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MIDWESTERN BUSINESS AND ECONOMIC REVIEW

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ON PATIENT FLEXIBILITY AND OTHER DETERMINANTS OF FLUCTUATIONS IN EMERGENCY DEPARTMENT VISITS

Jeremy Davis
William Hymes
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ABSTRACT

The purpose of this study is to determine the causes of fluctuations in the number of patients seen daily in the emergency department (ED) of a particular hospital. We show that the number of ED visits is higher with warmer weather, on Mondays, and on the day after certain holidays. We find a decrease in ED visits on the weekend and as one gets further away from the disbursement dates of social welfare programs. Of particular interest, our results indicate that the demand for ED services is somewhat "elastic"—with respect to the perceived need for medical care. Relying on ED utilization data and regression analysis, we find indications that a significant percentage of ED traffic at this hospital is discretionary and non-emergent. These results are prior to the implementation of the Affordable Care Act (ACA) and only directly applicable to the hospital for which we have data. Still, hospital management may benefit from models like this for budget and trend forecasting. This could lead to better allocation of staff, improved patient experience, more efficient efforts to redirect non-emergent visits to more appropriate venues, and presumably, a higher level of patient care.

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INTRODUCTION

Health care and health insurance continue to be a source of immense frustration in both economic and political markets. Consumers, producers, and third-party insurers are frequently unhappy—far more often than one would expect from a normally functioning market.[1] Of course, the markets for health care and health insurance are not normal for a variety of economic and political reasons (Schansberg, 2014). In any case, consumers, providers, taxpayers, politicians, and various interest groups all want "solutions".

Health care and health insurance involve complicated economic markets, with many and varied government interventions, applied to a complex social problem (Schansberg 2011). Government provides health insurance and health care to military veterans—and health insurance to the elderly and the indigent. This necessarily results in market distortions, but it is difficult to imagine fundamental and feasible changes in policy for these populations. The subsidy for health insurance through employers creates far greater distortions in the market for health insurance—and thus, health care (Schansberg, 2014). But ending this subsidy is politically untenable. Failing to address the largest public policy distortions, piecemeal reforms are likely to have minimal impact and other large-scale political approaches are bound to be largely ineffective.

Still, modest reform efforts should be explored. One potential opportunity for improvement is in the operation of "emergency departments" (ED's) or what are popularly called "emergency rooms" (ER's). ED's are often over-crowded (A. Boyle et. al., 2012). Yet, some patients seek out expensive ED services, even when conventional health care delivery methods would be as effective and more efficient. Hospital administration and politicians want to reduce costs. Hospital staff members seem to be overworked. Patients want reduced wait times in the ED. How do we address these problems?

LITERATURE REVIEW

One consideration: When it comes to health care services, the conventional wisdom is that demand is highly "inelastic". For example, it's often said that if you're having a heart attack, you're not going to be searching for lower prices or trying to assess provider quality. But this confuses a specific (highly inelastic) demand for certain health care services with overall demand for health care services, which turn out to be relatively elastic. Consider allergy shots, well-checks, MRI's, lab services, broken bones, and a variety of other non-emergent conditions—where consumers have considerable flexibility.[2] In a word, the question is more complicated than typically assumed and the data are decidedly mixed.[3]

Similarly, conventional wisdom imagines that all ED services are relatively inelastic—the most inelastic of all health care services. After all, those who pursue ED services presumably have an "emergency". But digging into the data and the public policy incentives, it's clear that indigents often use ED services to substitute for conventional medical care.

Hunt et. al. (2006) identify "frequent users" of ED services and find that they often have health insurance and are more likely to be in poor

health than less frequent users. Tang et. al. (2010) finds increased ED use from 1997-2007 (almost doubled over population growth), most of which is explained by increased use by those with Medicaid. They conclude that "ED's are increasingly serving as the safety net for medically underserved patients."[4] So, our model will also allow us to test the relevant hypothesis: Is the demand for ED services relatively steady or does it vary significantly with non-emergency considerations?

A number of scholars have analyzed the relationship between ED performance and activity. For example, patient safety and care is reduced when an ED becomes overcrowded. Sun et. al. (2012) found that patients admitted on days with high ED crowding experienced a 5% higher probability of inpatient death. Wiler et. al. (2012) predict the length of stay in ED's and find that length of stay was higher on weekdays, days with a higher percentage of daily admissions, higher "elopements" (patients leaving before official discharge), and higher periods of ambulance diversion.

A handful of studies look at the number of patients seen in the ED on a daily basis. Faryar (2013) uses ANOVA to measure correlations between single variables and ED visits in a county with rural, suburban, and urban hospitals. J. Boyle et. al. (2012) develop models to predict ED presentations and hospital admissions. Their conclusion: useful ED "prediction tools can be generated from access to de-identified historic data, which may be used to assist elective surgery scheduling and bed management." The current study adds to this part of the literature by using multi-variate analysis of a data set from one hospital to empirically estimate the determinants of ED admissions.

The purpose of this study is to develop a model that can predict the daily number of patients seen in the ED of a single hospital (where we have data). This hospital is a Level I Trauma Center and often treats patients who do not have insurance. So, this model will be most applicable to similar hospitals and extrapolation to other hospital models would require cautious speculation.

One key question is the extent to which health care services should be delivered by ED's, rather than more conventional methods. Uscher-Pines et. al. (2013) provide a thorough literature review and a useful framework for analyzing patient decisions. Shaw et. al. (2013) develop a model of "objective factors [and] subjective perceptions" for modeling decisions to pursue ED care, even with non-ED medical needs. Kangovi et. al. (2013) rely on interviews and finds cost, accessibility, and quality to be the key determinants. Raven et. al. (2013) compare patient complaints with medical diagnoses to look for patterns in mismatches between seeking and needing ED care. Morgan et. al. (2013) survey efforts to reduce ED

usage, divided into five categories: patient education, creation of non-ED options, enhanced use of managed care, pre-ED diversion efforts, and financial incentives for patients.

But for the purposes of this paper, we will hold this question constant. As such, given current levels of ED demand, knowledge of daily market demand for ED services would allow efficient staffing of the ED. The hope is that such models will help hospital management—to increase the likelihood that an ED is appropriately staffed, to deliver higher-quality care, to improve efficiency, and to receive higher patient satisfaction scores. This model also allows us to test the "elasticity" of demand for ED services—not based on price, but on health-related preferences.

METHODOLOGY

The dependent variable is the total number of patients seen in the ED of a single, urban hospital in the Midwest that is the top service provider for indigent care—on each day during 2012.[5] One would expect the number of daily ED visits to be a function of the number of trauma-related events each day. This is especially true in the current case, where the hospital under study is a Level I Trauma Center. But data on trauma-related situations are difficult to find and trauma events are difficult to quantify. We used car accidents as a key subset of trauma events. If someone is in a car accident that requires an ambulance, they will end up in an ED. If someone is in a non-injury car accident, they still may want to be checked out at an ED. Fortunately, the local 911 service keeps track of all the reported car accidents in the city.

From the experience of those in this ED, warmer weather seems to be associated with trauma occurrences and ED visits. Temperatures are a daily event, but they're also part of a seasonal pattern—with expectations of engaging in certain behaviors that may cause more/less ED activity. Initially, we used monthly binary variables to capture weather-related variation through its seasonality. Average daily ED visits varied from 190 in November and December to 224 in July. Visits were below average from October through February; and above average from March through September—a clear cyclical pattern over the months.

Then, we switched to more specific variables: average daily temperature, amount of precipitation, and severe weather events. Zibners et. al. (2006) find little relationship between hourly temperature, precipitation, and ED visits. But Faryar (2013) finds correlations between temperature and ED visits: less for "extremely cold" weather and more for the day after that weather breaks. Attia and Edward (1998) find no relationship between precipitation and ED visits. Marcilio et. al. (2013)

find no relationship between temperature and ED visits, but the study is in Brazil and only for the summer. Perry et. al. (2011) find a positive relationship between hot weather and ED visits for heat-related illnesses.[6]

Talking with hospital professionals, they hypothesized that disbursements from public assistance programs might affect ED visits. For example, some recipients spend their money on alcohol, increasing their likelihood of being seen in an ED. Foley (2008) provides another precedent for studying the potential linkage here. He found a connection between disbursements and money-related crimes. As time from disbursement increased, financial crimes became more likely.

As it turns out, the timing of disbursements differs between states and over time. The three largest welfare programs for the poor are Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP or "Food Stamps"), and Supplemental Security Income (SSI). SNAP and SSI distribute funds on the first of the month. The timing of TANF payments is staggered among recipients—and interestingly, the schedule changed in the middle of 2012. Following Foley (2008), we have constructed an index that weighs the amount and timing of disbursements.[7] We didn't have strong expectations for this variable, imagining that time until disbursements could be positively or negatively related to ED use.[8]

Holidays are another potential explanatory variable. Some holidays may tend to have more ED visits; other holidays may lead to fewer. (Faryar [2013] analyzes all federal holidays together and finds a negative correlation with ED visits.) Some holidays might be expected to *create* ED visits—particularly those with a celebratory nature (e.g., New Years, July 4th).[9] Some holidays may lead to fewer discretionary visits—particularly if the opportunity costs of an ED visit are higher on that day. For example, "missing" Christmas or Thanksgiving would be relatively painful.[10] Beyond that, people may perceive that ED visits on key holidays will be more painful with a much longer wait—or if they've traveled for the holiday, they may be more reluctant to visit a "foreign" ED. For more marginal holidays, it's not clear what one might expect, so we created a third binary variable for seemingly less significant federal holidays and other odd days.[11]

There may be a difference in ED visits between weekdays and the weekend. One might expect more visits on the weekend. When people have more free time on the weekend, they may be more likely to have an accident that would bring them to the ED. To the extent that people cannot access non-ED services, the ED may be the best option. Or ED visits are discretionary, we might find fewer visits on weekends. In turns out that average visits for our data were highest on Mondays (231) and lowest on the weekend (209 on Friday; 184 on Saturday; and 188 on Sunday). This

lines up with Faryar (2013), who finds that ED visits in her data set are greatest on Mondays and lowest on Saturdays.

Because the impact of particular days was not clear, we used binary variables for each day of the week. When the coefficients for Tuesday, Wednesday and Thursday were not (close to being) statistically significant, we reduced our set of variables to Mondays and the weekend days. We also created a binary variable for days after a big holiday—which could be treated as a (post-weekend) Monday by patients. Related to this, we might find more or fewer ED visits on other days when school is out of session—e.g., in the summer or on Spring/Fall breaks. So, we also explored ED visits as a function of when K-12 schools are not in session.

Finally, we have two variables with a "superstitious" background. Many people, including some doctors and nurses, believe that a full moon affects pregnancy in particular—and a person's physical or mental health in general. If people have more psychological problems during a full moon, this would be an important factor to include in the model, since the ED at this hospital has a section for emergency psychiatric services. Belleville (2012) finds that, "Contrary to popular belief, there is no connection between lunar phases and the incidence of psychological problems." Gans and Leigh (2015) find no significant impact on conceptions, births, and deaths in a 29-year data set. But it's worth taking another look at the full moon as a factor.[12]

The second superstitious variable concerns Friday the 13th. Many people believe that the day has supernatural powers—as an "unlucky" day when bad things are more likely to happen. If so, it may increase the number of visits to the ED. Then again, there may be fewer visits on Friday the 13th, if people are more careful on the three Friday the 13ths that occurred during 2012.

The model is:

$$Y = B_0 + B_1 * CarAccidents + B_{2i} * WeatherVariables + B_3 TimeWelfareDisbursement + B_{4i} * HolidayIndicators + B_{5i} * DayIndicators + B_6 * K12NotInSession + B_7 * FullMoon + B_8 * Friday13th$$

RESULTS

We used Ordinary Least Squares (OLS) regression analysis and tested models with linear and semi-log functional forms. Semi-log is a bit more reasonable theoretically and one would expect less trouble with heteroscedasticity. But the model has relatively little variance in the values of the dependent variable, so heteroscedasticity was not a significant problem. Moreover, Jones et. al. (2008) find that multiple linear regression models were as effective, in this context, as more sophisticated models. Since a.) the model results were little different; b.) semi-log results are

considerably more difficult to interpret; and c.) we'd like to present a model that is more likely to be used by practitioners, we'll focus on the linear results here. The results from the OLS model are presented in Table 1.

Discussing the statistically insignificant variables first: Surely, accidents influence ED visits. But as a relatively small contributor to overall ED volume, the variable did not have enough precision to attain statistical significance. Precipitation and storms might contribute to any given ED visit, but they are also a seemingly small factor—and are likely offset by people being more cautious. Not surprisingly, the "miscellaneous" holidays don't contribute anything significant to the model. If people treat them as "just another day", then they shouldn't impact ED use. Demand-enhancing holidays were also insignificant—perhaps reflecting a combination of a relatively dangerous day and a relatively high-opportunity-cost holiday to miss with an ED visit. Finally, neither full moon nor Friday the 13th was statistically significant.

Average temperature was statistically significant. As the weather warms, ED visits increase. We had a sense of this with the seasonal variance in ED visits by month. Here, a 50 degree change in average temperature results in 30 more visits—about a 15% increase for this ED. Time since the next welfare disbursement was negatively correlated with ED visits. When one has received a government payment recently, ED visits are somewhat more likely: another ten days is correlated with an increase of ten visits. And K-12 school being out of session slightly decreased the number of ED visits. (Note that "not in school" also acts to slightly increase the net coefficient on weekends and most holidays.)

Four days of the week had coefficients that were statistically significant: Monday was positive; Friday, Saturday, and Sunday were all negative. The coefficients indicate that this ED can generally expect 25% more patients on a Monday than on a Saturday (221 vs. 177), all other things equal. Likewise, the use of ED services is greatly reduced on "high opportunity cost" holidays—30% lower, holding all other variables constant (144 vs. 205). And similar to our "Monday" result, ED usage on the day after a key holiday increased by 13 visits on average (about 7% higher than normal).

SUMMARY AND CONCLUSIONS

One key summary result: Many patients (at least for this ED) seemed to be using discretion to postpone seeking medical attention from the weekend to the beginning of the next week. Likewise for big holidays and the day afterwards. This could be driven by preferences (e.g., wanting to have fun on a weekend), constraints (e.g., the availability of free "child care" through K-12 education), or perceptions of constraints (e.g., longer

ED waits on weekends). In any case, this speaks to the literature where scholars and practitioners have expressed concern that some patients are seeking ED care instead of more-appropriate types of "urgent care". More broadly, it speaks to the literature on the demand for health care and the assumption that consumption of health care services—even, ED services—is not nearly as inflexible as one might assume.

The purpose of this study has been to determine the causes of fluctuations in the daily number of patients seen at a specific ED. This study has shown that the number of visits is higher with warmer weather, on Mondays, and the day after key holidays. The study shows a decrease in ED visits on the weekend and as one gets further away from welfare disbursement dates. Of particular interest, our results indicate that the demand for the ED is somewhat "elastic"—with respect to the perceived need for medical care.

Note that these results are prior to the implementation of the Affordable Care Act (ACA)—and only directly applicable to this one hospital. As the burgeoning literature on post-ACA ED usage indicates, these results may not be applicable to current economic and political institutions. And certainly, the results cannot be extrapolated confidently to other hospitals—particularly to those that do not actively serve an indigent population. Still, hospital management may be able to use models like this for budget and trend forecasting. This would lead to better allocation of staff in the ED, improved patient experience, and more appropriate levels of patient care.

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AN ANALYSIS OF PEDAGOGICAL APPROACHES IN DIVERSE TOPICAL AREAS

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ABSTRACT

All pedagogical topical areas cover a wide range of topics and require different tools and techniques to help students learn concepts and relationships to other topics. This study examines three different pedagogical tools (mathematical modeling, conceptual mapping, and systems thinking) and how they are applied in three topical areas (finance, public administration, and information systems). While each of these tools can be applied to multiple topical areas, we have chosen to illustrate them with respect to a specific topical area. It is hoped that this manuscript jump starts a discussion on using different teaching methodologies to teach conceptually challenging concepts.

INTRODUCTION

Enhancing student learning opportunities requires instructors to perfect existing teaching methods, look for alternative tactics, and sometimes consider innovative mixing of old and new techniques to achieve desired learning outcomes. There is an adage that states that 'if all you have is a hammer, everything looks like a nail.' While many teaching techniques have value and a place in the teacher's 'pedagogical toolbox,' there is value in acquiring new techniques and learning new ways to apply familiar tools.

The objective of this examination of teaching practices is to encourage teachers to consider alternative approaches to helping students learn difficult topics. Of course, when selecting a pedagogical strategy, instructors must consider the learner's background knowledge, experience, the learning venue (in class, online, or hybrid) and of course, the desired learning outcomes. For the purposes of this research project, the authors chose to examine the use of mathematical modeling for teaching finance courses, systems thinking for teaching information systems courses and conceptual mapping for teaching public administration courses. The usefulness of these pedagogical tools will be considered using a model for pedagogical reasoning and action proposed by Lee Shulman (Shulman,

1987). Shulman's model is discussed in the subsequent section. The model has six elements (comprehension, instruction, evaluation, transformation, reflection and new comprehension) and this study will focus on three of those elements; those three elements are comprehension, instruction and evaluation. This is due to the fact that it is not possible to do justice to all six elements in one manuscript of limited length. Hence, the research objective and hypothesis can formally be stated as follows:

Research Objective: To apply elements of Shulman's Model of Pedagogical Reasoning and Action to the instructional components of finance, information systems (IS) and public administration (PA) in the hopes of optimizing the comprehension and evaluation components. Mathematical modeling (finance), systems thinking (IS) and conceptual mapping (PA) will serve as the basis for this analysis.

Hypothesis: Instructors who utilize Shulman's model in the instructional component will find that it enhances student comprehension of the material being covered and produces desirable results on evaluation metrics such as exams and quizzes.

The next section provides some background information on this topic as well as a brief review of the relevant literature. This section will also introduce Shulman's Model of Pedagogical Reasoning and Action which serves as the basis for the analysis conducted in this research project. This will be followed by a section in which the three pedagogical approaches, alluded to earlier, will be contrasted; this section will keep the discussion focused on the three pedagogical topical areas (finance, information systems and public administration) that is the topic of this manuscript. The subsequent section provides the appropriate context for the manuscript. The final section offers some concluding comments, implications for future research projects on related topics as well as the practical implications of this study.

BACKGROUND AND LITERATURE REVIEW

Shulman observed, 'Thus, teaching necessarily begins with a teacher's understanding of what is to be learned and how it is to be taught.' (Shulman, 1987). While there are many ways to teach difficult topics, it may be easy for instructors and researchers to gravitate toward one or two learning theories that they are familiar with and not challenge themselves to experiment with other methodologies to improve student understanding of the course material (Clark, 2009). Even professors, experts in their

respective subject matters, can profit from looking at their areas of interests through a new lens.

To evaluate the usefulness of the tools discussed in this paper, the authors chose to apply a model of pedagogical reasoning and action (Shulman, 1987). The elements of Shulman's model, which are described in Table 1, can be used to evaluate the usefulness of a teaching methodology. Using Shulman's model as a lens, this paper examines three teaching methodologies as they are applied to three pedagogical topical areas.

MATHEMATICAL MODELING

Mathematical modeling has two components: model creation and model analysis (Toews, 2012). Model creation allows for characterization of relationships between phenomena being examined, and model analysis requires the application of conventional mathematical reasoning. For example, a mathematical model can be used to help students understand the finance topic of stock valuation, a critical concept covered in many finance courses (Chen & Jassim, 2013).

Indeed, Tularam stresses the 'ingrained nature of mathematics in finance' in his article addressing the importance of teaching mathematics in finance courses (Tularam, 2013). The use of a relevant mathematical model can help explain the impact of an event on stock price or to explain

Table 1: *Shulman's Model of Pedagogical Reasoning and Action*

Comprehension	Of purposes, subject matter structures, ideas within and outside the discipline
Transformation	Preparation: critical interpretation and analysis of texts, structuring and segmenting, development of a curricular repertoire, and clarification of purposes
	Representation: use of a representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations, and so forth
	Selection: choice from among an instructional repertoire which includes modes of teaching, organizing, managing, and arranging
	Adaptation and Tailoring to Student Characteristics: considerations of conceptions, preconceptions, misconceptions, and difficulties, language, culture, and motivations, social class, gender, age, ability, aptitude, interests, self-concepts, and attention
Instruction	Management, presentations, interactions, group work, discipline, humor, questioning, and other aspects of active teaching, discovery or inquiry instruction, and the observable forms of classroom teaching
Evaluation	Checking for student understanding during interactive teaching Testing student understanding at the end of lessons or units Evaluating one's performance, and adjusting for experiences
Reflection	Reviewing, reconstructing, reenacting and critically analyzing one's own and the class's performance, and grounding explanations in evidence
New Comprehensions	Of purposes, subject matter, students, teaching, and self consolidation of new understandings, and learnings from experience

Source: 'Knowledge and Teaching: Foundations of the New Reform' by L. Shulman, 1987, Harvard Educational Review, 57(1), p. 15.

a concept such as the inverse price/yield relationship. Each model has its pros and cons, but unfortunately, models, by their very nature, simplify reality, and as a result, are imperfect. As observed by George Box (1976, p. 792) '…all models are wrong,' but he goes on to say in other works that some models are still useful. In practice, companies often use an assortment of valuation models and derive estimates of value by using weighted averages of value obtained from the selected models (Chen & Jassim, 2013). Thus, the usual presentation in most higher education business courses relates the various components of valuation, but often across several chapters or at least several segments of the course.

SYSTEMS THINKING

Moving beyond a single concept and understanding how parts of the mathematical model are related may involve 'systems thinking.' There are many descriptions of 'systems thinking,' but Arnold and Wade proposed an objective definition 'Systems thinking is a set of synergistic analytics skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them to produce desired effects. These skills work together as a system' (Arnold & Wade, 2015, page 675). Furthermore, 'system thinking' is equated with 'anticipatory learning' allowing learners to see the 'big picture' and understand the patterns in inter-relationships (Senge & Fulmer, 1993).

The study of information systems includes a host of subjects not limited to information technology (IT) hardware and software, computer networks, transaction processing, data analytics, machine learning, artificial intelligence, system development life cycles, and many more complex topics. The typical 'Introduction to Information Systems' course present students with a dizzying array of concepts, acronyms, and terms that are outside most student's previous experience. To effectively teach these topics to students with limited exposure to information systems knowledge, many instructors use systems thinking concepts, that is systems are combinations of interacting elements, acting synergistically to achieve a defined purpose. Using systems thinking, students can relate the elements that they learn about in an information systems course to how organizations can use these technologies to attain organizational goals.

CONCEPTUAL MAPPING

Conceptual mapping is a graphical approach to organizing knowledge and representing knowledge (Novak & Canas, 2008). Course concepts and relationships can be identified by using boxes, circles, and lines to

specify hierarchical relationships between concepts within a given context (Novak & Canas, 2008). Conceptual mapping facilitates 'meaningful learning' by presenting material that is conceptually clear and relatable to the learners existing knowledge and assisting the sequence of learning through progressively more explicit knowledge that can be integrated into current understanding (Novak & Canas, 2008).

CONTRASTING PEDAGOGICAL APPROACHES

As described in the review of relevant literature, mathematical modeling, conceptual mapping, and system thinking all have use in specific venues. In this section, this paper will evaluate the value of these approaches for certain topical areas using Shulman's model as a guide. This section is divided into three subsections. In the first subsection, Shulman's model will be applied to the teaching of finance courses. Mathematical modeling will constitute the basis for this analysis. In the second subsection, Shulman's model will be applied to the teaching of information systems (IS) courses. Systems thinking will constitute the basis for this analysis. In the final subsection, Shulman's model will be applied to the teaching of Public Administration (PA) courses. Conceptual mapping will constitute the basis for this analysis.

SHULMAN'S MODEL FOR TEACHING FINANCE COURSES

As described in table 1, Shulman's model of pedagogical reasoning and action involves the following components: Comprehension, transformation, instruction, evaluation, reflections and new comprehensions. As stated in the introductory section, this manuscript will focus on three of those items: Comprehension, instruction and evaluation. This is owing to the fact that it is extremely difficult, if not impossible, to do justice to all six elements of the model in one manuscript of finite length.

Comprehension refers to the issue of student understanding of the material being covered in a given course. Instruction refers to the tools utilized by the instructor in a manner that optimizes the comprehension aspect of the model; and evaluation refers to the testing process whereby students are evaluated on the material covered in a given course or portion thereof. Evaluation includes, but is not limited to, homework assignments, other class exercises and projects, quizzes and exams. As with comprehension, the evaluation aspect of Shulman's model is heavily dependent on the instruction component. In other words, the instruction

component can essentially "make or break" both the comprehension and the evaluation components.

The instruction component of the model is essentially where mathematical modeling lends itself as an effective pedagogical tool with respect to finance courses. Finance is largely a quantitative field. Finance professionals spend a significant portion of their workday in front of computer terminals analyzing and interpreting financial data. The profession, by its very nature, involves dealing with highly complex mathematical and quantitative models such as the Black Scholes Option Pricing Model. This model is often times built into hand held devices of professional option traders.

In any given course, the instruction component of the course must mirror the real world characteristics of the subject matter that is covered in the course. Finance is no exception. The evaluation component, of Shulman's model with respect to finance courses, involves a significant amount of quantitative problems and results on the various evaluations tools utilized in a course, such as quizzes and exams, will be less than satisfactory if the instructional component does not effectively deliver on the comprehension component of Shulman's model.

Due to the quantitative nature of the field coupled with an expectation by employers that individuals working in the field will be quantitatively oriented, mathematical modeling is an appropriate pedagogical tool to be utilized as part of the instruction component of Shulman's model of pedagogical reasoning and action. Appendix A, located in the online appendix, has some examples of how mathematical modeling can actually be deployed in finance courses to teach key concepts.

SHULMAN'S MODEL FOR TEACHING IS COURSES

As with finance courses, the analysis of IS (information systems) courses will focus on the comprehension, instruction and evaluation aspects of Shulman's model of pedagogical reasoning and action. Once again, the goal of the instruction component of the model is to optimize the results of the comprehension and evaluation aspects. To that end, systems thinking is advocated as an effective pedagogical tool to utilize for the instruction component of Shulman's model in IS courses.

Many definitions of systems thinking have been proposed. Arnold et al. (2015) used a systems thinking approach to identify a complete and universally applicable definition of systems for use in educational efforts. The objective definition they derived from distilling other research on systems thinking is: *'Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems,*

predicting their behaviors, and devising modifications to them to produce desired effects. These skills work together as a system.'

An alternative way to view systems thinking is as follows: A big picture view of the whole. In the real world, systems thinking can be used to see how individual components interact as part of the whole. It is equally applicable in academia and can particularly be a useful tool for teaching IS courses. IS courses, by their very nature, involves several systems that interact in some way towards a whole component and so instructors can begin by helping students understand and identify the various systems. Anecdotally, instructors, such as myself and fellow IS colleagues at my university, who use systems thinking have found that it facilitates student engagement and discussion, and increases student participation in the learning process. IS courses often involve having the students develop projects using computer applications on real-world data. The systems thinking approach has a proven track record to help students develop models that facilitate successful completion of such projects. By their very nature, IS courses often require the instructor to become more involved in student out of class assignments such as research projects. Typically, instructors who embrace systems thinking move from behind the desk to interact with the students and in doing so facilitate and enhance the learning experience of students.

In summary, systems thinking is an effective tool to deploy in IS courses since the technique involves analytic analysis of various components. Furthermore, the diversity and complexity associated with IS courses lends itself quite effectively to a systems thinking approach of pedagogical delivery. Hence, employing systems thinking as the appropriate pedagogical tool in the instructional aspect of Shulman's model of pedagogical reasoning and action should ideally result in optimizing both the comprehension and the evaluation aspects.

SHULMAN'S MODEL FOR TEACHING PA COURSES

As with finance and IS courses, the analysis of PA (public administration) courses will focus on the comprehension, instruction and evaluation aspects of Shulman's model of pedagogical reasoning and action. As with the previous two disciplines discussed earlier, the goal of the instructional component of the model, with respect to PA courses, is to optimize the results of the comprehension and evaluation components. To that end, conceptual mapping can be an useful pedagogical tool to utilize for the instruction component, of Shulman's model, in PA courses.

A concept map is a way of showing the relationships among concepts. It is a visual tool for organizing knowledge. Concepts can be represented

as boxes or circles and organized in a manner that shows the relationship of concepts to an outcome such as organizational performance. The technique for visualizing relationships among different concepts is called 'conceptual mapping.'

So how do we begin developing a concept map? We start with the big picture and ask how does the public administration curriculum, as a whole, hang together? What are the relationships within courses and among various courses? The latter aspect is very critical for assisting students with curriculum ending assessments. One way of visually depicting the core curriculum is shown graphically, in the first example, in appendix B which is located in the online appendix. It is certainly not the only way, but one way. Note that the key outcome is to influence organizational performance in some manner. In fact, connecting knowledge to organization performance makes it an anchor for what is learned. One of the ultimate goals, of most PA courses, is to be able to use knowledge gained to help public organizations perform more effectively. Conceptual mapping is an effective means of helping students understand how concepts covered in core courses can be used to improve organizational performance.

We can expand the depiction of concepts by looking at each course and ask what the major conceptual components that influence organizational performance are? An illustration using concepts that relate to a course in public human resource management is depicted in the second example in appendix B. In the HR example are shown six major areas: labor/management relations, HR functions, personnel systems, individual rights, discrimination, and diversity. Again, this is just one way to think about the overall structure of the course in HR management. There are many others. However, the story does not end here. What is important is the content of each box. For example, HR functions can be further broken down into such functions as recruitment, selection, pay, performance management, and position classification. Moreover, performance management, for example could be broken down into different forms of appraisal instruments. So, it is the detail that counts which leads to drilling down within broader conceptual areas. The more depth that can be added to a conceptual map the stronger the likelihood of an outcome that will allow students to retain and organize learning.

As another illustration consider the content shown in the final two examples, in appendix B, that shows just some of the numerous terms within the realm of organizational theory. Students can find the chaos shown in the illustration a daunting challenge in terms of how to organize thinking about the subject. As can be seen, it is quite a combination of terms. The challenge is to organize the terms in a way that makes knowledge

of the concepts easier to retain and selection of appropriate concepts for application to real-world problems easier to determine.

In summary, conceptual mapping is an effective instructional tool in PA courses since it helps provide an understanding of numerous overlapping areas that are of importance to this pedagogical discipline and therefore is advocated as being an effective way for students to select and apply the knowledge imparted in PA courses. Hence, conceptual mapping is advocated as an effective tool to utilize in the instruction aspect of Shulman's model of pedagogical reasoning and action with respect to PA courses. Due to the nature of the subject matter, utilizing conceptual mapping in the instruction component should ideally optimize the comprehension and evaluation components of the model with respect to PA courses. It also has the advantage of something each student can adapt as a useful learning technique.

DISCUSSION

This study is only a preliminary investigation into this issue. The authors acknowledge that additional research is needed on this topic. However, it is hoped that this manuscript serves as a "food for thought" for instructors teaching in the three subject areas addressed in this study. In other words, impacted instructors might want to reevaluate their instructional techniques based on the ideas illustrated in this study.

It is hoped for that this study jump starts a discussion on appropriate teaching methodologies for certain subject matters. It is also hoped for that this study, which is qualitative and theoretical, serves as the catalyst for a continuing research thread that ultimately culminates in empirical validation of the ideas illustrated in this manuscript.

CONCLUSIONS

The purpose of this paper has been to discuss three pedagogical approaches to teaching three pedagogical topical areas. These three pedagogical approaches are mathematical modeling, systems thinking and conceptual mapping and the three pedagogical topical areas are finance, information systems and public administration.

The paper used Shulman's Model of Pedagogical Reasoning and Action to illustrate the usefulness of mathematical modeling, systems thinking and conceptual mapping in finance, IS and PA courses, respectively. The paper's intention is to illustrate that effectively utilizing the model for the instructional component should optimize both the comprehension and evaluation components.

This paper was relatively narrow in scope in that it only considered three pedagogical approaches (mathematical modeling, systems thinking and conceptual mapping) with respect to three pedagogical topical areas (finance, information systems, and a public administration). In doing so, the paper illustrated three pedagogical approaches that can be used effectively to teach the three topical areas that is the subject of this manuscript.

The three pedagogical approaches and the three topical areas, discussed in this paper, are certainly not an exhaustive list by any stretch of the imagination. Future papers could consider other topical areas and introduce readers to other pedagogical approaches that could constitute a part of an instructor's 'pedagogical toolkit.' Furthermore, Shulman's model of pedagogical reasoning and action is not the "only game in town" for evaluating pedagogical approaches for diverse topical areas. Future studies might want to address the issues discussed in this manuscript using a different pedagogical model.

This paper was qualitative. It introduced a pedagogical model (Shulman's Model of Pedagogical Reasoning and Action) and then utilized it to evaluate three diverse pedagogical topical areas (finance, IS and PA) in the context of three pedagogical approaches (mathematical modeling, systems thinking and conceptual mapping). Future studies might want to empirically evaluate the arguments, advocated in this manuscript, by utilizing data from exams, quizzes and other course assignments (the evaluation component of Shulman's model). This is another potential avenue for future research projects on this topical area.

Shulman's model has six elements, but this manuscript focused on only three of those elements (comprehension, instruction and evaluation). Future studies could expand on this manuscript by addressing how instructors can use the remaining three aspects effectively in their respective courses. This is another potential avenue for a future research project.

This study has some practical applications. It has laid out certain pedagogical tools that may be appropriately suited to certain topical areas due to the nature of the subject matter. Instructors teaching in the subject areas, covered by this study, could potentially consider revising their pedagogical delivery techniques and strategies based on the illustrations shown in this study.

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I THOUGHT I KNEW: THE DUNNING-KRUGER EFFECT IN THE PRINCIPLES OF ECONOMICS CLASSES

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ABSTRACT

This research study provides evidence for the Dunning-Kruger effect from the principles of economics classes with students of Generation Z. We examine the Dunning-Kruger effect with a diverse student body from three universities. We used a classroom-experiment and collected data of students' self-assessment on their final exam and paired these data with their actual exam grade, cumulative GPA, and personal characteristics. The results of our study show that although overestimation exists among students of all grade levels, students with a low GPA greatly overestimate their performance.

INTRODUCTION

Most educators, if not all, in higher education have heard or experienced the following situations: before the exam, some students show up underprepared but believe that they have mastered all the materials. During the exam, they scratch their head over those questions but still feel good about their performance in general, so they submit the exam early and rush out of the classroom without spending time verifying their answers. After the exam, usually the same students contact the instructors asking for opportunities to make up the points because they receive a lower grade than what they have expected.

Although this is just an anecdote, overconfidence and overestimation of one's knowledge, ability, and performance are widely observed both inside and outside the classroom. Kruger and Dunning (1999) found that low-ability individuals tend to overestimate their performance while high-ability individuals, on average, correctly evaluate or slightly underestimate their performance. This asymmetric error in self-evaluation is known as the "Dunning-Kruger effect." The authors claimed that low-ability individuals suffer from a double-burden of not only being ignorant but also unaware of their ignorance due to their lack of cognitive ability in the initial stage.

In other words, people's ability of "knowing about knowing" is bounded by their ability of knowing itself. This is an important issue for students: In the short run, such overconfidence can cause students' procrastination and under-preparation in their coursework. In the long run, this may lead to delays in fulfilling major requirements for graduation, especially for those underperformers who could benefit tremendously from being aware of the reality at an early stage.

This study identifies and raises the awareness of the existence of the Dunning-Kruger effect with students in the introductory courses of economics. We test the following hypotheses using a classroom-based experiment: (1) whether students overestimate their test performance; (2) if the answer to the previous questions is "yes," who tend to overestimate in self-assessment, those with higher or lower GPA; and (3) do students' characteristics, such as gender, race, and school year, interfere with their self-evaluations. We design a classroom survey and collect data from three universities across the United States. We use an incentivized task to solicit student predictions of their final exam grades immediately after the exam. We compare the students' predicted grades and their actual grades at the individual level and further analyze what factors contribute to their inaccurate predictions. The results of this study show that students' cumulative GPA in college is an important factor explaining the discrepancy between their self-assessed grade and the actual performance. Although overestimation exists in all High, Medium, and Low GPA groups, students with higher GPA are less likely to overestimate their performance. Specifically, on average, for every 1-point increase in a student's GPA, there is a 0.279 decrease in the student's overestimation on self-assessment in terms of letter grade, which is defined as the difference between a student's expected letter grade and the actual letter grade received. Besides, the likelihood of a student's overestimation on self-assessment decreases by 13.4 percentage points with every 1-point increase in the student's GPA. We did not observe other personal characteristics such as gender, race, and school year have any significant impact on distorting one's self-assessment.

This research is different from previous studies in two ways. First, we incentivized our task by providing students with extra credits only if they correctly estimated their final exam grade. Compared with a non-incentivized task, this encourages students to provide a more accurate measure of their test performance and reduces the impact of their wishful thinking. Second, we examined the discrepancy between students' self-assessment and their actual performance using both nonparametric estimation and parametric estimation and measured the magnitude and the likelihood of this discrepancy as well. Also, our research study extends the existing literature to include the current student body of Generation Z.

It provides empirical evidence that the "unskilled-and-unaware" effect is still prevailing in the principles of economics classes nowadays.

The rest of this paper proceeds as follows. Section 2 offers a literature review on the Dunning-Kruger effect and various classroom-based research studies. Section 3 explains the design and procedure of our experiment and provides the summary statistics. Section 4 presents our data analysis and the results. Section 5 discusses the implications of our findings and concludes.

LITERATURE REVIEW

Kruger and Dunning (1999) identified an asymmetric bias in individuals' self-evaluations. They ran ability tests on humor, grammar, and logic with 194 student subjects and asked them to evaluate their absolute and relative performance. They discovered that while high performers tend to underestimate themselves, inflated self-assessment is prevailing among subjects of the bottom quartile for all types of tests. These subjects, who ranked in the 12th percentile, perceived that they ranked in the 62nd percentile. The authors claimed that the low-performers suffer from a dual-burden of being ignorant about their own ignorance because their lack of cognitive ability bounds their metacognitive ability to realize their lack of skills.

The Dunning-Kruger effect has been verified and studied ever since. Miller and Geraci (2011) showed that psychology students with lower grades overestimate their performance, while those with higher grades have more accurate estimations or even underestimate their performance. The authors argued that a possible explanation of such overconfidence among low-performing students is because their desired grade influences their predicted grade. Serra and DeMarree (2016) also discovered in their study that students' wishful thinking leads to overestimations of their predicted grade, and this is especially true for those with lower grades. They surveyed a psychology class, asking students to predict their exam performance at different times. They found that regardless of when the students were asked, their desired grade always influences their predicted grade. The authors explained that a student's desired grade might provide an anchor for their predicted grade, and low-performing students are less likely to adjust as well as lack the ability to incorporate more information to adjust their predicted grade to match their actual grade, compared with those high-performing students. Grimes (2002) also used a survey asking students in economics classes to predict their exam scores 48 hours prior to the exam, right before the exam, and right after the exam, respectively.

Results show that as time passes by, preparing for the exam and the experience of taking the exam assist students to revise their expectations and calibrate their predictions. However, overconfidence is still prevailing even after students take the exam. In addition, the author found a gender effect in calibration. Female students are more realistic, and their estimated performance is closer to the actual performance compared with their male counterparts. In another research study targeting economics students, Nowell and Alston (2007) found that on average, male students, low-performing students, and students in lower-divisions overestimate their performance to a larger degree. Besides, the authors claimed that grading practices might influence the student's estimation. For instance, curving increases uncertainty and thus reduces the accuracy of students' estimation. Ferraro (2010) also discovered the Dunning-Kruger effect in his study with economics students that low performing students tend to overestimate their performance, and such overconfidence leads them to make wrong economic decisions. Feld, Sauermann, and De Grip (2017) asked their economics students to predict their exam grades four weeks in advance. They found that low-skilled students are vastly overconfident while those high-skilled are more accurate in assessing their skills. Besides economics and psychology students (Kruger and Dunning, 1999; Dunning, 2011; Miller and Geraci, 2011), researchers have discovered similar findings using college student survey data in medical schools (Hall et al., 2016), aviation schools (Pavel et al., 2012), biology classes (Ainscough et al., 2016), and chemistry classes (Bell and Volckmann, 2011; Brandriet and Bretz, 2014; Pazicni and Bauer, 2014).

EXPERIMENT DESIGN AND DESCRIPTIVE STATISTICS

We designed a classroom experiment and collected data from introductory-level economics classes from three four-year universities across the United States in December 2018. All three institutions are four-year regional universities. Two of them are public universities located in the Northeastern region and Midwest, respectively, and the third institution is a private university located in Hawaii. The university in the Northeastern region enrolls about 8,500 students in both undergraduate and graduate programs. The other public university located in the Midwest has an enrollment of more than 5,000 students and offers bachelor's and master's programs. The private university in Hawaii has about 1500 students with a focus on undergraduate education with few graduate programs. For all three institutions, the economics department resides in the business school, and the principles of economics course is part of the university's general education program. None of the institutions offers

an economics master's degree, but all the business schools have master's programs. All three institutions are regional universities, with the student bodies well representing the demographics of the local population. The students of the two institutions on the mainland, United States, are mainly white and Hispanic. The majority of the students in the institution located in Hawaii are Asian-Americans, Native Hawaiians, and other Pacific Islanders. All the classes involved in this research study are traditional face-to-face classes. All our instructors posted students' grades via their university's online learning platform (Canvas/Desire2Learn) in a timely fashion during the semester and maintained an up-to-date gradebook to keep students informed about their class standings. None of the instructors curved student grade for any assignment or exam, since curving increases uncertainty and reduces the accuracy in student estimation (Nowell and Alston, 2007).

We solicited student self-assessment data in a survey at the end of the final exam. We asked the students to choose a grade level that best describes their exam grade from the choices of "90 and above," "80-89," "70-79," "60-69," and "59 and below." We used this post-exam survey rather than a pre-exam survey to elicit subjects' assessment on their exam performance because previous research indicates that the experience of taking the exam may induce a calibration of students' judgment on their performance (Grimes, 2002; Serra and DeMarree, 2016). We incentivized our task, which is different from most previous studies on the topic of the Dunning-Kruger effect. In our experiment, students were informed that they could earn two extra points for their final exam if and only if they answered the survey question correctly. We offered this incentive to encourage students to provide an estimated grade that matches or as close to the actual grade as their ability allows, as well as to reduce the influence of their desired grade and unmindful guesses. This incentive is crucial to our experiment design because empirical research studies have shown that hypothetical payoffs may not elicit truthful responses from subjects (Cummings et al., 1995; Harrison and Rutstrom, 2008; Murphy et al., 2005; Neill et al., 1994; Vlaev, 2012). For example, Vlaev (2012) found that people follow distinct decision-making processes when facing real rewards compared with hypothetical payoffs. Therefore, the author concluded that subjects should be observed and measured in real situations with incentivized tasks.

A total of 213 students participated in this study. We complemented the survey data collecting students' estimated exam grades with the students' actual exam grades, cumulative GPA, and their characteristics including gender, race, and school year. Table 1 provides the summary statistics of our data at the institution level. The variable *Cumulative*

GPA is the students' cumulative GPA starting from their first semester in the institution to the semester prior to our research. We obtained this information from the University's Registrar or the equivalent office of the institution. We excluded 17 students from our sample because they were either freshmen or transfer students in their first semester at the institution with a 0 cumulative GPA at that point. We categorized students' GPA into three groups of Low, Medium, and High GPA with cut points of 2.50 and 3.50, respectively.[21] The numbers of the variable *Actual exam score* are the actual scores that students receive for their final exam, reported by the course instructors. We classify these observations into five categories of A, B, C, D, and F, with exam scores of 90 and above, 80-89, 70-79, 60-69, and 59 and below, respectively, to match the ranges of students' self-assessed exam grades. The summary of this variable is represented in the *Actual exam grade* with the numbers 4, 3, 2, 1, and 0 assigned to letter grade A, B, C, D, and F, respectively. Information on student gender and race was reported by the instructors based on their observations and interactions with the students. Since the students were not aware that they were part of a research, we did not ask them to report their race or solicited any personal information from them. Also, the race data are not available from the institutional level, either. Therefore, we only categorized student race into white and non-white to make this variable more accurate. A student's *School year* was institutionally defined based on credit hours completed. We required this information from the University's Record Office or the equivalent office at the institution.

DATA ANALYSIS AND RESULTS

We employed both nonparametric and parametric analyses to examine the existence of the Dunning-Kruger effect in our economics classrooms. Furthermore, we investigated what factors contribute to the student's inaccurate self-assessment. The nonparametric statistical tests do not require model specification and thus offer qualitative analysis with greater robustness. For these nonparametric analyses, we conducted Kruskal-Wallis rank tests and ANOVA followed by Tukey post hoc tests. The Kruskal-Wallis rank test examines if the samples of interest originate from the same distribution. In our study, we test whether the cognitive biases of students in various groups follow the same distribution. We used the analysis of variance (ANOVA) and a posteriori test, the Tukey test to explore the differences in the self-perceptions between students of various GPA groups. While ANOVA examines the overall significance among all groups, the Tukey tests execute pairwise tests to identify which specific groups are different.

Table 1: Summary Statistics

Variable	Full sample (n=196) Mean (std.dev)	Institution 1 (n=52) Mean (std. dev)	Institution 2 (n=44) Mean (std. dev)	Institution 3 (n=100) Mean (std. dev)
Cumulative GPA	3.025 (0.670)	3.226 (0.551)	2.775 (0.653)	3.030 (0.702)
GPA Group (1=Low [0-2.499]; 2=Medium [2.5-3.499]; 3=High [3.5-4.0])	2.061 (0.721)	2.250 (0.653)	1.773 (0.711)	2.090 (0.726)
Actual Exam Score	70.187 (19.256)	68.461 (18.234)	51.780 (15.443)	79.184 (14.886)
Actual Exam Grade (0=F; 1=D; 2=C; 3=B; 4=A)	1.816 (1.463)	1.769 (1.423)	0.477 (0.762)	2.430 (1.320)
Estimated Exam Grade (0=F; 1=D; 2=C; 3=B; 4=A)	2.423 (1.022)	2.308 (1.001)	2.000 (0.988)	2.670 (0.985)
Self-Assessment (1= Underestimate; 2=Accurately estimate; 3= Overestimate)	2.347 (0.718)	2.308 (0.701)	2.818 (0.390)	2.160 (0.748)
Male	0.531 (0.500)	0.327 (0.474)	0.500 (0.506)	0.650 (0.479)
White	0.673 (0.470)	0.115 (0.323)	0.750 (0.438)	0.930 (0.256)
School Year (1= Freshman; 2=Sophomore; 3=Junior; 4=Senior)	2.245 (0.817)	2.288 (0.800)	2.432 (0.789)	2.140 (0.829)

We used parametric analyses to complement our nonparametric statistical tests. We employed two sets of regression models to investigate what factors contribute to students' cognitive bias in terms of magnitude and tendency, respectively. The cognitive bias is defined as the discrepancy between a student's self-assessed final exam grade and the actual grade. The following presents our data analyses and the results.

KRUSKAL-WALLIS RANK TESTS

We first perform the Kruskal-Wallis rank tests[22] to examine if the students' cognitive biases in different groups have the same distribution. Table 2 presents the hypotheses and test results. In sum, the results show that there are systematic differences in the distributions of the students' cognitive biases in various groups by exam grade, cumulative GPA, school year, and institution. Intuitively, these findings imply that students' exam grade, cumulative GPA, school year, and institution influence their cognitive biases in underestimating or overestimating their exam

performance. We conduct the ANOVA and Tukey post hoc tests to further investigate the difference in the students' cognitive biases among different GPA groups, which is believed to be the main reason causing the Dunning-Kruger effect.

Table 2: Results of Kruskal-Wallis rank tests

Null hypothesis	χ^2	p-value	Test result
The distributions of the students' cognitive bias are the same among different groups with a final exam letter grade of A, B, C, D, and F.	86.430	0.0001	The null hypothesis is rejected at the 1% significance level.
The distributions of the students' cognitive bias are the same among the High, Medium, and Low GPA group.	15.601	0.0004	The null hypothesis is rejected at the 1% significance level.
The distributions of the students' cognitive bias are the same among freshman, sophomore, junior, and senior students.	6.608	0.0855	The null hypothesis is rejected at the 10% significance level.
The distributions of the students' cognitive bias are the same between male and female students.	1.592	0.2071	The null hypothesis cannot be rejected.
The distributions of the students' cognitive bias are the same between white and non-white students.	0.565	0.4521	The null hypothesis cannot be rejected.
The distributions of the students' cognitive bias are the same among different institutions.	22.295	0.0001	The null hypothesis is rejected at the 1% significance level.

ANOVA AND TUKEY POST HOC TESTS

Since it is unrealistic to ask students to pinpoint their expected exam score, instead, we ask them to select the grade level of their estimated exam score from a range of choices of "90 and above," "80-89," "70-79," "60-69," and "59 and below." Based on the answers provided, we code students' estimate exam grades as A, B, C, D, and F, respectively, with A=4, B=3, C=2, D=1, and F=0, which are consistent with the grading scheme. We also code students' actual exam grades in the same format. We create a variable, *Overestimation*, where *Overestimation = Estimated exam grade - Actual exam grade,* to denote a student's cognitive bias. This variable is a categorical variable equal to an integer $Z \in [-4, 4]$, with $Z>0$, indicating overestimation and $Z<0$ indicating underestimation. For example, if a student's self-assessed exam grade was "A" while he or she actually received an "F," then for this person, *Overestimation=4-0=4*, which implies that the student has overestimated his or her grade at four levels. If a student's self-assessed exam grade was C and his or her actual exam grade was A, then for this person, *Overestimation=2-4=-2*, which implies that the student has underestimated his or her grade at two levels. If a student correctly estimated his or her exam grade, then *Overestimation=0.* In other words, the larger the discrepancy is between one's estimated exam grade and the actual exam grade, the greater the cognitive bias.

Figure 1 presents the distributions of the variable *Overestimation* in different GPA groups. Within the High GPA group (GPA≥3.50),

54.4% of the students accurately predicted their exam grade. 21.1% of them overestimated their grade by one grade level, and 5.3% of them overestimated their grade by two grade levels. On the other hand, 14.0% of the students in the High GPA group underestimated their grade by one grade level, and 5.3% underestimated their grade by two grade levels. The same token can be used to interpret the disparities between the estimated and actual exam grades for students in the Medium GPA group (2.50≤GPA<3.50) and the Low GPA group (GPA<2.50). It is worth pointing out that as GPA decreases, the percentage of students accurately assessing their grade is declining, and they overestimate their performance at higher degrees. In total, 53.2% of the students in the Medium GPA group and 68.9% of the students in the Low GPA group overestimated their exam grade from one to four grade levels compared with that of 26.4% in the High GPA group.

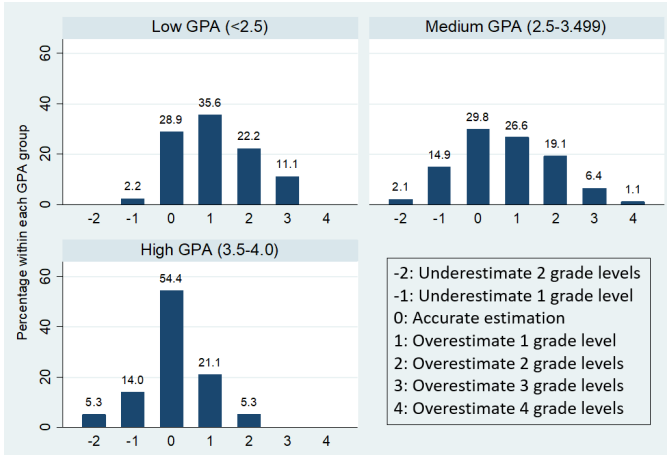

Figure 1. Cognitive bias by GPA group

We conducted a one-way analysis of variance (ANOVA) to compare the mean values of *Overestimation* among different GPA groups upon checking the normal distribution assumption.[23] Table 3 presents the results of ANOVA. We observe that on average, students in the Medium and Low GPA groups overestimate their final exam grade, as the mean values of *Overestimation* in these two groups (0.691 and 1.111, respectively) are positive and statistically different from zero both at the 1% level. On the other hand, students in the High GPA group have a mean value of *Overestimation* close to zero (0.070), and this number is not statistically different from zero. This result implies that an average student in the High GPA group tends to assess his or her exam grade accurately. Also, the result shows that the effect of GPA on *Overestimation* is significant, with

F (2, 193) =11.76 and p<0.0001. This result implies that students in the High, Medium, and Low GPA groups in our sample demonstrate different patterns in their self-assessment.

Table 3. ANOVA

Dependent variable: *Overestimation*	Frequency	Mean	Std. dev.	95% Confidence level for T-test
High GPA (3.5-4.0)	57	0.070	0.884	[-0.16, 0.30]
Medium GPA (2.5-3.499)	94	0.691***	1.245	[0.44, 0.95]
Low GPA (0-2.499)	45	1.111***	1.027	[0.80, 1.42]
Total	196	0.607***	1.161	[0.44, 0.77]

*** p<0.01, ** p<0.05, * p<0.1

Moreover, we conducted a series of Tukey's range tests as post hoc analyses for ANOVA for pairwise comparisons between the means of the variable *Overestimation* in every GPA group. Table 4 presents the test results. The results show that the mean value of *Overestimation* in every GPA group is statistically different from one another. For example, given the means of both High and Medium GPA groups are greater than 0, the difference in the means of *Overestimation* between these two groups (-0.621) indicates that on average, students in the High GPA group are more accurate in assessing their exam performance compared with those in the Medium GPA group. This result is significant at the 1% level. By the same token, we conclude that on average, students in the Medium GPA group overrate their exam performance at a lower degree compared to those in the Low GPA group (-0.420), and the same is true between the High and Low GPA groups (-1.041). These results are significant at the 10% and 1% level, respectively. In other words, we observe that students in the Low GPA group are the ones who overrate their performance the most, which is consistent with the findings in the previous literature. However, unlike Kruger and Dunning (1999), we find that most of the students with a high GPA accurately measure their exam performance rather than underestimate their performance.

Table 4. Results of Turkey tests for pairwise comparison

Comparison between GPA groups	Δ Mean *(Overestimation)*	Std. err.	t	P>|t|	[95% confidence Interval]	
High – Medium	-0.621***	0.185	-3.36	0.003	-1.058	-0.185
Medium – Low	-0.420*	0.197	-2.10	0.092	-0.891	0.052
High – Low	-1.041***	0.220	-4.74	<0.001	-1.560	-0.522

*** p<0.01, ** p<0.05, * p<0.1

PARAMETRIC ANALYSIS

Following the nonparametric statistical tests, we constructed a linear model to further investigate to what extent each factor contributes to the student's cognitive bias:

$$Overestimation = \beta_0 + \beta_1 Cumulative\ GPA + \beta_2 Male + \beta_3 White + \beta_4 Freshman + \beta_5 Junior + \beta_6 Senior + \beta_7 Institution2 + \beta_8 Institution3 + \epsilon$$

with the dependent variable *Overestimation* and the independent variable *Cumulative GPA* defined the same as in the previous context. The rest of the independent variables are all binary variables. We conduct an OLS regression and find that the coefficient of *Cumulative GPA* equals -0.279 and is statistically significant at the 5% level. This number implies that on average, when the cumulative GPA increases by 1 point, *Overestimation* decreases by 0.279 letter grade level, ceteris paribus. To be specific, regarding students who overestimate in their self-assessment, an increase in the cumulative GPA reduces their overconfidence; for students who underestimate (*Overestimation<0*), an increase in the cumulative GPA leads to a further underestimation of their performance. We observe that the coefficient of the variable *Junior* is 0.323 and is statistically significant at the 10% level. This result implies that junior students tend to overestimate their exam performance compared with their sophomore counterparts. We also observe an institution effect where students of Institution 2 significantly overestimate their performance. We do not find any statistically significant coefficient of the gender or race variable. In addition, we run a Tobit regression for robustness check. We do not observe any significant difference between the results of these two regressions. Table 5 presents the results of our OLS and Tobit regressions.

In addition, we employed a multinomial logistic regression to identify which groups are more likely to overestimate, accurately estimate, or underestimate in their self-assessment. In other words, while the above OLS and Tobit regressions focus on examining the *magnitude*, the multinomial logistic regression examines the *likelihood or tendency* of how each variable affects one's cognitive bias. We observe that when the cumulative GPA increases by 1 point, the likelihood of accurate estimation increases by 10.7 percentage points (marginal effect=0.107), while the likelihood of overestimation decreases by 13.4 percentage points (marginal effect=-0.134). These results are significant at the 10% and 1% level, respectively. These findings echo our conclusions from the nonparametric statistical tests that students with a high GPA are less likely to overestimate but more likely to estimate their performance accurately. Table 6 presents the marginal effects of our multinomial logistic regression.

Table 5: Results from OLS and Tobit regressions

	(1) OLS	(2) Tobit
Cumulative GPA	-0.279** (0.113)	-0.279** (0.111)
Male	0.221 (0.161)	0.224 (0.158)
White	-0.348 (0.243)	-0.349 (0.238)
School Year		
Freshman	0.321 (0.217)	0.318 (0.213)
Junior	0.323* (0.194)	0.321* (0.191)
Senior	-0.024 (0.263)	-0.025 (0.257)
Institution		
2	1.032*** (0.287)	1.027*** (0.283)
3	-0.120 (0.255)	-0.125 (0.251)
Constant	1.277*** (0.438)	1.284*** (0.43)
Observations	196	196
R-squared	0.2711	0.0998

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Marginal effects of multinomial logistic regression

Variable	Underestimate		Accurately estimate		Overestimate	
	Marginal effect	Std. err.	Marginal effect	Std. err.	Marginal effect	Std. err.
Cumulative GPA	0.027	0.036	0.107*	0.059	-0.134**	0.052
Male	-0.118**	0.048	0.062	0.071	0.056	0.070
White	-0.058	0.069	0.141	0.119	-0.083	0.116
Freshman	-0.117**	0.056	-0.051	0.100	0.168*	0.097
Junior	-0.130**	0.054	0.057	0.093	0.073	0.092
Senior	0.034	0.097	-0.076	0.112	0.041	0.106
Institution 2	-0.092**	0.037	-0.286**	0.130	0.378***	0.127
Institution 3	0.149**	0.074	-0.101	0.128	-0.048	0.129

*** p<0.01, ** p<0.05, * p<0.1

CONCLUSIONS

In this research study, we test the Dunning-Kruger effect with students in the introductory-level economics classes from three universities. This paper contributes to the existing business education literature by offering empirical evidence confirming that the unskilled-and-unaware effect is still prevailing in the classroom of higher education. It also provides a fresh look into the Dunning-Kruger effect in a less-frequently studied discipline. While previous literature heavily involves college students in psychology classes who were millennials or belong to an even earlier

generation, this research study consists of Generation Z students in the economics classes.

We find that the cumulative GPA is an essential factor that explains the disparity between a student's self-assessed exam grade and the actual grade. However, unlike what is found in the previous literature (e.g., Dunning, 2011), we observe that students with a high GPA (3.5-4.0) tend to accurately estimate rather than underestimate their performance. We find mixed effects of one's gender and school year and no effect of one's race. The results of this research offer practical insights for instructors of all disciplines. Students tend to overestimate their performance in general with the low performers being the most overoptimistic. It relies on the instructors to break the students' illusionary overconfidence in their academic performance. Being transparent with students and continually sharing information about their class standing, progress, and trajectory help them stay informed and calibrate in the process of self-assessment. Further research would be worthwhile in search of the best practice to reduce students' cognitive bias.

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E-TRANSPARENCY AND ECONOMIC PERFORMANCE: EVIDENCE FROM ARKANSAS COUNTIES

Mavuto Kalulu[24]

ABSTRACT

Economic studies demonstrate a negative relationship between corruption and economic development. Economic reasoning suggests that transparency affects economic performance through its effect on corruption. This paper empirically examines the relationship between e-transparency and economic performance using Arkansas county-level data. County-level governments are just as prone to corruption as state and federal governments. The empirical results demonstrate a positive relationship between e-transparency and per-capita income. More e-transparent counties have higher per-capita income.

INTRODUCTION

Literature at the macro level typically shows that corruption has a negative and direct impact on economic growth and development. It also has an indirect effect on a country's economic performance by affecting many factors that affect economic growth, such as investment and taxation (Transparency International, 2014). Corruption at the local government level has a direct effect on its citizens because of how close local governments are to the people. Local governments oversee the provision of many services such as drivers' licenses, emergency services, health care, infrastructure, and public safety (Istrate and Nowakowski, 2013). A corrupt local government negatively affects the delivery of these important services.

Some researchers have pointed out that transparency reduces corruption and improves financial performance (Benito and Bestida, 2009; Bertot, Jaeger, and Grimes, 2010). The monitoring of public officials' decisions and decision outcomes limit their opportunities for corrupt practices. Folsher, Krafchik, and Shapiro (2000) further argue that the "institutionalization of transparency in budget practices creates the demand for those types of government systems which are key to combating corruption: namely an independent, effective and efficient auditing system, an internal accountability system, and an information system that produces timely and accurate information." Djankov et al. (2003) point out that more

transparent governments allow the economy to incur lower social costs as the government undertakes the task of controlling economic disorder. Thus, transparency improves economic performance both directly and indirectly by reducing corruption.

Not all researchers subscribe to this common wisdom that transparency is a cure for corruption and hence a key ingredient to economic performance. Bac (2001) argues that being transparent can reveal to bribers which public officials to approach to obtain benefits corruptly. Lindstedt and Naurin (2010) argue that transparency is necessary but not a sufficient ingredient. To be effective, citizens must be able to act upon the available information. Scholars such as Fukuyama (2015) argue that too much transparency undercuts deliberation and makes it difficult to reach deals. It also deters many good people from entering government by imposing a huge burden on those who enter government. All these negatively impact economic performance.

This study empirically tests what relationship exists between transparency and economic performance using e-transparency in Arkansas, which, according to a 2013 Transparency Report Card by Sunshine Review, has the worst county e-transparency in the nation. E-transparency is defined as the use of information and communication technologies to handle some or all of transparency-related information flows (Heeks, 2008).

Understanding the relationship between transparency and economic performance at the county level is important because it helps fill the gap that exists in the literature on lower levels of government. Past studies on transparency focused largely on national governments and large cities (Harder and Jordan, 2013). For the state of Arkansas, the findings of this study can inform policymakers on the benefits of expanding e-transparency to county governments. In its current form, Arkansas Act 303 of 2011 authorizes the Department of Finance and Administration "to create a free website, accessible to the public that contains state financial information" in recognition of the importance of transparency at the state level. No such law exists that requires county governments to do the same.

The study uses an e-transparency measure constructed by Harder and Jordan (2013). To the best of my knowledge, the Harder and Jordan index is the only measure of e-transparency that has been created for Arkansas counties. There is also an e-government measure created by Warner (2015), but its focus is on what services county governments provide their citizens through internet-enabled applications. This study focuses on the disclosure of county governments' policy decision making processes, policies, and policy outcomes. Thus, Harder and Jordan (2013) is more

applicable to this study than Warner (2015). A discussion of the Harder and Jordan index is presented in section 3.

The rest of the paper is organized as follows. The next section discusses e-transparency as a measure of transparency. Section 3 reviews the literature. Section 4 discusses the data. Section 5 provides the methods and results of the empirical analysis. Section 6 concludes and offers some policy recommendations.

E-TRANSPARENCY AS A MEASURE OF TRANSPARENCY

It is important to note that the measure of transparency used here is e-transparency. One traditional argument against e-transparency is the financial costs of implementing the technology (Breton et al., 2007). A lack of information on websites may be a reflection of the financial and technological constraints that some counties face. Despite the financial constraint argument, some argue that e-transparency is a good indicator of how transparent governments are, especially now that technology makes this possible at a seemingly affordable cost (Bannister and Cannolly, 2011). Moon (2002) argues that the emergency and proliferation of the internet has enabled governments and citizens to interact more efficiently online. It has also led to citizens wanting government transactions published online (Grimmelikhuijsen and Welch, 2012; Margetts, 2011).

Internet use has indeed grown over the last two decades. Data obtained from the Pew Center for Research shows that use of the internet in the United States has grown from 50 percent of the adult population in 2000 to 88 percent in 2016 (Pew Center for Research, 2017). In the wake of this growth, at least 36 states have passed legislation that requires a centralized, searchable website that provides information to the public about state expenditures or state contracts (National Conference of State Legislatures, 2015). But while state governments have made progress in providing public information, the same is not true for local governments. The 2013 Transparency Report Card released by the Sunshine Review found that state governments were more e-transparent than local governments. Sixty percent of state websites scored a "B" or above compared to 28 percent for counties and 44 percent for cities (Ballotpedia, 2013). (See appendix A for the checklist used to measure transparency.)

How does Arkansas fare on e-transparency? According to the 2013 Transparency Report Card, Arkansas counties are the worst in the nation. While Arkansas's state government ranks 36th in the nation and earns a letter grade of B, Arkansas counties received an F. Currently, there is no legal requirement for Arkansas counties to publish public information

on websites. A clear example is the publication of financial information. Arkansas counties are legally only required to publish annual financial reports once per year in a widely circulated local newspaper (AR. § 14-21-102 [2014]). Expanding the media of providing financial information to online publication ensures that a greater number of voters have access to such information at any time they wish to view the information.

Some counties have decided on their own to publish public information on their websites, but other counties have not. The amount and quality of information published varies across counties. Such variation allows us to investigate whether or not more e-transparent counties economically outperform less e-transparent ones. For estimation purposes, it is highly likely that the decision by the counties to publish public information is not exogenous. This poses a problem in establishing causality in the relationship between e-transparency and economic performance. I address this problem in the methods section to ensure the validity of the estimates.

LITERATURE REVIEW

Corruption is a problem that has existed since the rise of organized states (Rose-Ackerman and Palifka, 2016). A voluminous amount of literature has examined the political, economic, and sociocultural consequences of corruption. Since the outcome variable in this study is economic performance, the literature review focuses on the economic impact of corruption, a channel through which transparency affects economic performance.

There are two divergent views on the economic effect of corruption. One view, known as the "grease the wheels" hypothesis, states that corruption enables entrepreneurs to circumvent heavy and rigid government regulations which impose expensive delays and waiting costs on entrepreneurs (Huntington, 2011). Empirical research that support this view highlights the importance government institutions and governance systems play in this relationship. Corruption increases productivity and entrepreneurship in highly regulated countries that do not have effective government institutions and governance systems (Dreher and Gassebner, 2011; Meon and Weill, 2010). The other view, known as the "sand the wheels" hypothesis, states that corruption is detrimental to economic performance through its effect on increased inefficiencies in the public sector (Meon and Weil, 2010). Myradal (1968) argues that corrupt public officials may deliberately slow down the bureaucratic processes to create opportunities to extract bribes. The delays and red tape created in areas such as contracting and auctioning have a negative impact on the performance

of the economy. Other scholars have shown that the negative impact of corruption is disproportionately severe on the poor and disadvantaged in society (Rose-Ackerman, 2005; Brunetti, 2003).

Of the two views, the "grease the wheels" hypothesis is the less prevalent one. The general consensus is that corruption has a negative impact on economic performance (Chêne, 2014). A meta-analysis by Ugur and Dasgupta (2011) finds that corruption has a negative effect on per-capita GDP growth, mainly through its negative effect on human capital and public finance. Since the general consensus is that corruption is detrimental to economic performance, the next three subsections focus on the theoretical and empirical literature that describes the relationship between transparency and corruption.

THEORETICAL MODEL: PRINCIPAL-AGENT MODEL

The principal-agent model is used to explain the relationship between transparency and corruption. One person or entity (the agent) makes decisions on behalf of another person or entity (the principal). The dilemma occurs when the principal's interests do not align with the agent's interests and one party possesses more information than the other. Akerlof (1970) showed that when there is information asymmetry between the buyer and the seller, the seller has the incentive to sell goods of inferior quality. Asymmetric information may also lead to buyers mistrusting sellers, which then leads to no goods being traded at all. When that happens, both the buyer and the seller become worse off.

In the case of the public sector, public officials (agents) are charged with the responsibility of providing services to voters (principals). Rose-Ackerman (1997) argues that public officials tend to have a monopoly of valuable information that voters are not privy to. The information asymmetry that exists between voters and government officials creates an opportunity for public officials to increase their expected payoff through corrupt means. Voters' failure to observe the actions of public officials reduces the likelihood of corrupt public officials getting caught.

Akerlof (1970) argues that symmetric information increases utility to all parties involved compared to an asymmetric information situation. In the case of public officials (agents), transparency in government processes and outcomes reduces the information asymmetry, which in turn reduces corruption by increasing the chances of public officials getting caught if they engage in corruption. Less corruption results in better delivery of quality services to voters – a similar desirable outcome as shown by Akerlof (1970).

EMPIRICAL STUDIES ON THE RELATIONSHIP BETWEEN TRANSPARENCY AND CORRUPTION

An extensive amount of literature has studied the relationship between transparency and corruption across countries, but empirical research on county-level transparency is less common. One of the most commonly used transparency measures is press freedom. A free media can provide impartial and sufficient information to citizens and independently scrutinize public officials (Färdigh, Andersson, and Oscarsson, 2011). Measures such as newspaper circulation, media ownership, and media competition show a strong negative relationship with corruption (Djankov et al., 2003; and Pellegrini and Gerlagh, 2008). Brunetti and Weder (2003) find a strong association between greater press freedom and less corruption. When governments know that citizens are watching and holding them accountable, the likelihood of engaging in corrupt practices is reduced (Kim et al., 2005). Lindstedt and Naurin (2010) argue that the effectiveness of press freedom in reducing corruption is dependent on the citizenry's ability to hold public officials accountable. If voters are apathetic regarding local politics, then efforts to improve transparency may not achieve the intended goal of reducing corruption.

Some researchers have found an interesting relationship between Freedom of Information Acts (FOIAs) and corruption. Tavares (2007) finds a positive relationship between the implementation of FOIAs and corruption. These findings are the complete opposite of Islam's (2006), who finds a negative relationship between FOIAs and corruption. Tavares's (2007) result is partially supported by Escaleras, Lin and Register (2010), who find a positive relationship only in developing countries and not in developed countries. This result may not be surprising. Developing countries are plagued with severe political and economic corruption. Corrupt government officials likely want to appear transparent while secretly plundering public resources. Passing FOIAs gives them that opportunity. Our study adds to this literature by using county e-transparency as a measure of transparency.

EMPIRICAL STUDIES ON THE RELATIONSHIP BETWEEN TRANSPARENCY AND ECONOMIC PERFORMANCE

Studies on transparency and economic performance at the county level are just as scarce as studies on the relationship between transparency and corruption at the county level. This may be partly due to the challenge of measuring transparency at lower levels of government. Research on transparency and economic performance focuses on cross-country data and

broadly assesses the effects of fiscal institutions on economic outcomes. Alesina et al. (1999) examine the effect of transparency on fiscal discipline in Latin America and find that the two are positively related. This finding is in line with those of other studies which examine the effect of fiscal transparency on public debt and find that strong budget institutions improve fiscal performance (Alt and Lassen, 2006; Dabla-Norris, 2010). Another relationship that has been investigated is that between fiscal transparency and credit ratings. Arbatli and Escolano (2015) find a strong positive relationship between the two.

Of particular relevance to this study, however, is research by Baldrich (2005), which finds a strong positive link between fiscal transparency and per-capita income at the country level. What is missing in the research is the effect of transparency on economic performance at lower levels of government. I use e-transparency to extend the cross-country relationship to county-level.

DATA

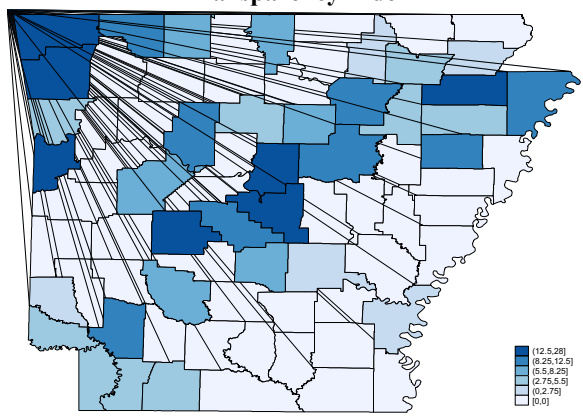
The outcome variable is county-level per-capita income, which is obtained from the US Census Bureau. The independent variable of interest is e-transparency. While county-level data on per-capita income are readily available from the Census Bureau, county-level data on e-transparency are not. The variable had to be constructed based on information from Arkansas county government websites. I rely on a county e-transparency measure constructed by Harder and Jordan (2013) to examine the relationship between transparency and economic performance.

JORDAN AND HARDER INDEX

Jordan and Harder created their index by combining various transparency indicators taken from a variety of literature, laws, and organizations dedicated to a more transparent government. The Jordan and Harder index comprises the following 16 components: budgets, tax information, elected officials' information (Piotrowski and Van Ryzin, 2007), open meetings, government contracts, criminal records, public records (Kopitis and Craig, 1998 & Armstrong, 2011), foreign language access, search functions (West, 2007), audits, building permits and zoning, lobbying, job openings, administrative officials' information, downloadable forms (Sunshine Review, n.d.) and interactivity (Pina et al., 2010). Some of the 16 components are then broken down into subcomponents, resulting in 34 different indicators of e-transparency, which I have provided in Appendix A.

Jordan and Harder searched the web using the Google search engine to determine which counties in Arkansas have websites. They determined that 35 out of 75 counties in Arkansas have websites. Next, Jordan and Harder assessed the websites of each of the 35 counties for 15 minutes to determine what information they publish on their websites. They assigned a value of 1 for each of the 34 indicators if the information is published online and a 0 if not. The e-transparency score for each of the counties is calculated by taking the sum of the 34 indicators. Figure 1 shows the heat map displaying how e-transparent Arkansas counties are based on Harder and Jordan's assessment.

Figure 1: Arkansas Counties Transparency Map Using Harder and Jordan's Transparency Index



No color represents counties that do not have a website and hence are less e-transparent based on our measure. The darker the color, the more e-transparency.

CONTROL VARIABLES

In addition to the variable of interest, I also control for other variables that explain the differences in economic performance across counties. Average weekly wage captures the differences in productivity across counties. The higher the average weekly wage, the higher the per-capita income. Data on average weekly wage are obtained from the Bureau of Labor Statistics. Other control variables include population density, educational attainment, median age, and the percentage of African-Americans in the county. Population can affect economic performance both positively and negatively. On the one hand, higher population creates more demand for goods and services leading to increased economic activity. On the other hand, higher population densities can cause congestion resulting

in productive inefficiencies. The expected signs for the other control variables are clearer. Counties that have more educated people tend to have higher per-capita income. Similarly, for median age, the expectation is a positive relationship as older people have lived longer and have had many years to save and invest their money. African-Americans tend to have less economic opportunities and, therefore, counties that have a higher percentage of African-American perform poorly compared to those that have a lower percentage. Data on these variables are obtained from the Census Bureau. Table 1 provides the descriptive statistics for all the variables included in the analysis.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Per capita income	19329.08	2685.84	12475.00	27744.00
E - transparency	4.34	6.69	0.00	28.00
Average weekly wage	623.20	118.28	419.65	1021.80
Population density	54.35	73.92	8.55	504.35
Median age	40.26	4.24	31.10	50.80
Education attainment (%)	14.18	4.97	6.40	31.60
African-American (%)	16.11	17.95	0.07	62.77

n=75

Notice from Table 1 the mean of transparency is 4.34 – a low value considering that the maximum possible points is 34. Overall, Arkansas counties are less e-transparent. The minimum score for e-transparency is 0 and the maximum is 28. Forty counties have a score of 0. Thirty-nine of the 40 score 0 because they do not have a website.

METHODS AND RESULTS

I use cross-county regressions to study the relationship between e-transparency and economic performance as measured by per-capita income. I am limited to cross-county analysis because the e-transparency index I use was constructed once using 2012 data. I estimate the relationship between e-transparency and per capita income using the following model:

$$Economic\ Performance = \beta_0 + \beta_1 Transparency_i + \beta_2 X_i + u$$

where $\boldsymbol{X}$ denotes a vector of control variables that includes the log of average weekly wage, the log of population, educational attainment, the log of median age, and the percentage of African-Americans. Relying on

the OLS results estimated from the above to make policy recommendations could be misleading if one does not consider the possibility of transparency being endogenous. Endogeneity makes it difficult to claim causality between transparency and economic performance. Counties that have better fiscal policies may also have higher incentives to be more transparent (Arbatli and Escolano, 2015). Alt and Lassen (2006) suggest using political variables such as electoral competition to instrument for transparency. Their argument is that counties that have more political turnover are expected to have greater transparency. Political parties in power have higher incentives to adopt transparency-enhancing institutions if they knew that there was a high probability of being opposed in the future. I follow Alt and Lassen's (2006) suggestion and instrument for transparency using the closeness of the 2012 presidential election. The measure of competition is the percentage of votes Mitt Romney received divided by the percentage of votes Barack Obama received in each county. Using the Durbin-Wu-Hausman test for endogeneity, I fail to reject the null hypothesis that e-transparency transparency is exogenous, leading us to rely on the OLS estimates. Column 2 of Table 2 shows the OLS estimation results using the log of per-capita income as a measure of economic performance.

Table 2: OLS Regression of Per Capita Income on County-Level Transparency in Arkansas

	OLS	Mixed Effect
Fiscal transparency	0.0069**	0.0079***
	(0.0033)	(0.0026)
Log of average weekly wage	0.1585*	0.1715**
	(0.0857)	(0.0772)
Log of population density	–0.0062	-0.0036
	(0.0301)	(0.0242)
Log of median age	0.2398**	0.2094
	(0.1015)	(1402)
Educational attainment	0.0116**	0.0105***
	(0.0054)	(0.0040)
Percentage of African-Americans	–0.0007	-0.008
	(0.0011)	(0.0007)
Observations	75	75
Number of Groups		26
F	19.18	
Wald chi2		61.53
R-squared	0.492	

Standard errors are in parenthesis are robust to heteroscedasticity.

The results show a positive and significant relationship between transparency and per capita income. On average, a unit increase in transparency is associated with a 0.7 percent increase in per-capita income.

I use the OLS estimation as a baseline, but it also functions as a robustness check for estimation method. The preferred estimation technique, however, is the mixed effects model. Recall that Jordan and Harder found that only 35 counties in Arkansas had websites in 2012 but the regression results I provide in Table 2 include all 75 counties in Arkansas. I include the 40 counties that do not have websites in the analysis to increase the sample. These 40 counties are automatically treated as non-transparent. This creates two different sets of zeros in our data. The first set of zeros comprise counties that have websites but do not publish any of the information that make up the index. The second set of zeros comprise counties that do not have websites. OLS (column 2) treats the zeros as being generated by the same process. The mixed effects model accounts for the possibility of the zeros being generated by different processes. The results of the mixed effects model are shown in column 3 of Table 2. On average, a unit increase in transparency is associated with a 0.8 percent increase in per-capita income.

With an average per-capita income of $19,000 for Arkansas counties, a marginal effect of 0.8 percent implies that on average a county that is 10 points more transparent than another will have a per-capita income

Table 3: OLS Regression of Per Capita Income on County-Level Transparency in Arkansas

Fiscal transparency	0.0121***
	(0.0035)
Log of average weekly wage	0.0069
	(0.1294)
Log of population density	0.0262
	(0.0369)
Log of median age	0.3682***
	(0.1027)
Educational attainment	0.0067
	(0.0056)
Percentage of African-Americans	0.0017
	(0.0015)
Observations	35
Number of Groups	
F	26.32
Wald chi2	
R-squared	0.6662

Standard errors are in parenthesis are corrected for heteroscedasticity

of $1,520 more than the less transparent one. The results fit the theory and other empirical findings that transparency is associated with higher economic performance (eg. Baldrich 2005).

Another robustness check is to run an OLS regression that only includes the 35 counties that have websites. The regression results for the subsample are shown in Table 3. Transparency still has a positive and significant effect on per-capita income: in this case, a unit increase in transparency is associated with a 0.12 percent increase in per-capita income.

CONCLUSION AND POLICY RECOMMENDATIONS

This paper has examined the relationship between county-level e-transparency and per-capita income. The biggest challenge of examining this relationship at the county level is how to construct a measure that truly reflects a county's level of e-transparency. I utilized an already existing measure of e-transparency constructed by Harder and Jordan (2013). Using this measure, I find that e-transparency is associated with greater economic performance at the county level, which is consistent with research by Baldrich (2005). Another challenge is the possibility of e-transparency being endogenous. To deal with that problem, I instrumented a political competition variable as suggested by Alt and Lassen (2006) and have statistically rejected endogeneity. Those challenges aside, I find a positive relationship between e-transparency and per-capita income.

Based on previous evidence that transparency is instrumental to combating corruption and my results showing a positive relationship between county-level e-transparency and per-capita income, Arkansas can benefit by amending its existing transparency laws to require that county-level governments publish financial information on their websites in a comprehensive and easily accessible manner for its citizens. Forty counties in Arkansas already have websites where they can easily upload financial information. The other 35 counties must create websites so that they can publish the financial information. Up front, counties will incur costs in creating an information system that will be used to gather and publish public information. However, for public officials, being transparent earns them the trust of their constituents. This trust is important because a lack of trust between government and the governed may lead to social instability and to an environment that is less than conducive to economic growth.

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ENDNOTES

1. See: chapter 1 in Goodman and Musgrave (1992) for a useful set of scenarios to depict the trouble with health care markets from the perspective of all agents involved. Their book set the table for the emergence of Health/Medical Savings Accounts.
2. Likewise, the demand for water is far more elastic than one might initially imagine. The demand for the water required for survival is perfectly inelastic. But most uses of water are far more elastic—from flushing toilets and taking showers to washing clothes and cars.
3. The "RAND Experiment" is considered the "gold standard" in this literature, but its results may be dated. Aron-Dine et. al. (2013) provide a reconsideration of its relevance and applicability today. See also: Folland et. al. (2013, p. 184) for a survey of the relevant contemporary literature on elasticity.
4. The extent to which ED's might be misused was presumably extended by the Emergency Medical Treatment and Labor Act of 1986—a federal law which requires ED's to treat patients, independent of their insurance status or ability to pay.
5. To preserve the anonymity of the hospital, we're only describing it in enough terms to give context. And while other information would have been interesting to add to our model, we only had access to the data included here.
6. Severe weather events were taken from the "Storm Events Database" from NCDC.NOAA.gov. There were 17 days with "severe weather" in 2012.
7. For the first seven months of 2012, TANF was distributed from the 5th to the 14th of the month, with approximately one-tenth of the caseload receiving benefits on each day. In August, they began a two-month transition to distribution from the 5th to the 23rd, with one-tenth receiving benefits every two days. In addition to calculating an index weighted by dollars, we created an index weighted by the number of recipients. SSI and TANF were responsible for 47% of the dollars and 23% of the recipients. Our tentative expectation was that the dollar-based index would be somewhat more significant than the recipient-based index. This turned out to be the case, so we only present the former here.
8. Our data are from the only local hospital which explicitly accepts patients without insurance. As the number of uninsured people increases, the number of ED visits might increase. Unfortunately, we don't have good data on the change in uninsured people over the year. Medicaid recipients and unemployment rates could be a good

proxy, but there was little change in the monthly employment rate that year and we do not have access to daily changes in Medicaid rolls in the city. Of course, the Affordable Care Act has changed this market significantly. Early results indicated that the ACA increased ED usage (Baicker et. al. [2013], Finkelstein et. al. [2011]), but more recently, Devoe et. al. (2015) found increased use of "community health center" services.

9. We also included St. Patrick's Day, Memorial Day, and Labor Day. Since our data set originates from Louisville, KY, we added ED-inducing holiday observations for the Kentucky Derby and "the Oaks" (the big race on the day preceding the Derby).
10. We added Christmas Eve and New Years Eve to this list. See: Reis et. al. (2005) for a similar phenomenon: ED visits were significantly lower in Boston when the Red Sox were playing post-season baseball in 2004.
11. For the former, we included the federal observance of New Years Day, MLK Jr. Day, Presidents Day, Patriots Day (9/11), Columbus Day, Election Day, and Veterans Day. For the latter, we included Super Bowl Sunday, Valentine's Day, Easter, Halloween, and "Black Friday". Reich et. al. (1994) find fewer ED visits on Super Bowl Sunday, particularly when a local team is playing.
12. The data for moon cycles was gathered from the U.S. Naval Observatory Astronomical Applications Department website.
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21. We selected these cut points because students are subject to academic probation with a GPA below 2.0. We have no student with a GPA below this threshold in our sample. Therefore, we arbitrarily chose 0-2.499 to categorize the Low GPA group. We selected 3.50 and above to categorize the High GPA group because all our institutions require students to maintain a GPA of 3.50 and above to be eligible for the Dean's List.
22. This test is a generalization of the two-sample Wilcoxon test. This nonparametric test compares rankings across subsamples to assess if they come from the same distribution.
23. Results of the Shapiro-Wilk test (Prob>z: 0.3321), Shapiro-Francia test (Prob>z: 0.8383), and Skewness/Kurtosis test (Prob>χ2: 0.3276) show that we cannot reject the null hypothesis that the variable Overestimation is normally distributed. That is, the sample distribution does not violate the assumption required by ANOVA.
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