A general equilibrium analysis of state and private colleges and access to higher education in the U.S.

Dennis Epple [a,b], Richard Romano [c,*], Sinan Sarpça [d], Holger Sieg [e,f]

[a] Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA 15213, USA
[b] NBER, USA
[c] University of Florida, Department of Economics, Gainesville, FL 32611, USA
[d] Koç University, Department of Economics, Sariyer, 34450 Istanbul, Turkey
[e] University of Pennsylvania, Department of Economics, Philadelphia, PA 19104, USA
[f] NBER, USA

ARTICLE INFO

ABSTRACT

We develop a general equilibrium model of the market for undergraduate higher education that captures the co-existence of public and private colleges, the large degree of quality differentiation among them, and the tuition and admission policies that emerge from their competition for students. A quantitative version of the model matches well estimates of enrollment elasticities, variation in need-based and merit-based institutional aid with, respectively, student income and ability, and aggregate characteristics of U.S. higher education including college attendance in public and private schools, tuition levels, and the provision of federal aid. Predictions about the provision of federal aid and the distribution of students across colleges by ability and income match the empirical counterparts well. We use the model to examine the consequences of federal and state aid policies. A one-third increase in the maximum federal aid increases college attendance by 6% of the initial college population, most of the increase being in state colleges and mainly of poor students. Elite private colleges reduce institutional aid and use the net funding gain to spend more on educational inputs and to substitute some highly able poor students for less able rich students. Reductions in federal or state aid result in substantially reduced attendance mainly by poor students. Reductions of support to state colleges induce private colleges to increase enrollments modestly and improve in quality as demand shifts toward them.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Against a backdrop of an increasing gap in earnings between college and non-college graduates and persistently increasing costs of higher education, access to higher education has become a major policy concern. The Obama administration has passed and is advocating a variety of policies to increase access. Federal expenditure on Pell Grants, a means-tested and the most costly federal aid program for college students, increased from 14.7 billion dollars to 32.4 billion dollars between the years 2007–08 and 2012–13, and the number of grant recipients rose from 5.5 million to 8.9 million.[1] Tax credits for college expenses have been increased, the federal subsidized loan program has been reformed to increase college loans, and income-based repayment of loans has been expanded.[2] In addition, the Obama administration has proposed initiatives to keep down student costs, e.g., provision of more federal aid to colleges that keep down net tuition.[3] Understanding the impact of changes in programs of such magnitude requires an equilibrium model of the market for higher education. The purpose of this paper is to provide a general equilibrium analysis of access to colleges and to examine the effects of changes in funding policies on college attendance.

We develop a new model of the U.S. market for undergraduate higher education to provide a framework for understanding equilibrium choices of students and providers and to gain insights into the effectiveness of public policies. Building on recent advances in modeling the equilibrium in the higher education market, our model includes competing state and private colleges with alternative objectives, students that differ by income, ability, and unobserved idiosyncratic preference

---

* Corresponding author.
E-mail addresses: epple@cmu.edu (D. Epple), romanor@ufl.edu (R. Romano), ssarpca@ku.edu.tr (S. Sarpça), holgers@econ.upenn.edu (H. Sieg).
[1] "The Federal Pell Grant Program," Congressional Budget Office Report, September 2013.

[2] https://www.whitehouse.gov/issues/education/higher-education.
[3] "FACT SHEET: President Obama's Blueprint for Keeping College Affordable and Within Reach for All Americans," press release, Office of the Press Secretary, The White House, January 27, 2012, https://www.whitehouse.gov/the-press-office.

for colleges, and federal aid modeled to approximate U.S. policy. The model predicts college qualities, admission practices, and the college attendance pattern, including the characteristics of students that do not attend college. A quantitative version of the model does a good job of matching aggregates as well as estimates of enrollment elasticities and variation in need-based and merit-based aid with, respectively, student income and ability. The model also does a credible job predicting the provision of federal aid and the attendance pattern of students that differ by income and ability. We employ the model to examine policy changes on attendance, with predictions in line with recent estimates. The analysis provides a more complete description of efficacy, with the potential to facilitate effective policy design.

One theoretical challenge is to capture the different objectives of private and public universities and the different constraints they face within a general equilibrium model. Our approach builds on the insight that neither public nor most private colleges are likely to maximize profit. Most private colleges focus primarily on their reputation. This motivates our approach of modeling private schools as maximizing quality, which depends on the measured abilities of their students and the educational resources colleges provide them.[4] We show that this leads private colleges to pursue a tuition and implied admission policy entailing merit aid to attract higher ability students and need-based aid to capture more revenues from higher-income students with stronger demands for college quality.

While private colleges are largely unconstrained in their policies, public universities face state mandates to provide affordable education to in-state students. This suggests modeling state universities as maximizing the aggregate achievement of in-state students. Public universities also face regulated price caps and have limited powers to set tuition and financial aid policies. However, they obtain direct subsidies from their state legislatures. Moreover, state regulated tuitions generally differ between in- and out-of-state students. With such a characterization of state colleges, our model shows that state colleges optimally use minimum ability admission thresholds that differ between in- and out-of-state students. Out-of-state students potentially provide two important functions for state schools. First, out-of-state students pay higher tuition rates and thus cross-subsidize the education of in-state-students. Second, they can provide valuable peer externalities since the admission standard for out-of-state students can be set higher than the admission standard for in-state-students. Our quantitative analysis suggests, however, the former force dominates leading to lower admission standards for out-of-state students.

A major goal of this paper is to evaluate the impact of public policies on access to higher education. In addition to state subsidies to public colleges, the federal government subsidizes higher education. Instead of providing higher education at subsidized rates, the federal government provides aid to students and their families that can be used at any college. The amount of available aid is basically determined by the difference between the cost of attending the college and the federally determined expected family contribution, as long as the difference is below a maximum amount of aid. The cost of attending includes the college's tuition, room and board, and an allowance for other expenses like books. Availability of federal aid increases qualifying students' demands to attend colleges. Faced with increased demand, private colleges might reduce institutional aid. Our analysis includes the equilibrium response of private colleges to provision of federal aid.

To assess the theoretical model and explore its quantitative implications, we develop a quantitative version of it. We calibrate the model using estimates of tuition effects on enrollment and variation in private college tuition with respect to student income and ability, and using important empirical aggregates including the proportion of students attending state versus private colleges and the proportion of college-aged individuals that attend college. In addition to matching well these values, the model predicts reasonably the distribution of federal aid and attendance patterns of students that differ by income and ability. After examining some variations in the model specification, we evaluate the effects of two policy changes. First, the Obama administration has significantly increased the amount of federal aid available to students. We show that a one-third increase in the maximum federal aid from $6000 to $8000 increases college enrollment by 6%, with those increases being primarily among relatively poor students and mainly at state institutions. Private schools react with a mixture of reduced institutional aid, increased expenditure on educational inputs, and by substituting some high-ability and lower-income students for some richer and less-able students. Average student costs among all public students fall by just $90, but the effects are very uneven depending on student characteristics. Some public school students save the entire $2000. Effects in private colleges are very different because of their policy changes, including increased average tuitions. The policy change leads average private student costs to *rise*, though again effects are very uneven and poorer students experience a cost saving. We find that decreases in federal aid of the same magnitude have approximately the opposite effects.

The second policy experiment is motivated by the reduced state subsidies coupled with increased tuition that have occurred in a number of states on the heels of the recent recession. We examine a revenue neutral reduction in the per student state subsidy of $2000 dollars accompanied by the same increase in tuition to in-state and out-of-state students. The share of the initial college population decreases by 9%. This enrollment decrease is entirely in state colleges, with mainly poor students exiting, but also with nontrivial exit of some upper-middle-income students who are too rich to qualify for federal aid. Increased federal aid protects some lower middle-income students from the state tuition increase who then remain in college. Demand shifts toward private colleges and they grow some. Elite private colleges substitute some higher-ability students of moderate income formerly at state institutions for some richer and lower-ability students.

A large literature exists on the economics of higher education. A general observation is that this literature has focused more on demand-side issues while taking as given college policies. We develop further the supply side of the market for higher education with our focus on college decision making and competition among colleges. By modeling college choices, we might better understand the quality variation across colleges, differences in tuition, admission and expenditure policies, variation in student bodies, and provide context to interpret and predict the effects of policy changes. A general equilibrium model is particularly useful to predict the effects of national policy changes on student attendance and costs. For example, the effects of a demand increase for higher education stemming from increases in federal grants on the tuition and admission policy of a college will depend on its market power and how competitors respond. A college monopolist will respond differently than would a college facing highly elastic demand due to close competitors. The market power of colleges will depend on differentiation among them. Concerted policy changes by Ivy League colleges would surely affect strategies of say Carnegie Mellon University and Rice, but not much say Gonzaga and the University of Georgia. Effects of changes in state college policies on college attendance are likely to depend on reactions of private colleges, with their reactions also relevant to their own students, as we find in our analysis. Policies that provide aid increases to the poorest students may impact state colleges more than private colleges, as we also find in our analysis. Designing national policies to promote attendance and to reduce student costs need

---

[4] We focus on the higher education market served by four-year institutions in this analysis and do not consider for-profit colleges. Over 90% of the degrees conferred during 2000–2012 by for-profit institutions of higher education are associate degrees (17.3%) or certificates (74.1%), e.g., in hair dressing, massage, welding, and computer systems administration (Chakrabarti and Grigsby, 2013). This raises the questions as to the extent to which for-profits compete for students with four-year institutions and whether they primarily serve a different demographic of students. While we have then not attempted to incorporate for-profit colleges into the analysis, such an extension is of interest, especially given their increasing role in higher education.