Enrollment Projection Analysis of Oregon Public Community Colleges

Prepared by Dr. Robert Vergun of *Portland Community College*
for the *Oregon Community College Presidents' Council*

Executive Summary

This analysis of Oregon public community colleges shows the impact of various factors on community college enrollment. An econometric model was applied to state-level enrollment data from 1986-87 to 2005-06, controlling for community college tuition and fees, state and local funding, tuition at four-year institutions, financial aid, population growth, unemployment, and inflation. The analysis also generates a forecast of enrollment from 2006-07 through 2008-09. The analysis finds:

- Over the past two years, total FTE enrollment has declined slightly, but it is projected to increase by 1.0% from 2005-06 to 2006-07. Furthermore, it is projected to increase between 2.7% to 3.1% from 2006-07 to 2007-08, and between 3.0% and 3.4% from 2007-08 to 2008-09.

- Unduplicated headcount has grown annually by about 3.5% to 4.5% over the past two years, and it is expected generally to maintain that same rate of growth over the next few years. It is projected to increase by 2.5% between 2005-06 to 2006-07. It is projected to increase between 4.3% to 4.7% from 2006-07 to 2007-08, and between 3.5% and 3.9% from 2007-08 to 2008-09.

- The enrollment forecast assumes that tuition and fees will grow at the projected annual rate of inflation (about 2.5% per year) over the next two years. If tuition and fees were instead to grow by 3.5% per year, this would result in a lower annual rate of growth of FTE by about one-half of a percentage point, and it would result in a lower annual rate of growth of unduplicated headcount by about one percentage point.

- About 80% of the impact of state funding on overall FTE enrollment has taken place indirectly, as colleges have adjusted tuition in response to state funding. Cuts in state funding historically over the past 20 years have had the greatest impact on FTE enrollments in Professional/Technical courses and in Post-Secondary Reading/Writing/Math Development Education courses in preparation for college-level Lower Division Collegiate and Professional/Technical programs. In addition to increases in tuition, community colleges have decreased their spending on administrative infrastructure and student services to offset cuts in state funding. This has dampened the impact of state funding cuts on instruction programs and enrollment.

- Despite the anticipated rise in enrollment, FTE and unduplicated headcount in 2008-09 will remain below their historical 2001-02 levels. The primary reason for this is that credit tuition and fees, adjusted for inflation, are anticipated to be almost 50% *higher* in 2008-09 than in 2001-02. Most of the tuition and fee increases took place in 2002-03 and 2003-04 in response to cuts in state funding.

- All else equal, for each one-percent *increase* in credit tuition and fees in any given year, there is a 0.86% *decrease* that same year in the number of students majoring in either a Lower Division Collegiate or Professional/Technical field of study (a decrease of about 1,440 students). Largely because of tuition increases, there has been a 15% decline from 2001-02 to 2005-06 in the number of these students at Oregon community colleges.

- All else equal, every one percentage-point increase in the unemployment rate leads to an increase in total FTE of 1.1%. FTE enrollment in predominately credit program areas *increases* during economic recessions, all else equal. By contrast, FTE enrollment in predominately non-credit program areas (such as English as a Second Language and High School Completion) *decreases* during economic recessions, all else equal.

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March 7, 2007

This enrollment analysis of Oregon public community colleges has four goals. First, the analysis shows the impact of various factors on community college enrollment, with a focus on the relationship between tuition and Full-Time Equivalent (FTE) enrollment. Second, the report provides a detailed analysis of factors affecting enrollment within various program areas, such as Lower Division Collegiate, Professional/Technical, and Developmental Education. Third, the analysis offers a technique to apply statewide results to individual community colleges. Last, the report generates a forecast of enrollment from 2006-07 through 2008-09 under plausible assumptions.

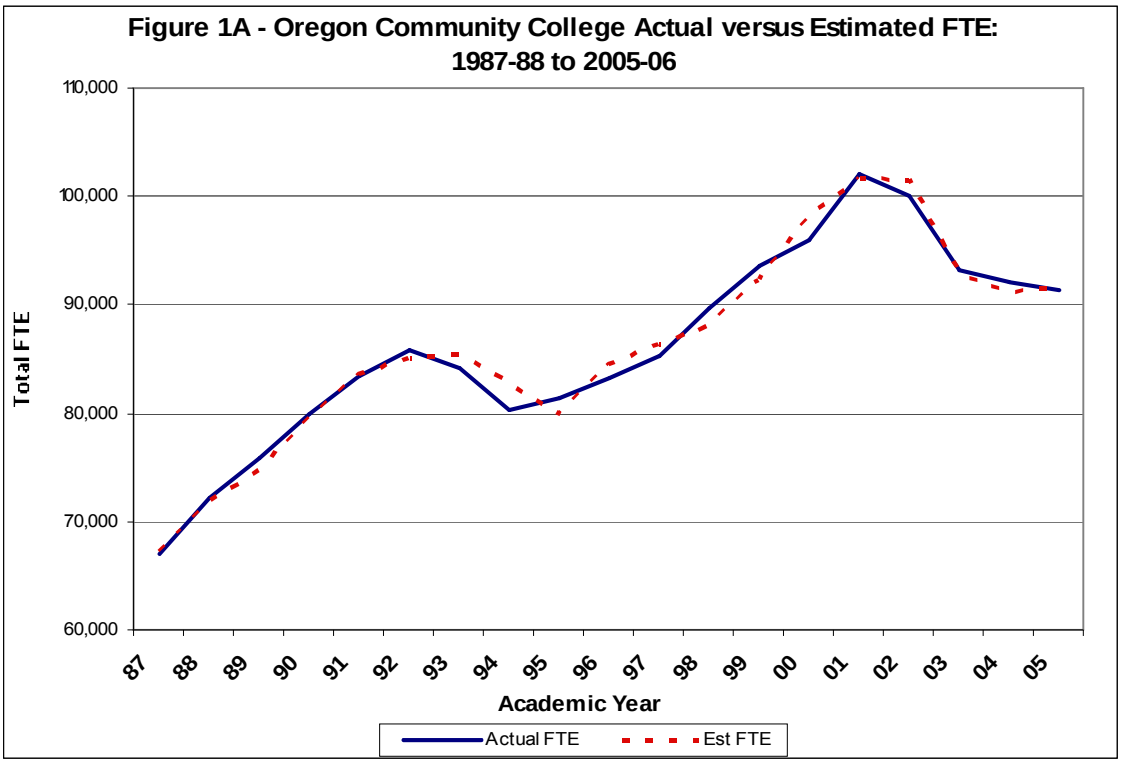
Enrollment Projection Model

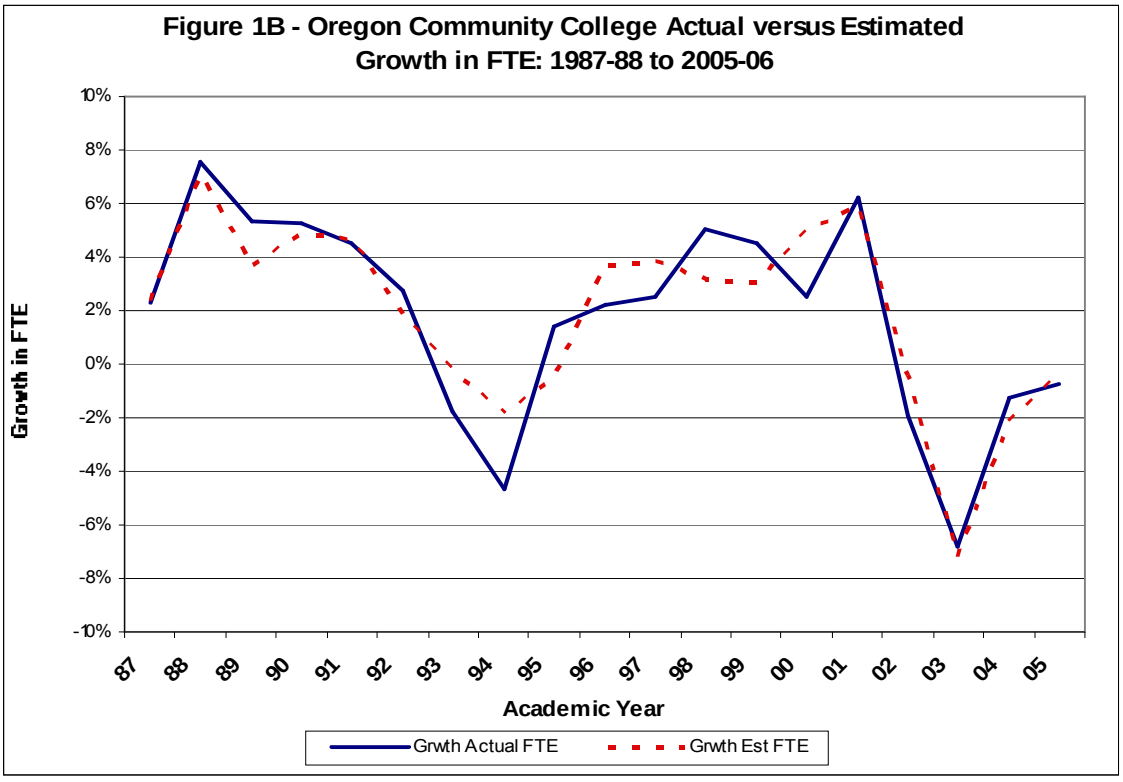
An econometric regression model[1] was applied to state-level enrollment data during a twenty-year period, from 1986-87 to 2005-06, controlling for community college tuition, state and local funding, tuition at four-year institutions, financial aid, unemployment, population growth, and inflation.

It is reasonable to expect that factors that influence enrollment might impact the enrollment in one program area to a greater or lesser extent than the enrollment in another program area. For instance, increases in tuition & fees at four-year institutions are likely to have a greater impact on Lower Division Collegiate enrollment at community colleges than, say, on Professional/Technical enrollment at the community college level. Therefore, separate models were developed to estimate FTE enrollment in each of the following five program areas: (1) Lower Division Collegiate; (2) Professional/Technical; (3) Post-Secondary Remedial Development Education (Reading/Writing/Math courses in preparation for college-level Lower Division Collegiate and Professional/Technical programs); (4) Other Developmental Education (e.g., Adult Basic Education, English as a Second Language, General Educational Development, High School Completion, and Adult High School Diploma); (5) and Other FTE enrollment.

Each model generated estimates of annual FTE enrollment growth in their respective program areas. Estimates of total FTE enrollment were then derived by aggregating the FTE estimates within each of the program areas. (See Methodological Appendix A). Figure 1A below compares actual historical FTE enrollment against those estimated by the model, and Figure 1B compares historical annual FTE growth against those estimated by the model.

Although FTE enrollment has generally been increasing during the past twenty years, annual growth has been negative during eight of the twenty years (below 0% growth). The model tracks historical FTE enrollment annual growth well, with an R-square of 0.87, meaning that the model explains 87% of the historical variation in FTE annual growth. The graphs also show that the model tracks historical FTE growth particularly well over the period corresponding to the most recent economic recession (after 2001), when Oregon community colleges experienced steep negative enrollment growth.





Source: For Actual FTE, Oregon Department of Community Colleges & Workforce Development/OCCURS. Estimated FTE is one-year ahead estimate, based upon regression estimates of the annual growth rate of FTE (See Methodological Appendix A).

Factors Affecting Enrollment

As mentioned, separate models were generated for each of the program areas: Lower Division Collegiate (LDC) enrollment, Professional/Technical (Prof/Tech) enrollment, Post-Secondary Remedial Developmental Education (PSR) enrollment, Other Development Education (Other DE) enrollment, and Other FTE enrollment. This allows for a more detailed analysis of the impact of various factors on FTE enrollment within each of the program areas.

Figure 2 - FTE of Oregon Community Colleges in 2005-06, by Program Area

	FTE	Percent
Lower Division Collegiate (LDC)	40,476.91	44.3%
Professional/Technical (Prof/Tech)	28,962.93	31.7%
Post-Secondary Remedial Developmental Education (PSR)	5,525.74	6.0%
Other Developmental Education (Other DE)	10,705.24	11.7%
Other FTE Enrollment	5,729.90	6.3%
Total 2005-06 FTE	**91,400.70**	**100.0%**

Source: Oregon Department of Community Colleges & Workforce Development/OCCURS.

Figure 2 shows the statewide distribution of FTE in Oregon Community Colleges by program area. There is some variation between Oregon community colleges in how particular courses are classified into one of the five program areas. As a general guideline, though, the Lower Division Collegiate (LDC) program area has as its focus courses that are the equivalent to those offered during the freshman and sophomore years at a typical 4-year university. In 2005-06, LDC FTE enrollment made up 44.3% of Total FTE. Most LDC courses are credit courses that can be earned toward a post-secondary degree or certificate.

The Professional/Technical (Prof/Tech) area has as its focus courses aimed at preparing or improving required skills specific to a professional or technical field. Slightly less than one-third of total FTE was generated from FTE enrollment in Prof/Tech courses (31.7%). Most, although not all, Prof/Tech courses earn credit toward a post-secondary degree or certificate. (In 2005-06, about 17% of total Prof/Tech FTE was comprised of *supplemental* courses, designed for the upgrading of workers' skills in their current career field rather than for degree or certificate attainment. Some Oregon community colleges offer these courses as non-credit Continuing Education Units).

The Post-Secondary Remedial Developmental Education program area has as its focus courses aimed at providing preparation in writing, reading, and math for students who intend to pursue college-level (LDC or Prof/Tech) instruction. These courses made up 6% of total FTE in 2005-06. They are generally earned for credit (i.e., students are charged the same level of tuition per credit as LDC or Prof/Tech courses), but the credits usually cannot be counted toward a college degree or certificate.

Other Developmental courses (11.7% of total FTE) include Adult Basic Education, English as a Second Language, General Educational Development, High School Completion, and Adult High School Diploma courses, and are typically non-credit. In some cases colleges charge very low fees for participation for these courses. The Other FTE category is composed of Adult Continuing Education (Self-Improvement), as well as hobby and recreational courses. Most of the FTE enrollment in these

courses is non-credit. While this "Other" category accounted for roughly 45% of the total *number* of students (not shown in the table), Figure 2 shows that it accounted for only 6.3% of total FTE enrollment in 2005-06.[2]

Elasticity Measures. Economists use the concept of *elasticity* as a measure of the extent to which one factor has an impact upon another. The elasticity measures the percentage change in one variable that results from a one-percent change in another variable. In the context of tuition & fees, for example, the elasticity would measure the percentage change in FTE enrollment generated by a one-percent change in tuition & fees.

The following is a discussion of the factors in the model, including tuition & fees, and their *elasticity* impacts on enrollment. The discussion includes the impact of FTE enrollment within the various program areas:

Community College Tuition and Fees for Credit Courses

Figure 3 shows the estimated impact on FTE enrollment of a one-percent increase in credit tuition & fees. The analysis finds that, all else equal, for each one-percent *increase* in average Oregon community college tuition & fees, total FTE in Oregon *decreases* by 0.454%. This is equivalent to a decrease of 419 FTE enrollments in 2006-07. This elasticity magnitude is in the range reported in some previous studies on the impact of tuition on community college enrollment.[3]

Figure 3 - Impact of Community College Tuition & Fees in Credit Courses

If Avg Credit Tuition & Fees at Community Colleges were 1% Higher in 06-07 than their actual 06-07 level:

	Elasticity	*Confidence Level*
LDC FTE in 06-07 would change by:	-0.582%	> 95% confidence
Prof/Tech FTE in 06-07 would change by:	-0.539%	> 95% confidence
PSR Dev Ed FTE in 06-07 would change by:	-0.517%	> 85% confidence
Total FTE in 06-07 would change by:	**-0.454%**	
Estimated 06-07 Total FTE Decrease:	**419**	

See Methodological Appendix A for Regression Analysis.

The table also shows the impact of tuition & fees on FTE within various program areas. Tuition & fees have approximately the same impact on FTE enrollment in the Lower Division Collegiate (LDC) and Prof/Tech program areas. For example, a one-percent increase in tuition & fees, all else equal, would result in a decrease in LDC FTE of 0.582% and a decrease in Prof/Tech FTE of 0.539%. (The impact of tuition & fees on PSR Developmental Education FTE is only statistically significant with 85% confidence).

About 15% of total FTE are represented by program areas (such as ESL, GED, Adult High School, Adult Basic Education, Hobby/Recreational courses) that are not significantly impacted by the tuition and fee schedule charged in most LDC, Prof/Tech and PSR courses. Thus, Figure 3 shows a lower impact of credit tuition & fees on *total* FTE (-0.454 elasticity) than on FTE in predominately credit program areas charging tuition, such as LDC, Prof/Tech and PSR Developmental Education.

Enrollment Demand Curve. Figure 4A shows a demand curve—the negative relationship, all else equal, between tuition and enrollment. In particular, it shows the relationship between *hypothetical* values of credit tuition in 2006-07 and what FTE enrollment *would* be in 2006-07 given those hypothetical values.

Figure 4A - Enrollment Demand Curve: Relationship Between Hypothetical Levels of Tuition in 2006-07 and the Total FTE in 2006-07 that Would Have Resulted From the Hypothetical Level of Tuition

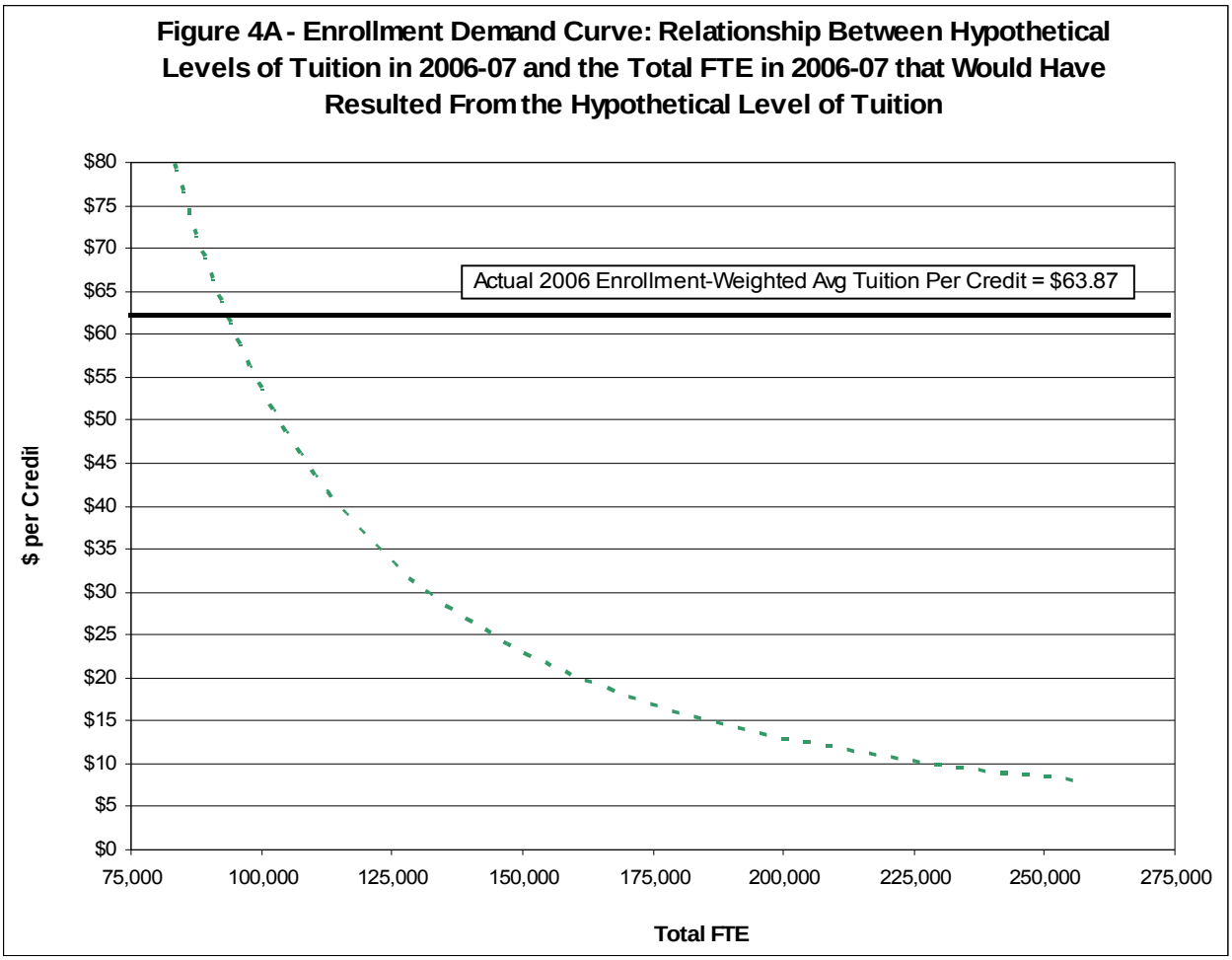


Figure 4B – Enrollment Demand Curve

Hypothetical Levels of 2006-07 Average Tuition Per Credit	Estimated 2006-07 Oregon Community College FTE, for Given Levels of Credit Tuition
$63.87 (Actual)	92,299
$53.76	100,000
$33.44	125,000
$23.03	150,000
$16.93	175,000
$13.02	200,000
$10.36	225,000
$8.46	250,000

Source: Derived from regression analysis (See Methodological Appendix A). Average credit tuition represents 2006-07 in-district tuition per credit rates, weighted by the 2005-06 FTE of the institution (excluding Adult Continuing and Hobby/Recreational Education FTE). The Figure 4 graph and table assume 2006-07 levels of state and local funding, population, financial aid, unemployment rate, and tuition & fees of 4-year institutions. The calculations also assume that fees change in proportion to tuition.

The average enrollment-weighted credit tuition in 2006-07 is $63.87 per credit, and therefore the corresponding anticipated FTE that year is 92,299. If hypothetically tuition per credit that year were $53.76 (a movement down the demand curve), FTE would be estimated at 100,000 in 2006-07. As tuition lowers, all else equal, FTE enrollment increases. As mentioned above, each one-percent decrease in tuition results in about a 0.454 percent increase in FTE, all else equal.

Figure 4B also shows that each successive increase in FTE enrollment would require successively *smaller* reductions in tuition. For example, an increase in FTE from 100,000 to 125,000 would require a hypothetical decrease in tuition from $53.76 to $33.44, a reduction of $20.32. However, an increase in FTE by the same amount, from 125,000 to 150,000, would require a hypothetical decrease in tuition from $33.44 to $23.03, a smaller reduction of $10.41.

Funding for Community Colleges

Direct versus Indirect Impact. The model takes into account two types of impacts of funding on FTE enrollment. The first (direct impact) pertains to the potential decision of colleges with limited funding to in turn limit resources available for instructional services, and consequently limit the availability of course sections and particular fields of study at the college. The second (the indirect impact) recognizes that colleges typically increase tuition when faced with cuts in state funding, resulting in a decrease in the demand for enrollment.[4]

Impact of State Appropriations. Figures 5A, 5B and 5C below provide estimates of the effect of state funding upon enrollment, showing the direct, indirect, and total impact. It should be noted that state funding in this analysis included only funding supporting general operating expenses of community colleges. Figure 5A shows the enrollment impact of state funding via the potential availability of course sections and/or fields of study within a college (the direct impact). This impact is slight; all else equal, for every one-percent change in funding, total FTE changes only by 0.064%, an increase comparable to only 59 FTE. *One reason for the modest effect is that the bulk of spending cuts at community colleges may initially focus on administrative infrastructure and student services rather than on instructional programs.*

It is noteworthy, however, that the direct impact of state funding on FTE enrollment in Prof/Tech and PSR Developmental Education is higher compared to the impact on the remaining program areas. Figure 5A shows that every one-percent change in funding, Prof/Tech FTE changes by 0.193% and PSR FTE changes by 0.478%, all else equal. By contrast, the impact upon LDC FTE is negligible (not statistically different from zero).

One reason for the disproportionate impact upon Prof/Tech FTE may be that these courses have on average a higher cost of instruction per FTE enrollment compared to LDC courses, and therefore may be an initial target of budget cuts when course sections or instructional fields of study are eliminated. Another reason for the large impact on Prof/Tech and PSR Developmental Education courses may be that courses in these program areas are disproportionately taught by adjunct faculty, making it less complex in some of the community colleges to eliminate courses (and faculty positions) in response to budget cuts.

In contrast to the direct effect, Figure 5B shows a substantially stronger impact of funding upon enrollment via the tuition response of community colleges to the funding changes (the indirect effect). In particular, for every one-percent change in funding, total FTE changes by 0.276%, an increase

Figure 5A - Direct Impact of State Funding

If State Funding to Oregon Community Colleges were 1% Lower in 06-07 than their anticipated 06-07 level:

(This Measures the Potential Impact of Funding on the Ability to Offer Course Sections and/or Fields of Study. ***Colleges May Choose to Adjust Non-Instructional rather then Instructional Expenditures in Response to State Funding Cuts. Hence, this Does Not Represent a Calculation of Instructional Funding per FTE.****)*

	Elasticity	*Confidence Level*
LDC FTE in 06-07 would decrease by:	0.016%	Not statistically differently from zero
Prof/Tech FTE in 06-07 would decrease by:	0.193%	> 90% confidence
PSR Dev Ed FTE in 06-07 would decrease by	0.478%	> 90% confidence
Other Dev Ed FTE in 06-07 would decrease by:	-0.280%	Not statistically differently from zero
Other FTE in 06-07 would decrease by:	0.063%	(See note below)
Total FTE in 06-07 would decrease by:	**0.064%**	
Estimated 06-07 Total FTE Decrease:	**59**	**Note: This Small Impact Suggests that Colleges Buffer the Enrollment Impact of State Funding Cuts by Cutting Non-Instructional Expenses**

Note: State funding during the 20 years of historical analysis typically showed no statistically significant impact on other FTE (such as Hobby/Recreational FTE). However, there was a change in the state funding reimbursable calculation after the most recent economic recession that, all else equal, led to an estimated 26% fall in other FTE that year (confidence level > 95%). See Methodological Appendix A for Regression Analysis.

Figure 5B - Indirect (Tuition-Response) Impact of State Funding*

If State Funding to Oregon Community Colleges were 1% Lower in 06-07 than their anticipated 06-07 level:
(Impact of Funding on Tuition and Subsequently on the Demand for Enrollment)

	Elasticity	*Confidence Level*
LDC FTE in 06-07 would decrease by:	0.354%	Not statistically differently from zero
Prof/Tech FTE in 06-07 would decrease by:	0.328%	> 88% confidence
PSR Dev Ed FTE in 06-07 would decrease by:	0.314%	> 88% confidence
Total FTE in 06-07 would decrease by:	**0.276%**	
Estimated 06-07 Total FTE Decrease:	**255**	

*The estimated tuition-response of community colleges due to state funding cuts is based upon a regression analysis from 1996-97 to 2006-07. Each one percent decrease in state funding, all else equal, has resulting in a .608% increase in tuition & fees (confidence level > 94%). See Endnote 4. See Methodological Appendix A for Regression Analysis.

Figure 5C - Total Impact (Combined Direct and Indirect Impact) of State Funding

If State Funding to Oregon Community Colleges were 1% Lower in 06-07 than their anticipated 06-07 level:

	Elasticity	*Confidence Level*
LDC FTE in 06-07 would decrease by:	0.370%	Not statistically differently from zero
Prof/Tech FTE in 06-07 would decrease by:	0.520%	> 90% confidence
PSR Dev Ed FTE in 06-07 would decrease by:	0.792%	> 90% confidence
Other Dev Ed FTE in 06-07 would decrease by:	-0.280%	Not statistically differently from zero
Other FTE in 06-07 would decrease by:	0.063%	(See note below)
Total FTE in 06-07 would decrease by:	**0.340%**	
Estimated 06-07 Total FTE Decrease:	**314**	

Note: State funding during the 20 years of historical analysis typically showed no statistically significant impact on other FTE (such as Hobby/Recreational FTE). However, there was a change in the state funding reimbursable calculation after the most recent economic recession that, all else equal, led to an estimated 26% fall in other FTE that year (confidence level > 95%). See Methodological Appendix A for Regression Analysis.

comparable to 255 FTE. About 80% of the impact of state funding on FTE enrollment has taken place indirectly, as colleges have adjusted tuition in response to state funding.

Figure 5C incorporates the direct impact of Figure 5A and the indirect impact of Figure 5B to derive the total impact. The table shows that for every one-percent increase in funding, total FTE increases by 0.340%, or what would be the equivalent of 314 FTE in 2006-07. It is important to note that state funding during the 20 years of historical analysis typically revealed no statistically significant impact on the "Other" FTE program area (including hobby/recreational courses). It should also be mentioned, though, that after the most recent economic recession, there was a change in the state funding reimbursable calculation that led to an estimated 26% fall in FTE within this program area (not shown in table, confidence level > 95%).

In short, for every one-percent *decrease* in state appropriations (including funding toward instructional and non-instructional expenses), total FTE *decreases* by 0.34% that year. In the face of state funding cuts, rather than cut instructional expenditure, colleges have tended to increase tuition and/or decrease expenditures *not* directly related to instruction. For instance, about 80% of the impact of state funding on overall FTE enrollment has taken place indirectly, as colleges have adjusted tuition in response to state funding. Cuts in state appropriations historically over the past 20 years have had the greatest impact on FTE enrollments in Professional/Technical courses and in Post-Secondary Remedial Development Education courses (Reading/Writing/Math courses in preparation for college-level Lower Division Collegiate and Professional/Technical programs).

Impact of Local Revenue (Non-Capital Expenditures). The econometric model also measured the impact of local revenue on enrollment (not shown in tables). Most of this local revenue is in the form of property tax revenue. Local revenue excluded self-supporting activities of a college, such as bookstore and food service activities. Moreover, local revenue included only funding that supports general operating expenses and excluded funding for capital projects.

The analysis found that changes in local revenue primarily affect enrollment in Professional/Technical courses. All else equal, for every one-percent decrease in local revenue, Prof/Tech FTE enrollment falls by 0.119% (confidence level > 90%). Again, the disproportionately impact on this program area may be due to the high instructional cost per FTE and the high percentage of adjunct faculty teaching Professional/Technical courses.

Impact of Tuition and Fees at 4-Year Institutions on Community College Enrollment

Figure 6 shows the impact of tuition & fees at 4-year institutions on Oregon community college FTE. The calculation of tuition & fees at 4-year institutions uses an average of tuition & fees at public 4-year institutions in Oregon, private 4-year institutions in Oregon, and private 4-year institutions nationally. This average is weighted by the estimated enrollment of first-year undergraduate Oregon residents among these three types of institutions. (See Methodological Appendix B).

At first, it would appear that the impact of tuition & fees at 4-year institutions is surprisingly strong; all else equal, for every one-percent increase in tuition & fees at *4-year institutions*, community college FTE enrollment increases by 0.450%. This elasticity impact is approximately the same magnitude (in absolute value) as the elasticity impact of *community college* tuition & fees upon FTE enrollment at community colleges. Recall that, all else equal, for every one-percent increase in tuition & fees at community colleges, FTE at community colleges decreases by 0.454%. Furthermore, the

impact of increases in tuition & fees at 4-year institutions on LDC enrollment at community colleges appears to be rather strong (an elasticity of 0.804%).

Figure 6 - Impact of Tuition & Fees at 4-Year Institutions on Community College FTE

If Avg Tuition & Fees at 4-Year Institutions* were 1% Higher in 06-07 than their actual 06-07 level:

	*Elasticity***	*Confidence Level*
LDC FTE in 06-07 would change by:	0.804%	> 95% confidence
Prof/Tech FTE in 06-07 would change by:	0.181%	Not statistically differently from zero
PSR Dev Ed FTE in 06-07 would change by::	0.678%	Not statistically differently from zero
Total FTE in 06-07 would change by:	**0.450%**	
Estimated 06-07 Total FTE Increase:	**415**	

*See Methodological Appendix B for an explanation of tuition & fees at 4-Year Institutions.
**Technically, this should be called the *Cross-Elasticity*, since it represents the impact of the price of one good/service (i.e., tuition & fees at 4-year institutions) on the demand for another good/service (i.e., community college enrollment).

See Methodological Appendix A for Regression Analysis.

One reason for the seemingly large impact of tuition & fees at 4-year institutions upon community college enrollment relates to the *actual dollar* difference of a one-percentage increase in tuition & fees at a 4-year institution versus a one-percentage increase in tuition & fees at a community college. Given that tuition & fees at a 4-year institution can be substantially higher than average tuition & fees at a community college, a one-percent increase in tuition & fees at 4-year institutions constitutes a much greater increase in actual dollars than a one-percent increase in tuition & fees at community colleges.

We can instead estimate the impact on community college LDC FTE resulting from a hypothetical $100 increase (in 2006 dollars) in community college tuition & fees. Given the elasticity estimates of the model, this would lower LDC FTE at community colleges by 2.18%, all else equal (not shown in tables).[5] However, the same ($100) increase in tuition & fees at a *4-year institution* would lower LDC FTE at community colleges by only 0.72%.

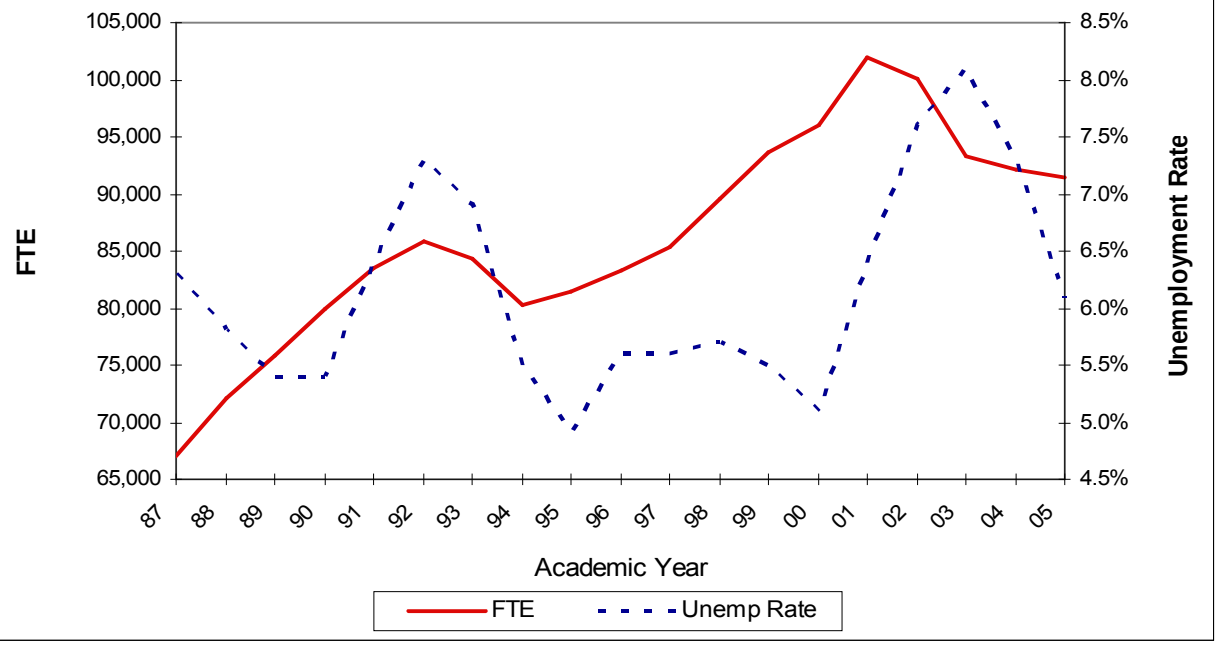
Impact of Unemployment on Community College Enrollment

Several studies suggest that community college enrollment increases during economic recessions.[6] Figure 7 below shows the relationship between FTE enrollment and the Oregon unemployment rate (the unemployment rate in the calendar year at the start of the academic year). Unfortunately, it is not clear from the graph if FTE increases or decreases during periods of high unemployment. For example, during the recent Oregon recession (beginning in 2001) the unemployment rate was *increasing* at a time when there was a steep *fall* in FTE. This would seem to suggest that economic slowdowns do *not* result in an increase in enrollment. On the other hand, during the prior recession (beginning in 1990), FTE was *rising* at a time of *increasing* unemployment. However, the rising trend in FTE began well before that recession, during a period when unemployment was actually falling (prior to 1990).

One could argue that FTE would have been rising during economic recessions if it were not for funding cuts and tuition increases that typically take place during economic downturns. Fortunately,

the econometric model used in this analysis can isolate the impact of unemployment on enrollment from the impact of tuition and funding on enrollment. Figure 8 (also below) demonstrates the impact of unemployment on FTE, holding other factors constant, such as tuition and funding. Figure 8 shows that, all else equal, a one percentage-point increase in the unemployment rate (for example, from the current 5.5 to 6.5) leads to an increase in total FTE of 1.093%. This is equivalent to an FTE enrollment increase of 1,009 in 2006-07.

Figure 7 - Oregon Community College FTE and the Oregon Unemployment Rate



Source: For FTE, Oregon Department of Community Colleges & Workforce Development/OCCURS. For Oregon Unemployment, US Bureau of Labor Statistics. The unemployment rate corresponds to the calendar year at the start of the academic year.

Figure 8 - Impact of the Oregon Unemployment Rate

If the Unemployment Rate in 2006 were One-Percentage Point *Higher:**

	Impact	*Confidence Level*
LDC FTE in 06-07 would be higher by:	2.016%	> 95% confidence
Prof/Tech FTE in 06-07 would be higher by:	1.801%	> 90% confidence
PSR Dev Ed in 06-07 would be higher by:	5.528%	> 95% confidence
Other Dev Ed FTE in 06-07 would change by:	-4.467%	> 95% confidence
Other FTE in 06-07 would change by:	-1.894%	Not statistically differently from zero
Total FTE in 06-07 would be higher by:	**1.093%**	
Estimated 06-07 Total FTE Increase:	**1,009**	

*This implies that the 2006 Oregon unemployment rate hypothetically would be 6.4 rather than the anticipated 5.4.
See Methodological Appendix A for Regression Analysis.

Surprisingly, the impact of unemployment on LDC enrollment and PSR enrollment is greater than the impact on Prof/Tech enrollment (2.016% increase in LDC FTE and 5.528% increase in PSR FTE,

versus 1.801% increase in Prof/Tech FTE). This runs counter to the commonly-held view that job seekers enroll in community colleges during recessions to gain vocational retraining. One reason why enrollment in all of these program areas increases during recessions may be that the *opportunity cost* of attending college during a recession is relatively low; students during a recession do not forego substantial income in order to attend college, since jobs are scarce.

Enrollment in the other program areas, predominately non-credit, *decreases* during a recession. For instance, FTE enrollment in Developmental Education other than PSR (e.g., ESL, GED, Adult High School, and Adult Basic Education) *decreases* during periods of high unemployment; each one-percentage point increase in the unemployment rate, all else equal, leads to a 4.467% decrease in Other Developmental Education FTE. Students enrolled in these programs typically do not receive financial aid. Thus, periods of high unemployment appear to further their inability to financially afford community colleges.

In short, FTE enrollment in predominately credit programs *increases* during economic recessions, all else equal. By contrast, FTE enrollment in predominately non-credit program areas tends to *decrease*, all else equal, during economic recessions.

Impact of Current Changes in FTE on Future FTE (Lag Effects)

It is reasonable to expect that prospective students who decide against enrolling during any particular year have a higher likelihood (compared with those who *do* decide to enroll that year) of *not* enrolling during the following year. Hence, we would expect there to be *lag effects*, that is, we would expect detrimental impacts on enrollments during any given year to last more than just that year.

The lag effect is strong in Developmental Education other than PSR program areas, such as in ESL, GED, Adult High School, and Adult Basic Education programs (confidence level > 95% over two subsequent years). All else equal, for every one-percentage point decrease in any particular year in the rate of FTE growth in Other Developmental Education, there is about a 0.22 percentage-point decrease in the rate of FTE growth in that program area during the following year, and about a 0.49 percentage-point decrease in the rate of FTE growth in that program area during the subsequent year.

These lag effects are also strong within the LDC program area (confidence level > 95% over two subsequent years). All else equal, for every one-percentage point decrease in the rate of LDC FTE growth, there is about a 0.21 percentage-point decrease in the rate of LDC FTE growth the following year, and about a 0.36 percentage-point decrease in the rate of LDC FTE growth during the subsequent year. Given that about 60% of total FTE in 2005-06 is comprised of FTE enrollment in either Other Developmental Education or in LDC program areas (recall Figure 2 above), the lag impact of decreases in FTE in these program areas has a non-trivial impact on total FTE.

A Strategy for Adapting the Model to Particular Community Colleges

The previous section examined the factors that impact community college enrollment, using Oregon statewide data. However, an individual community college may ask the question: What is the likely impact of the various factors (tuition, funding, etc.) on the FTE enrollment within my *own* institution? Although the model developed in this analysis uses aggregated statewide enrollment, the results may be adapted for use by individual community colleges, with some caveats.

One methodological issue that first needs to be addressed, though, is that the distribution of FTE by program area statewide in Oregon may be different from the distribution of FTE by program area for any individual community college. As we have seen, the impact of factors on enrollment, such as tuition, differs by program area. One benefit of the framework used in this analysis, however, is that it separates out the effect of various factors on enrollment by programs areas, each showing the separate elasticity impact related to that particular program area. An individual community college can take advantage of the separate elasticity estimates to approximate the impact of factors on total FTE in their own institution.

As a reasonable approximation, the elasticity impact on total FTE can be calculated as an average of the elasticity impact on enrollment within each of the program areas. This average would be weighted by the distribution of FTE by program area within that institution. For example, in 2005-06, the FTE enrollment distribution in one of the public community colleges in Oregon, *Portland Community College*, was:

45% LDC
35% Prof/Tech
4% PSR Development Education
10% Other Developmental Education
6% Other FTE

Recall (Figure 3) that the credit tuition & fees elasticity impact for each of the program areas was estimated as:

-0.582% for LDC
-0.539% for Prof/Tech
-0.517% of PSR Development Education
Negligible for Other Developmental Education (mostly non-credit)
Negligible for Other FTE (mostly non-credit)

The elasticity impact of credit tuition & fees on total FTE at *Portland Community College* would then be approximately:

Figure 9 – Example of Adapting Model to an Individual Community College

[(.45)*-0.582%] + [(.35)*-0.539%] + [(.04)*-0.517%] + [(.10)*0%] + [(.06)*0%] = -0.471%

Portland Community College **Estimated Elasticity Impact of Credit Tuition & Fees on their Total FTE**

As an approximation, a one-percent *increase* in credit tuition & fees at *Portland Community College* would result in a 0.471% *decrease* in their total FTE enrollment, holding all else equal.

Caveats Regarding the Approximation Technique. There are three caveats regarding the above approximation technique, each relating to characteristics of a particular institution.

Tuition-Response of Colleges. The first caveat pertains to the impact of state funding on enrollment. The elasticity impact of state funding on enrollment is largely dependent on the tuition-response of the college to changes in funding. For every one-percentage decrease in state appropriations, Oregon community colleges have responded on average over the past 10 years with an increase in credit tuition & fees of 0.608%. This tuition-response is responsible for most of the decline in enrollment

stemming from state funding cuts. However, if the tuition-response of an individual community college is higher (lower), the approximation technique may underestimate (overestimate) the impact of funding on enrollment.

Structural Unemployment. The second caveat pertains to structural unemployment. Structural unemployment takes place when there is a long-term mismatch between the skills of job seekers and the types of skills demanded by employers. Examples include: technological advancements and the resulting changes in the demand for workers in a particular industry; increases over time in the demand for workers having high levels of educational attainment; and regional unemployment resulting from large employers leaving an area. A community college located in a region that has experienced substantial and long-term increases in structural unemployment may also face a substantial increase in the demand for retraining, and hence an increase in enrollment demand that is higher than what has been estimated in the model.

Competing Institutions. The third caveat pertains to the effect of a community college's tuition & fees on its enrollment, particularly in regions served by more than one public community college (or perhaps by a private alternative to a public community college). The model developed in this analysis focuses on the impact of statewide *average* tuition & fees in Oregon on enrollment. However, it may not pertain to situations in which one particular community college serving a region holds tuition relatively stable, while a second college decides to increase tuition substantially. In this case, students may choose to enroll in the least expensive of the community colleges serving that region. In these specific situations, we would expect there to be an even greater tuition elasticity impact on enrollment than what is estimated in this analysis, as students enroll in the alternative institution. If, however, the two colleges in the region tend to experience similar patterns of tuition increases, the approximation technique shown above is appropriate for projecting the impact of tuition increases on enrollment at those individual colleges.

Enrollment Projection

This last section presents a short-term forecast of enrollment, based upon the findings of the econometric model developed in this analysis. Projections after 2006-07 assume that state funding will grow at a rate of 6.525% per year (low case) and 9.687% per year (high case). *These annual growth rates are equivalent to a 10% (low case) and 15% (high case) increase in 07-09 biennium funding over 05-07 biennium funding.*

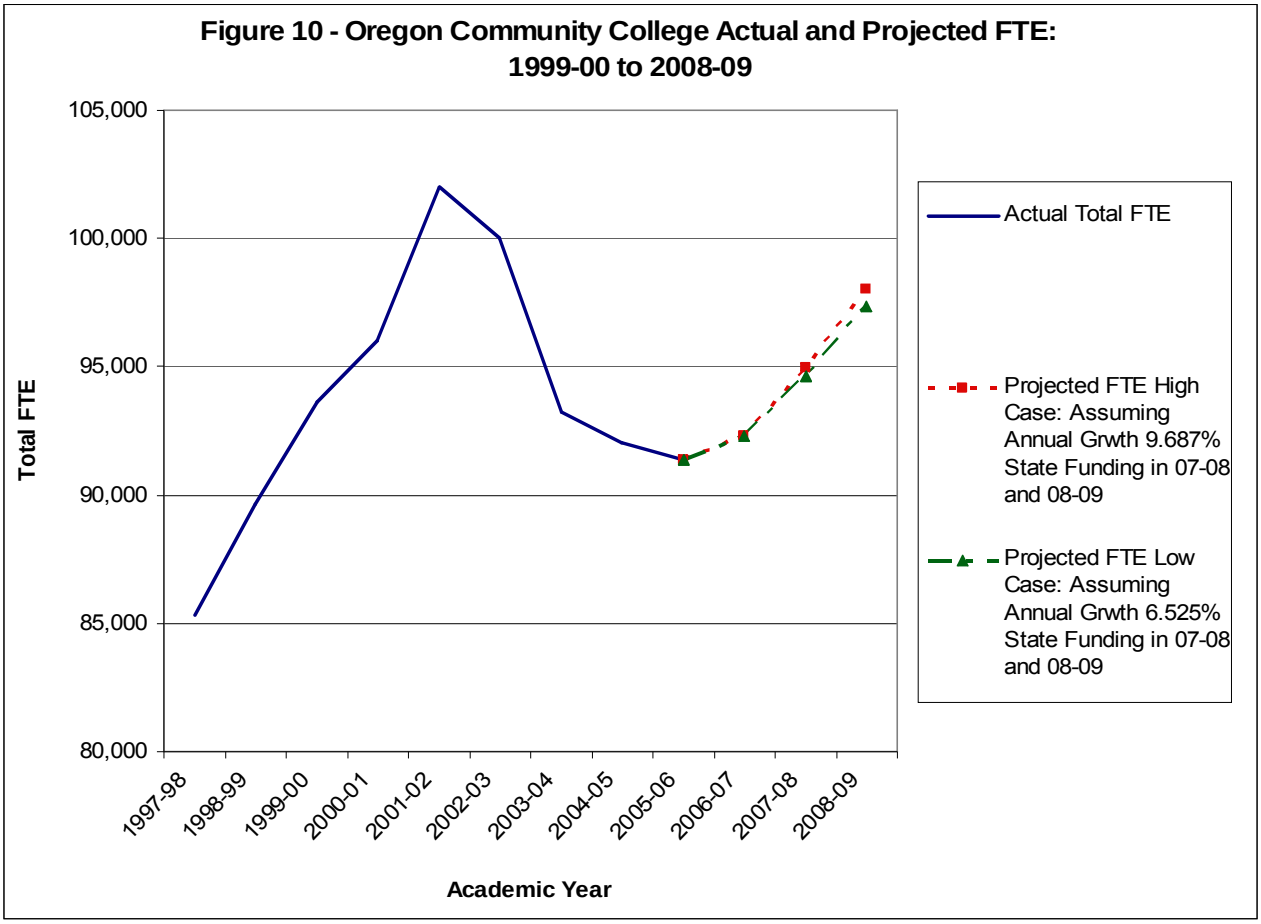
The projections also assume that the tuition response of community colleges to state funding during these two years would be similar to the responsiveness of tuition to funding that has taken place over the previous 10 years.[7] This implies that tuition will grow at a very modest rate (about 2.5% per year, the rate of inflation).

According to Figure 10 (below), total FTE enrollment is anticipated to increase by 1.0% between 2005-06 and 2006-07. Moreover, FTE enrollment growth is expected to be moderately higher over the subsequent two years. FTE enrollment is projected to increase between 2.7% to 3.1% from 2006-07 to 2007-08, and between 3.0% and 3.4% from 2007-08 to 2008-09.

The primary reason for the increased projected growth after 2006-07 is that the rate of state funding growth is expected to be higher compared to the rate of funding growth over the past few years. Another reason, though, is that the Oregon Department of Consumer and Business Services anticipates that the unemployment rate will rise by slightly over one-half of a percentage point as we move from

calendar year 2006 (5.4 percent) to calendar years 2007 and 2008 (6.0 percent each year). As shown previously, community college enrollment rises when the unemployment rate also rises.

Figure 10 - Oregon Community College Actual and Projected FTE: 1999-00 to 2008-09



Academic Year	Actual Total FTE	*Growth Actual Total FTE*	Projected FTE, High Case: Assuming 9.687% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected FTE (High Case)*	Projected FTE, Low Case: Assuming 6.525% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected FTE (Low Case)*
1997-98	85,346	*2.5%*				
1998-99	89,616	*5.0%*				
1999-00	93,648	*4.5%*				
2000-01	96,037	*2.6%*				
2001-02	102,019	*6.2%*				
2002-03	100,023	*-2.0%*				
2003-04	93,221	*-6.8%*				
2004-05	92,054	*-1.3%*				
2005-06	91,401	*-0.7%*	91,401		91,401	
2006-07			92,299	*1.0%*	92,299	*1.0%*
2007-08			95,162	*3.1%*	94,821	*2.7%*
2008-09			98,382	*3.4%*	97,655	*3.0%*

The low case and high case are equivalent to an increase in 07-09 biennium funding over 05-07 biennium funding of 10% and 15%, respectively. Source: For Actual FTE, Oregon Department of Community Colleges & Workforce Development/OCCURS. Projected FTE is derived from the regression estimates of the annual growth rate (See Methodological Appendix A).

Despite the anticipated rise in enrollment, though, total FTE enrollment in 2008-09 (between 97,655 and 98,382) will remain below its historical height of 102,019 in 2001-02. The primary reason for this is that average credit tuition in Oregon community colleges, adjusted for inflation, is anticipated to be almost 50% higher in 2008-09 than in 2001-02.

Given the estimates of FTE growth, an econometric analysis further estimated the ratio of unduplicated headcount to FTE enrollment, yielding estimates of the unduplicated headcount.[8] Figure 11 below shows the actual and projected total unduplicated headcount. Note that within the past two years, headcount growth (shown below in Figure 11) has exceeded FTE enrollment growth (shown above in Figure 10).

One possible explanation is that the number of part-time credit students have increased as tuition growth has lessened. This analysis finds, for example, that for every one-percent decrease in the growth rate of tuition and fees, the growth rate of *unduplicated headcount* increases by about one percentage point. By contrast, for every one-percent decrease in the growth rate of tuition and fees, there is an increase in the growth rate of *FTE enrollment* of about one-half of a percentage point.

However, much of the recent headcount growth has been in non-credit areas. A more plausible explanation for the recent headcount growth is that it is the result of the economy growing out of a recession. Recall that non-credit enrollment tends to increase when the economy expands, while credit enrollment tends to increase when there is a recession. Non-credit enrollment accounts for roughly 40% of unduplicated headcount, but accounts for roughly 15% of FTE enrollment. Thus, we would expect headcount growth to exceed FTE growth as the economy expands.

Figure 11 - Actual and Projected Unduplicated Headcount

Academic Year	Actual Unduplicated Headcount	*Growth Actual Unduplicated Headcount*	Projected Unduplicated Headcount, High Case: Assuming 9.687% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected Unduplicated Headcount (High Case)*	Projected Unduplicated Headcount, Low Case: Assuming 6.525% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected Unduplicated Headcount (Low Case)*
1997-98	352,660	*1.8%*				
1998-99	373,158	*5.8%*				
1999-00	392,472	*5.2%*				
2000-01	403,931	*2.9%*				
2001-02	406,434	*0.6%*				
2002-03	377,596	*-7.1%*				
2003-04	330,595	*-12.4%*				
2004-05	346,206	*4.7%*				
2005-06	357,511	*3.3%*	357,511		357,511	
2006-07			366,280	*2.5%*	366,280	*2.5%*
2007-08			383,461	*4.7%*	382,087	*4.3%*
2008-09			398,236	*3.9%*	395,292	*3.5%*

The low case and high case are equivalent to an increase in 07-09 biennium funding over 05-07 biennium funding of 10% and 15%, respectively. Source: Oregon Department of Community Colleges & Workforce Development/OCCURS data. Projected Headcount was derived from a regression analysis of FTE to Headcount Ratio (see Endnote 8).

According to Figure 11, the number of students is anticipated to increase by 2.5% between 2005-06 and 2006-07. It is projected to increase between 4.3% to 4.7% from 2006-07 to 2007-08, and between 3.5% and 3.9% from 2007-08 to 2008-09.

Combined Enrollment in LDC and Professional/Technical

Figure 12 below shows the projected FTE enrollment for combined LDC and Professional/Technical enrollment. Between 2005-06 and 2006-07, combined LDC and Professional/Technical FTE is anticipated to decrease by 0.4%. However, it is expected to grow slightly over the subsequent two years. In particular, it is projected to increase between 3.4% to 3.8% from 2006-07 to 2007-08, and between 2.9% and 3.4% from 2007-08 to 2008-09.

Figure 12 - Estimated and Projected Combined LDC and Professional/Technical FTE Enrollment

Academic Year	Actual LDC & Prof /Tech FTE	*Growth Actual LDC & Prof/ Tech FTE*	Projected LDC & Prof/Tech FTE, High Case: Assuming 9.687% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected LDC & Prof/Tech FTE (High Case)*	Projected LDC & Prof/Tech FTE, Low Case: Assuming 6.525% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected LDC & Prof/ Tech FTE (Low Case)*
1997-98	59,735	*2.4%*				
1998-99	61,157	*2.4%*				
1999-00	64,956	*6.2%*				
2000-01	67,918	*4.6%*				
2001-02	73,961	*8.9%*				
2002-03	74,084	*0.2%*				
2003-04	70,953	*-4.2%*				
2004-05	69,877	*-1.5%*				
2005-06	69,440	*-0.6%*	69,440		69,440	
2006-07			69,167	*-0.4%*	69,167	*-0.4%*
2007-08			71,808	*3.8%*	71,496	*3.4%*
2008-09			74,240	*3.4%*	73,586	*2.9%*

The low case and high case are equivalent to an increase in 07-09 biennium funding over 05-07 biennium funding of 10% and 15%, respectively. Source: For Actual FTE, Oregon Department of Community Colleges & Workforce Development/OCCURS. Projected FTE is derived from the regression estimates of annual growth rate (See Methodological Appendix A).

Figure 13 (below) shows the projected unduplicated headcount for combined LDC and Professional/Technical enrollment, defined as students majoring in either an LDC or in a Professional/Technical field of study. Between 2005-06 and 2006-07, the number of these students is anticipated to decrease by 1.2%. However, LDC and Professional/Technical headcount is expected to increase slightly over the subsequent two years (between 2.1% to 2.5% from 2006-07 to 2007-08, and between 0.9% and 1.3% from 2007-08 to 2008-09).

It should be noted that, over the past 10 years, combined LDC and Professional/Technical FTE has typically been growing at a *higher* rate than combined LDC and Professional/Technical unduplicated headcount (statistically significant with > 89% confidence). This trend is independent of changes in tuition growth. The trend may reflect a long-term structural change, whereby the typical student majoring in LDC and Professional/Technical program areas is increasingly more likely to enroll full-time at the community college. This may also reflect a gradual shift away from enrollment at 4-year

institutions toward community colleges as the dollar gap between the costs of attending these institutions widen.

Despite the anticipated growth in the near-term in the unduplicated headcount of LDC and Professional/Technical students, the number of these students in 2008-09 (between 171,872 and 173,400) is anticipated to be slightly less than 20% of the historical height of 213,006 students in 2000-01. This is revealing, given that the adult population (age 18-64) between 2000-01 and 2008-09 is expected to growth roughly 13% over this same time span. Again, the decrease in the number of LDC and Professional/Technical students in 2008-09 as compared to 2000-01 is largely the result of budget cuts and tuition increases that took place following the 2001 economic recession in Oregon.

Figure 13 - Estimated and Projected Combined LDC and Professional/Technical Unduplicated Headcount (Number of Students Majoring in either an LDC or Professional/Technical Field of Study)

Academic Year	Estimated LDC & Prof/Tech Unduplicated Headcount	*Growth Actual LDC & Prof/Tech Unduplicated Headcount*	Projected LDC & Prof/Tech Unduplicated Headcount, High Case: Assuming 9.687% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected LDC & Prof/Tech Unduplicated Headcount (High Case)*	Projected LDC & Prof/Tech Unduplicated Headcount, Low Case: Assuming 6.525% Annual Grwth State Funding in 07-08 and 08-09	*Growth Projected LDC & Prof/Tech Unduplicated Headcount (Low Case)*
1997-98	183,577	*0.1%*				
1998-99	201,029	*9.5%*				
1999-00	204,643	*1.8%*				
2000-01	213,006	*4.1%*				
2001-02	198,412	*-6.9%*				
2002-03	186,234	*-6.1%*				
2003-04	172,031	*-7.6%*				
2004-05	173,625	*0.9%*				
2005-06	168,900	*-2.7%*	168,900		168,900	
2006-07			166,892	*-1.2%*	166,892	*-1.2%*
2007-08			171,139	*2.5%*	170,397	*2.1%*
2008-09			173,400	*1.3%*	171,872	*0.9%*

The low case and high case are equivalent to an increase in 07-09 biennium funding over 05-07 biennium funding of 10% and 15%, respectively. Source: Estimates of historical headcount derived from Oregon Department of Community Colleges & Workforce Development/OCCURS data. Some Oregon community colleges were unable in particular years to classify a high percentage of their total headcount enrollment into a program area (defined in this analysis as > 5% unknown program area). These schools were excluded from the calculation of combined LDC and Prof/Technical headcount in Oregon. The percent distribution of combined LDC and Prof/Technical students obtained from the remaining schools was then applied to the total Oregon combined LDC and Prof/Technical headcount to yield an estimate of combined LDC and Prof/Technical headcount in Oregon. Projected Headcount was derived from a regression analysis of FTE to Headcount Ratio (see Endnote 8).

Figure 14 below uses the same unduplicated headcount data as in Figure 13, but presents it in terms of *market penetration rates*, the percentage of the Oregon adult population age 18-64 enrolled in Oregon community colleges as a student majoring in either an LDC or Professional/Technical field of study. The market penetration rate was 8.40% at the onset of the most recent recession in 2001. Notice, however, that penetration rates since then have experienced a 20% decline, reaching 6.67% in 2006-07.

Recall that LDC enrollment in particular is characterized by a substantial lag effect; decreases in enrollment persist for a few years subsequent to the initial fall in enrollment. This is one reason for the

gradual decline in penetration rates as shown in Figure 14 that persisted even a few years after the substantial credit tuition hike that took place in Oregon community colleges in 2002-03 and 2003-04. It is beyond the predictive scope of the model as to whether the penetration rate will recover after 2008-09, but it depends largely on whether state funding per capita (adjusted for inflation) returns to the growth rates experienced prior to the economic recession of 2001.

Figure 14 - Market Penetration Rates of LDC and Professional/Technical Students (Percent of Oregon Adult Population Age 18-64 Enrolled as a Student Majoring in either an LDC or Professional/Technical Field of Study)

Academic Year	Estimated LDC & Prof/Tech Penetration Rate	Projected LDC & Prof/Tech Penetration Rate, High Case: Assuming 9.687% Annual Grwth State Funding in 07-08 and 08-09	Projected LDC & Prof/Tech Penetration Rate, Low Case: Assuming 6.525% Annual Grwth State Funding in 07-08 and 08-09
1997-98	8.51%		
1998-99	9.28%		
1999-00	9.17%		
2000-01	8.99%		
2001-02	8.40%		
2002-03	7.82%		
2003-04	7.17%		
2004-05	7.19%		
2005-06	6.86%		
2006-07		6.67%	6.67%
2007-08		6.74%	6.71%
2008-09		6.74%	6.68%

The low case and high case are equivalent to an increase in 07-09 biennium funding over 05-07 biennium funding of 10% and 15%, respectively. This table was derived from Figure 13, and from Population Estimates (US Census) and Projections (Oregon Office of Economic Analysis, Dec 2006). The Market Penetration Rate is defined here as the percentage of the Oregon population age 18-64 enrolled as a student majoring in either an LDC or Prof/Tech field of study at Oregon public community colleges. Assumes the percentage of LDC and Prof/Tech students that reside out-of-state or are international is the same percentage as total students that reside out-of-state or are international (Source: Table 16 of *Oregon Community College Profiles*, Oregon Department of Community Colleges & Workforce Development, 1997-98 through 2004-05). Assumes percentage out-of-state or international in 2005-06 through 2008-09 is the same as in 2004-05.

Conclusions and Policy Implications

The innovative feature of this model of community college enrollment is that separate models were developed for each of the major program areas. This revealed important factors affecting enrollment in one program area that were not necessarily important factors in another program area:

- State funding cuts have the greatest impact on Professional/Technical FTE enrollment and Post-Secondary Remedial Developmental Education FTE enrollment.

- Not surprisingly, increases in tuition & fees at four-year institutions have a greater impact on Lower Division Collegiate FTE enrollment than on Professional/Technical FTE enrollment.

- Credit tuition increases have similar impacts on Lower Division Collegiate FTE enrollment, on Professional/Technical FTE enrollment, and on Post-Secondary Remedial Developmental Education FTE enrollment.

- FTE enrollment in predominately credit programs increases during economic recessions, all else equal. However, FTE enrollment in predominately non-credit program areas tends to decrease, all else equal, during economic recessions.

- Lag effects were particular high within the Lower Division Collegiate program area, as well as in Developmental Education other than Post-Secondary Remedial (e.g., ESL, GED, Adult High School, and Adult Basic Education).

The separate models have yielded estimates of FTE annual growth rates in each of the program areas, and results from these models were combined to generate estimates of total annual FTE growth (R-square of 0.87). It should be noted that one of the benefits of creating separate models by program area is that it more easily allows individual community colleges to adapt some of the results of the model to their particular institution. However, some caveats to this strategy were discussed.

Based upon estimates of FTE growth, an econometric analysis of the ratio of unduplicated headcount to FTE enrollment was conducted, yielding estimates of the growth in unduplicated headcount. The next few years will experience a modest increase in both FTE and unduplicated headcount, but they will not reach their historical levels experienced at the onset of the economic recession of 2001. This is largely the result of the funding cuts and tuition hikes that took place immediately following the recession. The effects of these funding and tuition policies are seen most strikingly in the almost 20% decline in the market penetration rate of LDC and Professional/Technical students since the onset of the recent economic recession.

Among all of the significant factors influencing enrollment, tuition and fees have played the largest role in explaining the enrollment declines since the onset of the recent recession in 2001. Since 2001, unemployment has decreased, tuition at 4-year institutions has risen (adjusted for inflation), and the adult population has increased, suggesting that FTE enrollment *should have* increased above the historically high 2001-02 levels. However, in spite of these factors that tend to increase enrollment, the almost 50% increase in tuition (adjusted for inflation) since 2001-02 has allowed enrollment to fall below its historically high 2001-02 levels.

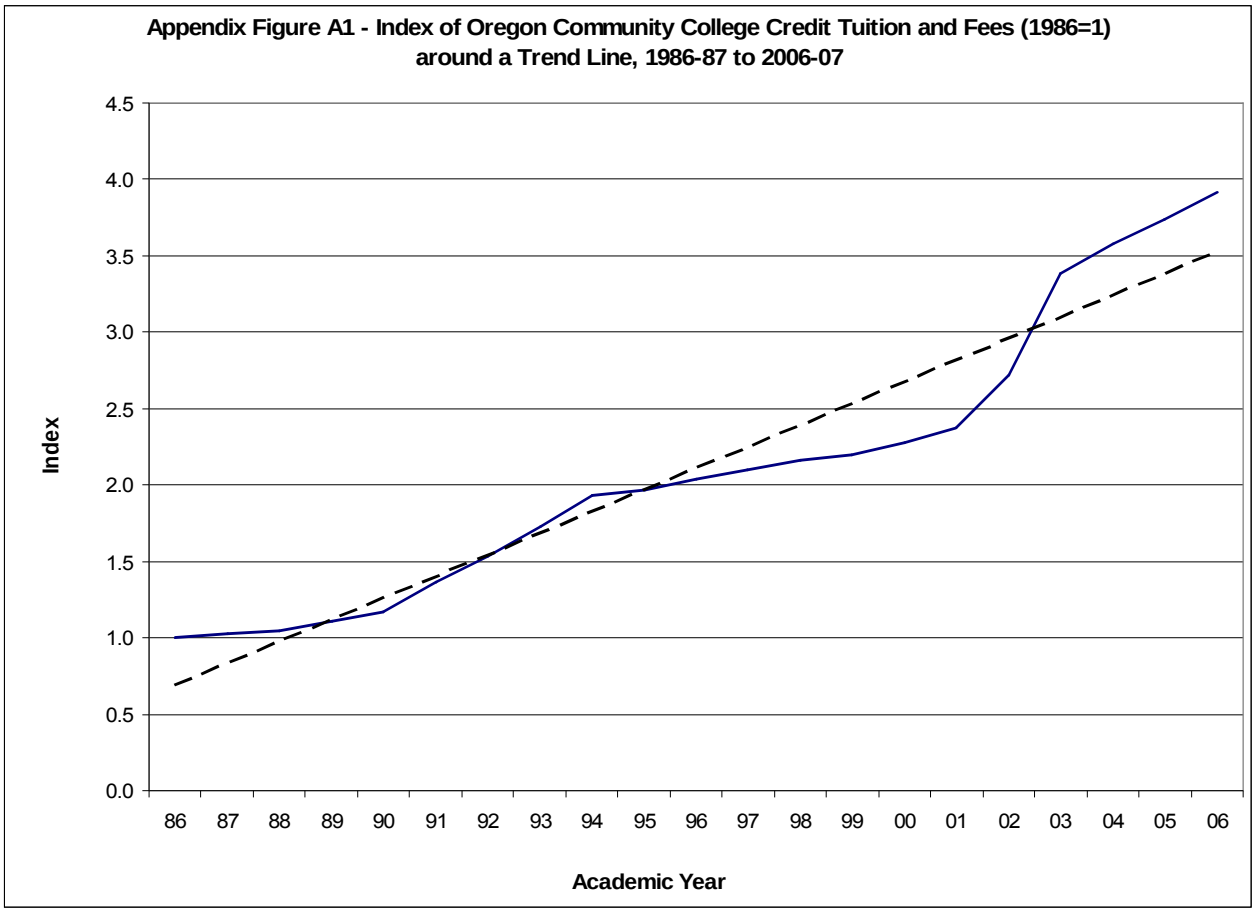
All else equal, if tuition currently were at the inflation-adjusted 2001-02 levels, current FTE enrollment would be about 128,000, approximately 25,000 higher than FTE enrollments were in 2001-02. Moreover, if today's tuition were about 25% lower than current tuition, current FTE enrollments would equal 2001-02 levels.

It would be tempting, then, to establish a policy to increase enrollment growth by placing a cap on tuition growth. *However, this policy is not supported by the analysis, particularly if such a cap is accompanied by insufficient state funding growth.* Recall that community colleges in Oregon, rather than cut the number of course sections and fields of study, have tended historically to respond to decreases in state funding by increasing tuition. However, if colleges were not given this option, they might then be more likely to respond to decreases in state funding by cutting the number of course sections and fields of study offered. This may, in the end, limit enrollment growth.

Methodological Appendix A: Econometric Analysis

Nonstationary Time Series

In time-series regression analysis, methodological issues arise when the dependent variable or one of the independent variables are non-stationary.[9] Non-stationary series include time-series whose mean value changes over time. Appendix Figure A1 shows as an example of a non-stationary time series, the *Index of Oregon Community College Credit Tuition and Fees* (See Appendix B for a discussion of sources of data).



Source: See Methodological Appendix B.

Suppose one were to conduct a simple regression analysis with FTE enrollment as the dependent variable and credit tuition & fees as the independent variable. As with tuition & fees, FTE enrollment is also likely to be non-stationary, in particular, FTE and tuition have increased over time (i.e., have a positive slope). The regression analysis would then likely yield a perverse result. Specifically, it would appear to show that *increases* in credit tuition result in *increases* in enrollment. Furthermore, often regressions that similarly fail to adjust for nonstationarity appear to explain an inflated percentage of the variance (i.e., have an R-square approaching one).

There are generally two approaches that can be used to address this non-stationary issue. Each approach depends upon the characteristics of the non-stationary process. The first assumes that the

time-series is *trend stationary*. In the case of tuition and fees, a trend stationary assumption would suggest that this time series is stationary around a linear trend. In other words, after adjusting for a trend, the mean value of the regression residual is constant with respect to time. In this case, the solution to the non-stationary issue would be to include a trend variable in the regression analysis as an additional independent variable.

It may be helpful to provide an intuitive example of how tuition and fees set by colleges might be trend-stationary. Suppose that real (inflation-adjusted) tuition has been growing at a constant rate of 2% for several years. However, because of a sudden budget crisis during one particular year, suppose that real tuition increases by 10% for that year only. When the budget crisis is over, suppose further that the college decides what general "path" to set tuition over the subsequent years. One alternative is to hold tuition constant or even cut tuition, such that within a few years it would be at the same level that it would have been had there been no steep tuition hike at all. This would represent a trend-stationary process, since tuition is reverting back to the original linear trend.

Appendix Figure A1 shows, though, that tuition & fees fall above or below the trend line for quite a number of consecutively years. For instance, between 1995 and 2002, a period of seven years, tuition & fees fell below the linear trend. Between 2002 and 2006, a period of four years, tuition & fees fell above the trend. Depending on the nature and extent of this *autocorrelation*, this may suggest that the trend-adjusted mean value of the time series is changing over time; the long spans of time in which tuition and fees deviate from the trend are, in fact, periods in which the mean value of tuition & fees is actually shifting, even after "subtracting" a trend. This would, then, defined the time-series as not only nonstationary, but also not *trend* stationary.

In fact, formal statistical tests show that real Oregon tuition & fees at community colleges, or nationally at community colleges, are unlikely to be trend stationary.[10] Since the time-series may not be trend stationary, including a trend variable into the regression equation would not fully rectify the stationary issue. In a nonstationary time series that is also trend nonstationary, there is little guarantee that the historical trend line will continue into the future. Therefore, projections of tuition, and projections of variables that are impacted by tuition such as enrollment, cannot be made based on following a trend line.

It may be helpful once more to provide an intuitive example of how tuition and fees set by colleges might be non-stationary, even after adjusting for a trend. Suppose in the hypothetical example (following the budget crisis and steep tuition hike) that colleges instead decide to set real tuition back to the 2% annual growth rate that took place prior to the tuition hike.[11] This would mean, though, that future tuition would be at levels *above* what would have taken place had there been no tuition hike; tuition would tend not to revert back to the original trend line. This represents a non-stationary process that is *also* trend non-stationary. Statistical tests on Oregon tuition and fees at community colleges suggest that this is the most common path taken by colleges when setting tuition policy.

One common method to deal with non-stationary series in regression analysis, including cases in which the variables are trend non-stationary, is to transform the variables into the *difference* of that variable from one year to the next. The resulting differencing typically generates a stationary time series. Specifically, the analysis used in this study transforms variables into the change from one year to the next in the value of the variable's *natural logarithm*. The annual change in the natural logarithm of a particular variable is approximately equal (for small changes) to the annual growth rate of that variable.

Regression Analysis

Appendix Figure A2 (below) shows the regression results that served as the basis of the model used in the analysis. The five regression analyses correspond to the five program areas discussed in the main report. No statistically significant autocorrelation was found in the estimates generated by any of the five models.[12]

One advantage of employing the natural logarithm in the regression analysis is that a regression coefficient used in a log-linear equation approximates the elasticity, the percentage change in the dependent variable that results from a one-percentage change in an independent variable.[13] For instance, in *Regression I,* a one percent increase in real (inflation-adjusted) community college credit tuition & fees results in a -0.582 percent decrease in FTE enrollment in LDC courses. In *Regression II*, a one percent increase in real (inflation-adjusted) community college credit tuition & fees results in a -0.539 percent decrease in FTE enrollment in Prof/Tech courses. Further, in *Regression III,* a one percent increase in real (inflation-adjusted) community college credit tuition & fees results in a -0.517 percent decrease in FTE enrollment in PSR courses. Because the regressions are log-linear, the total elasticity impact (the impact of tuition & fees on *total* FTE) is simply an average of the elasticity impacts within each of the program areas, weighted by FTE enrollment in the individual program area.

Note also that the dependent variables measuring enrollment is represented by *FTE per capita* (per the adult population age 18-64). Because the regression is log-linear, the "per capita" component of the dependent variable is additively separable (log (X/Y) = log X – log Y). Hence, the elasticity impact of tuition on FTE per capita is equal to the elasticity impact of tuition on FTE alone. The use of the "per capita" functional form also serves the purpose of allowing an additional degree of freedom in the regression analysis, since a population variable was then not necessary as one of the independent variables. The implicit assumption of this functional form, though, is that every one-percentage point increase in population growth results in a one-percentage point increase in FTE enrollment, all else equal.

Total estimated FTE was derived from aggregating the estimated FTE within all of the program areas, based upon program-area FTE growth estimates generated from Regression I through V. As a check, the annual change in the natural log of total *estimated* FTE was regressed against the annual change in the natural log of total *actual* FTE (1996-2005). This yielded an intercept of zero and slope of one (confidence level > 99.99%), indicating an unbiased fit. The regression yielded an R-Square of 0.87.

This overall fit is higher than the fit of any of the individual regressions corresponding to the various program areas. One reason why this may be the case is that the regression errors pertaining to one particular program area may be *negatively* correlated with the regression errors pertaining to another program area. For instance, an under-prediction of LDC FTE may correspond to an over-prediction of PSR FTE. Thus, the variance of the error in the total FTE model may be less than the sum of the variances of the errors within each of the program area models.[14]

Last, one important assumption in conventional (ordinary least squares) regression analysis is that changes in the dependent variable do not *cause* changes in any of the independent variables. In other words, there is no *simultaneous equation bias*. One could argue that this bias might be present in the case of state funding. Specifically, state funding growth may increase *as a result of* increases in FTE growth. The effect would be that the regression coefficient measuring the direct impact of funding on enrollment would be upwardly biased.

However, the ordinary least squares regression results show that the direct impact of funding within most reimbursable program areas is small, even if statistically significant. Thus, an econometric technique used to adjust for simultaneous equation bias, such as two-staged least squares, is not likely to result in a large downward modification of the regression coefficient representing the direct impact of funding on enrollment.[15]

Secondly, in theory the simultaneous equation bias might be a problem if the regression analysis were run on data for an individual community college in the Oregon community college system; higher FTE enrollment for a college may result in a larger *share* of the "pie" in terms of state funding allocated to a particular institution in the college system. However, the regression analysis was run on statewide data, and it is assumed that the annual growth in the *size* of the "pie" allocated from one particular year to the next (the annual increase in funds given to all community colleges statewide) is *not* largely determined by statewide FTE enrollment growth. In fact, it appears to be the case nationally that the more important determinant of state funding growth to community college systems is changes in the "health" of the state budget, driven in some states by changes in the "health" of the economy (see Betts and McFarland, 1995).

Appendix Figure A2 - Regression Results of FTE Enrollment in Oregon Community Colleges (R-Square 0.87)

	Regression I		Regression II		Regression III		Regression VI		Regression V	
	Annual Chg in Natural Log Per Cap Lower Division Transfer (LDC) FTE		Annual Chg in Natural Log Per Cap Prof/Tech FTE		Annual Chg in Natural Log Per Cap PSR Developmental Ed FTE		Annual Chg Natural Log Per Cap Other Developmental Ed FTE		Annual Chg in Natural Log Per Cap Other FTE	
1986-2005	Coeff	*P-Value*	Coeff	*P-Value*	Coeff	*P-Value*	Coeff	*P-Value*	Coeff	*P-Value*
Intercept	-0.001	*0.96*	0.010	*0.46*	0.012	*0.75*	0.007	*0.69*	-0.002	*0.94*
Cost of Attendance Variables										
Annual Chg Natural Log Real Oregon Community College Credit Tuition & Fees	-0.582	*<0.01*	-0.539	*<0.01*	-0.517	*0.15*	-----	-----	-----	-----
Annual Chg Natural Log Real Tuition & Fees at 4-Year Institutions	0.804	*0.05*	0.181	*0.59*	0.678	*0.53*	-----	-----	-----	-----
Annual Chg Natural Log Real Financial Aid per LDC-Prof/Tech FTE	0.066	*0.54*	0.032	*0.70*	-----	-----	-----	-----	-----	-----
Funding to Community Colleges										
Annual Chg Natural Log Real per cap State Appropriations to CCs	0.016	*0.88*	0.193	*0.07*	0.478	*0.06*	-0.280	*0.28*	0.063	*0.85*
Annual Chg Natural Log Real per cap Local Non-Capital Revenue to CCs	0.008	*0.91*	0.119	*0.09*	0.026	*0.87*	-0.106	*0.51*	0.352	*0.11*
Transition: Change in FTE Reimbursable Funding Policy (Dummy Variable)	-----	-----	-----	-----	-----	-----	-0.089	*0.26*	-0.263	*0.03*
Economic Variables										
Annual Change Oregon Unemployment Rate	0.020	*0.05*	0.018	*0.06*	0.054	*0.04*	-0.046	*0.06*	-0.019	*0.47*
Lag Effects										
1-Year Lag Annual Chg in Natural Log Per Cap LDC FTE	0.211	*0.39*	-----	-----	-----	-----	-----	-----	-----	-----
2-Year Lag Annual Chg in Natural Log Per Cap LDC FTE	0.360	*0.08*	-----	-----	-----	-----	-----	-----	-----	-----
3-Year Lag Annual Chg in Natural Log Per Cap LDC FTE	-0.221	*0.27*	-----	-----	-----	-----	-----	-----	-----	-----
1-Year Lag Annual Chg in Natural Log Per Cap Prof/Tech FTE	-----	-----	0.241	*0.22*	-----	-----	-----	-----	-----	-----
2-Year Lag Annual Chg in Natural Log Per Cap Prof/Tech FTE	-----	-----	-0.006	*0.97*	-----	-----	-----	-----	-----	-----
1-Year Lag Annual Chg in Natural Log Per Cap PSR Developmental Ed FTE	-----	-----	-----	-----	0.182	*0.33*	-----	-----	-----	-----
2-Year Lag Annual Chg in Natural Log Per Cap PSR Developmental Ed FTE	-----	-----	-----	-----	0.032	*0.86*	-----	-----	-----	-----
1-Year Lag Annual Chg Natural Log Per Cap Other Developmental Ed FTE	-----	-----	-----	-----	-----	-----	0.216	*0.36*	-----	-----
2-Year Lag Annual Chg Natural Log Per Cap Other Developmental Ed FTE	-----	-----	-----	-----	-----	-----	0.492	*0.06*	-----	-----
1-Year Lag Annual Chg in Natural Log Per Cap Other FTE	-----	-----	-----	-----	-----	-----	-----	-----	0.225	*0.32*
2-Year Lag Annual Chg in Natural Log Per Cap Other FTE	-----	-----	-----	-----	-----	-----	-----	-----	-0.058	*0.79*
Other										
Transition: Change in Development Ed Def'n (Dummy Variable)	-----	-----	-----	-----	0.431	*<0.01*	-0.201	*0.04*	-----	-----
R-Square (0.87 for Total Model)	**0.76**		**0.79**		**0.76**		**0.51**		**0.54**	
Percentage of Total 04-05 FTE Represented by the FTE in the Program Area	**44.3%**		**31.7%**		**6.0%**		**11.7%**		**6.3%**	

Total estimated FTE derived from aggregating the estimated FTE in all of the program areas, generated from Regression I through V. The annual change in the natural log of total *estimated* FTE was regressed against the annual change in the natural log of total *actual* FTE (1996-2005), yielding an R-Square of 0.87.

"Real" indicates that values have been adjusted for inflation. See Methodological Appendix B for data sources. Since the regression equations are log-linear, the coefficients approximately represent elasticities (see discussion in Methodological Appendix A). Annual changes in the natural log approximately equal the annual growth rate. Tests for autocorrelation were not statistically significant. Per cap represents the adult population age 18-64.

Methodological Appendix B: Sources of Data

Enrollment Data

Full-Time Equivalent (FTE) data by program area were obtained from the *Oregon Community College Profiles*, published by the Oregon Department of Community Colleges & Workforce Development and from the *Oregon Community College Unified Reporting System* (OCCURS) dataset. In the Oregon public community college system, one annualized FTE is equal to 510 clock hours of instruction. The main report defines the five FTE program areas used in the analysis. These are the same categories reported in the *Oregon Community College Profiles*.

Price Indexes used in the Analysis

The purpose of the price indexes used in this analysis was to represent the growth of prices (including tuition and fees) over time. The analysis made use of three indexes. The consumer price index was used to adjust for inflation in several of the variables in the regression analysis. The other two indexes developed were related to the growth of credit tuition and fees in community colleges and in 4-year institutions. These were used as independent variables in some of the regression models.

Consumer Price Index. This index, published by the US Bureau of Labor Statistics, represents the change in the cost of living over time as a typical consumer purchases a given "basket of goods".[16] Several of the variables in the analysis were adjusted for inflation using the *Consumer Price Index* for the Portland-Salem, OR-WA area (Series ID CUURA425SA0, CUUSA425SA0). Variables in the regression analysis that were converted into "real" values (i.e., adjusted for inflation) included: community college credit tuition and fees, tuition and fees at 4-year institutions, state appropriations, local revenue, and financial aid. The academic-year variables were deflated by the consumer price index corresponding to the beginning year (i.e., calendar year) of the academic year. Column I of Appendix Figure B1 (below) shows the index used to represent changes in the cost of living.

Since this analysis included forecasting, a prediction of the 2007 and 2008 consumer price index was used, based upon forecasts (as of December 2006) from the Oregon Office of Economic Analysis.

Index of Oregon Community College Credit Tuition and Fees. An Oregon public community college credit tuition and fees index was developed, similar in structure to the Consumer Price Index.[17] The purpose of the *Index of Oregon Community College Credit Tuition and Fees* was to represent the growth of Oregon community college credit tuition and fees over time. The regression analysis made use of the annual change in the natural log of this index as one of the independent variables.[18]

From 1987-88 to 1995-96, the index was derived from data on in-district credit tuition and fees charged by individual colleges, found in the US Department of Education IPEDS dataset. Data from 1996-97 to 2006-07 were derived from credit tuition and fees data on individual colleges, as reported in *Oregon Community College Profiles*, published by the Oregon Department of Community Colleges & Workforce Development.

The price index used an enrollment-weighted average of credit tuition and fees charged by the community colleges. In particular, it was weighted by the 2001-02 reimbursable in-state FTE,

excluding Self-Improvement FTE. The 2001-02 year was chosen to match the weight year used by the US Bureau of Labor Statistics in their most current version of the *Consumer Price Index*.

For 1984-85 and 1985-86, no reliable individual college-level data on tuition and fees could be found for all individual Oregon community colleges. Hence, growth in credit tuition and fees during these years was approximated by the growth in average credit tuition, *unweighted* by enrollment, as reported in the *Oregon Community College Profiles* (Oregon Department of Community Colleges & Workforce Development).[19] In the 1980s, fees represented a small fraction (less than 4 percent) of total tuition and fees.

Column II of Appendix Figure B1 shows the index used to represent Oregon community college tuition and fees.

Index of Tuition and Fees at 4-Year Institutions Attended by Oregon Residents. The third index used in this analysis represents the growth of tuition and fees at 4-year institutions faced by the typical perspective college student residing in Oregon. As with the consumer price index, which is an index composed of several sub-indexes (food and beverages, housing, transportation, etc), this index is composed of three sub-indexes, representing: private 4-year institutions in Oregon attended by Oregon residents, private 4-year institutions nationally attended by Oregon residents, and Oregon public 4-year institutions attended by Oregon residents. These are shown in columns III, IV, and V in Appendix Figure B1.

Data on Oregon public 4-year institutions were derived from historical data on in-state tuition and fees charged by individual OUS institutions, as reported in the *OUS Factbooks*. The calculation of average tuition and fees was weighted by the Fall 2002 unduplicated count of students residing in Oregon and attending OUS institutions, as reported in *2002 OUS Factbook*. Fall 2002 was chosen to approximately match the weight year used by the US Bureau of Labor Statistics in their most current version of the *Consumer Price Index*.

Data on private 4-year institutions in Oregon was derived from the US Department of Education's IPEDS dataset. The calculation of average tuition and fees was weighted by the average of the 2001-02 and 2002-03 IPEDS count of first-time first-year degree-seeking students residing in Oregon. The data relating to private 4-year institutions nationally made use of data reported by the College Board's *Trends in College Pricing 2006.* The College Board weights these data by full time enrollment.

The above three indexes were then averaged into a single index, reflecting the growth of tuition and fees at 4-year institutions attended by Oregon residents. The calculation of this average was weighted by the percentage of 2001 Oregon high school graduates responding to a 2002 OUS survey that indicated that they plan to attend an Oregon private 4-year institution, versus an out-of-state private 4-year institution, versus an OUS 4-year institution (directly or indirectly via a community college).[20] As with the community college index of credit tuition and fees, the regression analysis made use of the annual change in the natural log of the *Index of Tuition and Fees at 4-Year Institutions Attended by Oregon Residents* as one of the independent variables. Again, the 2002 survey was chosen approximately to match the weight year used by the US Bureau of Labor Statistics in their most current version of the *Consumer Price Index*.

Column VI of Appendix Figure B1 shows the index used to represent tuition and fees at 4-year institutions attended by Oregon residents.

Appendix Figure B1: Cost of Living Index and Price Indexes of Tuition & Fees at Oregon Public Community Colleges and 4-Year Institutions

Calendar Year	I: Cost of Living Index (Derived from BLS Portland-Vancouver Consumer Price Index) and Inflation Rate (Annual Growth in Index)		Academic Year	II: Index of Oregon Community College Credit Tuition & Fees Attended by Oregon Residents (Enrollment-Weighted, Non-Inflation Adjusted)		III: Index of Tuition & Fees at 4-Year Private Institutions in Oregon Attended by Oregon Residents (Oregon Resident Enrollment-Weighted, Non-Inflation Adjusted)		IV: Index of Tuition & Fees at 4-Year Private Institutions Nationally (Enrollment-Weighted, Non-Inflation Adjusted)		V: Index of In-State Tuition & Fees at 4-Year Public OUS Institutions in Oregon Attended by Oregon Residents (Oregon Resident Enrollment-Weighted, Non-Inflation Adjusted)		VI: Index of Tuition & Fees at 4-Year Institutions Attended by Oregon Residents (Oregon Resident Enrollment-Weighted, Non-Inflation Adjusted, Derived from III, IV, V)	
	Index (1986=1)	*Annual Growth*		Index (1986=1)	*Annual Growth*	Index (1986=1)	*Annual Growth*	Index (1986=1)	*Annual Growth*	Index (1986=1)	*Annual Growth*	Index (1986=1)	*Annual Growth*
1986	1.0000		**1986-87**	1.0000		1.0000		1.0000		1.0000		1.0000	
1987	1.0249	*2.50%*	**1987-88**	1.0308	*3.08%*	1.0587	*5.88%*	1.0586	*5.86%*	1.0377	*3.77%*	1.0521	*5.21%*
1988	1.0601	*3.43%*	**1988-89**	1.0466	*1.53%*	1.1439	*8.04%*	1.2022	*13.56%*	1.0873	*4.77%*	1.1531	*9.60%*
1989	1.1127	*4.97%*	**1989-90**	1.1064	*5.72%*	1.2256	*7.15%*	1.3012	*8.23%*	1.1726	*7.84%*	1.2439	*7.87%*
1990	1.1774	*5.81%*	**1990-91**	1.1673	*5.51%*	1.3410	*9.41%*	1.4029	*7.81%*	1.2862	*9.70%*	1.3525	*8.73%*
1991	1.2375	*5.10%*	**1991-92**	1.3624	*16.71%*	1.4642	*9.18%*	1.4738	*5.05%*	1.7068	*32.70%*	1.5440	*14.17%*
1992	1.2920	*4.41%*	**1992-93**	1.5330	*12.52%*	1.6028	*9.48%*	1.5693	*6.48%*	1.7930	*5.05%*	1.6465	*6.64%*
1993	1.3372	*3.51%*	**1993-94**	1.7289	*12.78%*	1.7436	*8.78%*	1.6532	*5.35%*	1.9136	*6.73%*	1.7548	*6.58%*
1994	1.3761	*2.90%*	**1994-95**	1.9281	*11.52%*	1.8392	*5.48%*	1.7602	*6.47%*	2.0684	*8.09%*	1.8741	*6.79%*
1995	1.4158	*2.89%*	**1995-96**	1.9626	*1.79%*	1.9717	*7.21%*	1.8349	*4.24%*	2.1772	*5.26%*	1.9725	*5.25%*
1996	1.4657	*3.52%*	**1996-97**	2.0412	*4.01%*	2.1445	*8.76%*	1.9517	*6.37%*	2.2819	*4.81%*	2.0983	*6.38%*
1997	1.5156	*3.40%*	**1997-98**	2.0993	*2.85%*	2.2579	*5.29%*	2.0705	*6.09%*	2.3244	*1.87%*	2.1922	*4.47%*
1998	1.5443	*1.89%*	**1998-99**	2.1619	*2.99%*	2.3316	*3.27%*	2.2092	*6.70%*	2.3693	*1.93%*	2.2869	*4.32%*
1999	1.5951	*3.29%*	**1999-00**	2.1955	*1.55%*	2.4810	*6.41%*	2.3308	*5.50%*	2.3934	*1.02%*	2.3844	*4.27%*
2000	1.6450	*3.13%*	**2000-01**	2.2744	*3.59%*	2.6211	*5.64%*	2.4140	*3.57%*	2.4348	*1.73%*	2.4677	*3.49%*
2001	1.6857	*2.47%*	**2001-02**	2.3755	*4.44%*	2.7344	*4.33%*	2.6100	*8.12%*	2.6068	*7.06%*	2.6373	*6.88%*
2002	1.6986	*0.77%*	**2002-03**	2.7203	*14.52%*	2.8878	*5.61%*	2.7126	*3.93%*	2.9580	*13.47%*	2.8288	*7.26%*
2003	1.7217	*1.36%*	**2003-04**	3.3833	*24.37%*	3.0304	*4.94%*	2.8463	*4.93%*	3.1557	*6.69%*	2.9844	*5.50%*
2004	1.7661	*2.58%*	**2004-05**	3.5817	*5.87%*	3.1915	*5.32%*	3.0108	*5.78%*	3.4627	*9.73%*	3.1925	*6.97%*
2005	1.8114	*2.56%*	**2005-06**	3.7413	*4.45%*	3.3610	*5.31%*	3.1511	*4.66%*	3.5858	*3.56%*	3.3342	*4.44%*
2006	1.8585	*2.60%*	**2006-07**	3.9148	*4.64%*	3.5555	*5.79%*	3.3371	*5.90%*	3.7421	*4.36%*	3.5128	*5.36%*

Source: **I**. Derived from Portland-Vancouver Consumer Price Index, US Bureau of Labor Statistics (BLS) data; **II.** Community College data derived from US Dept of Education IPEDS, Oregon Community College Profiles (Oregon Department of Community Colleges & Workforce Development); **III**. Data on Private 4-Year Institutions Attended by Oregon Residents derived from US Department of Education IPEDS data; **IV.** Data on Private 4-Year Institutions Nationally derived from College Board's *Trends in College Pricing 2006*; **V.** Data on Oregon Public OUS 4-Year Institutions Attended by Oregon Residents derived from OUS Factbooks; **VI.** Combined 4-Year Index calculated as an Oregon-Resident Enrollment Weighted Average of II, III, and III. See Methodological Appendix B for a detailed discussion of the data sources.

Oregon Unemployment Rate

Data on the unemployment rate was obtained from the US Bureau of Labor Statistics' report on the Oregon unemployment rate (non-seasonally adjusted). Since this analysis included forecasting, a prediction of the 2007 and 2008 Oregon unemployment rate was used based upon information provided in December 2006 from economists at the Oregon Department of Consumer and Business Services. The unemployment rate in this analysis corresponded to the beginning year (i.e., calendar year) of the academic year. This would allow some lag time for unemployment to have an impact upon enrollment decisions.

Community College Funding

Annual State Appropriations to Community Colleges. These data are related to general operating expenses, rather than capital improvements. Data was used from the Oregon Department of Community Colleges & Workforce Development. In the regression analysis, these data were adjusted for inflation ("real" appropriations) using the *Consumer Price Index* (see above). In addition, the analysis used appropriations per capita, specifically, per Oregon population age 18-64. This was done to control for any state revenue changes over time generated from gradual shifts in the size of the potential labor force. Population data used in this analysis corresponded to the population measured just prior to the beginning year of the academic year (i.e., July 1).

Local Revenue Funding to Community Colleges. These data are typically related to property taxes, although they exclude revenues related to capital improvements. The funding does not include revenue from college self-supporting activities, such as food services or bookstore activities. The data used in this analysis are derived from data presented in *Community Colleges in Oregon: Covering Education (A Reporter's Guide to Education in Oregon)*, published by the Oregon School Board Association (April 2005). In the regression analysis, these data were adjusted for inflation using the *Consumer Price Index*. As with state appropriations, the analysis used local revenue funding *per capita*.

Change in FTE Reimbursable Funding Policy. Following the most recent recession in Oregon, there were changes in the definition of allowable state reimbursable FTE, affecting the enrollment growth rate of several non-credit courses. This factor was introduced into the regression model of largely non-credit courses as a dummy variable.

Financial Aid

The regression models for LDC and Prof/Tech enrollment included a variable controlling for financial aid. In particular, the model used financial aid expenditures of all Oregon community colleges, including aid originating from federal, state, and other sources. These data were collected from the *Oregon Department of Community Colleges & Workforce Development Revenue and Expenditure Reports.* They included tuition discounts, scholarships and grants, loans, and work-study. As a proxy of the typical aid amount given to a LDC and Prof/Tech student, total expenditures were divided by the combined FTE enrollment in LDC and Prof/Tech program areas. In the regression analysis, these data were adjusted for inflation using the *Consumer Price Index*.

Endnotes

[1] This analysis makes use of an econometric model developed by Dr. Robert Vergun of the Office of Institutional Effectiveness at *Portland Community College.* The econometric model was developed for the purposes of his own scholarly research and was not developed as part of his official job assignments.

[2] Source: Oregon Department of Community Colleges & Workforce Development/OCCURS data for 2005-06. These are students with no major and who are predominately taking courses in the "Other" program area.

[3] **McIntyre, Chuck & Barbara Beno (1993) "1993 Report on Fee Impact," Chancellor's Office of California Community Colleges, Unpublished Study (See http://www.cccco.edu/reports/attachments/1993_fee_impact.htm)** find that FTE enrollment of California community college students falls by about 0.8% for each one-percent increase in tuition. **Park, George and Robert Lempert (1998) "The Class of 2014: Preserving Access to California Higher Education," Rand Corporation, Appendix B** find that the number of California community college students falls by 0.47% for every one-percent increase in tuition. **Leslie, L. & Paul Brinkman (1989) "The Economic Value of Higher Education," *Journal of Higher Education*, 60(5), Sept./Oct, pp. 609-611** find the equivalent of an elasticity of approximately -0.3 in community colleges. Some studies, though, find enrollment at community colleges to be less responsive to tuition increases. For example, the number of students falls by 0.21% for each one-percent increase in tuition, as reported in **Heller, Donald (1997) "Student Price Response in Higher Education: An Update to Leslie & Brinkman," *Journal of Higher Education*, 68(6), Nov. /Dec., pp. 624-659**. Moreover, some studies report significant decreases in community college enrollment in response to tuition increases only after tuition has reached a threshold point. See **Abou-Sayf, Frank K. (2001) "Tuition Increases, Demand and Academic Performance," *Journal of Applied Research in the Community College, 9*(1), pp. 25-44.** However**,** testing for a quadratic relationship between the natural log of tuition and the natural log of FTE, the current analysis did not find a statistically significant quadratic log-linear impact of tuition on FTE enrollment. This suggests no "threshold" effects, at least in the historical range of tuition growth. This also suggests that the elasticity of demand does not vary greatly as one "moves" up or down the enrollment demand curve (i.e., the second derivative of log FTE enrollment with respect to log tuition is relatively constant).

[4] Annual Chg Natural Log Real CC Tuition & Fees=0.030 - (0.608*Annual Chg Natural Log Real Per Cap State Appr)
--- *Confidence Level > .94* ---

From 1996 (after state funding growth adjustments from State Measure 5 were complete) to 2006; R-Sq=.31.

For every one-percentage *decrease* in per capita state appropriations, Oregon community colleges during 1996 through 2006 have responded on average with an *increase* in tuition & fees of 0.608%. In the simulations predicting future tuition growth over the next few years, however, nominal tuition growth is assumed not to fall below the rate of inflation.

[5] This methodology is similar to the "student price response coefficient" methodology developed by **Leslie, L. & Paul Brinkman (1989) "The Economic Value of Higher Education," *Journal of Higher Education*, 60(5), Sept./Oct, pp. 609-611.**

[6] **Betts, Julian & Laurel McFarland (1995) "Safe Port in a Storm: The Impact of Labor Market Conditions on Community College Enrollments", *Journal of Human Resources*, vol. 30:4, pp. 741-765**; **Pennington, Kevin & Mitchell Williams (2002) "Community College Enrollment as a Function of Economic Indicators", *Community College Journal of Research and Practice*, vol 26, pp. 431-437**; **Sundberg, L.L. (1998) "How Community Colleges Can Increase Enrollments During Times of Low Unemployment", *ERIC Document Reproduction Services*, ED 418 739; Wyoming Community College Commission (1999) "Student Access Study", *ERIC Document Reproduction Services*, ED 437 130.**

[7] See Endnote 4.

[8] The relationship between total FTE and unduplicated headcount was based upon the following regression estimate:

FTE to Headcount Ratio = -0.314 +
(0.355*Year Lag FTE to Headcount Ratio) + (0.0002*Year) + (0.150* Annual Chg Natural Log Real CC Tuition & Fees)
--- Confidence Level >.95 --- *--- Confidence Level >.72 ---* *--- Confidence Level >.95---*

From 1986 to 2005; R-Sq=.87.

Given also that each one-percent increase in tuition and fees results in a -.454% decrease in FTE (see Figure 3), it can be mathematically derived that each one-percent increase in tuition and fees results in a -1.039% decrease in Headcount.

LDC and Prof/Tech students were defined based upon a student's major code. Unfortunately, the Oregon Department of Community Colleges & Workforce Development/OCCURS data set has only 10 years of reliable data that identify LDC or Prof/Tech students. The relationship between FTE in LDC and Prof/Tech combined and unduplicated headcount in LDC and Prof/Tech combined was based upon the following regression estimate:

FTE to Headcount Ratio in LDC-Prof/Tech =
-13.540 + (0.324*Year Lag FTE to Headcount Ratio in LDC-Prof/Tech) +
--- Confidence Level >.67 ---

(0.0069*Year) + (0.151* Annual Chg Natural Log Real CC Tuition & Fees)
--- Confidence Level >.89 --- *--- Confidence Level >.81 ---*

From 1995 to 2005; R-Sq=.90.

[9] A *weakly stationary* time series is one in which the mean and variance do not vary with time, and one in which the autocorrelation function depends only on the lag. For a technical discussion, see **Burke, Simon P. and John Hunter (2005) *Modeling Non-Stationary Economic Time Series: A Multivariate Approach*, Palgrave Macmillan, New York.**

[10] See ibid for a formal discussion of autocorrelation and unit roots. An Augmented Dickey-Fuller Test failed to reject the null hypothesis that Oregon real tuition & fees at community colleges contain a unit root with a drift, as opposed to the alternative hypothesis of trend stationarity (1984 to 2006). The KPSS Trend Stationary Test accepted the alternative hypothesis of a unit root with a drift (confidence level > 89%), rejecting the null hypothesis of trend stationarity. The same tests were also conducted on national data as a comparison and yielded similar results. The Augmented Dickey-Fuller Test failed to reject the null hypothesis that real tuition & fees at community colleges at the national level (data sources: College Board, *Trends in College Pricing 2006*) contain a unit root with a drift, as opposed to the alternative hypothesis of trend stationarity (1976 to 2006). The KPSS Trend Stationary Test accepted the alternative hypothesis of a unit root with a drift in national data (confidence level > 88%), rejecting the null hypothesis of trend stationarity.

[11] This path would represent a unit root with a drift. See Endnote 10.

[12] Since the regressions use lag terms of the dependent variable as independent variables, the conventional Durbin-Watson test is invalid. To test for autocorrelation, the residuals were regressed against one-year lagged residuals, revealing no statistically significant relationship. One of the regression models (LDC FTE) demonstrated autocorrelation when the model incorporated only two lagged terms of LDC FTE, but showed no autocorrelation when a third lagged term was added.

[13] This does not hold for dummy variables. Otherwise, take the case of a simple regression:
Natural Log FTE (time= t) - Natural Log FTE (time= t-1) = Constant + [ß * (Natural Log Real Tuition & Fees (time= t)
- Natural Log Real Tuition & Fees (time= t-1))].

The elasticity impact of real tuition & fees on FTE at time= t is defined as the percentage change in FTE at time= t resulting from a one-percentage change in real tuition and fees at time= t. At time= t, this is approximately:

[(∂ FTE)/ (FTE)] ÷ [(∂ Real Tuition & Fees)/ (Real Tuition & Fees)] =
[(∂ FTE)/ (∂ Real Tuition & Fees)] ÷ [(FTE)/ (Real Tuition & Fees)] = ß.

[14] This follows from: (Var X + Y) = (Var X) + (Var Y) + 2* Covariance (X, Y), where the covariance of the residual errors is negative in the example provided. The *sum of the variance* of the residual errors of the individual program-area models is 10.5% greater than the *variance of the sum* of the residual errors of the program-area models. The indicates a general negative correlation between the errors in the program-area models and may explain why the entire model has a better fit than any one of the individual models.

[15] **Betts, Julian & Laurel McFarland (1995) "Safe Port in a Storm: The Impact of Labor Market Conditions on Community College Enrollments", *Journal of Human Resources*, vol. 30:4, pp. 741-765.** As a check of simultaneous equation bias, a two-staged least squares analysis was conducted on the current model using lagged state funding as the instrument for contemporaneous state funding. The regression coefficient representing the direct impact of funding on enrollment did not change substantially.

[16] See http://www.bls.gov/cpi/home.htm. In Appendix Table B1, though, the index is converted so that 1986=1.000.

[17] Both the Consumer Price Index and *the Index of Oregon Community College Credit Tuition and Fees* are Paasche-style indexes. A Paasche index is the average prices of individual goods and services (in this case, individual community college tuition & fees), weighted by a "basket of goods" purchased by consumers. This analysis uses as the weight the reimbursable in-state FTE of the community college, excluding self-improvement FTE. Since the "basket of goods" is calculated toward the *end* period of the index, it is referred to as a Paasche index. (If the "basket of goods" were calculated toward the *beginning* period of the index, it would be referred to as a Lasperyres index). It should be mentioned that if the index were a Paasche indexes in a strict sense, the weight year would have been the last year of the index (2006) rather than toward the end period of the index time frame (2001).

[18] The annual growth rate of prices is approximately equal to the annual change in the natural log of prices. Methodological Appendix A discusses the reason that the change in the natural log of prices is used.

[19] Each college was given equal weight.

[20] Source: **OUS Office of Institutional Research Services (July 2002) *Where Have Oregon's Graduates Gone? Survey of the Oregon High School Graduation Class of 2001 (***http://www.ous.edu/dept/ir/reports/01_whogg.pdf). Note that the analysis does not assume that perspective students *actually attend* these 4-year institutions; they may only *plan* to attend. For example, students planning to attend OUS schools by first enrolling at a community college may not actually follow through on this intent. The model developed in this analysis implicitly assumes that perspective students' enrollment at community colleges is impacted by their *intent* to enroll at 4-year institutions, not by whether they *actually* enroll at 4-year institutions. The calculation of the weight for this index includes students who *plan* to enroll in the OUS system after taking coursework at a community college.