OFFICE OF FINANCIAL MANAGEMENT

STATE OF WASHINGTON

EVALUATION OF LONG-TERM HIGHER EDUCATION ENROLLMENT FORECASTING

FORECASTING DIVISION

JANUARY 1999

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ACRONYMS USED IN THIS PAPER

CPI = Consumer Price Index
FTE = Full Time Equivalent
HECB = Higher Education Coordinating Board
OFM = Office of Financial Management
PR = Participation Rate
SBCTC = State Board for Community and Technical Colleges
TSR = Time Series Regression
WTECB = Workforce Training and Education Coordinating Board

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Evaluation of Long-Term Higher Education Enrollment Forecasting

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PART I

Introduction

THIS REPORT responds to the requirements of Engrossed Substitute Senate Bill 6108 which requires the Office of Financial Management (OFM) to develop experimental long-term higher education enrollment forecasting models for consideration by the Legislature. As a preface to the examination of the experimental models, this report summarizes current approaches to higher education enrollment forecasting. The strengths and weaknesses of OFM experimental models are then evaluated. The final section of the report provides a summary of findings and conclusions.

Appendices addressing the following topics are provided in separate documents:

- Budget Bill Proviso Language (ESSB 6108)
- Literature Review
- Survey of Other States
- Participation Rate Method
- Workforce Demands
- Applications Match Study
- Technical Documentation for OFM Experimental Models

Current Approaches to Higher Education Enrollment Forecasting

There are presently four predominant approaches to higher education enrollment and demand forecasting in Washington State government:

1. Projections based on ***Current Participation Rate*** and Population Growth (OFM, also HECB, SBCTC, WTECB)
2. Projections based on ***Participation Rate Goals***

   Examples:
   - Achieving parity with peer states
   - Aiming for a particular percentile rank among states (HECB)
3. Current Participation Rate projections supplemented with ***analysis of special demand factors***

   Examples:
   - Occupational and labor market demand (WTECB)
   - Training and educational needs of special population groups – e,g., minorities, dislocated workers, persons on public assistance (SBCTC)
4. ***Estimate of unserved applicants*** to Washington four-year higher education institutions ("Applications Match Study") (OFM, institutions)

Experimental models and details on each of the approaches are provided on the following pages.

OFM Experimental Models*

I. Washington Time Series Regression Models (2)

Model 1:

Dependent Variable - Enrollment (headcount)

Two-year
Four-year public
Four-year private

Model 2:

Dependent Variable - Participation Rate (age: 17-22, 23-29, 30-44, 45+)

Four-year-public
Community college

II. Cross Sectional 50 State Model (point in time)

Dependent Variable:

1995 Enrollment

Independent Variables:

Same variables tested as in time series models, plus net migration and education levels of state residents

Independent Variables Tested (selected list)

Cost Factors:

- Annual tuition and fees
- Annual room and board charges
- Financial aid: federal and state grants, federal and state work-study and loans
- State higher education expenditures
- State unemployment rate
- Geographical accessibility (share of state population in counties with community colleges)
- Income changes (per capita income, median household income)
- State poverty rate
- Price changes (Seattle CPI, U.S. implicit price deflator for personal consumption, U.S. average higher education deflator)

Earnings Factors:

- Unemployment rates: high school and college graduates
- Average earning of high school graduates (U.S., age 18-24, 25-34)
- Average earnings of college graduates (U.S., age 18-24, 25-34)

Social and Demographic Factors:

- Number of high school graduates in Washington
- Female labor force participation rate (U.S.)
- State population by age: 17-22, 17-24, 23-29, 30+, 30-44, 35-44, 45+

Industry Demand for Post-Secondary Training:

- Washington employment growth (total and traded sector employment)
- Washington occupations requiring college-degree workers

***NOTE: A cross-sectional/time series involving Washington and five other jurisdictions with relatively unconstrained access to higher education was also tested. However, as a result of severe data limitations, this model was not completed.**

PART II

Strengths and Weaknesses of Modeling Approaches

THE FOLLOWING SECTION examines the strengths and weaknesses of current approaches to higher education enrollment forecasting and OFM experimental models.

Current Participation Rate Method

What is a participation rate?

The number of persons of a particular age and gender enrolled in public or private education institutions per 100 persons in that age group.

How are FTE enrollments projected based on current participation rates?

Current participation rates for persons of a particular age and gender are applied to corresponding population forecasts. The forecasts for all age and gender combinations are summed to obtain a total headcount projection. Headcounts are converted to FTEs based on historical ratios.

What factors affect FTE enrollment projections under the current participation rate method?

- Current demand and enrollment policies, as reflected in current level enrollments.
- Population growth (especially age distribution).
- Ratio of part-time to full-time students (i.e., recent FTE to headcount ratio).

Results of current participation rate method

	FTE Projections*		
	Four-Year Public*	Two-Year Public*	Private Four-Year (estimate/share)
1997-98 *actual*	81,000	118,000	35,000
2009-10	101,000	142,000	43,000
2019-20	104,000	154,000	45,000
Difference 1998-2010	20,000	24,000	8,000
Difference 1998-2020	23,000	36,000	10,000

**Public system reflects state funded FTEs. Two-year system includes Technical Colleges.*

Strengths of current participation rate method

- Captures the influence of population growth on enrollment.
- Relatively objective method for enrollment forecasting.
- Can be applied regionally.
- Relatively simple to explain and understand.

Weaknesses of current participation rate method

- Does not capture the influence of factors other than population.
- Reflects policy choices and constraints inherent in the current participation rate.
- Assumes that current participation rate will remain the same.
- Does not differentiate among different types of enrollment (e.g. degree areas, vocational/academic).

Projections Based on Participation Rate Goals *(Example: HECB Master Plan)*

How are FTE enrollments projected based on participation rate goals?

Washington's rank in higher education participation is compared with that of other states for each segment of the higher education system (two-year, four-year, upper division, lower division). A desired rank and participation rate is chosen as a policy goal. The chosen participation rate is applied to OFM's forecast of Washington population to obtain a projection of headcount enrollment. Headcounts are converted to FTEs based on recent historical ratios.

What factors affect enrollment projections based on participation rate goals?

- Enrollment policy and behavior in the 50 states.
- Participation rate goal for Washington.
- Population growth (especially age distribution).
- Ratio of part-time to full-time students (i.e., recent FTE to headcount ratio).

Results of FTE enrollment projections based on participation rate goals*

	FTE Projections**		
	Four-Year Public	Two-Year Public	Private (estimate/share)
1997-98 *actual*	81,000	118,000	35,000
2009-10	116,000	142,000	50,000
2019-20	141,000	154,000	61,000
Difference 1998-2010	35,000	24,000	15,000
Difference 1998-2020	60,000	36,000	26,000

* *HECB goal: current participation rate for lower division; national average participation rate for upper division by 2010, 70th percentile by 2020.*

** *Public system reflects state funded FTEs. Two-year system includes Technical Colleges.*

Strengths of enrollment projections based on participation rate goals

- Relatively objective method for enrollment forecasting, once goals are set.
- Captures the influence of population growth on enrollment.
- Relatively simple to explain and understand.

Weaknesses of enrollment projections based on participation rate goals

- Projections represent policy goal, rather than objective assessment of forces affecting enrollment.
- A policy goal does not automatically translate into demand – i.e., meeting the goal may require policy and administrative intervention (e.g., financial aid, additional spending, additional capacity, geographic accessibility, modified admissions requirements).
- The policy goal is not based on economic, labor market, or social conditions specific to Washington.
- Method does not differentiate among different types of enrollment (e.g., degree areas, vocational/academic).
- Method assumes participation rates of other states are static.

Supplementary Analysis of Special Demand Factors: *Occupational and Labor Market Supply and Demand*

How are FTE enrollments projected based on occupational and labor market demand?

- Forecasts of Washington employment by industry are combined with Washington occupational distribution and U.S. data on occupational change to arrive at a forecast of Washington job openings by occupation.
- Information from U.S. data about training requirements for occupations is applied to obtain a forecast of job openings requiring post-secondary training below the baccalaureate level.
- Projected job openings are compared with the projected supply of workers for these types of jobs to obtain an estimate of the gap between demand and supply of workers with post-secondary vocational training below the baccalaureate level.
- Based on the current production rate of vocationally trained students, an estimate is developed of the number of additional post-secondary student FTEs required to close the gap between demand and supply.

What factors affect FTE enrollment projections based on occupational and labor market demand?

- Industry and occupational change.
- Gap between supply and demand for vocationally trained workers.
- Population growth.

Enrollment projection results based on occupational and labor market demand*

	Current Participation Rate FTE Projections Two-Year Public	Additional FTEs Recommended to Reduce Gap Between Labor Market Supply and Demand	TOTAL
1997-98 *actual*	118,000		**118,000**
2003-04	133,000	18,000	**151,000**
Difference 1998-2004	15,000		**33,000**

**The WTECB does not have a position recommending 18,000 net additional FTEs to the two-year college system. WTECB recommends 18,000 additional vocational FTEs. This change could be produced through a combination of net additional FTEs and changing the allocation of FTEs between the three mission areas of the colleges.*

Strengths of method based on occupational and labor market demand

- Addresses economic and labor market factors.
- Combined with other research (e.g., employer surveys), can provide a generally valid picture of overall education and training gaps.

Weaknesses of method based on occupational and labor market demand

- Results, in part, reflect a policy goal rather than objective demand for training/education.
- Employment and occupational needs are only one factor affecting students' decisions to seek post-secondary education.
- Some data sources supporting the projections are weak (e.g. link between occupations and education/training requirements).
- Method depends on economic and labor market forecasts that contain subjective elements.
- Assumes education and training institutions are responsible for closing a major part of the gap between supply and demand (employers, for example, could assume more responsibility).
- Does not provide basis for determining whether the gap between supply and demand should be closed by increasing the net number of FTEs or by re-allocating FTEs in the public higher education system.

Estimate of Unserved Applicants to Washington Four-Year Higher Education Institutions *("The Applications Match Study")*

How are enrollments projected based on the applications approach?

- The *Applications Match Study* results are not formally combined with projections.
- A measure of "qualified but unserved Washington resident applicants" to the four-year institutions is obtained.
- The estimate is used in combination with other information to assess whether or not additional enrollments should be funded.

What factors affect enrollment projections under the applications study approach?

- The number of applicants to four-year public institutions.
- The number of qualified applicants not subsequently enrolled or accepted for admission in Washington's higher education system.

Results of current participation rate method

	Unserved Applicants to Four-Year Public Institutions
Fall 1994	1,800 – 2,300
Fall 1995	1,700 – 2,000
Fall 1996	1,500 – 2,000
Fall 1997	1,500 – 2,000

Strengths of applications study approach

- Relatively objective measure of unserved applicants.
- Adjusts for "multiple applications" in assessing unmet demand.
- Systemwide approach (reflects students served anywhere in the system).

Weaknesses of applications study approach

- Does not measure total unmet demand.
- Individuals discouraged by lack of financial resources, distance/time barriers, high admissions standards, or other (real or perceived) obstacles do not even reach the application stage and are not part of measurable demand.

OFM Experimental Models, Washington Time Series Regression Models *Dependent Variable – (1) Enrollment Level, (2) Participation Rate*

What is a "time series regression" model?

The time series regression model uses statistical methods to identify factors that affect higher education enrollment. ***Factors*** are selected (or rejected) based on their statistical correlation with enrollment trends. The method also assigns a value or weight to each ***factor*** reflecting the degree to which it influences enrollment.

How are FTE enrollments projected based on the Washington time series regression model?

Forecasts are developed or assumptions made about future trends for each of the ***factors*** that influence higher education enrollments. Taking into account the weight or importance of each factor, the effects are summed to arrive at a total forecast of enrollment.

What factors affect enrollment projections under the Washington time series regression model?

	Public Four-Year	Public Two-Year	Private Four-Year
Behavior of Independent Variable*	Effect on Dependent Variable**		
Washington college age population (17-22, 17-29, 30+) rises	+	+	+
Washington average tuition, public four-year increases			+
U.S. average wages of high school graduates age 18-24 increases	–		
Net cost (tuition-grants) as a pct of per capita income increases		–	
State appropriations to higher education institutions increase	+	+	
Loans and work study subsidies increase	+		
Washington unemployment rate increases	+		
Washington employment in knowledge-based industry sectors increases	+		+
Washington total employment increases	–	+	
Washington public expenditures on four-year (two-year) institutions increases	+	+	
Public 4 year part. rate (lagged) increases		+	
Public enrollment lids (after 1981) applied	–	–	
Geographic coverage of institutions increases		+	
War (Vietnam, early 1970s), including draft deferrals	+		
Recession		–	

* *Independent variables are displayed from both regression models.* See appendices for detailed description of variables.

** ***Model I dependent variable is " enrollment level." Model II dependent variable is "participation rate."***

+" and "–" are the sign of the value of the respective factor, if relevant. For instance "+" means the dependent variable increases as the value of the factor increases; "–" means the dependent variable decreases as the value of the factor increases.

What factors were tested but failed to show up as significant in the regression models?

During the model construction process, numerous explanatory factors were tested (see Appendix to this document), individually or collectively, for their significance in explaining enrollment trends in Washington. Statistical tests, theoretical considerations, and judgments jointly determined the final model structure. Typically, the final regression models each contain less than five explanatory variables. But some of the proposed factors did not survive in any of the final models, due either to their close relationship with other explanatory factors, because they do not (apparently) affect higher education enrollments, or due to measurement difficulties.

An Appendix to this document contains a full list of variables tested, including those which did not survive tests of statistical significance. Among the variables not included all (or some) of the models are the following:

Poverty rates. Since participation in higher education has been consistently very low among economically at risk populations (persons in poverty or close to the poverty level), the relatively small historical variations in poverty rate over the past 30 years have not had a noticeable effect on higher education enrollments.

Average wage of college graduates. While the general wage level of high school graduates appears to have had an effect on higher education enrollments, the general wage level of college graduates did not turn out to affect enrollment trends in any of the models. It appears that the decision to pursue post-secondary education has been more sensitive to fluctuations in the real wage of high school graduates than to variations in the wages of college graduates.

Growth of occupations requiring college degrees. Efforts to incorporate a variable reflecting changes in occupational demand for post-secondary education did not succeed. A variable representing overall job growth in knowledge-intensive industry sectors did, however, survive in at least one of the models. The failure of a suitable occupational variable to survive is probably due either to (1) measurement problems (reliable historical measures of the educational requirements of occupations are not available), and/or to (2) the possibility that the state's post-secondary education system has been more responsive to general economic and cultural factors affecting enrollment behavior than to specific occupational factors.

Tuition in the public system. Tuition did not show up as a significant factor in explaining historical variation in Washington public higher education enrollments. This is not a surprising outcome. Historical variation in real (inflation adjusted) tuition levels has been relatively small. In addition, levels of financial assistance have often risen in tandem with tuition increases. As a result, it does not appear that changes in tuition have had a large effect on enrollments. However, this does not mean that a large change in real tuition (unaccompanied by increases in financial aid) would not depress higher education enrollments. Tuition, however, is a significant factor in the 50 state model (discussed below) because variation in tuition across states is large enough to make a difference in enrollment behavior.

Results of Illustrative Forecasts Based on Experimental Time Series Models

The two experimental time series models were used to produce illustrative forecasts. The forecasts rely on assumptions about the future values of independent variables. Assumptions about these values were based on the historical behavior of the variables as well as judgments about the possible behavior of the variables in the future. Since resources were not available to conduct extensive research or to consult experts in support of these judgments, the forecast results reported here should be considered illustrative rather than definitive

Assumptions Used for High, Medium, and Low Projections*

HIGH	Public Four-Year	Public Two-Year	Private Four-Year
Washington college age population (17-22, 17-29, 30+)	OFM medium forecast	OFM medium forecast	OFM medium forecast
Washington real average tuition, public four-year			Constant
U.S. real average wages of high school graduates age 18-24	20% below 1997		
Washington unemployment rate	Average		
Washington employment in knowledge based industry sectors	Average + 1%		Average + 1%
Washington total employment		= Average growth + 1%	
Washington real public expenditures on four-year (two-year) institutions	=GF revenue growth	=GF revenue growth	
Public enrollment lids (after 1981)	Partial lid = .33	Partial lid = .33	
Geographic distribution of institutions		Constant	

MEDIUM	Public Four-Year	Public Two-Year	Private Four-Year
Washington college age population (17-22, 17-29, 30+)	OFM medium forecast	OFM medium forecast	OFM medium forecast
Washington real average tuition, public four-year			Constant
U.S. real average wages of high school graduates age 18-24	Constant		
Washington unemployment rate	Average		
Washington employment in knowledge based industry sectors	Average growth		Average growth
Washington total employment		= Average growth	
Washington real public expenditures on four-year (two-year) institutions	= GF revenue growth	= GF revenue growth	
Public enrollment lids (after 1981)	Partial lid = .75	Partial lid = .75	
Geographic distribution of institutions		Constant	

LOW	Public Four-Year	Public Two-Year	Private Four-Year
Washington college age population (17-22, 17-29, 30+)	OFM medium forecast	OFM medium forecast	OFM medium forecast
Washington real average tuition, public four-year			Constant
U.S. real average wages of high school graduates age 18-24	20% above 1997		
Washington unemployment rate	Average		
Washington employment in knowledge-based industry sectors	Average growth – 1%		Average growth – 1%
Washington total employment		Average Growth – 1%	
Washington real public expenditures on four-year (two-year) institutions	= 601 growth	= 601 growth	
Public enrollment lids (after 1981)	Partial lid = .75	Partial lid = .75	
Geographic distribution of institutions		Constant	

**Includes variables from Models I and II. Forecasted values of variables not shown in the chart were assumed to equal 1996 levels.*

Results of Projection Based on Washington Time Series Model I

Two-Year Public System*

	Time Series Model I			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
1997-98 *actual*	118,000	118,000	118,000	118,000	118,000
2009-10	161,000	146,000	140,000	142,000	142,000
2019-20	172,000	156,000	148,000	154,000	154,000
Difference 1998-2010	43,000	28,000	22,000	24,000	24,000
Difference 1998-2020	54,000	38,000	30,000	36,000	36,000

**State funded FTEs, includes Community and Technical Colleges*

Four-Year Public System*

	Time Series Model I			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
1997-98 *actual*	81,000	81,000	81,000	81,000	81,000
2009-10	117,000	107,000	99,000	101,000	116,000
2019-20	123,000	110,000	97,000	104,000	141,000
Difference 1998-2010	36,000	26,000	18,000	20,000	35,000
Difference 1998-2020	42,000	29,000	16,000	23,000	60,000

***State funded FTEs.*

Four-Year Private

	Time Series Model I			Other Projections	
	H	M	L	Current Part Rate CF	Constant Market Share
1997-98 *actual*	35,000	35,000	35,000	35,000	35,000
2009-10	45,000	43,000	40,000	43,000	50,000
2019-20	51,000	45,000	40,000	45,000	61,000
Difference 1998-2010	10,000	8,000	5,000	8,000	15,000
Difference 1998-2020	16,000	10,000	5,000	10,000	26,000

TOTAL SYSTEM

Difference 1998-2010	89,000	62,000	35,000	52,000	74,000
Difference 1998-2020	112,000	77,000	51,000	69,000	122,000

Results of Projection Based on Washington Time Series Model II

Two-Year Public System*

	Time Series Model II			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
1997-98 *actual*	118,000	118,000	118,000	118,000	118,000
2009-10	149,000	138,000	132,000	142,000	142,000
2019-20	160,000	149,000	142,000	154,000	154,000
Difference 1998-2010	31,000	20,000	14,000	24,000	24,000
Difference 1998-2020	42,000	31,000	24,000	36,000	36,000

**State funded FTEs, includes Community and Technical Colleges*

Four-Year Public System**

	Time Series Model I			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
1997-98 *actual*	81,000	81,000	81,000	81,000	81,000
2009-10	110,000	104,000	101,000	101,000	116,000
2019-20	115,000	107,000	104,000	104,000	141,000
Difference 1998-2010	29,000	23,000	20,000	20,000	35,000
Difference 1998-2020	34,000	26,000	23,000	23,000	60,000

***State funded FTEs.*

Four-Year Private

	Time Series Model I			Other Projections	
	H	M	L	Current Part Rate CF	Constant Market Share
1997-98 *actual*	35,000	35,000	35,000	35,000	35,000
2009-10	46,000	43,000	40,000	43,000	50,000
2019-20	52,000	45,000	40,000	45,000	61,000
Difference 1998-2010	11,000	8,000	5,000	8,000	15,000
Difference 1998-2020	17,000	10,000	5,000	10,000	26,000

TOTAL SYSTEM

Difference 1998-2010	71,000	51,000	39,000	52,000	74,000
Difference 1998-2020	93,000	67,000	52,000	69,000	122,000

Strengths of the Washington time series regression models

- Based on population factors, as well as tuition, financial aid, economic, and public policy factors.
- Does not assume participation rates hold steady.
- Factors used reflect mainly Washington conditions.
- Provides a range of projections (high, medium, low), depending on assumptions about future conditions.
- Provides perspective on the range of plausible forecasts and the risk in forecast results.
- Highlights the fact that government policy factors have a major affect on higher education demand and enrollment.
- Uses relatively objective statistical procedures to identify the factors that significantly affect state post-secondary enrollment.

Weaknesses of the Washington time series regression models

- Since historical demand for higher education has never been completely unconstrained by public policy, forecasting models based on historical experience are limited. *(See Addendum below on Demand Measurement.)*
- New or emerging factors affecting demand for higher education (e.g., Internet access) cannot be fully captured by these types of models.
- Essentially assumes current method of delivering educational services.
- Data are inadequate to fully capture and model the effects of certain variables on demand for higher education, such as labor market factors or technological change.
- Other factors may be omitted from the models due to the lack of historical data.
- Procedures for selecting (and rejecting factors) require some judgment and discretion.
- The weights assigned to certain factors can change (sometimes significantly) when data are revised or new factors are introduced in the model.

Addendum on Demand Measurement

Enrollment or participation rates are used in the models to represent aggregate demand for post-secondary education. Washington college enrollment, however, does not fully capture demand because state policies have a "capping (rationing) effect" on enrollment, resulting in unmet demand that is not included in the enrollment statistics. The concern that enrollment is not an adequate representation of demand is addressed in several ways:

- The time series models include a period in Washington enrollment history when enrollments were relatively unconstrained.
- The 50 state cross section model includes jurisdictions where demand is relatively unconstrained by policy, thus allowing estimation (simulation) of Washington enrollment under alternative policy conditions.

- The time series models also include qualitative variables reflecting major policy events that had capping effects on enrollment.
- Supply variables, such as state spending on higher education, are included and tested to determine if supply factors override all socioeconomic and demographic factors.

Experimental 50 State Model

How are enrollments projected based on the 50 State Model?

The 50 state model is ***not*** a forecasting model – rather it endeavors to explain differences in enrollment among the 50 states at a point in time (Fall 1995). Although the model does not produce forecasts, it identifies factors that affect enrollment levels. The model also suggests what effect changes in certain policy factors might have on enrollments.

What factors affect enrollment levels based on the 50 State Model?

Behavior of independent variable	Public Four-Year	Public Two-Year	Private Four-Year	Private Two-Year	Private Four-Year
Behavior of Independent Variable	**Effect on dependent variable***				
Larger college age population	+	+	+	+	+
Higher per capita personal income		+	+		+
Higher state unemployment rate	–	–			
Higher public two-year enrollment as % of age 17+ population	–				
Higher average tuition		–	–		–
Higher state appropriations for public 2 yr (4 yr) institutions	+	+			
Higher number of scholarships awarded – private			+	+	
Higher state appropriations for private institutions			+		+
More freshmen 4 yr in-migrants			+		
Larger number of private institutions			+	+	+

"+" and "–" are the sign of the value of the respective factor, if relevant. For instance "+" means the dependent variable increases as the value of the factor increases; "–" means the dependent variable decreases as the value of the factor increases.

Results of enrollment estimates based 50 State Model

Model implies that:

- Washington four-year public headcount enrollment would be about 12,000 higher, if Washington enrollment in two-year institutions was at the median level (rather than ranked fourth).

- Washington four-year public headcount enrollment would be about 5,000 higher if Washington appropriations (per capita 17+) for public four-year institutions were at the 90th percentile instead of the 10th percentile among the 50 states.

A great deal is left unexplained:

- The estimate of Washington four-year public headcount enrollment in 1995 is 16,000 higher than actual enrollment, even after taking into consideration state appropriations and enrollment levels at two-year public institutions.
- The estimate of Washington two-year public enrollment in 1995 is 68,000 lower than actual enrollment, even after taking into consideration per capita public expenditures, personal income, and tuition. Overall, however, the model explains a very large percentage of variation in enrollments across the states and has a relatively low standard error.

Strengths of enrollment estimates based on 50 State Model

- Takes into consideration population as well as other factors affecting enrollment.
- Provides order of magnitude measure of policy factors, which affect demand and enrollment.
- Provides relatively objective method of assessing differences in enrollment levels among the states.

Weaknesses of enrollment estimates based on 50 State Model

- Data are inadequate to fully capture and model the effects of certain variables on demand for higher education, such as labor market factors or technological change.
- Other factors may be omitted from the models due to the lack of data for the 50 states.
- Procedures for selecting (and rejecting factors) require considerable judgment and discretion.
- The weights assigned to certain factors can change (sometimes significantly) when data are revised or new factors are introduced in the model.
- The weights associated with some of the variables in the present OFM model are unrealistic.

PART III

Findings and Conclusions

1. The Participation Rate (PR) approach (using current PR or PR goals) is the predominant method for projecting ***long-term*** higher education enrollment in Washington and in nearly all of the other states.

2. The PR method is relatively simple, has relatively modest data requirements, can be applied objectively (once PR goals are established), and reflects the impact of population change on enrollments.

3. Although variations of the PR approach are predominant in ***long-term*** forecasting, a considerable number of states (and institutions) use more elaborate models to develop ***short-term*** higher education enrollment forecasts.

4. Short-term models used by other states include demographic factors as well as factors involving ***student flow*** (retention, length of stay, high school graduation rates, transfer policies), ***price factors*** (tuition/financial aid) and ***local economic conditions*** (local unemployment rate and wages/incomes).

5. The PR approach for long-term forecasting in Washington is supplemented by analyses of vocational and workforce training needs (e.g., Workforce Training Board studies) as well as other special analyses (e.g., SBCTC consideration of re-training needs or impact of *WorkFirst* on enrollments).

6. The PR approach, however, has some weaknesses. The PR approach:
   - Does not capture the effects of factors other than demographics, such as economic and labor market conditions and public policy.
   - Reflects policy choices and constraints, as well as economic and cultural factors, inherent in the current PR or the PRs of other states.
   - Does not always specify the public policy and administrative interventions needed to achieve enrollment goals (e.g., financial aid, additional spending, additional capacity, geographic accessibility, modified admissions requirements).
   - Does not always differentiate among different types of enrollment (e.g., degree areas, vocational/academic).
   - Is not based on an objective assessment of forces affecting enrollment.
   - Is not based on economic, labor market, or social conditions specific to Washington.

7. Experimental "time series regression" (TSR) models developed by OFM address some of the shortcomings of the PR method, but have weaknesses of their own.

8. Illustrative forecasts produced by the TSR Models suggest that:
   - Forecasts based on the current participation rate are well within the range of plausible projected enrollments.
   - Factors such as wage disparity between college and non-college graduates, employment growth in knowledge based industries, and public spending and enrollment policies will determine whether actual demand is above or below the current participation rate projection.
   - Projections through 2010 based on HECB participation rate goals are also well within the range of plausible projected enrollments produced by the multi-factor time series model.
   - However, projections for 2020 based on HECB participation goals are closer to the high end of the illustrative forecasts produced by the multi-factor time series models. This implies that certain policy, economic, and cultural factors responsible for current participation rates must change for the year 2020 goals to be achievable.

TOTAL SYSTEM, Projected FTE Increases
(Public Two-Year + Four-Year + Private Four-Year)

	Time series Model I			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
Difference 1998-2010	89,000	62,000	35,000	52,000	74,000
Difference 1998-2020	112,000	77,000	51,000	69,000	122,000

	Time series Model II			Other Projections	
	H	M	L	Current Part Rate CF	HECB Goal
Difference 1998-2010	71,000	51,000	39,000	52,000	74,000
Difference 1998-2020	93,000	67,000	52,000	69,000	122,000

9. The TSR models are an improvement because they:
   - Are based on population factors, as well as tuition, financial aid, economic, and public policy factors.
   - Do not assume participation rates hold steady.
   - Rely mainly on factors reflecting Washington conditions.
   - Provides a range of projections (high, medium, low), depending on assumptions about future conditions.
   - Provide perspective on the range of plausible forecasts and the risk in forecast results.
   - Highlight the fact that government policy has a major effect on higher education demand and enrollment.
   - Use relatively objective statistical procedures to identify the factors that significantly affect state post-secondary enrollment.

10. The TSR models, however, also exhibit several significant weaknesses:

- Since historical demand for higher education has never been completely unconstrained by public policy, TSR models (based on historical experience) are limited.
- New or emerging factors affecting demand for higher education (e.g., Internet access) cannot be fully captured by TSR models.
- TSR models essentially assume the current method of delivering educational services.
- Data are inadequate to fully capture and model the effects of certain variables on demand for higher education, such as labor market factors or technological change.
- Factors may be omitted from the models due to the lack of historical data.
- Procedures for selecting (and rejecting factors) require considerable judgment and discretion.
- The weights assigned to various factors are relatively unstable – i.e., they can change based on new data or the introduction of new factors in the model
- The method contains many subjective elements.

11. Overall, the TSR models:

- Add to our understanding of the factors affecting higher education enrollments.
- Highlight issues and factors which policy-makers need to consider in planning for higher education needs.
- Highlight the fact that demand for higher education is not something that exists objectively, apart from policy, but is highly dependent on public choices.
- Help policy-makers understand the magnitude of upside and downside risks inherent in higher education forecasts.
- Are potentially helpful and useable in formal, long-term higher education forecasting as a compliment to other perspectives, provided that

  1. Data limitations are ameliorated,
  2. Weights assigned to various factors are stabilized, AND
  3. The forecast effort is supported by a formal assumption setting process which includes input from a variety of sources including*:

     - Policy-makers
     - Stakeholders
     - Technical experts

* The two experimental time series models in this report were used to produce illustrative forecasts. The forecasts rely on assumptions about the future values of independent variables. Assumptions about these values were based on the historical behavior of the variables as well as judgments about the possible behavior of the variables in the future. Since resources were not available to conduct extensive research or to consult experts in support of these judgments, the forecast results reported here should be considered illustrative rather than definitive

APPENDIX

Time Series Models, Explanatory Variables

Based on the human capital investment theories and the empirical findings of relevant research, a data set containing economic, social, demographic, and policy factors was compiled to explain the historical changes in higher education enrollment in Washington.

During the model construction process, all the explanatory factors were tested, individually or collectively, for their significance in explaining the enrollment trends in Washington. Statistical tests, theoretical considerations, and judgments jointly determined the final model structure. Typically, the final regression models each contain less than five explanatory variables. But some of the proposed factors never were able to enter into any of the final models, due either to their close relationship with other explanatory factors or measurement issues.

All the explanatory factors tested are listed below; those with trailing asterisks (**) are the ones dropped from all the regression models:

Cost factors:

- Annual tuition and fees, by institutional control and type
- Annual room and board charges
- Financial aids: federal and state grants; federal and state work-study and loans
- State higher education expenditures by institutional control and type
- State unemployment rate
- Average wages of high school graduates (U.S.; age 18-24 and 25-34)
- Geographical accessibility (share of state population in counties with community colleges)
- Income changes: per capita income, U.S. median household income**
- State poverty rate**
- Price changes: Seattle CPI, U.S. implicit price deflator for personal consumption, and U.S. average higher education deflator**

Earnings factors:

- Unemployment rates: high school graduate, some college, and college graduates (U.S.; age 18-24, 25-34)**
- Average wage of high school graduates (U.S.): age group 18-24, age group 25-34**
- Average wage of those with some college education (U.S.): age group 18-24, age group 25-34**
- Average wage of college graduates (U.S.): age group 18-24**, age group 25-34**

Social, demographic, and policy factors:

- Number of high school graduates in Washington**

- Female labor force participation rate (U.S.)**
- State population by age: 17-22, 17-24, 23-29, 30+, 35-44, 45+
- Capping effect – periods affected by more restraining enrollment policy
- Vietnam War effect – years affected by the Vietnam War recruitment and the return of veterans to school

Industrial demand for post-secondary training:

- Washington employment growth (total and traded sector employment)
- Washington occupations requiring college-degree workers**
- Demand index – growth of professional jobs**
- Demand index – market demand for workers with college degrees**
- Demand index – market demand for workers with associate degrees**

50-State Cross Sectional Model, Explanatory Variables

A model was constructed that uses economic, social, demographic, and institutional factors to account for the differences in college enrollment patterns among the 50 states. The year of observation is 1995. All the explanatory factors tested are listed below; those with trailing asterisks (**) are the ones that fail to enter into any of the regression models:

Cost factors:

- Annual tuition & fees, by institutional control and type
- Annual room & board charges
- Financial aids: federal and state need-based grants**; federal student loans**
- State higher education expenditures by institutional control and type
- State unemployment rate
- Geographical accessibility (number of institutions by institutional control and type)
- State per capita income
- State poverty rate (1990)**

Social, demographic, and policy factors:

- Number of high school graduates**
- State population by age: 17-22, 17-24, 23-29, 30+, 35-44, 45+
- State net population migration: 1985-90**, 1990-94**
- Interstate student migration: in-migrating freshmen**, out-migrating freshmen**, freshman net migration**, in-migrating newly graduated freshmen, out-migrating newly graduated freshmen**
- Index: share of 1990 population – with college degree**, with advanced degree**, with associate degree**, with some college**
- Higher education spending as a share of total state expenditures, 1994-95**
- Number of SAT takers as a share of total high school graduates**

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