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**DETAILS ON PRODUCTIVITY**


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In this appendix, we consider in further detail how productivity measures are used and manipulated in our model. In one definition, Epstein (1992) defines productivity improvement as a measurable reduction in cost while maintaining or improving key measures of effectiveness. To address this measure in our simulations, we take the graduation and advancement rates for each system in Eqs. A4 and A9 as our key measures of effectiveness. We define an annual rate of productivity improvement  $p_1$  as the rate at which the minimum revenues needed per student can decrease while the graduation and advancement rates remain unaffected. We thus rewrite Eq. B1 for the maximum enrollment for each system in the constrained admissions case as

$$\begin{aligned}
 Enrollment(sys, year) &\leq \left( \frac{1 + \Delta(HEPI) + p_1}{1 + \Delta(HEPI)} \right)^{Year-1995} * \\
 Enrollment(sys, 1995) &* \frac{Revenues(sys, year)}{Revenues(sys, 1995)}
 \end{aligned} \tag{D1}$$

where  $\Delta(HEPI)$  is the annual change in the Higher Education Price Index (HEPI), as shown in Figure 6 (see Chapter 2). Note that we have defined the productivity  $p_1$  relative to  $\Delta(HEPI)$ , so a productivity improvement of  $p_1 = 0$  means that the number of dollars necessary

for each system to educate an undergraduate just keeps pace with inflation.<sup>1</sup>

Figure 5 (see Chapter 2) compares UC and CSU enrollments for  $p_1 = -2\%$  (“low efficiency”),  $p_1 = 0\%$  (“flat efficiency”), and  $p_1 = 2\%$  (“high efficiency”) in the constrained admissions case, assuming the “optimistic” scenario for state general fund revenues. For comparison, enrollments under the unconstrained (“base”) admissions case are also presented in the figure. We see that a high rate of productivity growth reduces the access deficit almost to zero, whereas a negative rate of growth causes very large access deficits, similar to the situation for the “pessimistic” estimate of revenues from the state general fund.

In a second definition, Epstein defines productivity improvement as a measurable improvement in some key measure of effectiveness while maintaining or reducing costs. To address this measure, our simulations use either unconstrained admissions or constrained admissions with  $p_1 = 0\%$ , and define an annual rate of productivity improvement  $p_2$  as the rate at which advancement and graduation rates increase, applied to all the cohorts.<sup>2</sup> Thus,

$$\begin{aligned} cADV_n(\text{sys}, \text{year}) &= cADV_n(\text{sys}) * [1 + p_2]^{Year-1995} \\ cGRD_n(\text{sys}, \text{year}) &= cGRD_n(\text{sys}) * [1 + p_2]^{Year-1995} \end{aligned} \quad (D2)$$

Figure 7 (see Chapter 2) shows the effect of variations in the advancement and graduation rates on enrollments and degrees awarded by CSU. Similar results were seen for UC, though the differences between low and high efficiencies were not as great (advancement and graduation rates are higher for UC, so there is less room for improvement).

<sup>1</sup>In fact, this method relies on average costs. A similar method can be used to perform this analysis with marginal costs, with some fixed (not proportional to student body) amount of revenues subtracted from the total.

<sup>2</sup>However, values for  $cADV$  and  $cGRD$  are capped with a maximum value of 1.0. These rates are applied to CC students mainly in terms of the progress of CC transfers through the other two systems.