Figures 14, 15, and 16 show how Yavapai College (red) compares to its peer (Large, Rural, Public) institutions when evaluating instructional costs per FTE and graduation rates, transfer rates, and persistence of part-time students (all using the IPEDS definitions).

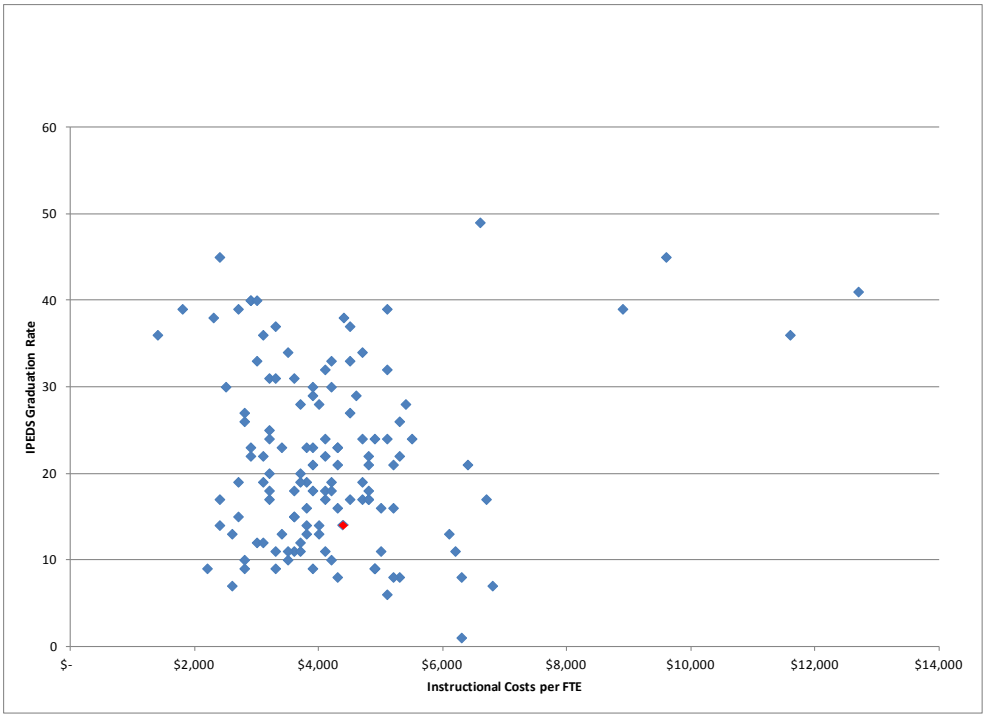

Figure 14. Graduation Rate versus Instructional costs per FTE for Yavapai College and its peers.

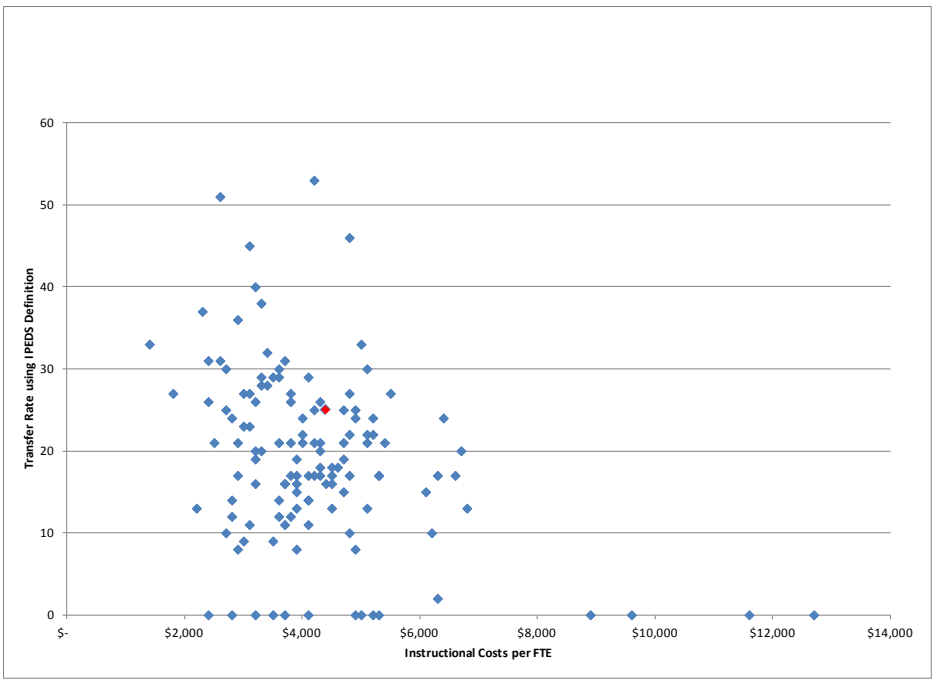

Figure 15. Transfer rate versus instructional costs per FTE for Yavapai College and its peers.

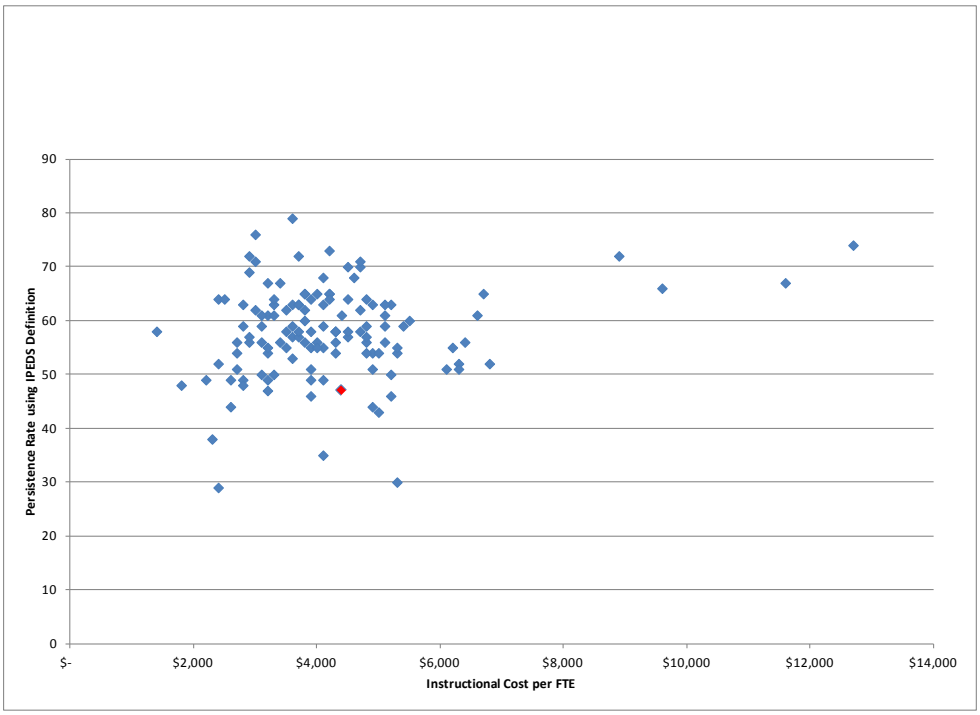

Figure 16. Persistence versus Instructional costs per FTE for Yavapai College and its peers.

Yet these data presented in Figures 14, 15, and 16, while valid, are potentially misleading in that each community college serves a unique population. For instance,

only 42% of Yavapai College's students were of traditional age (<24) in FY2010, compared to the national community college average of 62%. This reflects a notably older demographic in the College's service district. Moreover the college has significantly fewer full-time (22%) students compared to its national community college peers (44%). These types of differences should be adequately accounted for when calculating the popular measures of completion, transfer and retention—if the measures are to paint an accurate picture. This level of detailed data is not available from the federal IPEDS data repository or from the State of Arizona. To get a true understanding of what is happening at Yavapai College, a more in depth study was required using student unit record data.

At Yavapai College, several variables were found to impact the predicted probability of student success: Pell grants (+), AGE (-), GENDER (-), Allied Health or Business major (+), having the same major on entry and exit (-), completing 15 credits in first year (+) and completing 30 credits in first year (+), faculty experience (-), pedagogical training (+), discipline size (-), average grades per discipline (-), participating in social activities on campus (+), increasing the proportion of classes taken from full-time faculty (+),increasing the instructional manpower resources (+), and the interaction for women who receive Pell grants (-). While each of these variables had a unique beta, indicating how it would affect the predicted probability of student success by itself, the more important issue was how these variables worked in tandem to predict the probability of student success for each of the 1241 possible groups of students.

Almost all of these variables have implications for the faculty and staff of Yavapai College and its Foundation. For example, though the College cannot affect

which students qualify for federal Pell grants, the college can work with its Foundation to grow endowments for need-based scholarships, which may improve the probability of student success.

The positive impact of majoring in Allied Health or Business bears further investigation. Further research is recommended as to what effect specific majors have on the probability of student success.

Having the same major throughout a student's tenure had the largest negative impact on the predicted probability of student success (-12.82 percentage points, while holding all other variables at their mean or mode). Again, this speaks to the importance of having effective assessment tools which help students identify their academic and vocational interests as well as effective academic advising for entering students who indicate their goal is to complete or to transfer.

Attending school half-time had the second largest single positive effect on the probability of student success. To the researcher, this speaks to the need of Yavapai College to encourage its students to take as many credits as possible and to make college a priority. Yet this needs to be done with sensitivity to the student's ability to balance the academic requirements of college with the other aspects of the student's life such as work and family.

Further research is needed to test the efficacy of the College's assessment and placement method, as well as the effectiveness of the Developmental Coursework. The lack of statistical significance for these variables was surprising, as the literature would suggest (Leinbach & Jenkins, 2008) that students who are college ready are more successful than students who are not college ready.

Further study is suggested to understand why increasing faculty tenure at Yavapai College decreases the predicted likelihood of student success. The method of assigning classes to faculty should be examined to explore the possibility of diversifying the portfolio of classes taught each semester. Also, the College should consider evaluating what effect attending conferences and taking sabbaticals has had on the probability of student success, as it relates to tenure.

Voluntary pedagogical training for faculty was found to improve the predicted probability of student success. Further study is suggested to ensure the training is effective, and not merely a reflection of the standard of excellence within the faculty who volunteer to participate in the coursework. Piloting mandatory pedagogical training could be used to test the ability of the semi-annual training to offset the negative impact of tenure. Also, perhaps new pedagogical topics (beyond online learning and technology in the classroom) could be explored to help longer-tenured faculty keep their courses fresh and interesting both for students and themselves. Based on the model, only 14 hours of pedagogical training per year are needed to offset the negative effect of an additional year of tenure, taking into consideration all other variables.

In regard to discipline size, Yavapai College offers 67 disciplines with a $39M budget. It is hard to believe that splitting the existing student base over more disciplines would be financially viable due to economies of scale. It may be worth further research to understand the kinds of interactions that are happening with students in smaller disciplines, to see if they could be replicated in the larger disciplines.

The negative impact of disciplines with higher grade point averages is interesting. The researcher does not believe all the faculty should become more stringent evaluators!

After reviewing more detailed data, six of the ten disciplines with the highest average GPAs were Career and Technical disciplines—again given that the study coincided with the national economic recovery, did students earn enough credits to get a job, but not enough to merit a completion? Another top ten discipline was continuing education, which does not lend itself to persistence or transfers, and the highest GPA was awarded by the Adult Education program, which provides the developmental education courses. Further study is required.

Participating in social activities had the third highest positive effect on the probability of student success. Given the relatively limited social activity offerings of the College, this would appear to be a real opportunity to engage with students by creating an extensive selection of activities with which students can form bonds with each other and the institution.

Discussion of the Research Questions

The primary research question of this study centered on the impact that instructional cost variables have on quality (i.e. student success). To that end, both the proportion of classes taken from full-time faculty and the amount of non-faculty labor resources had positive effects on the predicted probability of student success.

Using an Excel spreadsheet, the researcher developed a tool to measure the effects that changing the values of the variables had on the predicted probability of student success. Of the 15 statistically significant variables in the final model, full-time faculty had the 10th largest magnitude on the probability of student success (2.71% points). This means that the change in the probability of student success caused by changing the proportion of classes taught by full-time faculty by 10% points (.33SD) was smaller than

changing 9 other variables by the same amount (or from 1 to 0, or from 0 to 1 for categorical variables). Because all of the relevant instructional cost data was collected, this study shows that this improvement comes at a cost of almost $1,000,000 per year (due to increasing the number of the more expensive full-time faculty). Stated another way, holding the rest of the Instructional system constant, it would cost Yavapai College $365,000 per year to improve the probability of student success by one percentage point (See Appendix D). Put in context, a one percentage point increase in student success requires approximately a one percentage point increase in Yavapai College's Education and General (Operating) budget.

Of the 15 statistically significant variables, other instructional labor costs had the 15th largest magnitude. And again, the improvement in student success comes at a significant cost: there would be a cost of over $700,000 per year to increase the amount of non-faculty instructional positions such that predicted student success would improve by 1.63 percentage points (See Appendix D). Or stated another way, holding the rest of the instructional system constant, it would cost Yavapai College $430,000 per year to improve the probability of student success by one percentage point. Put in context, a one percentage point increase in student success requires almost a 2% increase in Yavapai College's Education and General (Operating) budget.

Given that Yavapai College is already the high-cost provider of community college education in Arizona, the researcher would be reluctant to advocate for increased Instructional spending in order to improve the likelihood of student success. Before recommending that the college hire more faculty and other instructional personnel, the researcher would refer readers back to the DEEP (Documenting Effective Educational

Practices) research discussed earlier. Gansemer-Topf, Saunders, Schuh, and Shelley (2004) indicated that *how money was spent* was more important *than how much money was spent*. But the DEEP study, as well as the IPEDS results in Figures 14 through 16 , indicates that changing how the money is spent (i.e. the instructional processes) would provide a more cost effective way to improve student success.

Jaeger and Eagan (2009) reached a similar conclusion, stating, "It is financially and administratively impractical for community colleges to begin reducing the proportion of part-time faculty members they employ; thus, community college administrators and policy makers should consider how they can improve the environment in which these part-timers work" (p. 20). In another study, the authors concluded that the achievement of the national completion goals would not come through increased revenue, but through productivity improvements such as "(i) systematically enabling students to reach graduation, (ii) reducing non-productive credits… (iii) redesigning the delivery of instruction, (iv) redesigning core support services, and (v) redesigning non-core services…." (Auguste, Cota, Jayaram, &, Laboissiere, 2010, p. 8).

Likewise, in the article "Breaking Higher Education's Iron Triangle," the authors concluded, "The aims of wide access, high quality, and low cost are not achievable, even in principle, with traditional models of higher education…." (Daniel, Kanwar, & Uvalic-Trumbic, 2009, p. 35).

Many options for re-engineering our core instructional processes exist, including activities based costing (Massy, 2002; Fried, 2006), lean analysis (Balzer, 2010; Bilas & Ewell, 2005; George, 2003; Tischler, 2006), responsibility centered management (Hanover Research Council, 2008; Hearn, Lewis, Kallsen, Holdsworth & Jones, 2006;

Lang, 2001; Strauss, 2002; Whelan, 1991), and others (Christensen & Eyring, 2011; Dickeson, 2010; Jenkins, 2006; Levin, 1991; Twigg, 2003; Twigg, 2003a; Twigg, 2005; Vedder, 2007; Zemsky & Finney, 2010; Zemsky, Massy & Oedel, 1993).

For example, there are other possible solutions to the part-time faculty problem rather than simply replacing them with higher-cost full-time faculty: colleges can improve their Instructional systems to enhance the likelihood that adjunct professors will improve the probability of student success as much as their full-time counter parts. Smith (2007) suggested several tools that help the part-time faculty be more effective at one community college such as administrative support, access to office equipment, mandatory office hours, email, internet access, informational reports from institutional research, and mentoring support from their chair. Many of these recommendations were similar to those made in a study at other community colleges (Roueche & Roueche, 1996) and at a four year flagship university (Fagan-Wilen, Springer, Ambrosino, & White, 2006). Green (2007) added several suggestions for ensuring adjunct quality including orientation to the school including services available to students as well as programmatic information, monitoring of key course materials such as the syllabus, and developmental opportunities.

Since class size was not found to be statistically significant in this study, increasing class size could help to offset the costs according to the majority of the literature (Dellow & Losinger, 2004; Malo & Weed, 2006; Middaugh, 2000, 2001; Middaugh, Graham, & Shahid, 2003; Seybert & Rossil, 2010, Sumner & Brewer, 2006).

With regard to the primary research questions:

1. Which variables from Tinto's model of institutional departure have a statistically significant relationship with student success (as measured by persistence, transfer and completion)?

   There are statistically significant positive relationships between the proportion of classes taken from full-time faculty and the predicted probability of student success. Likewise, there is a statistically significant positive relationship between other labor and the predicted probability of student success. There are not statistically significant relationships between non-labor costs, class size, or online classes and the probability of student success when all other variables are taken into consideration.

2. Based on the literature, do any of the variables which typically impact Instructional costs have a statistically significant impact on Student Success at Yavapai College? If so, to what extent?

   At Yavapai College, increasing the proportion of classes taught by full-time faculty by 10% (.33SD) increases the predicted probability of student success by 2.71 percentage points, at a cost of $365,000 per percentage point, or roughly 1% of the Operating Budget. Similarly, increasing the amount of non-faculty instruction positions by $6.07 per student credit hour (.33SD) would improve the predicted probability of student success by 1.63 percentage points, at a cost of $430,000 per percentage point, or roughly 1% of the Operating Budget. (See Appendix D)

Summary

Per the Arizona Community College Presidents, the Arizona Board of Regents, the National Governors' Association, and the President of the United States, the ultimate goal is to increase completion. Based on the results of this study, instructional cost variables can impact the predicted probability of student success. As such, AZ legislators may need to re-evaluate their higher education funding policies if they truly desire to achieve their stated objective of higher completion rates. Moreover, Resource Dependency Theory (Pfeffer & Salancik, 2003) would suggest that government funding needs to be at a level that will make colleges pay attention to this goal. While hesitant to suggest a specific target funding level, the researcher would suggest that providing less than 2% of a community college's funding is not enough to focus the leaders of community colleges on helping the State to achieve its goals.

Before the public funding will be increased, the researcher believes a more fundamental discussion regarding higher education as a public good versus a private good must be held. The CollegeBoard publishes a periodic report outlining the benefits of higher education to individuals and to society. Their data demonstrate that college graduates enjoy higher earnings (which create more tax payments for society) (p. 11), lower unemployment rates (which lowers unemployment costs to society such as welfare, subsidized housing, food stamps, Medicare, Medicaid, unemployment insurance and Supplemental Security Income) (p. 21), higher job satisfaction (p. 19), better pensions (p. 23), more access to health insurance (p. 24), lower poverty rates (p. 25), lower smoking rates (p. 27), lower obesity rates (p. 29), healthier babies (p. 30), more volunteerism (p. 32), and higher voter participation rates (p. 33). The report concludes, "Students who

attend institutions of higher education obtain a wide range of personal, financial, and other lifelong benefits; likewise, taxpayers and society as a whole derive a multitude of direct and indirect benefits when citizens have access to postsecondary education" (Baum, Ma, & Payea, 2010, p. 4). Leaders in higher education need to be conversant in this data so that we can gently remind policy makers of these benefits to their constituents.

Harvey and Green (1993) created several possible definitions of educational quality including "value for money" in which outputs (completions) are exchanged for money (state appropriations). Based on the results of this study, it is imperative that educational leaders have the skills needed both 1) to protect existing and develop new resources and 2) to develop new Instructional models focused on student success and that require fewer financial resources.

Using the Tinto Departure Decision Model as a basis for constructing a research model, it is clear that a student's goals and commitments have the largest impact on the predicted probability of success. Adding the 2nd block of variables – including the statistically significant majoring in business or allied health, having the same major when you start and finish, completing 15 or event 30 credits in the first year of all—increased the predictive ability of the model by 8.5 percentage points, the largest increase of any block. Helping students define their goals and find their passion is probably the most important thing that Yavapai College can do to increase the probability of student success.

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APPENDIX A: Terminology

Definitions from IPEDS unless otherwise noted

Instruction : A functional expense category that includes expenses of the colleges, schools, departments, and other instructional divisions of the institution and expenses for departmental research and public service that are not separately budgeted. Includes general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions. Also includes expenses for both credit and non-credit activities. Excludes expenses for academic administration where the primary function is administration (e.g., academic deans). Information technology expenses related to instructional activities if the institution separately budgets and expenses information technology resources are included (otherwise these expenses are included in academic support). Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.—IPEDS Glossary

Academic Support: A functional expense category that includes expenses of activities and services that support the institution's primary missions of instruction, research, and public service. It includes the retention, preservation, and display of educational materials (for example, libraries, museums, and galleries); organized activities that provide support services to the academic functions of the institution (such as a demonstration school associated with a college of education or veterinary and dental clinics if their primary purpose is to support the instructional program); media such as audiovisual services; academic administration (including academic deans but not department chairpersons); and formally organized and separately budgeted academic personnel development and course and curriculum development expenses. Also included are information technology expenses related to academic support activities; if an institution does not separately budget and expense information technology resources, the costs associated with the three primary programs will be applied to this function and the remainder to institutional support. Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.—IPEDS Glossary

Student services : A functional expense category that includes expenses for admissions, registrar activities, and activities whose primary purpose is to contribute to students emotional and physical well - being and to their intellectual, cultural, and social development outside the context of the formal instructional program. Examples include student activities, cultural events, student newspapers, intramural athletics, student organizations, supplemental instruction outside the normal administration, and student records. Intercollegiate athletics and student health services may also be included except when operated as self - supporting auxiliary enterprises. Also may include information technology expenses related to student service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support.) Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.—IPEDS Glossary

Institutional support : A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the costs associated with student services and operation and maintenance of plant will also be applied to this function. Institutions include actual or allocated costs for operation and maintenance of plant, interest and depreciation.—IPEDS Glossary

Operation and maintenance of plant (expenses -- GASB unaligned form reporters)	A functional expense category that includes expenses for operations established to provide service and maintenance related to campus grounds and facilities used for educational and general purposes. Specific expenses include utilities, fire protection, property insurance, and similar items. This function **does not** include amounts charged to auxiliary enterprises, hospitals, and independent operations. Also includes information technology expenses related to operation and maintenance of plant activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support). GASB institutions have these expenses charged to or allocated to other functions.—IPEDS Glossary

Price: What students pay in the form of tuition & fees to attend a class—based on G. Winston

Costs: What colleges pay (in operating expenses) to employees and suppliers to provide a class—based on G. Winston

Capital Expense: an outlay of money in excess of $5000 to procure an asset, typically a building or a piece of equipment, which provides benefits for more than 1 year

Operating Expense: an outlay of money which is a) not capital, and b) used to facilitate the day to day activities of an organization (egs. salaries, supplies, services, etc.)

APPENDIX B: VARIABLES – Technical

Student Cohort Definition: all students, both full- and part-time, who have a high school diploma or equivalent (i.e., dual enrollment students are excluded), entering college for the first time since receipt of the diploma or equivalent during the 2007 Summer or Fall term or Spring 2008 term, and who enroll in credit or developmental education courses and have a declared intent of completing an award or transferring. Students who first enroll in the summer prior to the fall term—such as those in summer bridge programs or those who begin college in an early starter program—should also be included in this cohort. The cohort assignment of a student remains the same throughout the tracking timeframe for the purposes of this request.

Student File

Course Definition: course information for all courses summer 2007 through summer 2011.

Course File

Desc.	Table	Field	Conditions
Term (Semester or Academic Period)	SSBSECT	SSBSECT_TERM_CODE	summ Summer or Fall 2007
Delivery mode (online, hybrid, traditional)	SSBSECT	SSBSECT_INSM_CODE	
Class Prefix (subject)	SSBSECT	SSBSECT_SUBJ_CODE	
Class Number	SSBSECT	SSBSECT_CRSE_NUMB	
Course Reference Number	SSBSECT	SSBSECT_CRN	
Course Title	SSBSECT	SSBSECT_TITLE	
Class size at census	SSBSECT	SSBSECT_CENSUS_ENR	45th day count census field.
Primary Division	SSBOVRR	SSBOVRR_DIVS_CODE	
Student ID (PIDM)	SFRSTCR	SFRSTCR_PIDM	
Final grade	SFRSTCR	SFRSTCR_GRDE_CODE	final grade.
Block or learning community			identifier for learning block courses.
Primary Instructor	SPRIDEN	SPRIDEN_ID	Primary course instructor.

Faculty Cohort Definition: all faculty: part-time, full-time, and temporary who are active during the fall 2007 term. Include faculty on sabbatical.

Faculty File

Desc.	Table	Field	Conditions
faculty id	SIBINST	SIBINST_PIDM	
faculty staff type	SIBINST	SIBINST_FSTP_CODE	
Highest degree earned	SORDEGR	SORDEGR_DEGC_CODE	Highest educational level attained
Faculty experience			total number of credits taught at PCC

Awards earned summer 2007 through summer 2011.

Awards File

Desc.	Table	Field	Conditions
Term (Semester or Academic Period	SHRDGMR	SHRDGMR_TERM_CODE_STUREC	summ Summer or Fall 2007
Award Category	STVDEGC	STVDEGC_ACAT_CODE	
Credits attempted	function	SOKODSF.F_GET_DEGREE_GPA_DATA	
Credits earned	function	SOKODSF.F_GET_DEGREE_GPA_DATA	
Credits passed	function	SOKODSF.F_GET_DEGREE_GPA_DATA	
Degree	SHRDGMR	SHRDGMR_DEGC_CODE	all degrees
Degree description	STVDEGC	STVDEGC_DESC	
Major	SHRDGMR	SHRDGMR_MAJR_CODE_1	all majors
Major description	STVMAJR	STVMAJR_DESC	
GPA	function	SOKODSF.F_GET_DEGREE_GPA_DATA	institutional GPA
Student ID	SHRDGMR	SHRDGMR_PIDM	

APPENDIX C: Methodology to Derive Variables

Assumptions:

- Per Kansas Study methodology, Instructional costs are included. Academic Support, Student Services, Plant & Operations Management, and Institutional Support costs are not included. Capital costs are not included.
- Per Kansas Study methodology, benefits are included in cost analysis. Benefits are modeled at 8.5% for part-time employees. FT employee benefits equal total benefits less part-time part-time benefits. FT benefits costs are then divided by total full-time salaries to get the annual FT benefits rate, which is applied to all employees regardless of actual individual benefit choices. (FY0708 27.5%; FY0809 29.3%; FY0910 30.6%; FY1011 29.2%).
- The College has six campuses. Instructional departments are structured differently on different campuses. The Campus that pays the instructor is credited with the course SCH (student credit hours), regardless of delivering campus, to accurately allocate departmental costs to various disciplines.
- Unlike Kansas Study methodology, this study includes non-faculty Instructional labor and non-labor Instructional costs.
    - The Instructional function is budgeted by departments. Most departments have only one discipline, though a few departmental budgets manage multiple disciplines. In this case where there are multiple disciplines within a single department, the non-faculty departmental costs are allocated by SCH per discipline. There is a one to one relationship between discipline and course prefix—the only exception is ART which is a department and a discipline, but has multiple course prefixes. Once again, the non-faculty departmental costs were allocated to each course prefix using the appropriate proportion of sch.

Instruction Costs Allocation Methodology

- Faculty & Other Instructor Salaries
    - Adjunct salaries are modeled at $620 per LH plus 8.5% for fringe. This is the standard rate which is used to compensate adjunct faculty during this timeframe.
    - Staff who taught are modeled at the adjunct rate whether they were paid extra or whether this was part of their staff duties.
    - Some Division Deans were expected to teach as part of their standard duties. The cost of the class was calculated using their salary divided by 30 load hours then multiplied by the number of load hours per class/course .
    - Full-time Faculty salaries are based on actual total annual comp (Base + Overload + Stipends) plus x% for fringe (see above).
    - Dual Enrollment Non-YC employee labor costs were estimated using an average stipend cost of $726 + 8.5% for fringe per course.

- Cross-listed or stacked courses (multiple sections in the same room at the same time taught by the same professor) were treated as 1 section so as not to double count load or costs.
- SCH for co-taught courses (multiple professors for the same section) were prorated based on “percentages of responsibility” from Banner or divided equally by the number of professors if no percentage of responsibility was available
- Other Instruction/Course types with their associated costs:
  - RO "ROTC" = excluded from this study
  - AM "Applied Music" = enroll x $450
  - PM "Private Music" = enroll x $225
  - INT "Internship" = enroll x $85
  - IS "Independent Study" = 0.33 load hoursper IS section

- Other Labor (6000 series) expenses (6003- Support Staff, 6006- Students, 6009- Instructional Specialist, 6010- Part-Time Instruction, 6011- Part-Time, and those staff in 6002- Salary – Program Director) wages and fringe were allocated to the class sections based on the sch for the class section as a proportion of the sch for the department.
- Non Labor (7000B) expenses were allocated to the class sections based on the sch for the class section as a proportion of the sch for the department.

Non-Cost Variables

- GPA: Simple average based on A=4, B=3, C=2, D=1, F =0; Withdrawals, Incompletes do not affect GPA

APPENDIX D: Calculations of Costs to Improve the Probability of Student Success

Cost Data were collected from tables as outlined in Appendix B. Cost variables were calculated as outlined in Appendix C. From there, using an Excel pivot table, I was able to determine

1. Costs of increasing the proportion of full-time faculty
    a. The average cost per credit of part-time faculty during the study ($1,063)
    b. The average cost per credit of full-time faculty during the study ($2,658)
    c. Using ratio analysis, calculate the cost of increasing the proportion of full-time faculty by 10% ($159.50/ credit)
    d. Multiply by the average number of credits per year (6,203) = $989,418
    e. Divide by the number of percentage points of improved probability of student success by adding more full-time faculty (2.67) = $365,099= "cost to improve 1 percentage point"
    f. Divide "cost to improve 1 percentage point" by E&G budget

2. Costs of increasing the amount spent on non-faculty instructional labor per student credit hour
    a. The average student credit hours taught per year during the study (115,465)
    b. Multiple average SCH by the amount of increase in OTHERLABOR to create the desired improvement in the probability of student success ($6.07/sch) = $700,877
    c. Divide by the number of percentage points of improved probability of student success by adding more non-faculty instructional resources (1.63) = $429,986 = "cost to improve 1 percentage point"
    d. Divide "cost to improve 1 percentage point" by E&G budget