# Market-Based Higher Education: Does Colorado's Voucher Model Improve Higher Education Access and Efficiency?

**Nicholas W. Hillman · David A. Tandberg · Jacob P. K. Gross**

**Abstract**   In 2004, Colorado introduced the nation's first voucher model for financing public higher education. With state appropriations now allocated to students, rather than institutions, state officials expect this model to create cost efficiencies while also expanding college access. Using difference-in-difference regression analysis, we find limited evidence that these outcomes occurred within the 4-year sector; however, the policy increased cost efficiencies among community college and reduced college access for some underrepresented groups. The paper discusses the challenges of applying market-based reforms to public higher education.

**Keywords**   Higher education finance · State policy · Market-based reforms

## Introduction

In 2004, the Colorado state legislature codified the nation's first voucher-based model for financing higher education. Instead of allocating state appropriations directly to public colleges and universities, the state now allocates these subsidies to students in the form of vouchers. By funding students rather than institutions, proponents of the policy believe colleges will be more attentive to consumer demands and, as a result, they will deliver education more cost efficiently while also expanding college access. With money now following the student, they believe Colorado colleges will compete with one another in order

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to attract and retain students and their associated tuition dollars. Accordingly, proponents believe that having students "vote with their feet" will create market forces that incent colleges to keep costs low, retain students, and improve their overall quality (Fischer 2005).

Critics of the policy are skeptical, arguing that the new funding model is a solution looking for a problem since it is unclear how market-based reforms will improve educational opportunities or outcomes (Prescott 2010). Due to market failures and information asymmetries, it is possible that this policy reform will reduce educational opportunities while increasing the costs of delivering education (Pusser 2006; Stater 2009). The claim that market mechanisms in higher education will necessarily yield more efficient and equitable results is based upon little empirical grounding (Fryar 2012). Furthermore, existing research demonstrates that resources matter in terms of improving student success, particularly among community colleges and institutions serving traditionally underrepresented students (Bailey et al. 2005; Dolan and Schmidt 1994; Pascarella and Terenzini 2005). This situation can be problematic because "doing more with less" may reduce educational quality or even compete with other educational goals.

In this study, we explore these claims more systematically in order to contribute to this ongoing higher education finance reform debate. Leslie and Johnson's (1974) description of higher education markets is instructive when considering how (and to what extent) state policies promote and prohibit educational competition. They explain how higher education has a long history of decentralization and autonomy from state and federal policymakers, which is why policymakers have embraced the idea of financing students rather than institutions. The underlying theory of action posits that putting money in the hands of individual consumers will require educational producers (i.e., colleges) to compete with one another. As a result of this competition, institutions will become more responsive to students' educational and financial needs. In Colorado, reformers wanted to increase educational efficiency and access, so they turned to market-oriented policy instruments to achieve these goals. However, perfect competition is rare in higher education markets, resulting in market failures that could interfere with these goals (Jongbloed 2004). The Colorado experiment brings these challenges to bear, where it is unclear whether the expansion of market competition has resulted in greater efficiency and access.

Colorado is not unique in its desire to introduce market forces into its higher education policy agenda. Ohio and Texas have explored similar voucher models (Camou and Patton 2012; Hamilton 2011), and several states have introduced business-like "pay for performance" funding schemes or deregulation efforts designed to make colleges more accountable to taxpayers and student consumers (Dougherty et al. 2012; Weibel et al. 2010). Given the growing political sentiment that views education as a private good, states are actively promoting policies designed to deregulate and decentralize state higher education systems; vouchers are one policy instrument aimed at achieving these ends (Pusser 2006; McLendon and Mokher 2009).

With this context in mind, we begin our analysis by describing the origins of Colorado's voucher-based model, followed by a discussion of theories and evidence regarding the impacts of market-based higher education reforms. Following these discussions, we explain our research design and offer a summary of the study's key findings. The paper concludes with a discussion of the educational and policy implications stemming from this particular case. Since advocates of the policy argued it would expand college access and increase efficiencies in the educational system, our aim is to examine whether the state has achieved these policy goals. Accordingly, our primary research question asks, "to what extent has the introduction of market-based reforms impacted college access and cost-efficiency in Colorado?"

## Tax and Expenditure Limits in Colorado

To understand the origins and design of Colorado's voucher-based model, we begin with a brief discussion of the state's fiscal environment leading up to the adoption of the new policy. In 1992, Colorado voters passed a referendum amending the state constitution to include a "Taxpayers Bill of Rights." Carried by a wave of anti-tax, anti-government sentiment, Colorado voters passed this referendum with 53 % of the vote and the new law took effect in 1994 (James and Wallis 2004). The amendment was designed to limit the size of state government by restricting the amount of state tax revenue growth and public expenditures allowable each fiscal year. These efforts are commonly referred to as tax and expenditure limitations (TEL) and Colorado led a new wave of TEL policies during the early 1990s (New 2010). As it was passed, the TEL amendment had three primary components. The first was that all tax increases had to be approved by taxpayers. Second, it mandated that the existing tax and expenditure limitations, originally passed in 1977 and 1991, could not be weakened without voter approval. Third, it limited growth in state revenues to the inflation rate plus population growth and it mandated that any revenue collected over the limit be refunded to the taxpayers. The end result was the most restrictive tax and expenditure limitation in the country and one of only a few that were constitutionally mandated (Waisanen 2010).

Under this new policy, Colorado's governmental agencies (including public colleges and universities) now have their revenues limited by the previous year's revenue total. As such, when revenue falls, the revenue limit for the next fiscal year falls as well (New 2010; Waisanen 2010). This has become known as the "ratchet down" effect (Prescott 2010, Waisanen 2010). This ratcheting down effect was particularly impactful when revenues fell in Colorado between 2001 and 2003 because it effectively capped revenues at pre-2000 levels. This ratcheting down effect has had a profound effect on the state's support in all areas of public finance, including public health, medical coverage, and housing for low-income families (Bell Policy Center 2003). For discretionary budget items (i.e., higher education), it created significant long-term impacts on how public agencies (i.e., colleges and universities) generate revenues to support their missions.

Higher education was especially hard hit by the state's TEL. The primary reason for this is because higher education is often treated as the "balance wheel" of state budgets (Hovey 1999). By virtue of being a discretionary budget item and the ability to generate its own revenue via tuition and fees, higher education often faces greater cuts than other public services when budgets are constrained by mandatory/entitlement spending such as medical programs, pensions, and public K-12 education (Delaney and Doyle 2011; St. Clair 2012; Zumeta 2006). In most states, higher education funding cuts would be passed onto students via increases in tuition levels; but in Colorado even tuition increases were subject to the TEL restrictions. Although Colorado was not particularly generous to higher education before the tax and expenditure limits, after the tax restrictions were enacted Colorado ranked last nationally in total educational funding (Prescott 2010). Policymakers and higher education leaders recognized that the funding trajectory they were on for higher education was unsustainable, so in 2001 a Blue Ribbon Commission appointed by Governor Bill Owens recommended several policy options for working around the tax and expenditure limits.[1]

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[1] In 2005 the CO voters passed are five year hiatus from the TEL restrictions and eliminated the ratchet effect (Watkins, 2009).

## College Opportunity Fund

The Blue Ribbon Commission's hallmark recommendation was to create a voucher-based financing model, known as the College Opportunity Fund (COF). Under this proposal, state appropriations would no longer be allocated directly to public colleges; rather, funds would go directly to students in the form of vouchers. This policy proposal would allow colleges to circumvent the TEL requirements since the funds would flow through students rather than public institutions. The COF proposal received surprisingly wide support from the higher education community, primarily because of its ability to get around the revenue and expenditure restrictions. Other proponents were also intrigued by the possibility that the voucher itself might motivate additional students to enroll in college, and those free-market adherents who believed that vouchers would increase competition and efficiency advocated on behalf of the proposal (Prescott 2010; Protopsaltis 2006).

In 2004, the state legislature codified the Commission's recommendation by passing SB 04-189 and by 2005 the state had implemented the new funding model. COF dramatically altered the postsecondary finance landscape in higher education. In the public 2- and 4-year sectors, tuition rose in the years after COF and state higher education appropriations declined (see Fig. 1). Tuition in the 4-year sector rose most rapidly since many institutions were underpriced relative to their peers; however, community college tuition grew less quickly since community college tuition was high even before COF (Heller 2000). The result was a spike in the tuition-to-appropriations ratio, where students attending 4-year (2-year) colleges now pay \$4 (\$2) in tuition for every \$1 in state appropriations. In both sectors, this marks a clear difference in financing strategies when compared to other states. For more details about Colorado's pricing model prior to COF, see Heller (2000).

The implementation of this policy was complicated from the beginning. Not only were students faced with a much larger tuition prices, but they also had to opt into the voucher program to cover these rising prices. To receive the voucher, students must first apply and enroll in college, and only after enrolling can they use their COF voucher to help pay their tuition bills. Recent program audits reveal the opt-in requirement to be a particularly

**Fig. 1** Ratio of state higher education appropriations (per FTE) relative to average tuition charges among Colorado and US colleges and universities (2010 dollars, in thousands)
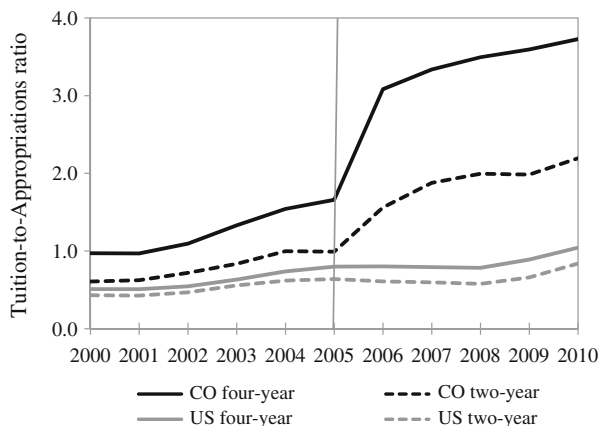
inefficient and ineffective design element, yet it remains a key component of the state's policy (Colorado Office of the State Auditor 2012). Additionally, the voucher is not means-tested, so all students who apply for it can receive the same amount of funds to help offset tuition and fees regardless of their financial needs, making is distinctly different from traditional forms of financial aid (i.e., grants and scholarships).

In its initial year, the average voucher was valued at $2,400 but by 2010 it declined to $1,320. Considering the rapid tuition increases, the purchasing power of the voucher clearly could not keep pace with tuition inflation. The average COF voucher covered 36 % of public 4-year tuition for full-time students during the 2006 academic year, but by 2011 it only covered 22 % (Colorado Office of the State Auditor 2012). More importantly, institutions immediately in the first year of the program increased their in-state tuition prices by at least an amount equal to the stipend, with some institutions going beyond that amount. Therefore, even its first year, the COF had no real purchasing power. That, combined with the program's inherent complexity, led to a perception of an ineffective program, yet little empirical research has examined the enrollment and financial impacts of this policy (Prescott 2010).

While the voucher component is the hallmark of the state's new financing model, the legislation also introduced fee-for-service contracts and performance contracts, so COF can be viewed as a package of reforms meant to address the serious financial challenges and unique circumstances facing postsecondary education in Colorado. However, the reform package was centered on the voucher program, and the voucher program generally served as the largest state funding source for the institutions, which is why we refer to it as a "voucher—based" model for financing higher education.

The fee-for-service contracts helped to ensure colleges receive "enterprise status." Governmental agencies receiving less than 10 % of their operating budgets from direct state appropriations are eligible for enterprise status, which allows institutions to operate outside of the TEL amendment (Prescott 2010). Gaining enterprise status would allow colleges to raise tuition at rates beyond what would have been feasible under TEL. Additionally, the fee-for-service contracts were created to allow the state to "purchase" specific educational services not covered by the vouchers, such as graduate education, rural education, dual enrollment, and various professional degree programs. In short, the fee-for-service contracts were meant to address the varied missions of the institutions and to provide a reliable (but not the primary) base of funding. The inclusion of the fee-for-service funds was critical to getting institutional buy-in in the first place. After the vouchers, the fee-for-service dollars made up the second largest form of state funding, as much as 47 %. However, there is significant variance in the degree to which institutions depend on the fee-for-service funding (Colorado Office of the State Auditor 2012; Prescott 2010).

The performance contracts were required of all public institutions and they are designed to hold institutions accountable for their performance in four areas: student access and success, quality, institutional efficiency, and addressing state needs including teacher education, and workforce and economic development. Like most performance funding programs, the goal behind the contracts was to provide greater flexibility for public institutions in exchange for focused accountability (Prescott 2010). However, by most estimates, the impact of the performance contracts was negligible. There was little oversight and accountability and there were no provisions to reward or punish institutions based on their performance (Colorado Office of the State Auditor 2012; Prescott 2010).

Taken together, COF is a package of three policy instruments (vouchers, fee-for-services, and performance contracts) that are expected to induce colleges to become more efficient and accessible for students. Because the state's COF reform is a package of three treatments, it can be challenging to decipher which of the three instruments is affecting the changes we observe in our analysis. Is it the voucher, the fee-for-service, or the performance contracts (or a combination of these) that drives the results? Considering the central role vouchers played in the policy debates leading up to Colorado's adoption of COF, and given the fact that they account for the majority of COF funds, we believe vouchers are the primary factor inducing the changes we observe in our analysis. Furthermore, since the performance contracts introduce no statutory or regulatory control over institutions, we believe they play a negligible (if any) role in the treatment package. Fee-for-services, on the other hand, may be contributing to the "treatment package" since it is plausible that colleges use these funds to cross-subsidize academic units, which in turn could impact efficiency and access outcomes. Disentangling the fee-for-services effects from the voucher effects is an empirical challenge, but in light of the fact that vouchers are the hallmark of the policy and they are the primary instrument through which the treatment package operates, we examine (in the following section) the voucher literature to anticipate some of the challenges and opportunities that may result from the state's policy reform.

## Literature and Theoretical Foundations

Vouchers in Education

Vouchers have a long history in education policy discourse, but it was not until ideological and political shifts in the 1960s that they began to gain currency as educational policy instruments (Levin 1992; Pusser 2006). A confluence of influential writings (e.g., Friedman 1962; Chubb and Moe 1990) coupled with the rise of postsecondary cost-sharing models have softened the policy ground for the introduction of vouchers at the postsecondary level (Archibald and Feldman 2006; Johnstone 2004; Zumeta 2006). Historically, vouchers have been chiefly used in the domain of primary and secondary schooling. Only recently have policymakers considered them in higher education. Regardless of the schooling level, the underlying logic is similar: Vouchers operate much like coupons redeemable for a certain dollar value at participating educational institutions (Barrow and Rouse 2008).

While we differentiate vouchers from grants and scholarships in this study, some observers draw parallels between the two funding strategies (Kane 1996). Similar to other subsidy mechanisms like tax credits or scholarships, vouchers are intended to benefit the individual student (rather than institutions) via direct monetary transfers. However, three important concepts separate vouchers from other funding policy instruments. First, they are designed to promote educational choices with the underlying assumption that greater choices will encourage competition among schools. Because students must choose where to apply their vouchers, schools will differentiate their offerings and operate more efficiently in order to attract students. Second, students and their families will make these educational choices based on their preferences and, therefore, will enroll in schools that are a better match with their individual needs and preferences. Third, by expanding choices, vouchers will encourage low-income students to attend schools they may not have previously believed were an option (Levin 1992). Generally, voucher proponents believe that increased competition will expand educational access with less investment of resources,

although the empirical evidence for this assertion remains mixed at best (Barrow and Rouse 2008).

It is a matter of ongoing debate whether the higher education enterprise follows this market logic.[2] Historically, this has been a contentious issue, yet observers have conceptualized higher education as a public good worthy of public subsidization because of positive externalities and market failures (Stiglitz 1999; Pusser 2002). However, Creedy (1994) notes postsecondary education has unique features that complicate our understanding of how higher education markets operate. Namely, he explains that the provision of education is subject to the rules of excludability (i.e., students who do not pay tuition do not receive their formal education) and rivalry (i.e., admission spaces and a college's service capacity may be limited). From the policy perspective, this fuels debates about whether education is a public or private good and whether market forces can be used to expand educational access. In recent years, there has been a growing shift towards viewing higher education increasingly as a private good, creating a policy environment where market-based finance reforms such as vouchers are likely to emerge (St. John 2003; McLendon and Mokher 2009).

Most postsecondary institutions are non-profit entities, and by virtue of this status are subject to nondistribution constraints that prohibit sharing of revenue (Steinberg 2006). This distinction alone makes the economic behaviors of colleges different from profit-maximizing firms; instead of maximizing profit for shareholders, these institutions exist to maximize public value. As a result, the economics of education literature posits that nonprofit colleges will maximize reputation and prestige (rather than profits) and unlike businesses, their aim is *not* to minimize costs (Archibald and Feldman 2011; Brewer, Gates, and Goldman 2002). Therefore, it is possible that the introduction of market-based reforms will not yield the results voucher proponents expect because of significant market failures and unique economic behaviors of postsecondary "markets" (Dill 2003; Winston 1999). Nevertheless, market-based approaches to funding higher education date back as far as at least 1972 with the introduction of the Basic Educational Opportunity Grant (now Pell Grants) which was designed to encourage choice by awarding portable grants directly to students. Similar market-based policy reforms have emerged over the years with "choice" becoming a central feature in state and federal finance mechanisms for postsecondary education (Pusser 2005). Due to these complications, it remains unclear to what extent the underlying theory of action (i.e., market-based reforms) is applicable to postsecondary education.

## Defining Efficiency and Effectiveness

When discussing market-based reform efforts, terms like *efficiency* and *effectiveness* warrant definition; these are particularly important to clarify given their wide use and high currency in public finance policy debates. Many state higher education reform efforts have been framed by policy makers as encouraging effectiveness and efficiency (Alexander 2000; McLendon and Mokher 2009), without clearly delineated meanings. Effectiveness and efficiency are related concepts tied to institutional goals and mission, use of inputs, and creation of outputs. Effectiveness can be defined as the degree to which outputs align with the mission and goals of an institution (Lindsay 1982). For example, if an institution's

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[2] According to data from the National Center for Education Statistics, there were nearly 4,500 postsecondary degree-granting institutions in 2009–2010. It is important to acknowledge the diversity of institutional types and missions when making broad generalizations about a higher education marketplace.

stated goal is to train workers for employment, then job placement would be an indicator of effectiveness. Efficiency extends the notion of effectiveness by considering inputs along with outputs and goal congruence. Efficient educational organizations use the least possible inputs to achieve a given quality and quantity of educational outputs and outcomes (Glover and Levacic 2007). Continuing the preceding example, the number of students who secure employment divided by the number who begin at the institution is a ratio of inputs to outputs, and may be an indicator of efficiency that is congruent with organizational goals. Further, a measure of the quality of the jobs (e.g., well-paying, stable employment vs. low-paying, insecure work) relative to the students' employment goals would provide another important indicator of efficiency. Further distinctions of efficiency can be made (e.g., technical efficiency, productive efficiency), but for the purposes of this paper we focus on a broad definition of efficiency. We discuss this in more detail below, but it merits mention that efficiency and measures of it are varied and at times contested. As Cameron (1978) points out, the "…criteria of efficiency, while being well used, are not sufficient for understanding institutional success in as much as educational institutions must not only demonstrate efficiency, i.e., using resources with little waste, but they must also be able to demonstrate the effective use of resources as well," (p. 610). It is outside the scope of this study to evaluate the effectiveness of institutions. Nevertheless, as discussed in greater detail below, we do address Cameron's notion of efficiency while acknowledging that we are leaving open the question as to whether any observed changes in efficiency were accompanied by increases or decreases in effectiveness or quality. We discuss these questions and issues in greater detail in the conclusion.

The notion that Colorado's voucher-based model will yield efficient and effective outcomes is not unique to educational settings and should be contextualized in the broader neoliberal project to promote market mechanisms in the provision of good and services (Pusser 2006). For example, in business enterprises such as banking, natural gas, and airlines, governmental deregulation and the introduction of market forces has resulted in greater cost efficiencies and productivity among providers (Stater 2009). Efficiency gains were passed along to customers and shareholder in the form of profits and/or price savings. This business logic drove many of the deliberations leading up to Colorado's adoption of COF, where legislators argued that market forces and business models would improve efficiency and access in higher education (Harbour et al. 2006). However, the extent to which these concepts apply in education remains uncertain (Baumol 1993; Archibald and Feldman 2011).

This study builds on and tests the three assumptions underlying market-based education reforms, namely that increased competition via student choice will lead to greater efficiency and access. We theorize that market-based reforms will contribute to greater competition among institutions, but the outcomes of this competition are uncertain: It is plausible that Colorado's reforms increased efficiency but not access, or vice versa. We describe next how these outcomes are operationalized and the dataset used to model these relationships.

## Data Sources and Variables

Data come from the National Center for Education Statistics' Delta Cost Project (DCP). The DCP dataset includes institutional administrative records derived from the Integrated Postsecondary Education Data System enrollment and financial surveys. Since we are most interested in how the voucher policy affects public colleges and universities, we constrain

our analysis to the public 2- and 4-year sectors. With this data, we created a balanced panel dataset (described in more detail below) incorporating the years 2000–2010. Our study compares public colleges in Colorado to public colleges from other states, resulting in a sample of 394 public 4-year institutions and 766 community colleges (n = 1,060). Within Colorado, there are 10 public 4-year institutions and 13 community colleges in our sample (n = 23). We utilize the 2000 Carnegie Classification to disaggregate our institutional sectors, where we exclude all administrative units, specialized institutions (i.e., Air Force Academy), and Tribal Colleges from the sample due to their unique relationships with state policy. Aims Community College and Colorado Mountain Community College are not subject to the COF policy, so they are also excluded from our analysis.

Outcome Variables

Since Colorado's stated policy goals are to improve institutional cost efficiency and to expand college access, we identify several outcome variables that allow us to explore these goals from multiple angles. Our first set of outcomes address the state's efficiency goals, where we examine:

1. Cost of delivering education per full-time equivalent (FTE) undergraduate;
2. Cost per completion; and
3. Number of completions per 100 FTE undergraduates.

Completions are measured by the total number of degrees, certificates, or other awards conferred during the academic year. The first two "efficiency" outcomes focus on cost efficiency while the third outcome addresses degree productivity. We chose these outcomes because state policymakers specifically addressed concerns about cost efficiency and degree productivity in their policy deliberations, but the higher education finance literature also suggests these are among the most important metrics to guide state and institutional financial planning efforts (Desrochers et al. 2010). Accordingly, we utilize Education and Related (E&R) expenditures in our cost models, which accounts for spending on teaching, student services, and general support and maintenance that contribute to the institution's educational mission (Desrochers et al. 2010).

The second set of outcome variables address to the state's access goals by measuring enrollment patterns for low-income and underrepresented minority students. Here, we use three additional outcomes:

1. Number of undergraduates receiving federal grant aid;
2. Number of undergraduates who are African American; and
3. Number of undergraduates who are Hispanic.

The federal grant aid outcome is a proxy for "low-income" status since the majority of federal grant aid is delivered via the Pell grant program (College Board 2012), which is targeted to students from low- and moderate-income families (U.S. Department of Education 2011). This variable is only available for full-time first-year students, so we suspect it under-estimates the actual number of low-income student enrollments, particularly in the community colleges. Nevertheless, these conservative estimates identify the number of students who are eligible for need-based aid across the two sectors. The racial/ethnic variables focus exclusively on African American and Hispanic students because several debates leading up to the policy adoption emphasized the importance of improving educational opportunities for these two racial/ethnic groups (WICHE 2009). We converted

these enrollment figures to their natural logs, thus allowing us to interpret results as elasticities (Becker 1990; Clotfelter 1992).

Control Variables

To account for variations among each institution's financial and enrollment profile, we include a series of control variables in our models. These controls are not displayed in our main regression tables due to space constraints; however, Table 2 displays summary statistics. We control for published in-state tuition and fees since this is likely to impact student enrollment demand (Heller 1999; Hemelt and Marcotte 2011). Additionally, our outcomes are likely a function of the institution's enrollment size since larger institutions may be able to achieve greater levels of cost efficiency than smaller institutions (Martin 2005); and larger state schools may be less accessible for low-income and minority students (Gerald and Haycock 2006). Campuses that primarily serve undergraduate students (rather than graduate students) and that enroll large shares of part-time students may also experience differences in terms of cost efficiency and access, so we include these control variables in our models. As discussed later, we also include institutional and year fixed effects to account for unobserved heterogeneity.

## Analytical Technique

Because COF was a state-level mandate beyond the direct control of each college, the new policy provides a plausible source of exogenous variation that may cause public colleges to respond to this intervention. As a result, the introduction of COF can simulate a natural experiment where we are able to observe changes in our outcome variables before and after the policy was introduced. These differences can then be compared against differences in outcomes that occurred among similar sets of colleges in other states that were never subject to the policy intervention. This counterfactual design is implemented via the difference-in-differences regression technique:

$$y_{it} = \alpha + \beta_1(treat) + \beta_2(post) + \beta_3(treat \times post) + \gamma_i + \eta_t + controls_{it} + \varepsilon_{it}$$

where y is the outcome, $\alpha$ is the intercept, (treat) is a dummy variable for Colorado institutions subject to COF, (post) is the years after the policy was introduced and the interaction between the two (treat × post) is the key variable of interest as it represents the impact of COF at these colleges. The variable $\gamma_i$ accounts for the institution-level (i) fixed effects that are relatively stable over time and are correlated with our controls, but that are unobserved in our model; and $\eta_t$ represents year (t) fixed-effects that account for unobserved factors that affect all institutions in each year (i.e., recessions, changes to federal aid policy, etc.).

The variable, $controls_{it}$, represents a vector of control variables discussed in the previous section and $\varepsilon_{it}$ is the error term. We initially ran the model with no controls, but adding them improved the explanatory power of the model while not biasing the parameter estimates of the average treatment effects. In previous iterations of our analysis, we also controlled for observable state-level demographic and economic conditions (e.g., unemployment rates, number of high school graduates, gross state product per capita) in addition to these institutional controls. The inclusion of this information introduced redundancy into the model without changing the results, so we opted to exclude these from the current study. We

conducted a Wooldridge test (see Drukker 2003) to assess whether the error term is serially-correlated over time; the test positively identified this to be the case. Accordingly, we implement the Prais-Winsten technique that adjusts standard errors for autocorrelation and panel heteroskedasticity (Greene 2011). Finally, our Hausman tests confirmed that fixed effects estimates are preferable to random effects in each of our models.

## Robustness Checks

We can never observe the counterfactual of what *would* have happened to Colorado colleges if the state had never adopted the policy, but by utilizing various comparison groups within the difference-in-differences design we can identify plausible scenarios of what *could* have occurred in the absence of the policy. Under this counterfactual design, it is important that the comparison and treatment groups follow similar patterns on the outcome variable during the pre-treatment years; ideally, these patterns will be perfectly parallel, but this is difficult to accomplish in quasi-experimental studies (Blundell and Costa Dias 2000). To test the robustness of our results, we run our models using four different comparison groups (Meyer 1995), described below.

### Geographic Comparisons

The first two comparison groups are determined according to geographical boundaries, a strategy that higher education scholars commonly use within the difference-in-differences design (Dynarski 2000; Flores 2010; Zhang and Ness 2010). Under this approach, we compare Colorado institutions against public 4- and 2-year institutions from the seven states that share a state boundary with Colorado. This group ("Neighbor States") yields 36 4- and 73 2-year institutions. While neighboring states may share some similar demographic and regional characteristics as Colorado, it would be incomplete to rely solely on these seven states as the only comparison group for Colorado. It is plausible that other states offer a more policy-relevant set of counterfactuals, so we expand the geographical boundary beyond bordering states to include states that are members of the Western Interstate Commission for Higher Education (WICHE). This second comparison group yields 70 public 4-year institutions and 172 community colleges from 14 Western states, excluding Colorado. We believe these first two comparison groups offer practical comparisons for state policymakers, yet we also believe institutions from other TEL states could also serve as relevant comparisons.

### TEL Comparisons

Although no states have adopted their own version of Colorado's voucher model, policy diffusion literature suggests that other states may follow Colorado's lead (Berry and Berry 1990; Karch 2007; McLendon and Cohen-Vogel 2008). It is plausible that higher education policymakers in other states with TEL's may eventually follow Colorado's lead by introducing vouchers as a way to circumvent their own state's tax and expenditure limitations. In addition, TEL states tend to have slower economic growth and lower levels of budgetary growth than non-TEL states (Deller et al. 2012; New 2010), making them a logical comparison groups since they operate under somewhat similar spending and revenue constraints as Colorado. Following this reasoning, we introduce two additional comparison groups: one that includes all states subject to TEL policies during the period of

our study, and one that includes all "Non-TEL" states. To identify TEL states, we utilized the National Conference on State Legislatures' 2010 state tax and expenditures limits report (Waisanen 2010). Within this group, there are 193 public 4-year institutions and 434 community colleges from which to compare Colorado institutions. The "Non-TEL" states results in 191 and 319 public 4- and 2-year institutions, respectively. Four states (IN, ME, OH, WI) adopted TEL policies during the period under investigation, making it difficult to determine which comparison group they most naturally belong to; results do not change systematically when they are included/excluded from either group, so we exclude them in the interest of parsimony.

## Limitations

Our study is limited in the following ways. First, we are careful to note that the implementation of COF was coupled with two other policy changes (fee-for-services and performance contracts) that were included in SB 04-189. While the COF voucher serves as the hallmark feature of the state's policy reform and makes up the majority of funding, we acknowledge that fee-for-services and performance contracts may play important roles in the state's new market-based financing model. Even with this context in mind, it is possible that some of the effects are at least in part a function of these other policy components (i.e., the entire "treatment package"). To the extent this is the case, results should be viewed as the combined effect of the three policy changes as they were implemented simultaneously.

Second, even within the quasi-experimental framework there is a chance that unobserved heterogeneity can introduce bias into our parameter estimates. While we believe the difference-in-differences design, our various control variables, and fixed-effects considerably reduce this bias, it is important to note that other unobserved factors could still be correlated with the error and the outcomes. For instance, it is possible that some colleges are more (or less) successful at implementing the new COF policy, which in turn could yield different outcomes at these institutions (Prescott 2010). If some colleges have administrative challenges when processing students' vouchers, this could result in differential effects on any of our outcome variables. Similar unobservables may still be present in our analysis, so perhaps case studies and further research could explore these implementation issues (and the possibility of heterogeneous effects) in more detail. Lastly, it is also possible that the policy did not make immediate impacts during the first few years of implementation. We only examine the first 5 years of implementations, so it is possible that our estimates could change over time as colleges (and students) adapt to this new financing model.

These are important limitations to take into account when interpreting the results from this analysis, so we are careful not to over-state the impacts of this policy reform. As Smart (2005) notes, knowledge in a field or on a specific topic is cumulative, built up through multiple studies and perspectives over time. We interpret our key findings in this study as a single contribution to understanding the short-term effects COF had on college efficiency and access, grounded in the broader literature on vouchers and market mechanisms. Certainly, additional perspectives on postsecondary vouchers are needed.

## Key Findings

Table 1 displays Colorado's enrollment and financial trends during the 5 years before and after introducing COF. Prior to COF, public 4-year (2-year) colleges enrolled

approximately 8,600 (2,800) undergraduate FTEs; enrollments grew by 8.2 % (11.0 %) in the years following COF. Similarly, the total number of completions grew in both sectors, with community colleges enrolling low-income and minority students at faster rates than the 4-year sector during the post-COF years. In the years after COF, low-income and minority enrollments grew in both sectors (between 13 and 19 %) with community colleges experiencing the largest changes after the policy. Completions also rose in both sectors, with community colleges growing at a more rapid rate than 4-year colleges. Notably, E&R expenditures increased by approximately 8 % in the 4-year sector, but dropped 1 % among community colleges. This suggests community colleges became more diverse and enrolled more students after COF, but had fewer financial resources to serve these students (Table 2).

Table 1 generalizes the enrollment and spending patterns taking place in the state pre and post COF, but were these trends driven by the introduction of COF, or were there other contemporaneous trends occurring at the institutions or across the nation? The regression results help disentangle this question, where we find mixed evidence regarding the impacts of COF. Tables 3 and 4 provide regression results for the average treatment effect of COF, disaggregated by four different comparison groups: neighboring states, WICHE states, TEL states, and non-TEL states. Across these four groups, we are curious to see if patterns consistently emerge where results are robust regardless of which comparison group we examine. Our goal is not to identify the "best" comparison group; rather, we examine the extent to which our results demonstrate consistent patterns across multiple counterfactuals. In quasi-experimental research, these falsification tests are critical to building a body of evidence regarding the impacts of a policy intervention (Cook and Campbell 1986).

When only one comparison group yields a statistically significant result, then we note this as "limited" evidence of the policy's impacts. If two or three groups are significant, then this provides stronger evidence of COF's impacts on efficiency and access. And if all four comparison groups yield statistically significant results for a given outcome, then this provides the strongest evidence to support our conclusions regarding the impacts of COF. Alternatively, the lack of significant findings can provide a narrative regarding the impacts

**Table 1** Institutional means for efficiency and access measures, pre and post COF

|  | Pre-COF | Post-COF | Change (%) |
|---|---|---|---|
| *Four-year colleges* | | | |
| Undergraduate FTE | 8,627 | 9,331 | 8.2 |
| Total completions | 2,053 | 2,316 | 12.8 |
| Total E&R expenditures (1,000s) | $101,549 | $110,014 | 8.3 |
| Low-income enrollment | 329.0 | 388.7 | 18.2 |
| African American enrollment | 318.4 | 372.1 | 16.9 |
| Hispanic enrollment | 995.4 | 1,132.1 | 13.7 |
| *Two-year colleges* | | | |
| Undergraduate FTE | 2,793 | 3,100 | 11.0 |
| Total completions | 623 | 846 | 35.7 |
| Total expenditures (1,000s) | $22,990 | $22,753 | −1.0 |
| Low-income enrollment | 161.0 | 190.6 | 18.4 |
| African American enrollment | 290.8 | 342.9 | 18.0 |
| Hispanic enrollment | 749.2 | 891.5 | 19.0 |

**Table 2** Descriptive statistics (standard deviation) of variables used in regression models

| | Public 4-year institutions | | | | | Public community colleges | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | CO | Neighbor | WICHE | TABOR | Non-TABOR | CO | Neighbor | WICHE | TABOR | Non-TABOR |
| Cost (in 1,000s) per FTE | 10.7 (2.9) | 12.5 (3.7) | 14.6 (4.3) | 14.8 (5.2) | 13.7 (4.0) | 8.7 (2.0) | 9.3 (2.5) | 10.3 (6.2) | 10.2 (4.6) | 10.2 (3.4) |
| Cost (in 1,000s) per completion | 46.5 (6.8) | 48.2 (12.3) | 54.5 (17.3) | 55.9 (18.1) | 56.7 (19.7) | 35.9 (15.6) | 46.7 (21.6) | 60.6 (50.0) | 54.2 (101.9) | 44.7 (18.5) |
| Completions per 100 FTE | 23.0 (5.4) | 26.3 (5.5) | 27.6 (6.5) | 27.1 (6.6) | 25.2 (6.9) | 27.0 (9.3) | 24.3 (15.1) | 20.9 (11.7) | 22.4 (10.9) | 26.0 (12.9) |
| Low-income enrollment | 361.6 (186.2) | 420.6 (352.3) | 507.2 (382.2) | 568.9 (662.7) | 485.5 (1,134.8) | 177.2 (122.8) | 223.8 (197.4) | 223.3 (259.4) | 275.1 (319.3) | 289.5 (378.0) |
| African American enrollment | 347.7 (324.8) | 481.9 (584.8) | 545.1 (716.8) | 1,525.1 (1,931.6) | 1,460.2 (4,290.7) | 319.2 (447.7) | 316.1 (410.8) | 761.7 (1,872.2) | 971.1 (1,749.7) | 752.9 (1,313.3) |
| African American enrollment | 1,070.0 (748.6) | 775.9 (1,327.4) | 1,895.8 (2,427.1) | 1,688.8 (5,156.8) | 573.4 (3,698.9) | 826.8 (688.1) | 940.5 (1,638.2) | 2,590.5 (5,247.7) | 1,589.3 (4,111.4) | 326.6 (797.2) |
| In-state tuition and fees (in 1,000s) | 4.1 (1.2) | 3.7 (1.1) | 4.2 (1.4) | 4.8 (2.0) | 5.3 (1.9) | 2.3 (0.3) | 2.2 (1.4) | 1.8 (1.4) | 2.2 (1.3) | 3.3 (1.7) |
| Undergraduate FTE (in 1,000s) | 9.0 (7.5) | 8.6 (8.4) | 10.4 (7.6) | 10.7 (10.9) | 8.1 (11.3) | 3.0 (2.3) | 3.5 (3.4) | 6.2 (7.3) | 4.9 (5.6) | 3.4 (4.2) |
| Share of undergraduates enrolled part-time | 20.3 (11.8) | 23.8 (11.6) | 22.9 (11.7) | 20.7 (10.5) | 19.9 (14.2) | 66.5 (9.2) | 62.4 (13.4) | 63.2 (14.9) | 60.2 (11.7) | 54.5 (15.1) |
| Undergraduates share of total enrollments | 84.0 (18.8) | 83.7 (9.3) | 84.9 (9.1) | 83.9 (8.9) | 86.0 (9.5) | 100.0 (0.0) | 100.0 (0.0) | 100.0 (0.0) | 100.0 (0.0) | 100.0 (0.0) |
| Federal grant aid per FTE (in 1,000s) | 1.0 (0.5) | 1.3 (0.5) | 1.3 (0.5) | 1.2 (0.6) | 1.2 (0.9) | 1.4 (0.7) | 1.3 (0.5) | 1.1 (0.6) | 1.4 (0.7) | 1.5 (0.8) |
| Institutions | 10 | 36 | 70 | 193 | 201 | 13 | 73 | 172 | 434 | 332 |

**Table 3** Regression estimates of treatment effect on various policy outcomes (public 4-year)

|  | Neighbor | WICHE | TABOR | Non-TABOR |
|---|---|---|---|---|
| *Efficiency* |  |  |  |  |
| 1. Cost (in 1,000s) per FTE | −0.427** (0.207) | 0.117 (0.218) | −0.216 (0.272) | −0.092 (0.224) |
| 2. Cost (in 1,000s) per completion | −2.423** (1.156) | 0.073 (1.109) | −1.247 (1.047) | −2.318* (1.217) |
| 3. Completions per 100 FTE | −0.001 (0.401) | 0.219 (0.365) | 0.083 (0.459) | 0.713 (0.586) |
| *Access* |  |  |  |  |
| 4. Low income enrollment (logged) | 0.080* (0.045) | 0.027 (0.040) | 0.002 (0.040) | 0.040 (0.038) |
| 5. African American enrollment (logged) | −0.039 (0.038) | −0.096*** (0.036) | 0.010 (0.034) | −0.022 (0.034) |
| 6. Hispanic enrollment (logged) | −0.137*** (0.025) | −0.150*** (0.025) | −0.137*** (0.025) | −0.188*** (0.029) |
| Observations | 506 | 880 | 2,233 | 2,211 |
| Groups (institutions) | 46 | 80 | 203 | 201 |
| Controls | Yes | Yes | Yes | Yes |
| Institution fixed-effects | Yes | Yes | Yes | Yes |
| Year fixed -effects | Yes | Yes | Yes | Yes |
| *Model $R^2$* |  |  |  |  |
| 1. Cost (in 1,000s) per FTE | 0.876 | 0.901 | 0.902 | 0.875 |
| 2. Cost (in 1,000s) per completion | 0.684 | 0.780 | 0.816 | 0.792 |
| 3. Completions per 100 FTE | 0.817 | 0.854 | 0.851 | 0.864 |
| 4. Low inc. enrollment (logged) | 0.892 | 0.954 | 0.888 | 0.913 |
| 5. Afr. Amer. enrollment (logged) | 0.974 | 0.975 | 0.982 | 0.981 |
| 6. Hispanic enrollment (logged) | 0.988 | 0.989 | 0.986 | 0.959 |

Panel corrected standard errors in parentheses, *p* values * <0.1, ** <0.05, *** <0.01

of a policy intervention. If COF has no significant patterns across all four comparison groups, then we conclude that the policy had null effects on that particular outcome.

Regression results are displayed in Tables 3 and 4, where we provide the parameter estimates for the key variable of interest (*Treatment × Post*). This variable represents the average effect of the policy on public 4- and 2-year outcomes in Colorado. Table 3 offers results for the 4-year sector, while Table 4 provides results for community colleges. For each sector, we model six outcomes (three for efficiency measures, three for access measures) and we disaggregate the findings by the four comparison groups. Each model includes control variables and fixed effects, as described previously, but we do not display these results due to limited space (available upon request).

Impacts on Efficiency

Our analysis produced fairly consistent results indicating efficiency gains across our measures for the community colleges, but not for the 4-year colleges. Some contextual information may help explain these differences. On average, Colorado's public 4-year

**Table 4** Regression estimates of treatment effect on various policy outcomes (community college)

|  | Neighbor | WICHE | TEL | Non-TEL |
|---|---|---|---|---|
| *Efficiency* | | | | |
| 1. Cost (in 1,000s) per FTE | −1.171*** | −1.537*** | −0.885*** | −0.598*** |
|  | (0.206) | (0.242) | (0.215) | (0.217) |
| 2. Cost (in 1,000s) per completion | −5.116** | −9.657*** | −5.020 | −7.077*** |
|  | (2.090) | (2.567) | (3.837) | (1.891) |
| 3. Completions per 100 FTE | 2.128* | 2.699*** | 3.082*** | 2.78*** |
|  | (1.215) | (0.981) | (0.927) | (0.935) |
| *Access* | | | | |
| 4. Low income enrollment (logged) | −0.108** | −0.223*** | −0.197*** | −0.093* |
|  | (0.053) | (0.056) | (0.047) | (0.049) |
| 5. African American enrollment (logged) | 0.02 | 0.123** | 0.107** | −0.022 |
|  | (0.057) | (0.057) | (0.054) | (0.056) |
| 6. Hispanic enrollment (logged) | −0.139*** | −0.093*** | −0.218*** | −0.313*** |
|  | (0.027) | (0.027) | (0.029) | (0.033) |
| Observations | 946 | 2,035 | 4,917 | 3,652 |
| Groups (institutions) | 86 | 185 | 447 | 332 |
| Controls | Yes | Yes | Yes | Yes |
| Institution fixed-effects | Yes | Yes | Yes | Yes |
| Year fixed -effects | Yes | Yes | Yes | Yes |
| *Model $R^2$* | | | | |
| 1. Cost (in 1,000s) per FTE | 0.777 | 0.813 | 0.767 | 0.774 |
| 2. Cost (in 1,000s) per completion | 0.673 | 0.560 | 0.137 | 0.562 |
| 3. Completions per 100 FTE | 0.562 | 0.614 | 0.682 | 0.667 |
| 4. Low inc. enrollment (logged) | 0.796 | 0.814 | 0.822 | 0.842 |
| 5. Afr. Amer. enrollment (logged) | 0.950 | 0.949 | 0.961 | 0.945 |
| 6. Hispanic enrollment (logged) | 0.979 | 0.979 | 0.967 | 0.938 |

Panel corrected standard errors in parentheses, *p* values * <0.1, ** <0.05, *** <0.01

colleges and universities spend approximately $10,700 in educational and related services per undergraduate FTE. In community colleges, this value is slightly lower at $8,700 per FTE; see Table 2 for descriptive statistics. Two trends are necessary to highlight in order to understand the efficiency outcomes. First, the total amount of money spent on delivering education (E&R expenditures) grew at a very slow rate in the community college sector. Even before COF, Colorado community colleges spent less than colleges from other states; and after COF, this pattern held steady. On average, total E&R expenditures grew by only 1 % annually between 2000 and 2010 while other states averaged between 2 and 3 % annual growth rates. The second trend relates to enrollment patterns, where Colorado community college enrollment grew by approximately 40 % during these years. By holding expenditures flat while enrolling more students, it is no surprise that community colleges reduced the E&R expenditures per FTE. Prior to COF, average E&R expenditures per community college FTE was approximately $9,100; but after COF this had declined to approximately $8,400. Table 4 illustrates this finding, where expenditures per FTE declined by $598 (Non-TEL) to $1,537 (WICHE).

Expenditures grew at much a faster rate in Colorado's 4-year colleges, while their enrollment levels did not. As a result, the cost per FTE stayed relatively flat within this

sector; expenditures per FTE were approximately $11,770 prior to COF and averaged $11,790 after the policy took effect. As a result, we do not observe consistent patterns in our first efficiency measure (Table 3). Only one comparison group (neighboring states) yields a statistically significant impact in our 4-year model, suggesting there is only weak evidence that COF introduced greater efficiency in this sector. In the community college analysis, all four comparison groups yield statistically significant results, giving us much stronger evidence of the policy's impact on cost per FTE.

When shifting attention to the second measure of efficiency, *cost per degree completion*, a similar pattern emerges where negative impacts occur more systematically among community colleges. Community colleges already spend the lowest per FTE (discussed above), but they also spend the lowest per completion. The average cost per community college completion is approximately $35,900 and after COF, this declined even further (Table 4). Three comparison groups yield statistically significant and negative coefficients on this measure, while public 4-year colleges experience significant results in two groups. In both sectors, there is moderate evidence that COF impacted costs per completions. In the 4-year sector, where it costs approximately $46,500 per completion, the policy reduced expenditures per FTE by approximately $2,400. Interestingly, the magnitude was greater (and with more variation) in the community college sector depending upon which comparison group is examined. It is important to note that most community colleges completions are categorized as awards (rather than degrees), which often can be completed in less than 2 years. While our goal was not to disentangle the two types of completions in this analysis, we remind readers that our completion data includes both awards and associate's degrees.

As discussed earlier, increasing the number of total completions relative to the number of enrollees is one way to increase efficiency. This brings us to the third efficiency measure, *completions per 100 FTE*, where Colorado colleges produce an average of 23 and 27 completions per 100 undergraduate FTE's in the 4- and 2-year sectors, respectively (Table 2). The regression coefficients demonstrate that after the introduction of the policy, these rates significantly increased for community colleges where they now produce between two and three more completions per undergraduate after the new policy. These patterns hold up across all four comparison groups, offering strong evidence of the policy's impact on this outcome measure. In the 4-year sector, however, there was no systematic pattern across the four comparison groups, suggesting COF made no impacts on this outcome measure. We will discuss these findings, among others, in the following section.

Taken together, COF appears to reduce the cost of delivering education at community colleges, and increase efficiency in terms of completions per 100 FTE. This is likely due to the sector's flat expenditure levels coupled with rising enrollment and completion levels. In only three of 12 instances did we find statistically significant relationships between COF and efficiency gains in the 4-year sector. Two of these were in the cost per completion model while one was in the cost per FTE model. We found no systematic patterns between COF and completions per 100 FTE in the 4-year sector. On the other hand, all but one of the 12 "efficiency" coefficients displayed in Table 4 were statistically significant in the community college sector. Since these findings are robust across all comparison groups, we believe COF made systematic impacts in the community college sector that were not experienced in the 4-year sector.

Early opponents of the policy worried community colleges would be impacted differently than 4-year institutions (Harbour et al. 2006) and our results provide evidence toward that end. Community colleges are now more "cost efficient" and they produce more graduates. However, with more students attending these colleges combined with relatively

low tuition levels, it not surprising to find efficiency gains because these colleges are now serving more students but with fewer resources. Meanwhile, the 4-year sector appears to have had fewer systematic changes in these efficiency outcomes, as we later discuss in greater detail.

Impacts on Access

Shifting our attention towards access outcomes, COF appears to have also impacted enrollment patterns for low-income, African American, and Hispanic students. Colorado's 2- and 4-year colleges enroll a relatively small number of students receiving federal grant aid; in fact, Table 2 indicates they serve fewer low-income students than do other states. While these initial enrollment levels are important to consider, we are more interested in how low-income enrollments changed (i.e., enrollment elasticity) after the policy took effect and in relation to other states. In the 4-year sector (Table 3), low-income enrollments rose by approximately 8 %, but a statistically significant patterns was only found in one model (neighboring states). There were no systematic enrollment differences for low-income students in the other three comparison groups. However, low-income enrollments reduced significantly in the community college sector after COF (Table 4). Across all four comparison groups, community colleges enrolled fewer low-income students than other states after the policy took effect.

When considering the policy's impact on enrollment trends according to students' racial/ethnic groups, more interesting patterns emerge in both the 4- and 2-year sectors. It is important to note Colorado colleges are slightly less diverse than colleges in other states, though this pattern is changing rapidly among the young adult population. For example, 69.7 % of the state's total population is classified as White non-Hispanic, while the US average is 63.4 % (U.S. Census Bureau 2013). But among young adults, approximately 23 % of the state's high school graduates are Hispanic and only 5 % are African American, compared to 19 and 14 % for the national averages, respectively (WICHE 2013). Despite the rapid growth in the state's Hispanic population, Colorado colleges tend to enroll smaller numbers of Hispanic students than other states. They also enroll smaller numbers of African American students, though both levels have been rising in recent years.

Similar to the low-income enrollment analysis, we are interested in determining whether enrollment levels for these two minority groups changed relative to other states after COF. In Table 3, we see that the introduction of COF is associated with negative impacts for both African American and Hispanic students within the public 4-year sector. For African American students, only one of the four comparison groups yield statistically significant results (WICHE), where the regression coefficient is negative, indicating that the policy reduced African American enrollments by approximately 9.6 % when compared against states that never adopted this voucher-based financing model. Since this variable was only found in one comparison group, we have limited evidence to suggest COF has negatively impacted African American enrollments in the public 4-year sector. A more systematic pattern emerges when shifting attention to Hispanic enrollment, where across all models the number of Hispanic students dropped in comparison with states that did not have a COF financing model.

Focusing on the community college sector (Table 4), we see a similarly clear pattern with Hispanic enrollments, where enrollments dropped significantly after COF and at larger magnitudes than what was found in the 4-year sector. This pattern is robust across all four comparison groups. Interestingly, African American enrollments followed a different

pattern in the community college sector than in the public 4-year sector; here, enrollments spiked after COF in two of the four comparison groups.

Among public 4-year colleges, five of the eight racial/ethnic access models yield negative and statistically significant patterns, providing evidence that the policy had negative impacts on college access for African American and Hispanic students. These negative impacts were primarily found among Hispanic students. Among community colleges, a more pronounced pattern emerges where six of the eight racial/ethnic diversity models yield significant impacts on African American or Hispanic enrollments. African American enrollments spiked up, while Hispanic enrollments declined relative to states that never adopted voucher-based financing models.

### Summary

Considering the results from the efficiency and access models, two key findings emerge. First, Colorado's COF policy has resulted in differential impacts between the 2- and 4-year sectors where community colleges have been most affected by this policy. This is particularly clear in terms of the costs of delivering education, as community colleges now spend less money per student yet more students are now earning credentials from this sector. Meanwhile, cost efficiencies at 4-year institutions have not been observed, yet these institutions have become less racially and ethnically diverse in the wake of COF.

Second, we found evidence that Hispanic student enrollments dropped in both sectors of higher education after COF. And while the 4-year sector had negative effects on African American enrollments, community colleges experienced a rise in African American enrollments. These efficiency and access findings are noteworthy because they suggest Colorado's market-based reform may not have achieved each of its original goals. It appears to have increased cost efficiencies within the community college sector, and only moderately impacted efficiencies in the 4-year sector. These have come at the expense of reduced access for low-income and minority students. The COF reform does not appear to have expanded college access in systematic ways; rather, it negatively impacted access for Hispanic and low-income students while increasing enrollment demand among African American students only in the community college sector. These conflicting outcomes will be discussed in more detail in the following section.

### Discussion and Conclusions

Colorado's desire to introduce market-based reforms into state higher education policy is not unique. States are continuously experimenting with financial reforms (i.e., performance funding, enterprise status, etc.) that are motivated by the idea that markets can improve educational efficiency and access. Interestingly, many of these efforts are undertaken with little to no empirical evidence that market-forces yield desirable educational outcomes (Fryar 2012).

Our study attempts to contribute to this research gap, as the Colorado experience provides unique insight into how market-based reforms effected cost efficiencies and enrollment patterns across the state's 2- and 4-year colleges.

Early proponents of Colorado's policy believed this reform would encourage colleges to become more cost efficient, especially in the 4-year sector where it costs the most to deliver education (Prescott 2010). By introducing market forces, their underlying theory of action posited that 4- and 2-year colleges would identify ways to deliver education at lower

costs. Our evidence suggests most of the state's cost efficiencies were realized in the 2-year sector, while 4-year colleges gained little to no efficiency. While it is beyond the scope of our study to examine "how" community colleges became more efficient after COF, we speculate that cost efficiencies were gained on the enrollment side of the efficiency equation. With more students matriculating in community colleges after COF, these open-access institutions may have responded by simply enrolling more students with the same amount of (and in some cases fewer) resources. Proponents may view this as a positive outcome since community colleges appear to be gaining economies of scale by delivering more education at lower costs. But considering research on the "community college penalty" and "undermatching," it is plausible that having more students attend community colleges without providing additional resources could slow down future educational attainment outcomes (Long and Kurlaender 2009; Bowen et al. 2009).

In terms of increasing total completions, there was no evidence of productivity gains in the 4-year sector; however, community colleges appear to have become more productive after COF. Across all four comparison groups, community colleges experienced higher completions (per 100 FTE) after the policy was implemented. While we did not disaggregate community college completions by *awards* versus *degrees*, it is possible that more students pursued awards (geared towards vocational education) after COF. If more students are now enrolling in award programs, which can be completed more quickly than degrees, then this could partly explain why total completions rose in this sector. Likewise, the community colleges may have altered internal policies and procedures in such a way that they a now doing a better job graduating their students. With this in mind, further research could explore the extent to which community colleges changed their production technologies because of COF.

Our focus on efficiency gains has emphasized findings from the community college sector. Public 4-year colleges also experienced some changes in cost efficiency, but these patterns were less systematic than what was found in community college sector. Considering how policymakers often point to 4-year colleges for their "out of control costs" (Johnstone 2001), we are curious why COF affected community colleges more than it did 4-year institutions. Instead, community colleges that already operate at low costs are most impacted by this policy. This seems to be an unintended consequence of the market-based reform, where community colleges are now doing even more with less and 4-year institutions are relatively unaffected by this change. This is problematic because community colleges serve traditionally underrepresented students, suggesting that COF disproportionately impacted the availability of educational resources for the state's least advantaged students, while leaving baccalaureate degree-seeking students unaffected. Glover and Levacic (2007) input–output framework of educational production draws our attention to an important aspect of considering what the effects of COF have been on community colleges and the students they serve: what is actually happening in the teacher/student relationship. The educative processes that occur within an institution can be thought of as the production technology that converts inputs into outputs. Although results from this study indicate that community colleges are graduating more students with fewer resources, it remains to be seen what effect, if any, COF has had on colleges' underlying production technology and the degree to which the gains that have been observed can be sustained over the long term. At some point, the gains in cost efficiency may negatively affect production. However, changes to the educative process are more likely a lasting source of efficiency and effectiveness.

This begs the question, why did the COF increase the cost efficiency of the community colleges and not the 4-year institutions? And why were most policy impacts found only

among the community college sector? Our analysis begins to address these questions, though further research would be required to fully understand why the policy had differential impacts for community colleges. We suspect one answer may be that the fee-for-service contracts dampened the impact of the COF stipends among the 4-year institutions in a way not experienced among the community colleges. In 2008, fee-for-service funding made up 55 % of the combined COF stipend and fee-for-service funds directed to the 4-year institutions. They made up only 18 % of those funds among the community colleges. This is important because institutions could count on the fee-for-service funds, while the COF funds depended on their enrollment levels (Colorado Commission on Higher Education 2008). Nevertheless, it might be easy to overstate the impact of the fee-for-service contracts in this regard. The funding was primarily directed to graduate education programs and very specific and specialized degree programs. Therefore, their overall impact on the outcomes assessed here may be limited. Furthermore, the 4-year colleges (especially the research universities) may have more diverse revenue streams, beyond the COF stipends and the fee-for-service contracts, which may have further damped the impact of the COF.

Shifting our attention to the access and enrollment impacts of COF, we again find differential impacts between the 2- and 4-year sectors. Proponents of COF argued market-based reforms would expand college access, but our findings suggest a more complicated picture. Despite the belief that SB 04-189 (2004) would create "flexibility for institutions [to] enhance more educational opportunities for low-income and other under-represented students," we find weak evidence that the policy has improved college access. Instead, 10 of the 16 access models we ran yielded negative and statistically significant impacts on minority enrollments. Our results show that fewer Hispanic students enrolled in both 2- and 4-year college after the policy and for African American students, 4-year enrollments dropped (in one case) while community college enrollments spiked (in two cases). Based on student price response theory, we suspect African American students may have decided to attend community colleges to avoid the state's higher priced 4-year colleges. Of course, more research would be needed to understand why these patterns occurred, but the balance of evidence outlined in this study found the policy negatively impacted minority enrollments.

Opponents of the COF proposal worried the policy change could limit college access since students would be required to opt-into the voucher program (Prescott 2010). Drawing from the research on the impacts of student financial aid, studies have consistently revealed that clear information, early awareness of eligibility requirements, and well-targeted subsidies can expand educational access, particularly among low-income and underrepresented minority students (Dynarski 2003; Goldrick-Rab et al. 2009; Scott-Clayton 2012). Since the voucher model can be confusing and cumbersome for students and institutions to navigate (Colorado Office of the State Auditor 2012), we suspect the opt-in component to be particularly problematic in terms of promoting college access. While the opt-in component may introduce complexity into the college-going process, the state audit (2012) also found the purchasing power of the voucher has declined substantially since 2005. This may have resulted in making college less affordable for students, likely for those who are from racial/ethnic minority or low-income families. We suspect this could be contributing to the growth in the share of students receiving federal aid (i.e., Pell) in the community college sector, but further research is necessary. Perhaps this is a combination of at least two factors: more students are now available for need-based federal aid and more low-income students are seeking out institutions where their vouchers have the greatest purchasing power. More research would be required to identify the extent to which this is the case, but

our results suggest that the policy change has a systematic relationship with changing the enrollment patterns of low-income and minority students. However, returning to Lindsay's (1982) definition of efficiency, which argues that one must consider inputs, outputs, *and* goal congruence, we speculate that increased efficiencies within the community college sector (i.e., more students graduated with fewer dollars spent), may not be congruent with the policy's and the sector's stated goals of serving more low-income and minority students.

Since there is limited research on the impacts of Colorado's voucher-based experience, our study set out to fill an important research gap related to the effects of state market-based higher education reforms. We hope this study encourages further inquiry into this topic, but we also hope it draws attention to important policy trade-offs that could emerge under market-based education reforms. Colorado's reform was driven by political ideology that advocated for vouchers as a solution to working around the state's tax and expenditure limitations problem. While it was successful in terms of circumventing the state's Taxpayer Bill of Rights, it may have been unsuccessful in terms of achieving other policy goals—namely, expanding educational access while simultaneously increasing cost efficiencies. While some observers may read these results as evidence of the policy's positive effects, we raised several concerns regarding the unintended consequences and trade-offs that could emerge from this reform effort. States considering similar educational reforms should look closely at Colorado's experience for guidance on how to design policies that do not tradeoff (either intentionally or unintentionally) one policy goal for another.

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