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THE POWER OF ATTENTION:
DO RANKINGS AFFEECT THE FINANCIAL RESOURCES OF PUBLIC COLLEGES?

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ABSTRACT

This paper investigates whether and how college quality rankings affect a key factor in the ranks measure of quality -- financial resources per student -- for public colleges. We show that when a public college is exogenously included in the U.S. News & World Report rankings educational and general expenditure per student increase by 3.2%. To fund the additional expenditure, state appropriations per student increase by 3.4 to 6.8%, while tuition is not responsive at all.

The state appropriation response may be realized in two potential channels: on the one hand, U.S. News rankings may allocate additional citizen attention to the issue of public college quality, and the increased attention steers more funding towards public colleges. On the other hand, college rankings may provide new information in addition to existing college guides. As the college quality beliefs of citizens are updated state governments may adjust funding accordingly. We find evidence in support of the first explanation.

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1 Introduction

A central assumption in the economics of information is that economic agents fully process all the information available. For example in Akerlof (1970), buyers do not observe the quality of a used car but they use price to infer the quality available on the market. Similar sophistication is assumed in studies regarding quality disclosure. The assumption of sophistication has lead empirical work on the responsiveness of consumers to disclosed information to be primarily concerned with accounting for consumers prior beliefs about product quality.[1] However, quality is often complex and thus costly to compute even when the information is available. When cognitive resources are scarce and the cost of processing information is high individuals may choose to not pay attention to the quality of a good at all times.[2] Quality disclosure can significantly reduce the cost of information processing for consumers by allowing simple head-to-head comparisons of measured quality. Thus, quality disclosure may also affect the provision of product quality through the allocation of limited attention. In this paper we ask, what is the effect of quality disclosure when some consumers are not already paying attention to quality?

College rankings present an ideal case to study the linkage between quality disclosure and public attention to quality issues. College education is a complex public good that is likely to directly or indirectly affect all citizens.[3] Given the facts that over 80% of college students are enrolled in public colleges and state appropriations are the largest source of revenue for public colleges the quality of public colleges is likely to be a key policy issue for state citizens. However, because college quality depends on many inputs and outputs it is difficult to compute in even in a very crude sense.

The computational difficulty presents a golden opportunity for media coverage. U.S. News and World Report (USNWR) magazine seized on this opportunity by publishing the first college rankings in the U.S., and has dominated the market ever since. Figure 1 shows clearly the large

[1] Many studies in this literature focus on whether the disclosed information yields a change in consumer priors (Jin and Sorensen (2006), Dranove and Sfekas (2007), and Chernew, Gowrisankaran, and Scanlon (2006)) or whether firms engage in behaviors that lead to changes in the disclosed information (Jin and Leslie (2003), and Dranove, Kessler, McLellan, and Satterthwaite (2004)).

[2] That individuals simplify complex information by only processing a subset of information in allocation of scarce attention was introduced to economics by Simon (1955). Recent experimental evidence in favor of a directed cognition model of individual information processing is provided by Gabaix, Laibson, Moloche and Weinberg (2006).

[3] See Moretti (2004) and Ciccone and Peri (2006) for recent estimates of the magnitude of human capital externalities due to higher education.

effect that the publication of the college ranking issue has had on USNWR newsstand sales. Before USNWR published its first rankings issue in 1983, there were no explicit numerical rankings of colleges.[4] Guidebooks such as Barron's Guide to Colleges provided only descriptive information concerning some attributes of college quality. By introducing explicit numerical rankings college by college, USNWR rankings dramatically increased the salience of college quality and therefore reduced the cost of information processing for state citizens.[5]

We examine whether USNWR ranking coverage affects a key factor in the UWNWR rankings measures of quality – financial resources per student – for public colleges.[6] The key issue we face in our empirical analysis is one of research design. When college quality is more valuable individuals are more likely to allocate limited attention to the issue of quality and the media is also more likely to publish college rankings. This feature makes it difficult to make causal statements about the effect of college ranking inclusion on college spending from a cross-sectional analysis.

To identify the effect of college rankings on the financial resources of colleges we take advantage of a large exogenous shift in the *scope* of the USNWR rankings in 1990. Specifically, we examine whether colleges exogenously added into the USNWR rankings increase their expenditure and revenue when they become subject to inclusion in the rankings, in comparison to colleges already in the rankings and colleges that are never in the rankings. Crucially for our research design, the expansion in scope satisfies two conditions: (1) exactly which colleges become newly included in the USNWR rankings in 1990 was based on pre-defined college characteristics, and (2) the timing of the rankings expansion was due to data availability to the USNWR and was not related to underlying changes in the attention to, or the value of college quality. Although the 1990 USNWR expansion applies to both public and private colleges, we focus on public colleges only, partly because public and private colleges differ greatly in their financial structure, partly because public colleges are much closely linked to public attention due to the involvement of state appropriations.

[4]See Bogue and Hall (2003) Chapter 3 for a more detailed history of college rankings before 1982.

[5]Every year USNWR sells over 2.2 million copies of its college ranking issue, driving its typical newsstand sales up by 40% and reaching an end audience of 11 million people (Dichev (2001)). With the annual sales of 700,000 copies of the related college guidebook, the USNWR rankings account for nearly half of the total market of 6.7 million copies of college guide publications. This is likely a conservative estimate, since it does not include the 8 million hits the USNWR website generates each year (Smith (2001)).

[6]USNWR rankings provides two incentives for colleges to increase expenditure per student: one is the 20% weight the USNWR algorithms puts on the total expenditure per full-time equivalent student (FTE), the other is the fact that a college can further improve its rankings by allocating the additional expenditure to other items covered by USNWR rankings (such as faculty salaries or faculty-student ratios).

Using college level data from 1987 to 1995 we find that inclusion in the USNWR ranking causes the public colleges to increase educational and general expenditures per student by 3.2%. Moreover, the expenditure response is funded by a 3.4% to 6.8% increase in state appropriations per student, while tuition is not responsive at all. These findings are consistent with a model of limited attention: if the USNWR ranking coverage increases citizen attention to the quality of the exposed colleges, the increased attention will result in more funding from the state government to improve college quality.[7]

While the salience of public college quality explains the observed response to USNWR rankings inclusion, there is another potentially important margin of response: prior updating. To disentangle the two potential explanations we look for evidence of differential responses indicated by attention allocation and prior updating. If the effect of USNWR inclusion is due to allocation of additional attention the response will be larger when more citizens begin paying attention in response to the rankings and smaller when more already pay attention. This is exactly what we find. We extend our simple model to allow for a prior updating response and show that prior updating can only explain the central findings if USNWR inclusion represents a *universal* negative shock to the prior of college quality. We also test differential response by prior-updating: if prior-updating is the main channel of action, state appropriation spending on public colleges should rise (fall) depending on whether USNWR delivers bad (good) news for a specific college relative to a major pre-USNWR college guidebook. We find no evidence in support of prior updating.

We see the broader contribution of the paper as twofold. First, our study provides additional evidence regarding the role of the mass media in the provision of public goods. Besley and Burgess (2002) show that public relief spending in India is more responsive to natural disasters when newspaper circulation is higher. Stromberg (2004) demonstrates that areas with access to radio received more relief funding during the great depression. Stromberg and Eisensee (2007) and Drury, Olson and Van Belle (2005) show that the salience of natural disasters increases public expenditure on humanitarian aid. Our findings that media affects the funding of public colleges due to the allocation of limited attention are in line with these results. Second, our study demonstrates that the disclosure of simplified information primarily acts through the allocation of limited attention and not additional information. This finding is complementary to recent

[7]The state appropriation response to USNWR rankings is also documented in anecdotal evidence: in 2000 the Republican Gov. James S. Gilmore III promised sustained budget increases to higher education so that colleges like Virginia Commonwealth University could realize its goal of moving from Tier 3 to Tier 2 in the USNWR rankings (Argetsinger (2000)).

studies on responses to the salience of tax rates (Finkelstein 2007, Chetty, Looney and Kroft 2007, Duflo, Gale, Liebman, Orszag, and Saez 2006) and the provision of simplified information (Hastings, Van Weelden and Weinstein 2007).

More narrowly speaking, our study contributes to a growing literature on the impact of USNWR college rankings. Prior studies have focused on the impact on the admissions market. For example, Monks and Ehrenberg (1999) and Pope (2006) examine how college admission outcomes respond to changes in a college's actual numeric ranking. By definition, a change of numeric ranking represents a piece of news on top of last year's rank, which leads to prior updating. But small changes in a college's numeric ranking are unlikely to generate significant attention to the overall issue of college quality. In comparison, focusing on whether a college is included in the USNWR rankings allows us to consider both attention change and prior updating. Out of the specific context of college rankings, our study is similar to Rezende (2007), who finds that an increase in the higher education accountability in Brazil has a positive effect on measures of faculty quality.

The rest of the paper is organized as follows. In the next section we discuss the background and conceptual framework. In section three we present the econometric specification and details of the data we use to conduct our analysis. The central results are presented in section four. Section five presents evidence on the importance of two mechanisms in explaining our findings. Section six concludes.

2 Background and Conceptual Framework

This section first discusses the background of USNWR college rankings, and then presents a simple model of public good provision when some citizens do not allocate attention to the quality of government services. After deriving testable implications from the limited-attention model, we contrast it with a model of prior-updating. Keeping both models in mind, we present the research design at the end of the section.

2.1 Background of USNWR College Rankings

The purpose of the USNWR college rankings is to provide the information necessary to allow meaningful comparisons of quality across colleges. At first glance this seems a simple enough task, but because college quality is such a complex good defining college quality based on easily comparable and observable measures is quite controversial.[8] An ideal measure of the quality of an undergraduate education would be the value added for a freshman completing his/her education at a given college. In practice a value-added approach is not implementable because: (1) output is difficult to measure due to the lack of data on post-education outcomes for each cohort of graduates at every college, and (2) high ability students sort into high quality colleges and therefore unbiased estimates of college and student-specific value added are very difficult to obtain. As a compromise, most existing measures of college quality focus on a long list of college inputs while assigning small weights to crude measures of output such as retention and graduation rates.[9]

The USNWR rankings are no exception. Table 1 describes the variables and weights used to compute the 1990 USNWR rankings. In addition to the survey measure of academic reputation (a 25% weight), four groups of college-level statistics were employed in the 1990 rankings: student selectivity (25%), faculty quality (25%), financial resources (20%), and student satisfaction (5%). Increases in state appropriations revenue affect the ranking of a college directly through increasing financial resources and indirectly through increasing faculty or student quality. Similar criteria were applied throughout the 1990s, although the definition of specific variables or specific weights may have changed from year to year in response to suggestions from colleges and education experts. One change in the measure of financial resources in 1992 was placing more weight on expenditures that are more directly related to instruction and student support.[10]

[8] See NORC (1997), Clarke (2000), and Dichev (2001) for an overview of the debate on how well USNWR rankings measure quality.

[9] To the best of our knowledge, the only exceptions are Princeton Review and the National Survey of Student Engagement (NSSE), both of which are based on surveys of student experience in college. See Pike (2004) for more details about the comparability between NSSE benchmarks and the USNWR rankings.

[10] According to the Integrated Postsecondary Education Data System (IPEDS), most educational and general expenditures can be decomposed into eight academic functions: (1) instruction, (2) research, (3) public service, (4) academic support (which includes library services), (5) student service, (6) institutional support, (7) operation and maintenance of plant, and (8) scholarships and fellowships. Since 1992, the USNWR has categorized these functions into two groups: the first group is comprised of instruction, academic support, student services and institutional support, the sum of which are calculated on the basis of per full-time-equivalent student. The second group includes research, public service, scholarships, and plant operation and maintenance (public service was added-in 1993). Unlike the first group, this second group is weighted by the proportion of undergraduate

2.2 Rankings and Public Higher Education Quality: Attention Effect

To understand how public good salience affects public good provision consider a static model where a citizen has an additively separable quasilinear utility function over two goods. Following Chetty, Looney, and Kroft (2007), we define one good as a public good H (higher education quality) and the other as a private good C. Citizens in a state are endowed with X units of the private good and a utility function of the following form:

$$u(C,H) = \left(\frac{1}{1-b}\right) C^{1-b} + \alpha \cdot H,$$

where $b > 0$. The quality of the public good is fully financed by a lump-sum tax on the private good, T, so that $T = H$ and $C = X - H$. The state government decides on the level of public good provision to maximize the utility of their constituents.

Suppose that the economy is populated by two types of citizens, who differ in their attention to the quality of public higher education.[11] The first type are full-optimizers who are completely aware of the level of higher education quality in their state. When the economy is populated completely by full optimizers the state government will choose H to maximize $u(C,H)$ subject to the budget constraint. Thus, when all citizens are paying attention, the optimal level of public good spending on higher education is $H_A^* = X - (\alpha)^{-\frac{1}{b}}$. This is the optimal level of public good provision that would obtain in the standard neoclassical model.

The second type is a citizen who is inattentive to the quality of public higher education and focuses their attention solely on private consumption. When the economy is populated by completely by inattentive citizens the state government will choose H to maximize $u(X-H,\hat{H})$ where $\hat{H}$ is the inattentive citizens fixed belief of how much is being spent by the government on higher education.[12] If no citizens are paying attention to public good provision it is optimal to not provide any public goods at all as taxation reduces private consumption.

Our central empirical implications are derived from an economy that has both attentive and inattentive citizens. Suppose the fraction of citizens who pay attention is θ and the fraction who

Full-Time Equivalents (FTE) in the total student body and thus become less important in the ranking algorithm.

[11] We do not explicitly model the allocation of attention, and for analytic tractability simply assume that some citizens are inattentive. Chetty, Looney, and Kroft (2007) demonstrate that the form of inattentiveness assumed here can be derived rationally from cognitive constraints.

[12] The exact value which $\hat{H}$ takes does not alter the key comparative static of the model. In a more generalized model, we could consider the government as an imperfect agent of citizens and allow the government to divert some tax revenues from higher education. However, since including political agency explicitly does not alter the key comparative static of the model we do not model political agency explicitly.

do not pay attention is given by $1-\theta$. The optimal level of public spending on higher education the government will choose is given by the solution to

$$max_H U = \theta(u(C,H)) + (1-\theta)(u(C,\hat{H})),$$

subject to $C = X - H$. The optimal level of higher education spending is given by,

$$H^* = X - (\alpha \cdot \theta)^{-\frac{1}{b}}. \tag{1}$$

Using equation (1) we obtain the following two propositions which we will test empirically.

Proposition 1: *Attention Effect* Taking the comparative static of higher education spending, H^*, with the respect to the fraction paying attention θ yields,

$$\frac{\partial H^*}{\partial \theta} = \frac{1}{b \cdot \alpha^{\frac{1}{b}}} \cdot \theta^{-\frac{b+1}{b}} > 0. \tag{2}$$

The key parameter of interest is θ, the fraction of the population paying attention to public higher education spending. Thus, if college rankings increase the fraction of the population paying attention to public college quality public spending on higher education will increase in response to college rankings coverage. Alternatively, if the increase in the coverage of USNWR rankings do not lead to an increase in θ or the increased attention does not affect public spending on higher education we will find no response to college ranking coverage .

Proposition 2: *Magnitude of the Attention Effect* From the comparative static of higher education spending, H^*, with the respect the fraction paying attention, θ, in (2) we have two further testable implications:

A) the ranking inclusion effect *falls* with fraction already paying attention, θ, i.e. $\frac{\partial H^*}{\partial \theta^2} < 0$.

B) the ranking inclusion effect *increases* with fraction who start paying attention in response to the USNWR rankings($\Delta\theta$), i.e. $[H^*(\theta + \Delta\theta) - H^*(\theta)]$ increases with $\Delta\theta$.

The first component of Proposition 2 indicates that the magnitude of the attention effect is smaller when more citizens already pay attention. This is because when more are paying attention the quality of public good provision is already closer to the preferences of state citizens for public college quality. By the same logic, the attention effect will be larger if more state citizens begin paying attention in response to the rankings. We test Proposition 2 empirically by examining whether responses to USNWR rankings differ by the fraction of state population who are already paying attention and the fraction of population near the margin of paying attention.

2.3 Rankings and Public Higher Education Quality: Prior Updating Effect

In this subsection we present a simple model of prior updating. Suppose all citizens are attentive to the provision of higher education quality but they have imperfect information about the quality of the public colleges. Assuming their existing belief is a noisy proxy of H, we denote the mean of the belief as $E(H) = \delta \cdot H$ where δ captures the estimation bias. If $\delta > 1$, citizens overestimate H. If $\delta < 1$, citizens underestimate H.[13] With the belief $E(H)$ and the assumption of risk neutrality, the optimal level of public spending on higher education is given by the solution to

$$max_H EU = \left(\frac{1}{1-b}\right)(X - H)^{1-b} + \alpha \cdot E(H).$$

The first order condition from the utility maximization problem yields:

$$H^* = X - (\alpha \cdot \delta)^{-\frac{1}{b}}$$

The comparative static of H^* with respect to δ is:

$$\frac{\partial H^*}{\partial \delta} = \frac{1}{b \cdot \alpha^{\frac{1}{b}}} \cdot \delta^{-\frac{b+1}{b}}. \tag{3}$$

To the extent that the information conveyed in the USNWR college rankings helps citizens to better estimate H, δ becomes closer to one after the publication of the rankings. The effect of a reduction in the bias of citizens priors of college quality on public college spending is expressed in the following proposition.

Proposition 3: *Prior Updating Effect* From the comparative static of higher education spending, H^*, with the respect with respect to δ, in (3) we have two testable implications:

A) ranking inclusion *increases* H^* if USNWR rankings encourage citizens to reduce an upward-bias in their college quality priors (i.e. δ is greater than one and falls in magnitude towards one).

B) ranking inclusion *reduces* H^* if USNWR rankings encourage citizens to reduce an downward bias in their college quality priors (i.e. δ is less than one and increases in magnitude towards one).

[13] Recent work by Gabaix and Laibson (2006) demonstrates how product attributes may be suppressed by firms when some consumers are unaware. In equilibrium all consumers have persistently biased beliefs about product attributes.

Proposition 3 indicates that inclusion in the USNWR rankings will increase (decrease) public college spending when USNWR reveals that colleges are worse (better) than citizens expected. This is because, before USNWR rankings, public higher education has been optimally chosen in response to the biased measure of quality. Thus if USNWR reveals that public spending is higher (lower) than what's needed in generating the desired quality, citizens will demand a reduction (increase) in spending. We empirically test for this by examining if the response to USNWR inclusion differs by the news content of the USNWR information. More specifically, we use the 1989 Barron's Guide to Colleges to measure the priors for college quality for the added schools. Comparing the prior to the USNWR information tells us whether a newly covered school receives a positive or negative news from the USNWR.

To summarize, both models predict that being included in the USNWR rankings may result in more state spending on public colleges, either because the USNWR rankings increase the allocation of citizen attention to the quality issues, or because the USNWR coverage represents a negative shock to the prior of attentive citizens. However, since USNWR emphasizes relative comparisons across colleges rather than an absolute measure of quality USNWR coverage cannot be a negative shock for every school. In other words, if prior updating is the primary channel of response, the increased USNWR coverage in 1990 must constitute positive shocks for some schools and negative shocks for other schools. Futhermore the fraction of population paying attention or near the margin of paying attention plays an important role in the attention model, but has no impact on prior updating. These different implications for heterogenous responses to ranking inclusion allow us to distinguish between the prior updating and increased attention margins of response to USNWR rankings.

2.4 Research Design

To test for the attention and information effects of the college rankings we exploit an exogenous change in the *scope* of the USNWR college rankings. Before 1990, USNWR rankings only covered the top 25 schools in two nationwide categories (national university and national liberal arts colleges) and four census regions (northeast, midwest, south and west). In 1990, USNWR rankings began to cover *all* the national universities and *all* the national liberal-arts colleges. If a college belonged to the two national categories (as classified by the most recent Carnegie Classification in 1987) but failed to make the top 25, it was classified into one of the four quartiles in its respective category. The four quartiles were ranked from the best (the 1st quartile) to the worst (the 4th quartile), but there were no numeric ranks within each quartile. Including

all national colleges in quartiles marks a major change in the scope of the USNWR rankings; the rankings now included 295 national universities and liberal arts colleges in addition to the top 25 colleges. This structure remained unchanged until 1995.[14] If being included in the USNWR rankings increase the salience of public college quality and increases the fraction of the population in those states paying attention we should observe an increase in state funding of higher education at those colleges relative to those that are not newly included at the same time.

Importantly, the change in the scope of the USNWR rankings in 1990 was exogenous to changes in the demand for public college quality. The timing of the changes in 1990 were determined by changes in the terms of the contract that USNWR magazine had with the supplier of the raw data (Sanoff (2007)). For the 1990 issue of the USNWR rankings a new data provider was found that allowed the publication of all individual data items for the colleges in the rankings tables. This made it possible for USNWR to add the four quartiles thus expanding the number of schools contained in the rankings to include all national colleges.[15] Furthermore, exactly which colleges were included in the rankings expansion in 1990 was determined by the pre-existing Carnegie Classification of colleges which groups institutions into national/regional universities and colleges based on whether a college offers Doctoral degrees and draws students from a national market. These two features allow us to estimate the causal effect of ranking inclusion on the allocation of public resources in higher education. Table 2 illustrates the changes in the scope of the rankings which underlie our research design.

Based on the expansion in scope of the USNWR rankings in 1990, we categorize all public four year colleges into one of three groups. *Previous-in* colleges are national and regional colleges that had been included in the USNWR rankings before 1990. National previous-ins include prestigious national universities such as University of California - Berkeley, University of Michigan and University of Virginia. Regional previous-ins include top regional colleges such as the East Carolina University, California Polytechnic Institute and St. Mary's College of Maryland.

[14] In the magazine issue, the rankings of regional colleges have always been restricted to top 15 or top 10 by region. The related USNWR college guidebook started to report regional quartiles in 1993. Because the magazine issue reaches much broader audience, we focus on the changes in the magazine issue. In 1995, national colleges in the first quartile were given specific ranks, expanding the rank list from top 25 to top 50. Compared to the 1990 change, this did not expand the scope of the ranking at all. Rather it gave more detailed information about the relative quality within the first quartile of the two national categories.

[15] "Starting with the 1990 edition, the magazine obtained data from an organization that did not place constraints on publication of the objective data. As a result, the magazine was able to show where schools ranked both overall and in reputation, as well as in the categories based on objective data." Sandoff, (2007), p.12

Added-in colleges are national colleges added into the rankings for the first time in the 1990 expansion of the USNWR rankings, such as the University of California - Irvine, University of Maryland - College Park and Oklahoma State University. *Never-in* colleges are colleges that were never included in the USNWR rankings during our sample period (1983-1995), such as the University of Northern Alabama, the University Maryland - Eastern Shore, and Central Connecticut State University. Our analysis centers on comparisons of changes in revenue and expenditure outcomes between added-in and never-in or previous-in colleges.

For our research design to yield an estimate of the causal effect of rankings on public spending the never-in or previous-in colleges must form a valid counterfactual for the added-in colleges. There are two potential concerns in this context. First, the added-in and control colleges might be following different time trends and so post-1990 differences may simply reflect differences in time trends across different types colleges. The second potential concern with our research design is that including the added-in colleges in the USNWR rankings may indirectly affect the provision of funding to the control colleges. Because state appropriation allocations are simultaneously decided on for all the colleges in the state and total state funding of higher education may not respond to rankings, the rankings may simply redistribute resources between colleges. We provide evidence below that neither is likely to be a major concern.

3 Econometric Specification and Data

3.1 Specification

The central question we tackle is whether the inclusion of a college in the USNWR rankings affects the expenditure and revenue of that college. We answer these questions in a simple difference-in-difference framework:

$$y_{it} = \beta \cdot D_{addedin,i} \cdot D_{t>=1991} + \eta_i + \lambda_t + \epsilon_{it},$$

where y_{it} denotes the log of revenue or expenditure per Full-Time Equivalent student (FTE) for college i in enrollment year t, $D_{addedin,i}$ is a dummy variable for a college i being an added-in college, $D_{t>=1991}$ is a dummy variable indicating a year after the 1990 expansion, η_i denotes college fixed effects, λ_t denotes a set of year effects, and ϵ_{it} is the error term independent of all the regressors. The coefficient of interest, β, reflects the impact of USNWR inclusion on the outcome y_{it}. The sample for our main analysis included added-in, previous-in and never-in

colleges.[16] We estimate the standard errors with an arbitrary covariance matrix to address the fact that inclusion in the USNWR is a permanent shock and the outcomes we study are likely to be autocorrelated within the same college (Bertrand, Duflo and Mullainathan (2004)).

Because of the timing of USNWR ranking issue publication does not perfectly correspond to college fiscal year and state budget allocation dates, there is some ambiguity in the precise timing of a governmental response to the change in scope of the rankings in 1990. More specifically, the financial data for enrollment year t are referred to as the revenues and expenditures incurred in the fiscal year $t+1$, which usually ends at June 30. Since the 1990 USNWR rankings were published in the Oct. 15 issue, the shift in the ranking scope should not affect who enrolled as freshmen in September 1990 but might have influenced the amount of financial resources received and spent up to the end of the fiscal year 1991.[17] Thus, 1990 is a year of partial treatment. To achieve clean identification, our main analysis focuses on the comparison of enrollment years 1987-1989 and enrollment years 1991-1995. We show below that our results are robust to including 1990 as a post-treatment observation.

3.2 Data Sources

The central analysis utilizes two major data sources: the USNWR magazines, and the Integrated Postsecondary Education Data System (IPEDS).[18] As noted above, a complete collection of the USNWR ranking issues since 1983 allows us to define treatment and control groups. However, while the USNWR publications provide some information on the variables of interest for the ranked colleges, it is necessary to track both ranked and unranked colleges before and after 1990. The IPEDS is a census of all the colleges operating in the U.S. collected by the Department of Education. It provides basic institutional information, such as degrees offered, private and public status, tuition, enrollment, faculty resources, and detailed financial information on revenue and expenditure.[19] The IPEDS data are merged with the ranking issues of USNWR by year and

[16] We also considered a regression discontinuity design to estimate the parameter of interest, however because we cannot obtain data on the reputational element of the USNWR rankings for the added-in colleges before 1990 we are unable to estimate the distance to the top 25 discontinuity in their rankings for the added-in colleges.

[17] Grapevine (http://www.grapevine.ilstu.edu/) provides more detailed information on the extent to which state budgets for higher education may differ at the beginning and end of a fiscal year.

[18] Table A1 summarizes the definitions, sources and unit of analysis of all the key variables used in this study.

[19] The analysis starts with 1987 because 1987 is the first year that the Department of Education provides college-level financial data in IPEDS (http://nces.ed.gov/ipeds/). The analysis ends with 1995 because this is the last enrollment year before a break in the IPEDS financial data collection to incorporate new accounting definitions which begins again in 1998.

institution name.[20]

We consider three measures of college revenue and expenditure per FTE from the IPEDS as outcomes.[21] First, we examine college expenditure on items covered by the USNWR rankings algorithm. We term this variable total main expense which includes expenditure on instructional activities and student support per FTE. We next examine total state appropriation revenue per FTE and total tuition and fee revenue per FTE.[22] Using all three outcomes allows to look at the overall effect of USNWR rankings on college spending per student and the source of the funding increase.

We supplement this data with additional data on college characteristics, state demographic characteristics, and USNWR circulation from 1989 Barron's Guide to Colleges, the 1990 Census, and the Audit Bureau of Circulation respectively. These additional variables allow us to better understand how the added-colleges differ from the control colleges and to control for different time trends by college type which may affect added-in colleges differentially. They also allow us to test the two potential mechanisms for the state appropriation response to USNWR inclusion in later analysis. We leave the full the description of these additional variables until section 5.

3.3 Sample Selection

We draw our initial sample from the IPEDS data. According to the IPEDS data, there were 1641 four-year colleges that offer at least one bachelor's degree in 1987. We further restrict our sample by excluding (1) the colleges located outside the continental United States (i.e. those in Puerto Rico, the US Virgin Islands, etc.), the District of Columbia and Maine (due to lack of control colleges), (2) the colleges that failed to report public and private status, (3) the colleges for which we do not have enough information to compute the total number of FTEs every year between 1987 and 1995, (4) the colleges that failed to report total revenues every year, and (5)

[20] By ranking issues, we are referring to the annual *America's Best Colleges* issue of the USNWR weekly magazine in years 1983, 1985, 1987, 1988, 1989, 1990, 1991, 1992, 1993, and 1994.

[21] The number of FTEs is calculated by taking the total number of full time students (undergraduates and graduates combined) plus one third of the total number of part-time students.

[22] We only include appropriation revenue for the state government as the appropriation revenue from the federal government is typically allocated by earmarks and is a very small fraction of college revenue. About 97% of public four year college appropriation revenue is from state governments. The tuition and fee measure captures the total revenue that a college receives per FTE and may differ from average list price tuition as many colleges discount tuition for some students they wish to enroll.

colleges that fail to report government appropriations every year. These criteria define a sample of 1156 colleges, which account for 89% of all the FTEs enrolled in four-year colleges as of 1987. Lastly, we limit our sample to only public colleges and obtain our analysis sample of 436 colleges. Of the 436 colleges there are: 40 previous-ins (9 of which are national), 115 added-ins, and 281 never-ins.[23] The geographic distribution of the colleges by USNWR ranking inclusion status is displayed in Figure 2.

3.4 Descriptive Statistics

Table 3 presents summary statistics on the sample of colleges which form the basis of our analysis. In the first panel of Table 3 we see that there are some differences between the added-in and control colleges in terms of the levels of expenditure and revenue. Never-in colleges spend and receive significantly less revenue than either added-in or previous-in colleges. In 1987, the average expenditure per student is ordered (from low to high) by never-ins, regional previous-ins, added-ins, and national previous-ins, with the added-ins closer to the regional previous-ins than to the national previous-ins. This is partly driven by the Carnegie Classification of college types, and partly by the history of college coverage in the USNWR rankings.

In the second panel of Table 3 we examine whether pre-existing trends differ across added-in and control colleges. We look at the trends in outcomes over the three years before USNWR included the added-in colleges. The results reveal that the pre-existing trends in outcomes between the added-in and other colleges are not statistically different at the 5% level. The lack of large differences in pre-existing trends in outcomes between colleges provides additional evidence that the timing of the USNWR expansion of coverage was not in response to different trends in the outcome variables across colleges. The key reason why differing pre-existing trends are less of a concern here than in Hoxby (2004) is that the college groups are not purely stratified by pre-1990 college quality. Although the added-in colleges are of lower quality than the previous-in national schools, many previous-in regional schools would be lower quality that those added-in.[24] It is also important to note that for state appropriations we can only reject the hypothesis

[23] In any specific year before 1990, the number of regional ranked colleges is less than 100, but the number of regional previous-ins is much larger than 100 because the identities of ranked colleges have fair amount of turnover. In contrast, the list of national previous-ins is very stable from year to year. We drop 20 colleges from the sample which appear in the rankings less than every year after 1990 because they are not strictly added-in or never-in colleges.

[24] In addition, as can be seen in Appendix Figure 7 in Hoxby (2004), the expansion in the dispersion of subsidy per student across public colleges is concentrated in 1971 to 1981.

that the pre-existing trends differ between the added-in and previous-in colleges at the 5% level. Ideally the time trends would be identical. We address this potential concern by examining how sensitive our results are to the use of a sample containing only the never-in colleges as the control group.

The results in the first two panels of Table 3 demonstrate the value of having two potential control groups for our research design. The previous-in colleges are more similar to the added-in colleges in terms of the level of outcomes. However, the never-in colleges are more similar to the added-in colleges in terms of the pre-existing trends in outcomes. Thus, each potential control group may represent a better counterfactual for the added-in colleges for different reasons. For example, as previous-in colleges are so similar in terms of expenditure per student to the added-in colleges that these colleges may represent a better counterfactual for what would have happened to the added-in colleges in absence of USNWR inclusion. In contrast, the similarity between previous-in and added-in colleges may trigger redistribution of state resources between them in response to USNWR rankings, and therefore never-in colleges would represent better counterfactuals. Below we show that our results are robust to the exact choice of control group which alleviates research design concerns specific to any one control group.

In the third and forth panels of Table 3 we look at differences in college and state characteristics between added-in and control colleges which may be related to college expenditure and revenue. In general added-in colleges are larger, more likely to be the state's flagship college and more likely to be national than previous-in or never-in colleges. In terms of the 1989 Barron's measure of college selectivity, the added-in colleges fall between the previous-in and never-in colleges. In panel 4 of Table 3 we see that there are no statistically significant differences at the 5 percent level in the state characteristics between the never-in and added-in colleges. There are some differences between the added-in and previous-in colleges in the share of pre-college age population.

The findings in the third and forth panels of Table 3 underscore the value of comparing changes in outcomes between added-in and never-in or previous-in colleges, rather than cross sectional comparisons alone. In this setting cross-sectional differences will only bias the results if levels of these variables determine future changes. For example, large colleges may receive an increase in state appropriations relative to smaller colleges, simply due to size difference. We address this concern by allowing outcome variables to follow different trends for colleges with different characteristics, and by estimating specifications which allow for college specific linear trends in the outcomes.

4 Basic Results

This section is divided into three subsections. We first examine how key expenditure and revenue outcomes respond to the sudden exposure to the USNWR rankings in 1990, followed by a robustness check of the state appropriation response to alternative specifications. The last subsection investigates whether the effect of USNWR ranking inclusion is driven by the redistribution of state funding between public colleges.

4.1 Expenditure and Revenue

In Table 4 we present the results of the effect of USNWR inclusion on college expenditure and revenue. Each column in the table presents the results from one regression with the column header noting the outcome used. Column (1) shows that USNWR rankings inclusion increases college expenditure per FTE on items included in the rankings by 3.2%. This effect is statistically different from zero at the 5% level. In column (2) we report the effect of USNWR ranking inclusion on total state appropriation revenue. The results indicate the USNWR ranking inclusion leads to an increase in the per-FTE state appropriation revenue of 6.8%, which is statistically significant at the one percent level. The magnitude of the response is also of interest. Public colleges typically receive 40-50% of their revenue from state appropriations. Thus, the increase in appropriation revenue accounts for nearly all of the additional college expenditure stimulated by USNWR coverage.

The central result is displayed graphically in Figure 3. Figure 3 shows the time series of state appropriation spending at the added-in and control colleges. The USNWR shock occurs after enrollment year 1989 and before enrollment year 1991.[25]. The figure displays graphically the increase in state appropriation spending per student at the added-in relative to control colleges in the post-USNWR ranking expansion period. It also shows that the added-in and control colleges follow similar pre-1990 trends in state appropriation spending per student as in Table 3.

While the response of expenditure and revenue per FTE to USNWR ranking inclusion is the most relevant policy parameter we have also examined whether total state funding or the

[25] As noted above 1990 is a partial treatment year due to the timing of fiscal year dates and state budget allocation decisions

total number of FTEs responds to USNWR rankings inclusion. We find that the majority of the response to the rankings is accounted for by reductions in FTE and not by increases in total dollar appropriated to a specific college. This is consistent with state governments keeping the total dollars allocated to higher education subsidies largely fixed, but changing the funding formula to reimburse colleges at a higher rate per enrollee. As public college quality is largely determined by the amount of state funding per student, responses along either margin are consistent with the model above.

The finding that the increase in college expenditure is financed by an increase in state appropriation revenue is confirmed by the results in column (3) of Table 4 which shows that tuition and fee revenue do not respond to USNWR inclusion.[26] This finding may indicate a well-known fact: public colleges are highly subsidized and the price that students face does not necessarily reflect consumer willingness to pay nor the underlying quality of the product.

4.2 State Appropriations: Alternative Time Trends

The results in Table 4 demonstrate that a college's state appropriation revenue (per FTE) increases in response to inclusion in USNWR rankings. We examine whether these results are robust to allowing for different time trends across different college characteristics. Recall that the added-in colleges are quite different from the control colleges in terms of college size and flagship status (see Table 3). It is possible that the increasingly national nature of the higher education market has led to state appropriations being increasingly allocated to large flagship colleges after 1990. This possibility alone could account for the results in Table 4. To address this concern we estimate our main specification allowing for colleges of different sizes and flagship status to follow different non-linear time trends.[27]

In column (2) of Table 5 we report the results including size quartile-year fixed effects in the specification. The coefficient estimate remains positive and statistically significant at the five percent level. The magnitude of the coefficient estimate is somewhat smaller than in Table 5, but still economically significant. In column (3) of Table 5 we report the results including

[26] The fact that ranking inclusion does not increase tuition and fee revenue is not necessarily inconsistent with the findings in Pope (2006) and Monks and Ehrenberg (1999) that increases in colleges' numeric ranking do affect admissions market outcomes. Since USNWR inclusion does not necessarily constitute good or bad news about a colleges quality we are estimating a different parameter.

[27] More precisely we allow the year fixed effects, λ_t in the main specification above, to differ by college size quartile and by flagship status.

flagship-year fixed effects in the specification. Again, the coefficient estimate is positive and statistically significant at the 5% level. The magnitude is also again quite close to the baseline estimate.

The results in columns (2) and (3) in Table 5 demonstrate that the effect of USNWR inclusion on public colleges found in Table 4 is not simply due to differences in trends based on observable differences in college characteristics between added-in and control colleges. However, it is also possible that added-in and control colleges are different in unobservable ways which may be related to their trends in revenue. For example, added-in colleges are typically lower in the college quality distribution than the previous-in national colleges and there may be different trends in outcomes by college quality. To address this issue we include college specific linear trends in our specification. This allows for each college to follow a different time trend in state appropriation revenue.[28] The results from this regression are reported in column (4) of Table 5. We see that the coefficient estimate remains positive and statistically significant at the 5% level. The magnitude of the coefficient estimate is half of the baseline estimate.

Another important concern to address is the fact that state appropriations to higher education are highly cyclical and sensitive to business cycle (see Kane, Orszag and Apostolov (2005)). Because the expansion of the scope USNWR rankings occurs at the beginning of a recession our coefficient estimate above may be due to the possibility that the control colleges are located in states where the recession was more severe. We examine this issue by including state-year fixed effects in our baseline specification. This allows for state appropriations to a college to follow a flexible time trend differentially by state. The results of the state-year fixed effect specification are reported in column (5) of Table 5. We can see that including state-year fixed effects has very little effect on either the statistical significance or magnitude of the central coefficient estimate. This suggests that USNWR inclusion is largely uncorrelated with state-level trends in outcomes.

Above all, Table 5 demonstrate that the finding that USNWR ranking inclusion increases state appropriation expenditure is robust to allowing the time trends in outcomes to follow a richer specification.

[28] We estimate the model

$$\Delta y_{it} = \beta \cdot D_{addedin,i} \cdot D_{t=1991} + \eta_i + \lambda_t + \Delta\epsilon_{it},$$

where Δy_{it} is the change in state appropriation per FTE to college i in year t, $D_{addedin,i}$ is a dummy variable for a college i being an added-in college, $D_{t=1991}$ is a year equal to 1991 indicator variable, η_i denotes the linear trend for college i, λ_t denotes a set of year effects, and $\Delta\epsilon_{it}$ is the error term independent of all the regressors.

4.3 State Appropriations: Alternative Control Groups and Time Horizons

In this subsection we examine whether the state appropriation revenue response to USNWR rankings inclusion results are sensitive to the choice of comparison group or time horizon. As noted above examining the sensitivity of the results to the choice of control group is worthwhile because each of the two control groups serves as a better counterfactual for the added-in colleges in different ways.

In column (2) of Table 6 we report the results of estimating our main specification using a sample of only the previous-in colleges as controls. The results indicate that we again obtain a positive coefficient which is statistically significantly different from zero at the 5% level. The magnitude of the coefficient is substantially larger than the baseline estimate in column (1) which is based on using both sets of colleges as controls. This may reflect the fact that the pretreatment trends for the previous-in colleges are not identical to those of the added-in colleges. In column (3) of Table 6 we estimate the main specification on a sample of only never-in colleges are controls. The coefficient estimate is positive, statistically significantly different from zero at the 5% level and very similar to the baseline estimate. Thus, the positive response of state appropriations to USNWR inclusion is not driven by the comparison of added-in colleges to any one control group.

Another potential concern with the research design is that the national previous-in colleges may also be treated by the 1990 ranking expansion. Before 1990, if a national college fell out of the top 25 college this would result in the college failing to appear in the rankings, which may be especially costly. After 1990, a national college out of the top 25 can still appear in one of the four quartiles. The change in the fall-back option implies that previous-in national colleges may be affected by the inclusion of added-in national colleges, which would invalidate the research design. We examine this issue by excluding national previous-ins from the sample and only comparing national added-in colleges against regional previous-in and never-in colleges. As shown in Column (4) of Table 5, the key coefficient remains positive, statistically significantly different from zero at the 5% level with nearly an identical magnitude as the baseline estimate.

We also examine the sensitivity of the results to the time horizon and the inclusion of 1990 as a post-shock year in Table 6. Whether the impact of USNWR inclusion is transitory or permanent is important in understanding how rankings affect the public spending on higher education. Since the 1990 USNWR inclusion of national schools is a permanent change, if it motivates governments to improve quality via increasing financial resources, the financial

increase should be permanent as well. In column (5) of Table 6 we examine whether the short run and long run effects of the rankings differ by allowing for different effects of the rankings in the first two years (1991-1992) and last three years (1993-1995) of the post-shock period. We find that there are no statistically significant differences in the short and long-run effects of USNWR ranking inclusion on state appropriations. In column (6) in Table 6 we lastly examine whether the results thus far are sensitive to including 1990 as a post-shock year. As noted above there is some ambiguity about the exact timing of the state legislature funding allocation decisions lining up with the USNWR ranking issue in 1990. Comfortingly the results in column (6) suggest that the central results are not sensitive to the exact definition of the post-shock time period.

4.4 State Appropriations: Redistribution Across Colleges

The results above demonstrate that the positive response of state appropriation revenue to USNWR ranking inclusion are robust to alternative specifications and control group choices. The robustness to the control group definition provides some evidence that USNWR rankings are not simply leading to the redistribution of total state expenditure from colleges with similar levels of spending to added-in colleges. However, because the nature of redistributive response to USNWR rankings depends on the precise objective function of state legislators, USNWR ranking inclusion may stimulate other types of redistributive responses. The potential redistributive responses of legislators range from (1) allocating state appropriations equally across all the colleges so that all colleges in a state are equally ranked in USNWR rankings to (2) allocating state appropriations to the best college in a state so that this college is higher ranked than those in other competing states.

To understand whether redistribution between colleges is a significant concern, we conduct two further tests. First, we examine whether inclusion in USNWR rankings has a differential effect of flagship colleges. A flagship college is typically the best college in a state. If the response of state appropriations to USNWR is simply due to redistribution of resources away from or towards the best college in the state we expect flagship colleges have a different response to inclusion in the USNWR rankings. We add two interaction terms in our model to test for this. We include an interaction of a flagship indicator with USNWR inclusion in 1990 and an interaction with whether the state's flagship college is a previous-in college or not. The results of this specification are reported in column (2) of Table 7. We find little evidence that flagship colleges or states that have previous-in flagship colleges have a different response to a college's

USNWR ranking inclusion.

The second test we examine is whether previous-in colleges experience a decrease in state appropriation revenue after 1990. Again is USNWR ranking inclusion leads legislatures to redistribute resources from previous-in towards added-in colleges we would expect a negative coefficient. We report the results of this specification in column (3) of Table 7. The results indicate that while the point estimate is negative the previous-in colleges do not experience a statistically significant drop in state appropriations relative to the never-in colleges after 1990. These findings provide little evidence that in response to USNWR ranking state legislators redistribute resources either away or towards the best colleges in their state.

We also conduct additional analysis at the state level which suggests that redistribution is unlikely to be driving our results. In an unreported analysis, we take state-year as the unit of observation, compute state appropriations per student including all the four-year public colleges within a state, and regress it (in log) on the interaction of the after-1990 dummy and the percentage of college students enrolled in the public added-ins as of 1987 (while controlling for state and year fixed effects). The coefficient of the interaction term is positive (0.0289) and statistically different from zero at the 15 percent level (p=0.138). The positive sign suggests that, on average, states that have more students in the public added-ins allocate more resources to higher education in response to the inclusion of USNWR rankings. We believe that the lack of statistical significance is due to the lack of power from only using data at the state level. A more direct test of whether never-in colleges experience funding cuts as the result of the 1990 USNWR change is repeating the above state-level regression but focusing on the state appropriation (per student) among all the never-ins in a state. If the 1990 USNWR inclusion motivates states to shift funding from the never-ins to the added-ins, the funding change for the never-ins should be more negative the more students there are in the added-ins. The regression results show the opposite: the coefficient on the interaction of the after-1990 dummy and the percentage of students in the added-ins is positive (0.014) and insignificant from zero (p=0.593). The two state-level regressions suggest that redistribution does not explain our key results.

5 Attention vs. Prior Updating Effects

Thus far we have not directly tested for either of the potential mechanisms underlying the public funding response to USNWR rankings. We directly test for both the attention and information

effects of college rankings in this section.

5.1 Attention Effect

We test for direct evidence of the attention effect by examining whether magnitude of the response of public funding to USNWR ranking inclusion varies as Proposition 2 predicts. As we cannot perfectly observe who does and does not pay attention to the quality of public colleges in a state, we consider the evidence from multiple measures of the fraction of citizens already paying attention and the fraction near the margin of paying attention. The empirical specification is:

$$\begin{aligned} y_{it} &= \beta_1 \cdot D_{addedin,i} \cdot D_{t>=1991} + \beta_2 \cdot D_{addedin,i} \cdot D_{t>=1991} \cdot \theta_i \\ &\quad + \beta_3 \cdot D_{addedin,i} \cdot D_{t>=1991} \cdot \Delta\theta_i + \eta_i + \lambda_t + \epsilon_{it}, \end{aligned}$$

where y_{it} is the log of state appropriations per FTE to college i in year t, $D_{addedin,i}$ is a dummy variable for a college i being an added-in college, $D_{t>=1991}$ is a year greater than 1991 indicator variable, θ_i is the fraction of the population already paying attention to higher education spending at college i before USNWR college rankings, $\Delta\theta_i$ is the fraction of population responding to USNWR rankings coverage of college i by starting to pay attention, η_i denotes college i fixed effects, λ_t denotes a set of year effects, and ϵ_{it} is the error term independent of all the regressors. Proposition 2 provides clear implications for the signs of the two interaction terms. For the response to USNWR rankings to be consistent with USNWR leading to increased attention allocation the response will be smaller when more are already paying attention ($\beta_2 < 0$), and larger when more begin paying attention in response to the USNWR ranking inclusion ($\beta_3 > 0$).

We use three sets of variables to measure θ_i, and $\Delta\theta_i$. The first set of variables are based on differences in demographic composition accross states. We believe the fraction of state population who are of college age (age 18-22) is a good measure of θ_i because they are likely to already be paying attention to measured college quality. Similarly, the fraction of population who are pre-college age (age 14-17) is a good measure of $\Delta\theta_i$ because they are about to attend college and therefore likely near the margin of paying attention to college quality. We measure both variables at the state level from the 1990 Census.[29]

The second set of variables are based on differences in which types of colleges students attend across states. We consider the percentage of state students who attend previously-in colleges as

[29]The 1990 Census collects information on the 1989 population and therefore precedes the 1990 expansion of the USNWR rankings.

a good measure of θ_i and the percentage of state students who attend added-in colleges as a good measure of $\Delta\theta_i$. The idea here is that if many of the popular colleges in a state are covered by USNWR before 1990 many will already be paying attention to public college quality. Similarly, if more popular colleges in a state are added to the rankings in 1990 more will begin paying attention to public college quality in response to the 1990 coverage expansion. We measure both variables by the enrollment share of the corresponding type of institutions within all public colleges in a state as of 1987.

Third, we break USNWR magazine sales into subscription and newsstand sales in each state. We consider USNWR subscription circulation per capita to be a good measure of θ as those who always receive the magazine are likely to be paying attention to the government's policy choices at most times. We consider USNWR newsstand circulation per capita to be a good measure of $\Delta\theta_i$ as those who purchase USNWR magazine only in response to a certain issue are likely to begin paying attention after the USNWR coverage. Both subscription and newsstand sales per capita are derived from the Audit Bureau of Circulation (ABC), based on state-level information for the USNWR issue of Oct. 30, 1989.[30]

We present the results of the test for the attention effect in Table 8. As a benchmark, Table 8 column (1) reports the baseline result from Table 4. In column (2) of Table 8 we see that the state appropriation response to the rankings is larger when a state has a larger fraction of their population pre-college age and smaller when the state has a larger fraction of population college age. These results support the attention effect, as the effect of USNWR inclusion should be larger when a larger fraction of the population begins paying attention to public college quality in response to USNWR ranking inclusion, and smaller when a greater fraction of the population is already paying attention. Column (3) provides additional evidence for the attention effect. As the model predicts, the interaction with percentage of state students at a previous college is negative and statistically significant at the 5 percent level, and the interaction with the percentage of students at an added-in college is positive and significant at the 10 percent level. In contrast, the interactions with the two USNWR circulation variables in column (4) do not provide evidence for an attention effect.

In column (5) of Table 8 we include all the interactions simultaneously in the specification. The results are broadly similar to those including each set of interactions separately, except that the interaction between rankings inclusion and USNWR circulation becomes statistically signif-

[30]The 1989 rankings were published in the Oct. 16 issue. ABC audits the total number of paid circulation for every issue of USNWR, but only breaks it down to state level for one random issue every half year.

icant. The signs of the interactions USNWR ranking inclusion with newsstand and subscription sales are now consistent with the attention effect. Higher levels of USNWR subscriptions reflect a greater fraction of the population already paying attention and higher USNWR newsstand sales reflect a greater fraction who begin paying attention in response to USNWR ranking inclusion. In sum, the results in Table 8 provide significant evidence that the positive response of public higher education funding to USNWR inclusion is being driven by the allocation of additional attention in response to USNWR rankings.[31]

5.2 Prior Updating Effect

We test for direct evidence of the prior updating effect by examining whether magnitude of the response of public funding to USNWR ranking inclusion varies as Proposition 3 predicts. We empirically test for the *prior updating effect* of college rankings by estimating the model,

$$\begin{aligned} y_{it} &= \beta_1 \cdot D_{addedin,i} \cdot D_{t>=1991} \cdot GoodNews_i + \beta_2 \cdot D_{addedin,i} \cdot D_{t>=1991} \cdot BadNews_i \\ &\quad + \beta_3 \cdot D_{addedin,i} \cdot D_{t>=1991} \cdot NoNews_i + \eta_i + \lambda_t + \epsilon_{it}. \end{aligned}$$

where y_{it} is the log of state appropriations per FTE to college i in year t, $D_{addedin,i}$ is a dummy variable for a college i being an added-in college, $D_{t>=1991}$ is a year greater than 1991 indicator variable, $GoodNews_i$, $BadNews_i$, $NoNews_i$, η_i denotes college i fixed effects, λ_t denotes a set of year effects, and ϵ_{it} is the error term independent of all the regressors. To test for the prior updating effect based on Proposition 3 we test for a negative response to good news ($\beta_1 < 0$) and a positive response to bad news ($\beta_2 > 0$). For the prior updating effect to account for the central findings above the we would need to find a positive response to bad news.

To measure the priors for college quality for each added-in college before the USNWR expansion in 1990 we use college level data from the 1989 Barron's Guide to Colleges (BGC). Based on measures of how selective admissions to a college are (such as total number of applications, percentage accepted and percentage enrolled), BGC groups colleges into nine categories ranging from highly-competitive (1) to non-competitive (9). To determine whether USNWR inclusion represents a good or bad information shock for the added-in colleges we use the BGC selectivity categories to generate quartiles of the BGC ranking distribution and compare this to the colleges

[31] While we have not modeled the political process directly we have also investigated whether the key interaction estimates are sensitive to the inclusion of interactions reflecting the political process such as voter turnout, the governor's party and seat advantage. We find that the inclusion of these political interactions does not alter the pattern of the results in Table 8 substantively.

place in the USNWR rankings quartile. Given the relative placement of a college in the two ranking distributions we can measure whether inclusion of a college in USNWR provides good news, bad news, or no news at all about a college's quality. More specifically, we classify the new information conveyed in the USNWR rankings in five categories: no news, clear positive news, clear negative news, ambiguous positive news and ambiguous negative news. The distribution of colleges in the five categories is relatively uniform within the added-in colleges: between 9% and 31% of colleges fall into each category, with 'Ambiguous Bad News' containing the most colleges and 'Certain Bad News' containing the least colleges. An example illustrating the creation of the good and bad news variables from the BGC and USNWR rankings is in Figure 4. The precise details of how these variables are constructed are in the methodological appendix.

In Table 9 we present the results allowing for the response of state appropriations to USNWR inclusion to vary according to the "news" content of the rankings for the added-in colleges. The first finding to note is that the coefficients on "clear positive news" and "ambiguous positive news" are statistically insignificantly different from zero and not negative as the prior updating effect would predict. The second finding to note is that colleges that clearly experience "bad news" about their quality receive less appropriation funding in response to USNWR inclusion than other added-in colleges. This response is exactly opposite of that implied by the prior updating effect in our model. In sum, the results in Table 9 do not provide any evidence that the positive response of public higher education funding to USNWR inclusion is being driven by the prior updating effect.

6 Conclusion

Examining the case of U.S. News and World Report college rankings we demonstrate that the provision of public higher education depends on the salience of public college quality. More specifically, we find that when a public college is exogenously included in the rankings expenditure per student increases by 3.2%. The majority of the additional expenditure is funded by a 3.4 to 6.8% increase in the state appropriation revenue per student, while tuition revenue is not responsive at all. Moreover, the state appropriation response is larger when a larger fraction of state citizens are close to the margin of paying attention and smaller when a larger fraction of state citizens are already paying attention. Both indicate that USNWR inclusion leads to the allocation of additional attention to the quality of public higher education. In contrast, we show that the state appropriation response is not due to citizens updating their priors of college qual-

ity upon the "news" content of the USNWR rankings. These results highlight the importance of attention allocation in understanding the effects of quality disclosure in the context of public goods.

One key caveat suggests a direction for future work. Because financial resources per student represent only one dimension of college quality, an important avenue for future work would be to test for a college gaming response to the USNWR rankings stimulated in part by the increased attention to college quality. If it is less costly to improve on-paper quality (as defined in the ranking algorithm), USNWR rankings may distort college behavior away from improving true quality, and therefore reduce welfare. To understand whether this is a concern, more extensive data is required, where both true-quality and on-paper quality can be separately measured. The response of alumni giving to the USNWR ranking exposure represents a possible case, since both the fraction of alumni giving and the total dollars donated by alumni are a component of the USNWR definition of quality. However, the total resources provided by alumni are much more likely to be related to true college quality than the identity of who provides them.

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8 Appendix A: Methodology Details

8.1 Construction of Good and Bad News Variables

In this subsection we describe the construction of the good and bad news variables used to test the prior updating effect in section 5.2 and Table 9. We construct the good and bad news variables for the added-in colleges from BGC 1989 and USNWR 1990 rankings as follows. Conditional on being a national university (including both private and public) and being rated by the BGC (156 colleges), we sort the colleges by BGC rating (1-9). We then classify the sorted colleges into groups with the same number of colleges as in the 1990 USNWR categories. For example, the USNWR rankings have 18 added-in colleges in the first quartile, 44 in the second, 49 in the third, and 45 in the fourth. According to BGC ratings, we denote the best 18 colleges as the first BGC quartile, the next 44 as the second BGC quartile, etc. In this way we are able to compare, under the same "quartile" cutoffs, whether the BGC quartiles match up with the USNWR quartiles. Specifically, the quartile-to-quartile comparison is implemented as follows. Since the BGC ratings are crude, it is possible that a quartile cutoff occurs in the middle of BGC original rating group. In that case, we call a BGC rating "ambiguous" if it corresponds to more than one BGC quartile. For an ambiguous BGC rating, we calculate its highest and lowest BGC

quartiles. A college receives good news for certain from the USNWR rankings if its BGC rating is not ambiguous (which means we know its BGC quartile for sure) and its BGC quartile is worse than its USNWR quartile. Similarly, the good news is certain if the college's BGC rating is ambiguous but the best possible BGC quartile for such rating is worse than the college's actual USNWR quartile. Following the same logic, a college receives bad news for certain from the USNWR if its worst possible BGC quartile is better than its actual USNWR quartile. The news from USNWR is "ambiguously good" if a college's best possible BGC quartile is equal to its USNWR quartile, and "ambiguously bad" if its worst possible BGC quartile is equal to its USNWR quartile. In all the other cases, there is no clear news. The same algorithm is applied to national liberal arts colleges.

TABLE 1: USNWR College Ranking Algorithm (1990)

Category	Weight	Detailed measures
Academic Reputation	25%	[Responses from Survey of College Presidents Conducted By USNWR]
Student Selectivity	25%	Acceptance Rate, Yield Rate, High School Class Standing, Average SAT/ACT Score
Faculty Quality	25%	Student-Faculty Ratio, Percentage of Faculty with Ph.D., Percentage of Part-Time Faculty, Average salary of Tenured Full Professors
Financial Resources	20%	Total Education and General Expenditures
Student Satisfaction	5%	Graduation Rate

Note: Source: USNWR magazine issue Oct. 15, 1990. The USNWR implements some minor differences in the ranking algorithm and the regional algorithm. This table reflects the national algorithm. Graduation rate performance refers to the difference between actual graduation rate and the graduate rate predicted by student SAT scores.

TABLE 2: History of Public College Inclusion in U.S. News College Quality Rankings

Year:	Before 1983	1983-86	1987-1989	1990-1994
US News Ranking Method:	No US News	Top 10	Top 25	Top 25 + 4 Tiers for National Colleges
		A. Included in U.S. News Rankings		
Public National College Examples	--	UC – Berkeley UNC – Chapel Hill U Wisconsin	UC – Berkeley UNC – Chapel Hill U Wisconsin UCLA U Michigan U Virginia	UC – Berkeley UNC – Chapel Hill U Wisconsin UCLA U Michigan U Virginia UC - Irvine U of Maryland – College Park Oklahoma St. U.
Public Regional College Examples	--	Appalachian St. U. East Carolina U. CA Polytechnic St. U.	Appalachian St. U. East Carolina U. CA Polytechnic St. U. St. Mary's College of MD CSU – Fresno Ohio Wesleyan U	Appalachian St. U. East Carolina U. CA Polytechnic St. U. St. Mary's College of MD CSU – Fresno Ohio Wesleyan U

B. Not Included in USNWR Rankings

Public National College Examples	All Colleges	UCLA U Michigan U Virginia UC - Irvine Pennsylvania St. U. Oklahoma St. U.	UC - Irvine U Maryland – College Park Oklahoma St. U.	--
Public Regional College Examples	All Colleges	St. Mary's College of MD CSU – Fresno Ohio Wesleyan U U Northern Alabama U Maryland – Eastern Shore Central Connecticut St. U	U Northern Alabama U Maryland – Eastern Shore Central Connecticut St. U	U Northern Alabama U Maryland – Eastern Shore Central Connecticut St. U

Source: U.S. News *America's Best Colleges* [various issues]. The number of colleges ranked includes both public and private colleges, and includes the total number of colleges in any category in a given year.

TABLE 3: Public College Characteristics, by USNWR Ranking Inclusion Status

	Added - In	Previous -In	Never -In	(1)-(2) t-stat [p-value]	(1)-(3) t-stat [p-value]
	(1)	(2)	(3)	(4)	(5)
(1) Levels of Outcome Variables (1989):					
Total Main Expense	7273	7165	5141	0.33	9.74
	(236)	(457)	(105)	[0.743]	[0.000]
State Appropriation Revenue	6156	6164	4306	0.10	7.28
	(251)	(368)	(125)	[0.987]	[0.000]
Tuition and Fee Revenue	2408	2080	1656	1.71	8.65
	(99)	(163)	(38)	[0.090]	[0.000]
(2) Trends in Outcome Variables (1987 to 1989):					
Percent Change in Total Main	0.11	0.11	0.09	0.30	1.43
Expense	(0.01)	(0.02)	(0.01)	[0.771]	[0.152]
Percent Change State Appropriation	0.08	0.12	0.07	1.77	0.66
Revenue	(0.01)	(0.02)	(0.01)	[0.078]	[0.507]
Percent Change Tuition and Fee	0.16	0.15	0.16	0.26	0.24
Revenue	(0.01)	(0.02)	(0.01)	[0.697]	[0.814]
(3) College Characteristics (1989):					
Enrollment (FTE)	17059	13842	5253	1.97	19.78
	(758)	(1733)	(226)	[0.051]	[0.000]
Flagship College	0.37	0.18	0	1.44	12.71
	(0.05)	(0.06)	(0)	[0.026]	[0.000]
National College	1	0.23	0	19.51	--
	(0)	(0.07)	(0)	[0.000]	
Barron's Guide 1989 Ranking	6.65	5.35	7.62	4.66	7.91
	(0.13)	(0.29)	(0.07)	[0.000]	[0.000]
(4) State Characteristics (1989):					
Pre-College Age Population Share	0.056	0.053	0.056	3.54	0.32
	(0.001)	(0.01)	(0.000)	[0.001]	[0.753]
College Age Population Share	0.067	0.068	0.067	1.47	0.56
	(0.000)	(0.001)	(0.000)	[0.140]	[0.580]
U.S. News Newsstand Circulation	191	184	179	0.35	0.96
(per million)	(11)	(10)	(7)	[0.734	[0.337
U.S. News Subscription Circulation	9.5	9.2	9.2	0.62	1.34
(per thousand)	(0.3)	(0.2)	(0.1)	[0.534]	[0.182]
Number of Colleges	115	40	281	--	--

Notes: Source: Authors' Calculations using data from the Integrated Post Secondary Education Data System, Barron's Guide to Colleges 1989, 1990 Census, the Book of the States, Audit Bureau of

Circulations, and U.S. News *America's Best Colleges* [various issues]. See Table A2 for the data source for each variable.

TABLE 4: The Effect of USNWR Ranking Inclusion on College Expenses and Revenue

Dependent Variable = Log (Financial Variable per FTE)

	Total Main Expense (1)	State Appropriation Revenue (2)	Tuition and Fee Revenue (3)
Added-in * After 1991	0.032**	0.068***	0.007
	(0.011)	(0.015)	(0.024)
Adjusted R^2	0.947	0.936	0.920
Number of Observations	3485	3488	3488
Number of Colleges	436	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for the regression of the relevant outcome on USNWR inclusion in 1990. The standard errors clustered by college are presented in parentheses. All models included college and year fixed effects. See text for details of exact model specification. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance.

TABLE 5: The Effect of USNWR Ranking Inclusion on College State Appropriations: Alternative Time Trend Specifications

Dependent Variable = Log (State Appropriation Revenue per FTE)

	Baseline	Size Quantile-Year Fixed Effects	Flagship-Year Fixed Effects	College Specific Linear Trends	State-Year Fixed Effects
	(1)	(2)	(3)	(4)	(5)
Added-in * After 1991	0.068***	0.053**	0.058***	0.034***	0.068***
	(0.015)	(0.021)	(0.016)	(0.010)	(0.012)
Size Quartile-year fixed effects	NO	YES	NO	NO	NO
Flagship-year fixed effects	NO	NO	YES	NO	NO
College-specific linear trends	NO	NO	NO	YES	NO
State-year fixed effects	NO	NO	NO	NO	YES
Adjusted R^2	0.936	0.937	0.936	0.139	0.966
Number of Observations	3488	3488	3488	3052	3488
Number of Colleges	436	436	436	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for the regression the log (State Appropriation Revenue per FTE) on USNWR inclusion in 1990. The standard errors clustered by college are presented in parentheses. All models included college and year fixed effects. See text for details of exact model specification. Baseline results in column (1) are from Table 3. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance.

TABLE 6: The Effect of USNWR Ranking Inclusion on College State Appropriations: Alternative Control Groups and Time Horizons

Dependent Variable = Log (State Appropriation Revenue per FTE)

	Baseline	Control = Previous in Only	Control = Never in Only	Control = Regional Only	Short-run and Long-run	Count 1990 As Post
	(1)	(2)	(3)	(4)	(5)	(6)
Added-in * After 1991	0.068***	0.102***	0.063***	0.069***	0.067***	0.059***
	(0.015)	(0.024)	(0.016)	(0.015)	(0.017)	(0.014)
Added-in * Year = 1991 or 1992	--	--	--	--	0.002	--
					(0.010)	
Adjusted R^2	0.936	0.952	0.935	0.933	0.936	0.938
Number of Observations	3488	1240	3168	3416	3488	3924
Number of Colleges	436	155	396	427	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for the regression the log (State Appropriation Revenue per FTE) on USNWR inclusion in 1990. The standard errors clustered by college are presented in parentheses. All models included college and year fixed effects. See text for details of exact model specification. Baseline results in column (1) are from Table 3. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance.

TABLE 7: The Effect of USNWR Ranking Inclusion on College State Appropriations: Redistribution Responses

Dependent Variable = Log (State Appropriation Revenue per FTE)

	Baseline	By Flagship College	Effect on Previous-ins
	(1)	(2)	(3)
Added-in * After 1991	0.068***	0.063***	0.063***
	(0.015)	(0.024)	(0.016)
Added-in * After 1991 * Flagship College	--	-0.040	--
		(0.033)	
Added-in * After 1991 * State Flagship College is Previous-In	--	-0.044	--
		(0.057)	
Previous-in * After 1991	--	--	-0.039
			(0.024)
Adjusted R^2	0.936	0.936	0.936
Number of Observations	3488	3488	3488
Number of Colleges	436	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for the regression the log (State Appropriation Revenue per FTE) on USNWR inclusion in 1990. The standard errors clustered by college are presented in parentheses. All models included college and year fixed effects. See text for details of exact model specification. Baseline results in column (1) are from Table 3. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance.

TABLE 8: The Effect of USNWR Ranking Inclusion on College State Appropriations: Attention Interactions

Dependent Variable = Log (State Appropriations per FTE)

	Baseline (1)	Demographic (2)	College Attendance (3)	USNWR Circulation (4)	All (5)
Added-in * After 1991	0.068***	0.075***	0.057***	0.079***	0.073***
	(0.015)	(0.015)	(0.016)	(0.023)	(0.015)
Added-in * After 1991 * Pre-College Age Population Share	--	0.046***	--	--	0.052***
		(0.016)			(0.016)
Added-in * After 1991 * College Age Population Share	--	-0.053***	--	--	-0.074***
		(0.016)			(0.016)
Added-in * After 1991 * Percent of Students at Added-in	--	--	0.019*	--	0.004
			(0.011)		(0.011)
Added-in * After 1991 * Percent of Students at Previous-in	--	--	-0.068***	--	-0.047***
			(0.017)		(0.017)
Added-in * After 1991 * USNWR Newsstand Circulation	--	--	--	-0.008	0.037**
				(0.028)	(0.017)
Added-in * After 1991 * USNWR Subscription Circulation	--	--	--	0.008	-0.067**
				(0.019)	(0.017)
Adjusted R^2	0.936	0.937	0.936	0.936	0.937
Number of Observations	3488	3488	3488	3488	3488
Number of Colleges	436	436	436	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for regressing the log (State Appropriation Revenue per FTE) on USNWR inclusion in 1990. The standard errors clustered by college are presented in parentheses. All models included college and year fixed effects. See text for details of exact model specification. Baseline results in column (1) are from Table 3. Additional State-Level Interactions are: per capita income, percent of population with college degree, unemployment rate, and the percentage of college students at public colleges. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance.

TABLE 9: The Effect of USNWR Ranking Inclusion on College State Appropriations: Prior Updating Interactions

Dependent Variable = Log (Financial Variable per FTE)

	State Appropriation Revenue (1)	Tuition and Fee Revenue (2)
Added-in * After 1991	0.078***	-0.022
	(0.028)	(0.026)
Added-in * After 1991 * Certain Good News	-0.025	0.009
	(0.034)	(0.037)
Added-in * After 1991 * Ambiguous Good News	0.031	0.007
	(0.035)	(0.030)
Added-in * After 1991 * Ambiguous Bad News	-0.019	0.087
	(0.034)	(0.066)
Added-in * After 1991 * Certain Bad News	-0.104***	-0.018
	(0.036)	(0.039)
Adjusted R^2	0.936	0.920
Number of Observations	3488	3488
Number of Colleges	436	436

Notes: Source: Author's Calculations. Each main entry in the table reports the coefficient for the regression the relevant outcome on USNWR inclusion in 1990. The standard errors clustered on college are presented in parentheses. All models included college and year fixed effects. Baseline results in column (1) are from Table 3. See text for details of exact model specification. * indicates significantly different from zero at the 10% level of significance; ** indicates significantly different from zero at the 5% level of significance; *** indicates significantly different from zero at 1% level of significance

TABLE A1: Variable Definitions, Sources and Units of Observation

Variable Name	Definition
A: Integrated Postsecondary Education Data System (IPEDS), College-level	
Total Main Expense	= Total funds spent on instructional expenditure, academic support, student services and institutional support functions per FTE in the 12-month fiscal year
Tuition and Fee Revenue	= Total funds received from Tuition and Fees per FTE in the 12-month fiscal year
State Appropriation Revenue	= Total funds received from State Appropriations per FTE in the 12-month fiscal year
B. U.S. News and World Report "America's Best Colleges" Issues, College-level	
Added-in	= Included in the USNWR rankings for the first time in 1990
Previous-in	= Included in the USNWR rankings before 1990
Never-in	= Never included in the USNWR rankings (during the sample period)
Percentage of State Enrollment at Previous-in	= Percentage of Students in a State attending Previous-in Colleges in 1987 (State-level)
Percentage of State Enrollment at Added-in	= Percentage of Students in a State attending Added-in Colleges in 1987 (State-level)
C. Barron's Profiles of American Colleges Book 1989, College-level	
Barron's Guide 1989 Ranking	= College selectivity category (1=most selective, 8=least selective)
No News	= Barron's Guide 1989 based ranking indicates the *same* quality as the USNWR 1990 quartile ranking
Certain Good News	= Barron's Guide 1989 based ranking indicates *clearly worse* quality than the USNWR 1990 quartile ranking

Ambiguous Good News	= Barron's Guide 1989 based ranking indicates *likely worse* quality than the USNWR 1990 quartile ranking
Ambiguous Bad News	= Barron's Guide 1989 based ranking indicates *likely better* quality than the USNWR 1990 quartile ranking
Certain Bad News	= Barron's Guide 1989 based ranking indicates *clearly better* quality than the USNWR 1990 quartile ranking

D. Author Collected from College Websites, College-level

Flagship Status	= College is the Flagship Campus in the State

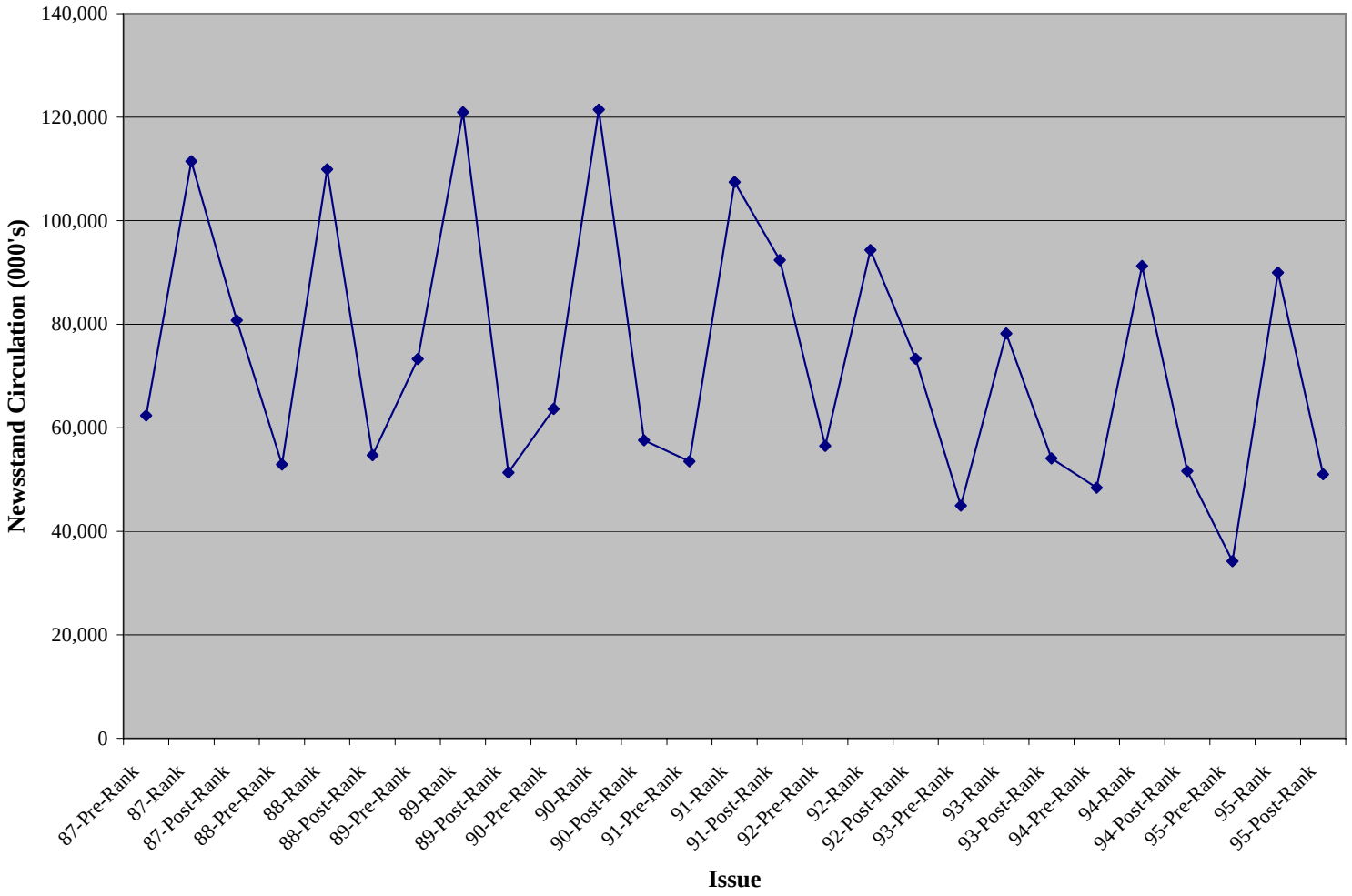
E. 1990 Census, State-level

Pre-College Age Population Share	= The share of the state population in 1990 that is aged 14 to 17
College Age Population Share	= The share of the state population in 1990 that is aged 18 to 22

F. Audit Bureau of Circulations (ABC), State-level & National-level

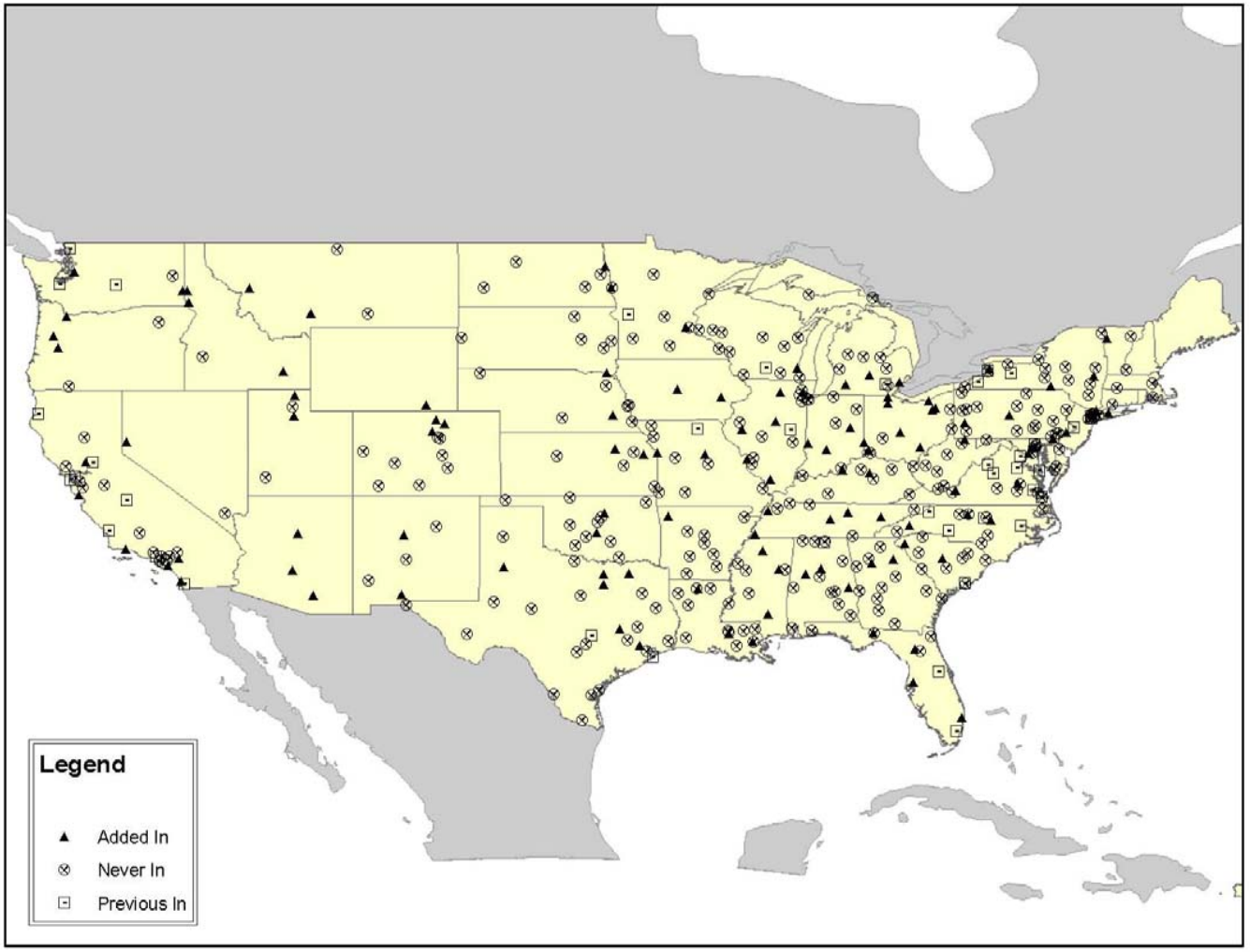
U.S. News Subscription Circulation	= U.S. News and World Report Subscriptions (October 30, 1989) Per 1000
U.S. News Newsstand Circulation	=U.S. News and World Report Copies Sold at the Newsstand (October 30, 1989) Per Million

FIGURE 1: U.S. News and World Report Newsstand Sales, 1986-1995



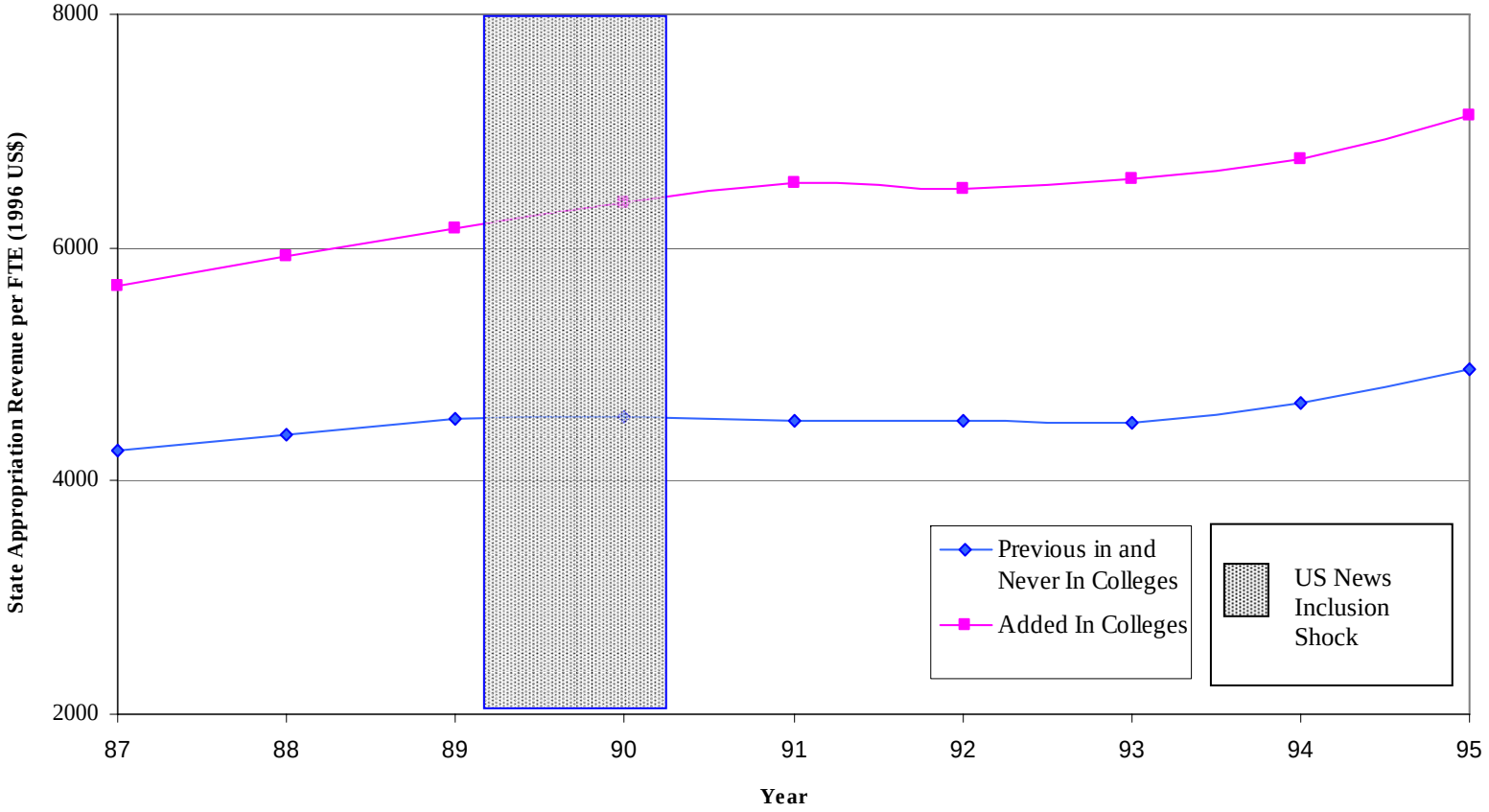
Notes: Source: Author's calculations using Audit Bureau of Circulations (ABC) national-level data for the newsstand sales of USUNWR for the college ranking and contiguous issues.

FIGURE 2: Public College Location Map, by USNWR 1990 Inclusion Status



Notes: Source: Author's Calculations using IPEDS and USNWR data from 1987-1995. All location are based on the college zip code in 1987.

FIGURE 3: Public College State Appropriation Revenue 1986-1995, by USNWR 1990 Inclusion Status



Notes: Source: Author's Calculations using IPEDS and USNWR data from 1987-1995. The years in the figure reflect enrollment years.

FIGURE 4: Illustration of the Creation of Informational Content Variables