

The Effect of Institutional Variation on Policy Outcomes:  
The Case of Charter Schools in the States

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## **Abstract**

Many proponents of school choice use the claim of the market's capability to enhance efficiency and improve performance to call for its expansion. But no markets are perfectly competitive, and the local market for public goods is filled with institutional arrangements that make it differ from the neoclassical ideal. In this paper, we look at a particular legal arrangement and assess how it affects the ability of charter schools to gain market share. Using data from 37 states that have adopted charter schools as an education reform, we estimate a fully Bayesian model of the effects of various provisions in the charter laws on charter school density or market share. We find that barriers to entry built into state laws governing the issuance of charters have a strong effect on the growth of charter schools.

**Keywords:** Charter schools, education reform, state policy, Bayesian data analysis

## **Institutions and the Market for Education**

There are many types of school reform being implemented in the United States - and many of them expand choice. Charter schools fit into a pro-market, pro-competition agenda that structures many debates about how to reshape the way in which education is delivered. They are arguably the most popular way to expand choice employed by policy makers.

Appearing first in the early 1990s and growing virtually exponentially in market share, charter schools now play a prominent role in the nation's public education system: As of May 2003, there were almost 2,700 charter schools operating in 41 states (and the District of Columbia) educating over 684,000 students (Center for Educational Reform 2003a). As is well known, charter schools, are publicly funded schools of choice that typically have fewer restrictions and regulations governing their behavior. In return for this greater freedom, charter schools are supposed to be held more accountable for their performance.<sup>1</sup> Given their allure, charter schools have sparked serious scholarly debate. The mainstream of research in charter school reform focuses primarily on assessing the effectiveness of charter schools and on their propensity to innovate and experiment (e.g. Cheung et al., 1998; Henig et al., 1999; Wong et al., 2000; Gill et al., 2001).

Given their prominence in the debates over markets and education, it is not surprising that charter schools have been the center of another literature: the effect of charter school competition on the traditional public schools (Teske et al.2000; Maranto et al., 1998; Finn et al., 2000). It is this area, the broader market for education in which charter schools play a part, that is the focus of this paper. Specifically, we investigate

empirically the effects of variation of a particular set of institutions—chartering laws—on the market share of charter schools in the states.

The crux of the market argument for school choice, as espoused by supporters of charter initiatives (and school choice more broadly), is that once traditional public schools lose their monopoly control over enrollments they cannot lag behind charter schools (or any superior school) in the quality of the services they offer to parents as consumers. If they do, the market will punish them: they will lose their students to “better” schools and some of them may even be forced to close their doors.<sup>2</sup>

One of the cornerstones of market theory is the assumption that there are no barriers to entry that prevent the new, innovative schools of choice, such as the charters, from increasing their share of the market. In any real market however, as Porter (1980) points out, there are a variety of factors that might serve as barriers to entry, including the deliberate tactics of competitors, switching costs, customer loyalty, economies of scale, and government policy. Even economist Milton Friedman (1962) believes that due to market imperfections such as monopolies and neighborhood effects, government is essential in setting and enforcing the rules of the game. However, as he asserts in the example of medical licensure, the consequence of such a barrier to entry may be a reduction in both the quantity and quality of the service provided.

Although economic theories examining the relationship between supply and demand sides of regulation have been around for over thirty years (Stigler 1971; Posner 1974; Peltzman 1976; Hammond and Knott 1988, to name but a few), the issue of legal

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<sup>1</sup> For a discussion of the myriad types of choice reforms, see Schneider, Teske and Marschall 2000, or Mintrom (2000).

barriers to entry in schooling is an area that is not rich in quantitative analysis. Here we are particularly interested in government policy—in the form of charter school legislation—as the crucial institution that shapes the market for education.<sup>3</sup>

In the real institutional environment of educational choice it is manifestly not the case that neoclassical perfect competition exists (Henig 1994). For example, in their investigation of legal barriers to entry in California and Michigan, Wong and his colleagues (2000) find evidence that there is “a significant positive relationship between a supportive legal environment and charter school density.” Similarly, Teske et al. (2000) note that in differences in charter laws in the states they study lead to different perceptions of charter schools by school district officials and different attitudes toward adopting the innovations of the new schools. The common thread in this research is that the nature of the market is mediated by legal and political factors.

In this paper, we look at a particular legal arrangement—charter school legislation—and assess how it affects the ability of charter schools to gain market share.

### **The Importance of Charter Laws**

Charter laws, as institutions shaping policy outcomes, have several important dimensions that might matter to their market share:

#### *Multiple Sponsors*

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<sup>2</sup> For the genesis of this market-based argument applied to education, see the work of Milton Friedman (1955; 1962).

<sup>3</sup> Note here that we are not advancing the normative argument that a broad market for education is inherently desirable (or even that charter schools are necessarily beneficial).

The first of these is the number of sponsoring authorities allowed to grant charters. Proponents of charter schools argue that one of the most important differences among charter laws is whether a school board is a single chartering authority. This, they argue, inhibits the development of numerous independent charter schools. The researchers in the Center for Education Reform (CER) make this assertion and further report that 57% of charter schools operating in the 2000/2001 academic year were approved by entities other than a local school board. States with multiple sponsors have on average nearly eight times more charter schools than states with a single sponsoring authority (CER 2003b).<sup>4</sup>

The importance of multiple sponsors is also emphasized in the empirical literature on charter schools. In their study of charter schools in four cities, Teske et al. (2000) note that school and union officials in Massachusetts credit the dual nature of that state's chartering provisions with facilitating the expansion of charters. Similarly, in discussing the case of the struggle of "Margarita Ortiz" to gain approval for a charter school in Oakland, Fuller (2000) notes:

But the Oakland school board refused to grant a charter for a new middle school; it said no to Ortiz and her comrades. The board was caught up in its own bureaucratic aloofness and penned in by the teacher union that feared the emerging threat posed by the new charters. Ortiz then figured out that Sacramento's charter law provided more than one way to secede from the education establishment. So she went to the priest, the city's fledgling Latino leadership, and well-heeled conservatives who backed school choice. Together they moved the county education office to approve their license for liberation. (2000:2).

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<sup>4</sup> Even though this assertion may be true looking at the raw data, it is somewhat misleading to compare the number of charter schools in bigger states to their amount in smaller states. Our alternative below is to substitute charter school density, constructed by dividing the number of charter schools in a state by the number of all schools (public and private) in the same state, for this simple count of charter schools.

### *Caps on Total Number*

Another provision in the charter law that can have an obvious effect on the absolute number and density of charter schools is the limit on the total number of charters that can be granted. This is a common provision: only 12 out of the 37 charter laws we study<sup>5</sup> do not place a cap on the number of charter schools in the state/district, or on their number allowed per year. Note that we do not include a measure of caps in our statistical model, for reasons given below.

### *Allowable Applicants*

A third provision of charter laws that is possibly important for charter school market penetration is the presence or absence of limits on exactly who can charter a school—for example, are for-profit EMO's (educational maintenance organizations) allowed, or only non-profit groups, or only groups affiliated with the traditional public schools? One reasonable conjecture is that states that permit a larger number of individuals and groups both outside and inside the structure of public schools to apply for a charter will have higher charter school density than states that allow only public schools and their personnel to start charter schools.

### *Conversions*

Finally, charter schools can be either newly created or the existing public or private schools can be converted into charter schools. In 2000 all the states with charter laws allowed for the conversion of public schools to charter status, but only 10 allowed

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<sup>5</sup> With regard to the availability of the data, we examine the market for schooling in the year 2000.

private school conversions.<sup>6</sup> It is reasonable that states that allow for both types of conversions will have, on average, more charter schools than states that prohibit private schools conversions.

We now turn to an empirical test of the effects of these provisions of charter law on the market share of charter schools.

### **Data and Hypotheses**

To determine the effects of variation in charter laws on charter market share, we gather data from various sources. Our dependent variable is constructed using data on regular public schools, alternative public schools, charter schools and private schools collected by the National Center for Education Statistics (NCES).<sup>7</sup> We simply divide the number of charter schools by the total number of schools in the state to derive the market share.

For our key independent variables, measures of charter law provisions, we use the Center for Education Reform's annual rankings of charter laws according to their "strength."<sup>8</sup> In 2000, the CER asked a panel of charter school experts<sup>9</sup> to rank each state's charter laws on several dimensions.

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<sup>6</sup> In addition, Mississippi severely limits the new start-ups. Mississippi's charter law not only prevents private school conversions but it prohibits newly created charter schools as well. Thus, only public school can convert to the charter status.

<sup>7</sup> We obtained the number of charter schools from [nces.ed.gov/pubs2002/overview/table9.asp](http://nces.ed.gov/pubs2002/overview/table9.asp); the data for private schools are available at [nces.ed.gov/pubs2002/digest2001/tables/dt063.asp](http://nces.ed.gov/pubs2002/digest2001/tables/dt063.asp); alternative and regular public schools figures are reported at [nces.ed.gov/pubs2002/overview/table1.asp](http://nces.ed.gov/pubs2002/overview/table1.asp). We change the number of charter schools in Kansas because the NCES reports only one charter school for that state for 2000/2001 academic year. We know from other sources, such as the CER, that at that time at least four charter schools were operating in Kansas.

<sup>8</sup> Rankings are available for 1997 to the present from the CER's website at [www.edreform.org](http://www.edreform.org).

<sup>9</sup> These charter school experts are: Jeanne Allen, President, The Center for Education Reform and Bruno Manno, Senior Fellow with the Annie E. Casey Foundation and Adjunct Fellow with the Hudson Institute. These specialists were building upon the expertise of Linda Brown, Director, Pioneer Institute Charter

The panel created a scale ranging from 0 to 5 where the higher scores correspond to the environment that strongly supports the expansion of charter schools. Thus, if the state's provisions under a particular criterion were evaluated as 0 it indicates that in this state the development of charter schools is strongly restricted while the score of 5 suggests that charter schools have a high chance to flourish in a given state.

We use the CER's ranking of 37 charter school laws in existence as of April 2000 to construct several of our independent variables all of which range from 0 to 5, where the higher number corresponds to the law that is supportive of charter school creation:<sup>10</sup>

- *Sponsors* represents the ease of the process of granting charters. States that limit authorization to local school boards receive the lowest ranking. There are more points for having some entity other than local school board as a sole sponsor and for providing an appeals process. An advisory appeals process receives lower score than a binding appeals process but the burdensomeness of the process is taken into account as well. States with multiple chartering authorities get the highest score in this category. Our hypothesis is that, *ceteris paribus*, states with more chartering authorities reduce the difficulty, on average, of an applicant in getting chartered—thus increasing the charter school density.
- *Applicants* measures the variety of allowable charter schools applicants. The higher score is associated with a more diverse potential applicant pool. Thus, states that limit eligible applicants to public schools and public school personnel,

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School Resource Center; Chester Finn, President of the Thomas B. Fordham Foundation; and John M. Olin Fellow at the Hudson Institute who assisted with 1997 and 1998 ranking (CER 1998). The panel was asked to evaluate is not the original law but its amended (current) version along with the state board regulations, department of education policy, legal rulings and “the realities of actual implementation” (CER 2003).

received lower score than states that allow, for example, museums and other cultural institutions, or for-profit concerns, to start charter schools. Our *ceteris paribus* hypothesis here is that fewer restrictions on who can start a charter should predict more charter school market share.

- *Conversions* evaluates the process of starting charter schools with regard to whether new schools, conversions of the existing public schools and conversions of the existing private schools are allowed. The more venues there are in a state for the creation of charter schools, the higher is the score assigned to the law provision by the panel of experts. Here we predict that, all else equal, states that allow new start ups, public schools conversions and private school conversions encourage charter school activity more than do states that limit this set of options.

Finally, we include several additional variables in our model as controls:

- *Alternatives* measures the market share of alternative public schools and private schools. To construct this variable, we divided the sum of private and alternative schools in a state by the total number of schools in that state. In accordance with the market model, our hypothesis is that, on average, the larger is the share of private and alternative public schools in the state, *ceteris paribus*, the lower is the share of charter schools.<sup>11</sup>

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<sup>10</sup> The exception is our measure of caps—limits on charter enrollment percentage—that are modeled as percentages as well. As we note below, however, we do not include this measure in the present analysis.

<sup>11</sup> We thus are considering the market share of all alternatives to traditional public schools as a fixed quantity to be apportioned to the various types of alternatives—in other words, a zero-sum system in which private schools, charter schools, and others are all competing for the same “shoppers.” An alternative is that a larger private school market suggests a weaker “public school ideology” (Moe 2001) and thus predicts an increase in market share. We suspect, following the “marginal consumer” literature (e.g. Schneider, Teske, and Marschall 2000; 1997) that the former case is more likely.

- *Time* represents years that passed since the law was adopted. This variable ranges from 0 for Oklahoma and Oregon to 8 for Minnesota. Our hypothesis here is simply that the marginal effect of time is to increase, on average, the market share of charter schools.
- *Population* measures the total population of each state as reported in the 2000 U.S. Census.<sup>12</sup> We have no *a priori* expectation of the effect of population on market share, but include it as a control in both the mean and variance equations of the model discussed below.
- *Finance* measures state level per pupil expenditures.<sup>13</sup> We expect that the more money the state spends per child enrolled in the traditional public school the less willing are the sponsors, particularly school boards, to introduce competition by granting a charter. Conversely, as the fiscal health of a state's school system decreases, charters are more likely to seem a viable alternative.

## Statistical Model

We believe that our data require a statistical model that departs somewhat from the normal methods applied in studies of this type. There are two issues in particular: the limited nature of the dependent variable, and the fact that our data are not sampled from a hypothetical population, but instead represent the entire population under study.

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<sup>12</sup> [www.census.gov/population/cen2000/tab02.pdf](http://www.census.gov/population/cen2000/tab02.pdf)

<sup>13</sup> The source of the data is the U.S. Department of Education, National Center for Education Statistics, Common Core of Data: "National Public Education Financial Survey," 1999-2000; and "State Nonfiscal Survey of Public Elementary/Secondary Education," 1999-2000 ([nces.ed.gov/quictables/Detail.asp?Key=778](http://nces.ed.gov/quictables/Detail.asp?Key=778))

Regarding the first point, there is a growing literature on the modeling of percentages or proportions as dependent variables. Of particular note is Paolino's (2001) maximum likelihood model that assumes the variable is distributed beta, and then improves over earlier beta models by allowing independent equations for both a mean and dispersion effect.

On the second point, as a growing body of literature in comparative and state politics and policy (e.g. Western and Jackman 1994; Gill 2001; Buckley 2003b) argues, the logic of statistical inference based on an assignment of probabilities according to relative frequency (including the familiar least squares and maximum likelihood estimators) is philosophically questionable when applied to analyses when no random sampling is used. In studies of state policy such as the present one, every attempt is made to gather data on *all* units in the population. Given this fact, Gill (2001) proposes two solutions: present additional measures of variance and treat the estimates obtained as population parameters, or use a fully Bayesian analysis and present results not as point estimates with standard error but as marginal posterior distributions.

Here we adopt the latter approach and, following Buckley (2003a), estimate a fully Bayesian model analogous to Paolino's model for beta-distributed dependent variables.<sup>14</sup> Our model is:

$$\text{Market Share}_i \sim \text{Beta}(a_i, b_i) \tag{1}$$

where

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<sup>14</sup> Note that the issue of caps on the number of charter schools suggests that a censored beta model may be more appropriate. While this is a possibility for further research, in our data only one observation – [Utah](#) – has charter density equal to its cap. As the econometric literature on censored normal regression illustrates (e.g. Greene 1980), the bias induced by not modeling the censoring is quite small when few observations are censored.

$$a_i = \frac{(E(\text{Market Share}_i))^2 (1 - E(\text{Market Share}_i))}{\text{Var}(\text{Market Share}_i)} - E(\text{Market Share}_i) \quad (2)$$

and

$$b_i = \frac{E(\text{Market Share}_i)(1 - E(\text{Market Share}_i))^2}{\text{Var}(\text{Market Share}_i)} - (1 - E(\text{Market Share}_i)). \quad (3)$$

This specification allows us to express both the variance and the expected value (or mean) of the dependent variable using functions that allow for the modeling of linear combinations of covariates. In our case, the mean is given by:

$$E(\text{Market Share}_i) = \frac{\exp(\mathbf{X}\boldsymbol{\beta})}{1 + \exp(\mathbf{X}\boldsymbol{\beta})} \quad (4)$$

where the matrix of covariates,  $\mathbf{X}$ , includes all of the variables described above (plus a constant) and the vector of coefficients,  $\boldsymbol{\beta}$ , is the target of estimation. No interactions or nonlinear combinations are included.

The variance of market share, in turn, is given by:

$$\text{Var}(\text{Market Share}_i) = \frac{E(\text{Market Share}_i)(1 - E(\text{Market Share}_i))}{\phi_i + 1} \quad (5)$$

where  $\phi_i$ , the dispersion, is defined in terms of a different linear combination of covariates:

$$\phi_i = \exp(\mathbf{Z}\boldsymbol{\Phi}). \quad (6)$$

Here, we include only a constant, our measure of population, and our measure of finances in the  $\mathbf{Z}$  matrix, and are interested in estimating the vector  $\boldsymbol{\Phi}$ .

Since this is a Bayesian model, we must also place priors on the two coefficient vectors. We assume no meaningful prior information and thus assign each coefficient and

independent normal prior with mean 0 and large variance to model our *a priori* ignorance.

We estimate the model using the method of Markov chain Monte Carlo (MCMC)

simulation.<sup>15</sup>

## TABLE 1 ABOUT HERE

### Results

Results of the estimation of our model are presented in Table 1. The table shows both the empirically computed means and standard deviations (from the simulation results) of the posterior distributions for each coefficient, as well as the 95% highest posterior density (HPD) regions.<sup>16</sup> As the table shows, we find some support for our hypotheses about the major dimension of chartering laws: the posterior means for the measures of chartering authority (*sponsors*), who may apply (*applicants*), and whether existing schools can be converted (*conversions*) are all positive. Note however that in case of applicants and especially conversions, the 95% HPD's contain zero and some negative values.

We interpret these results as indicating strong support for our hypothesis about multiple sponsors, weak support for the effect for allowing more applicants, and essentially no effect of conversions. Note also that the results for the control variables are in accordance with our expectations—the posterior for the effect of time places most

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<sup>15</sup> We estimate the model using the free software package WinBUGS (Gilks, Thomas, and Spiegelhalter 1994; Spiegelhalter, Thomas, and Best 2000). The posteriors are simulated using the Metropolis-Hastings algorithm for 1 million iterations, following a 1 million iteration burn-in (the model tours the posterior space rather slowly). Note that following Paolino (2001), we also report as a measure of model fit what he

probability mass on the coefficient having a positive value, while those for finance and alternatives are mostly negative. The effect of population also has a posterior density with a negative 95% HPD.

FIGURE 1 ABOUT HERE

Since the substantive impact of the estimates reported in Table 1 is somewhat difficult to glean from the reported posteriors alone, we turn to the method of generating predictions via posterior predictive distributions (Gelman et al. 1995: 161-190). Specifically, we estimate posterior distributions of the effect of increasing the sponsor measure and the applicants measure, independently, from their minimum observed value (0) to their maximum (5), while holding all other covariates constant at their sample means. By using the posterior distributions estimated for the  $\beta$  and  $\Phi$  vectors, our predictions are true posterior densities (not point predictions) and can be interpreted as such. Figure 1 presents the results of both analyses. The posterior of the applicant effect has a positive mean (0.011), but a large standard deviation (0.017) and thus a relatively large 95% HPD ([-0.023,0.046]). The sponsor effect, on the other hand, has a positive mean (0.042) and smaller standard deviation (0.023) with a corresponding 95% HPD ([0.002,0.096]) that does not include 0.

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terms the mean squared error of the estimate, which is the mean of  $[E(\text{Charter Density}_i) - \text{Charter Density}_i]^2$ .

The complete code for the model is included in the Appendix.

<sup>16</sup> These 95% HPD's are sometimes used, especially by those unfamiliar with Bayesian data analysis, in a manner analogous to the more familiar confidence interval, with the difference being that one can actually make the statement that the probability of a given coefficient being equal to zero is equal to or less than 0.95.

Taking the mean of the posterior predictive density of the sponsor effect as a point estimate, allows us to state that increasing the sponsor measure from 0 to 5 while holding all other covariates constant at their means predicts, on average, an increase in market share of 0.042 or 4.2%. This is a substantively significant effect that suggests that the provision of charter laws regarding what bodies may sponsor them is important to overall charter market share.

## **Discussion**

“Institutions matter” is a familiar refrain in political science and policy studies, and it comes as no surprise that they matter in the case of school choice policy. The institutional environment that states create for their school choice initiatives (or, more accurately, the environment created by political conflict and compromise) can have a profound effect on the performance policies and programs, including market-based reforms. In our examination of the effect of charter school legislation on market share, we find that one particular set of provisions regarding who can grant charters has a substantial effect on their share of a market for education. This finding supports earlier qualitative research and anecdotal evidence suggesting that multiple sponsoring authorities enable charter school founders to avoid procedural or political obstacles occasionally erected by one authority.

Those applying the market model to even private goods must take into account the actual institutional arrangements, historical circumstances, and other factors that may make the market less than fully competitive. This point is even more germane in the case of public goods. Since at least 1990, with the publication of Chubb and Moe’s seminal

study of school choice, advocates of market-like approaches to school reform have been forced to pay at least superficial attention to how markets for schools might actually function. Our work shows that the concern for how public policies affect access to the local market for schools matters substantially. Consistent with economic theory that emphasizes the importance of barriers to entry, our findings suggest that actors who support or oppose the successful spread of charter schools as an educational alternative have, in the sponsorship provisions of charter legislation, a potentially powerful lever for affecting the market share of the charters. In turn, both proponents and opponents of charter schools are justified in focusing on this seemingly minor provision of charter laws.

## References

- Buckley, Jack. 2003a. "Estimation of Models with Beta-Distributed Dependent Variables: A Replication and Extensions of Paolino (2001)". *Political Analysis* 11(2): 204-205.
- Buckley, Jack. 2003b. *Advances in the Quantitative Empirical Analysis of Public Policy*. Unpublished doctoral dissertation, State University of New York at Stony Brook.
- Center for Education Reform. 1998. "Ranking Of Charter Legislation Released; California Jumps into the Top Ten, Mississippi Still Weakest in Nation, Four New States Join the Charter Ranks." Washington, D.C. Posted December 2, 1998. Accessed July 25, 2003.
- Center for Education Reform. 2003a. "CER Releases 8th National Charter School Directory. Some 2,700 Schools Serve Nearly 685,000 Students Nationally." <http://www.edreform.com/press/2003/csdirectory.htm>. Washington, D.C. Posted January 21, 2003. Accessed July 25, 2003.
- Center for Education Reform. 2003b. "Testimony Before the Maryland Senate Education, Health and Environmental Affairs Committee." Washington, D.C. Posted February 6, 2003. Accessed July 25, 2003.
- Cheung, Stella, Mary Ellen Murphy, and Joe Nathan. 1998. "Making a Difference? Charter Schools, Evaluation and Student Performance." Minneapolis, MN: Center for School Change.
- Finn, Chester E., Jr., Gregg Vanourek, and Bruno V. Manno. 2000. *Charter Schools in Action: Renewing Public Education*. Princeton, N.J.: Princeton University Press.

- Friedman, Milton. 1955. *The Role of Government in Education*. "Economics and Public Interest." R. A. Solo. New Brunswick, N.J., Rutgers University Press.
- Friedman, Milton. 1962. "Capitalism and Freedom." [Chicago], University of Chicago Press.
- Fuller, Bruce. 2000. "Introduction: Growing Charter Schools, Decentering the State." In Bruce Fuller (ed.). *Inside Charter Schools: The Paradox of Radical Decentralization*. Cambridge, Mass.: Harvard University Press.
- Gelman, Andrew, John B. Carlin, Hal S. Stern, and Donald B. Rubin. 1995. *Bayesian Data Analysis*. London: Chapman and Hall.
- Gilks, W. R., A. Thomas, and David J. Spiegelhalter. 1994. "A Language and Program for Complex Bayesian Modeling." *The Statistician* 43:169-178.
- Gill, Brian P., P. Michael Timpane, Karen Ross, and Dominic J. Brewer. 2001. "Rhetoric Versus Reality: What We Know and What We Need to Know About Vouchers and Charter Schools." Santa Monica, CA: Rand Corporation.
- Gill, Jeff. 2001. "Whose Variance is it Anyway? Interpreting Empirical Models with State-Level Data." *State Politics and Policy Quarterly* 1 (Fall):318-338.
- Greene, William. 1980. "On the Asymptotic Bias of the Ordinary Least Squares Estimator of the Tobit Model." *Econometrica* 48: 505-514.
- Hammond, Thomas, and Jack Knott. 1988. "The Deregulatory Snowball: Explaining Deregulation in the Financial Industry." *Journal of Politics*, 50: 3-30.
- Henig, Jeffrey. 1994. *Rethinking School Choice: Limits of the Market Metaphor*. Princeton; Princeton University Press.

- Henig, Jeffrey R., Michele Moser, Thomas T. Holyoke, and Natalie Lacireno-Paquet. 1999. *Making a Choice, Making a Difference? An Evaluation of Charter Schools in the District of Columbia*. Washington, D.C.: The Center For Washington Area Studies, George Washington University.
- Hill, Paul, Lawrence C. Pierce, and James W. Guthrie. 1997. *Reinventing Public Education*. Chicago: University of Chicago Press.
- Jackman, Simon. 2000. "Estimation and Inference via Bayesian Simulation." *American Journal of Political Science* 44(2): 375-404.
- Maranto, Robert Antony, Scott Milliman, Frederick Hess, and April Gresham. (1999). "Arizona Charter Schools and District Schools." In Maranto, Milliman, Hess and Gresham, eds. *The Frontiers of Public Education: Lessons From Arizona Charter Schools*. Boulder, Colorado: Westview.
- Mintrom, Michael. 2000. *Policy Entrepreneurs and School Choice*. Washington, D.C.: Georgetown University Press.
- Moe, Terry M. 2001. *Schools, Vouchers, and the American Public*. Washington, D.C.: Brookings Institution.
- Paolino, Philip. 2001. "Maximum Likelihood Estimation of Models with Beta Distributed Dependent Variables." *Political Analysis* 9(4): 325-346.
- Peltzman, Samuel. 1976. "Toward a More General Theory of Regulation." *Journal of Law and Economics* 19: 211-240.
- Peltzman, Samuel. 1989. "The Economic Theory of Regulation after a Decade of Deregulation." Brookings Papers: Microeconomics.
- Porter, Michael. 1980. *Competitive Strategy*. New York, NY: Free Press.

- Posner, Richard A. 1974. Theories of Economic regulation. *Bell Journal of Economics and Management Science* 5: 335-58.
- Schneider, Mark, Paul Teske, Christine Roch, and Melissa Marschall. 1997. "Networks to Nowhere: Segregation and Stratification in Networks of Information about Schools." *American Journal of Political Science* 41:1201-1223.
- Schneider, Mark, Paul Teske, and Melissa Marschall. 2000. *Choosing Schools: Consumer Choice and the Quality of American Schools*. Princeton, NJ: Princeton University Press.
- Spiegelhalter, David J., Andrew Thomas, and N. G. Best. 1999. *WinBUGS Version 1.2 User Manual*. Cambridge, U.K.: MRC Biostatistics Unit.
- Stigler, George. 1971. "The Theory of Economic Regulation." *Bell Journal of Economics and Management Science* 2: 3-21.
- Teske, Paul, Mark Schneider, Jack Buckley, and Sara Clark. 2001. "Does Charter School Competition Improve Traditional Public Schools?" In Paul E. Peterson and David Campbell (eds.) *Charters, Vouchers and Public Education*. Washington, D.C.: Brookings Institution Press.
- Western, Bruce and Simon Jackman. 1994. "Bayesian Inference for Comparative Research." *American Political Science Review* 88: 412-23.
- Wong, Kenneth, Francis Shen, and Gabrielle Novacek. 2000. "Institutional Effects of Charter Schools: Competition, Innovation, and Segregation." Presented at the 2000 Annual Meeting of the American Political Science Association, August 31-September 4, Washington, D.C.

## Appendix: WinBUGS Model

```
model{
  for (i in 1:n){

    m[i] <- b0 + b1 * rest[i] + b2 * popul[i] + b3 * finance[i]
    + b4 * time[i]+ b6 * conversions[i] + b7 * sponsors[i] + b8
    * applicants[i]

    disp[i] <- z0 + z1*popul[i] + z2*finance[i]

    phi[i] <- exp(disp[i])
    E[i] <- exp(m[i])/(1+exp(m[i]))
    V[i] <- E[i] * (1-E[i])/(phi[i]+1)
    a[i] <- (pow(E[i],2) * (1-E[i])/V[i])-E[i]
    b[i] <- (E[i] * pow(1-E[i],2)/V[i])-(1-E[i])
    p[i] ~ dbeta(a[i],b[i])
    d[i] <- pow(E[i]-p[i],2)

  }

  ## Priors
  b0 ~ dnorm(0, .0001)
  b1 ~ dnorm(0, .0001)
  b2 ~ dnorm(0, .0001)
  b3 ~ dnorm(0, .0001)
  b4 ~ dnorm(0, .0001)
  b6 ~ dnorm(0, .0001)
  b7 ~ dnorm(0, .0001)
  b8 ~ dnorm(0, .0001)
  z0 ~ dnorm(0, .0001)
  z1 ~ dnorm(0, .0001)
  z2 ~ dnorm(0, .0001)

  ## MSE
  mse <- mean(d[])

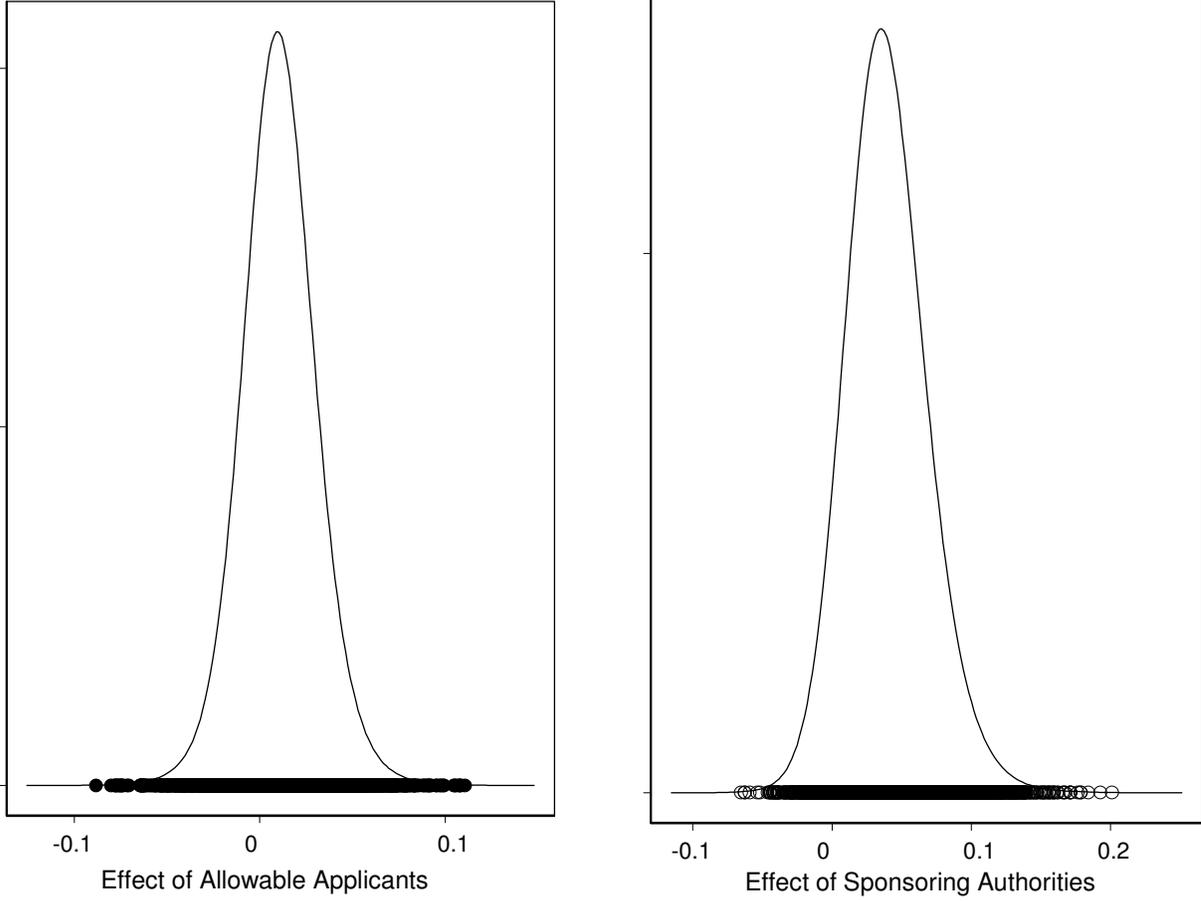
  ##Predictions: Sponsor Effect
  pm[1] <- b0 + b1 * mean(rest[]) + b2 * mean(popul[]) + b3 *
  mean(finance[]) + b4 * mean(time[]) + b6 *
  mean(conversions[]) + b7 *0 + b8 * mean(applicants[])

  pm[2] <- b0 + b1 * mean(rest[]) + b2 * mean(popul[]) + b3 *
  mean(finance[]) + b4 * mean(time[]) + b6 *
  mean(conversions[]) + b7 *5 + b8 * mean(applicants[])

  for (j in 1:2){
    pdisp[j] <- z0 + z1*mean(popul[])+ z2*mean(finance[])
    pphi[j] <- exp(pdisp[j])
    pE[j] <- exp(pm[j])/(1+exp(pm[j]))
    pV[j] <- pE[j] * (1-pE[j])/(pphi[j]+1)
    pa[j] <- (pow(pE[j],2) * (1-pE[j])/pV[j])-
    pE[j]
    pb[j] <- (pE[j] * pow(1-pE[j],2)/pV[j])-(1-
    pE[j])
    pp[j] ~ dbeta(pa[j],pb[j])
    pd[j] <- pow(pE[j]-pp[j],2)
  }
  sponseff<- pp[2]-pp[1]
}
```

<i>Variable</i>	<i>Posterior Mean (Standard Deviation)</i>	<i>95% Highest Posterior Density [2.5%, 97.5%]</i>
<i>Mean Model</i>		
Sponsors	0.423 (0.095)	[0.226, 0.618]
Applicants	0.179 (0.107)	[-0.036, 0.376]
Conversions	0.109 (0.167)	[-0.229, 0.418]
Alternatives	-0.751 (1.326)	[-3.212, 1.996]
Time	0.059 (0.044)	[-0.024, 0.153]
Population	-0.034 (0.008)	[-0.051, -0.019]
Finance	-0.221 (0.082)	[-0.356, -0.033]
Constant	-4.472 (0.786)	[-6.098, -3.071]
<i>Dispersion Model</i>		
Population	0.236 (0.080)	[0.079, 0.388]
Finance	0.040 (0.143)	[-0.245, 0.318]
Constant	3.065 (1.207)	[0.667, 5.419]
Mean squared error of the estimate	0.00048 (0.000049)	[0.00038, 0.00056]

**Table 1:** The table presents the results of the Bayesian beta regression, in the form of means, standard deviations, and 95% highest posterior densities computed empirically from simulation (1 million iterations of the Metropolis-Hastings algorithm after a burn-in of 1 million).



**Figure 1:** Comparing the posterior predictive densities for the effect of varying the applicants and sponsors measures, respectively, their full range (while holding all other covariates at their sample means) shows that the sponsor effect (mean 0.043, standard deviation 0.023) is substantively significant. The applicants effect (mean 0.011, standard deviation 0.017), however, is not. Results are kernel density plots computed from 30,000 MCMC iterations after the 2m iterations used to estimate the results in Table 1.