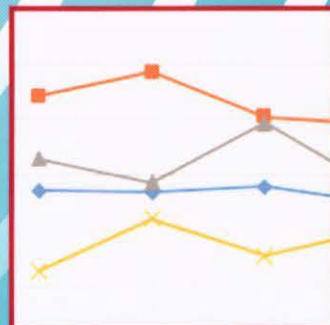


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Journal of Undergraduate Research



Volume Twelve
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University of Rochester

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From the Editors

Throughout the years there has been much discussion on the correct nature of college education. Some groups believe that college education is actually training intended to prepare students for careers in a given field. Others feel that it has an intrinsic worth that cannot be measured against the job market. Regardless of this difference, each party shares an interest in examining what exactly is the fundamental purpose of higher learning. And it is in this investigation that the two camps find more common ground than immediately apparent.

Those who argue for the intrinsic worth of college education often cite the importance of developing critical thinking skills; this group believes that higher learning is a key step in teaching a person how to ask questions and solve problems effectively, and that this is worthwhile in its own right. However, such skills are an absolute necessity for success in most careers. An advertiser who is able to make bold insights into his target demographic will ultimately arrive at new ways of marketing his product. A manager who is able to synthesize new solutions to problems in the workplace will see an increase in her office's productivity. Both schools of thought seem to rely on the importance of critical thinking, and they only differ in how this skill is (or isn't) applied. So, perhaps the discussion should shift to questions on how a school can best develop the critical thinking skills of its students?

With this focus, undergraduate research makes a strong case for itself. We at the Journal of Undergraduate Research (JUR) believe that taking part in undergraduate research is the best way a student can not only become more acquainted with her field, but also learn how to think critically. This issue of JUR contains articles from a number of academic fields, including Economics, Mathematics, Political Science, and Religious Studies. Despite the eclectic nature of these subjects, all of these articles are united in their impressive display of higher-order thinking and problem-solving. It is our pleasure to present such research at a professional level. We hope that in doing so we encourage more students to take up undergraduate research and engage in the fundamental purpose of higher learning.

Sincerely,

Corey Garvin

The logo for the Journal of Undergraduate Research (JUR) is displayed in a large, bold, lowercase sans-serif font. The letters are black and have a modern, clean design.

Journal of Undergraduate Research

University of Rochester | Volume 12, Issue 1 | Fall 2013

Professor Interview

RENEE MILLER, PhD

DEPARTMENT OF BRAIN AND COGNITIVE SCIENCE

8

10

Deciphering the Oregon Death With Dignity Act

JOSH SCHULMAN

Zoroastrian Dakhma-Nashini: A Case Study on Ritual Change

KASSANDRA VIERS

16

24

Regime Support across Asian Countries: A Test of Modernization Theory and the "Asian Values" Hypothesis

JOSH SCHULMAN

t a b l e o f c o n t e n t s

k -Goldbach Decomposition For
 Polynomials
 JIASHUO LUI

30

34

De VIC Generations- A Model
 to Understand the Financial
 Market
 YIQIAO YIN

About the Journal

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Professor Interview

Renee Miller, Ph.D.

Professor of Brain and Cognitive Sciences



jur: What or who first influenced you to become interested in research?

Miller: I transferred to U of R as a junior, and it was Rebecca Loy, Ph.D., an adjunct professor here at the time, who first inspired me to do research. In the summer after I graduated, I volunteered in her lab at Monroe Community Hospital that was involved in Alzheimer's research. It was a slightly impoverished lab and the research was somewhat haphazard- some days I would file papers, and others there would be an experiment to work on. But after that, I got a job as a technician at the medical center that was also involved in Alzheimer's research. While I was working on this research, I was nominated for the Sproull Fellowship, and being awarded this honor influenced me to go to graduate school.

jur: On what other research projects have you previously worked?

Miller: I completed my dissertation on Parkinson's disease. We looked at humans and animals that exhibited Parkinson's symptoms for a common molecular signature, and we discovered six genes that were significant. Since then, there have been further studies and meta-studies on this topic, and a gene linked to a common metabolite has been identified as a possible marker.

jur: Tell us about the research on which you are currently working and how you got involved with it.

Miller: First of all, the research I was previously doing was studied on human brains post-mortem and mice. I knew that I wanted to teach and work with undergraduates, and since most universities do not have vivariums, I needed to work with a model organism that was easy to care for and transportable. Second, in all of the prior work that I had done, including the research on Parkinson's, there were always sex differences within the control group and within

the experimental groups. I am a proponent of personalized medicine, in which not every diagnosis of the same disease is identical – there can be contributing factors such as age, gender, and individual genetic makeup. Therefore, I wanted to do more research into genetics, so I joined Dr. Doug Portman's lab, which works with the model organism *C. elegans*, a nematode. In collaboration with Dr. Portman, we identified sex differences and sex-specific behaviors at the molecular level. We have identified molecules that force nematodes to make different choices in given situations, such as exploring or nesting, based on their sex. We have found that males are more likely to explore, while females tend to stay in one place. This behavior has been traced to the effects of one gene, in one pair of neurons within the 1,000 cells that make up a *C. elegans* worm. Synaptic connections between neurons are also of interest and we are looking at characteristics of these connections in males and females.

jur: What is the goal of your research?

Miller: Ultimately, we hope to find a template for what makes one sex more vulnerable to disease by looking at the subtle changes that modify behaviors that both sexes do. While it's not a direct route from *C. elegans* to humans, the principles that we discover in this system will provide us with the category of changes that modify behaviors, making one sex more susceptible to a certain diseases, and we'll have a better idea of what to look for in humans. For instance, all of the differences in gene expression that we have observed occur in the adolescent to adult transition stage; no differences have been found in early development. It seems that once gender roles become important for reproduction, then differences in gene expression become apparent.

jur: You have published a book titled *Cognitive Bias in Fantasy Sports: Is Your Brain Sabotaging Your Team?*. Can you tell us more about the book's premise?

Miller: Actually, the ideas in the book are applicable to all decision-making, but fantasy sports are my hobby, so that is what I decided to focus on. Basically, our mind leads us to an answer, a decision about our fantasy team, in a biased way instead of analyzing all possibilities and selecting the best in an unbiased way. This has to do with which pathways are reinforced in learning, memory, and reward--specifically the reward

of being right. This reward involves the neurological systems that reinforce existing ideas, prioritize recent ones, and overvalue the things we possess, versus the things that others possess. All of these processes have the possibility to work to our advantage, disadvantage, or be neutral. My advice is usually to avoid biases you are aware of.

jur: How do you achieve a balance between family life and research demands? Will you encourage your children to pursue science and research?

Miller: I have two boys, ages 9 and 11, and it has always been a challenge to balance research and family, especially with the publishing of my book, which is like having another part-time job. It has been especially important to be efficient with time management. But my kids have always been really supportive. Sometimes they roll their eyes and say “Oh you’re doing fantasy sports stuff again,” but the other day my son Googled my name and was impressed with the fact that all of my work that came up. My one son was involved in a fantasy baseball league, and the other enjoys watching basketball with me, so I hope that sports are something we can come to share and do together. As far as science goes, they’ve been coming to the lab since before they could walk; actually, it was easier when you could just push them in a stroller- because research takes place at all times of day. Right now, neither of them want to go into science or medicine; in fact, they aren’t particularly set on any career, but both want to go to U of R. One of my boys has told me he even wants to take one of my classes.

jur: On a different note, a subject that currently seems to be receiving increased attention is the interface between science and religion: do you believe a scientist can be religious?

Miller: I am Jewish by conversion – my ex-husband introduced me to Judaism. It wasn’t a forceful introduction, he just introduced me to it and said it was important to him and that he had grown up in it. The tenets of Judaism really appealed to me, especially the emphasis on the value of education. I think that the interpretations of the Old Testament are really practical and aren’t all completely metaphysical, but that they are applicable to everyday life. I think that science and religion are compatible and I view the stories as a learning tool, teaching about how to live your life while on Earth. But perhaps people who are Jewish but not scientists view it differently. I think everyone could benefit from the positive principles taught by religion. It is a little hard with the kids, with what they are taught in classes about God creating the world, because I teach them about evolution, but I think the stories are more in service of how to live life than to be taken literally.

jur: For a final question, what is the most important quality for someone interested in research to have?

Miller: I’m stuck between flexibility and creativity. No doubt, you need to be smart, hard working, and determined, but I think flexibility is an important trait because research doesn’t always work out in the way you want it to. You need to plan in great

detail, for five to ten years sometimes, for a grant or a job. And you can make great plans and start carrying them out, but they might not work and you need to reassess and make a new plan, so flexibility is a key to success. You can even scale this down to a day-to-day basis with a to-do list – let’s say you go to the fridge and there’s none of the reagent you need and it won’t be in for three months. You need to think of a new method or another project to work on so that you use your time productively.

Deciphering the Oregon Death With Dignity Act

Josh Schulman, 2015

Adviser: Professor Stuart Jordan

Department of Political Science, University of Rochester

Following Thomas Jefferson's iconic declaration, life, liberty and the pursuit of happiness have been entrenched into the American political system as unalienable rights. However, serious debate has been rooted in the question of whether or not an individual also has the right to willfully decline these unalienable rights, choosing instead the right not to pursue happiness, to forego liberty, or to choose death. The concept of the right to die has been pushed into the forefront of American public policy through the passing of the Oregon Ballot Measure 16 of 1994, known as the Oregon Death with Dignity Act (ODWDA), which legalized the practice of assisted suicide among residents of Oregon who meet the criteria explicitly defined in the legislation. Since the passing of the initiative, its implementation as well as constitutional challenges and attempts to repeal have provided a highly intriguing case study of the battle between the state and federal governments over physician-assisted suicide (PAS). This paper will examine the different political variables that influenced the ODWDA saga and ultimately the decision in *Gonzales v. Oregon* (2004), because it serves as an integral example of the complexity in enacting controversial policy in state governments, as well as the importance of permitting states to exist as laboratories of democracy free from overzealous federal regulation.

The main question that will be addressed in this paper is "which political variables are the most important for understanding the complex nature of the ODWDA saga and the *Gonzales* decision?" In a policy battle that stretches for over twelve years and becomes the center of major national attention and controversy, there are inherently numerous key individuals, groups, statutes, and factors that play pivotal roles in determining the policy's outcome. In the case of ODWDA, identifying the most influential political variables becomes an essential tool for deciphering its complexity and developing an appropriate understanding of the totality of its circumstances. ODWDA is a multifaceted political saga that primarily developed through the variables of administrative abuse by Attorney General John Ashcroft, administrative deference, and the development of new federalism. The complex nature of ODWDA provides a unique modern case study into the implementation of a highly controversial state social policy and the subsequent process of scrutiny from both the administrative

and judicial levels.

The first section of this paper will examine the history of ODWDA from its implementation to the *Gonzales* decision to illustrate its unusual and difficult path to constitutionality. It will be divided into three subsections that represent the three pivotal stages of the ODWDA saga: Implementation and *Glucksberg*, the Ashcroft Directive, and *Gonzales v. Oregon*. The first subsection discusses the early implementation problems of ODWDA as well as detailing the 1997 Supreme Court case *Washington v. Glucksberg*, the first major decision by the Court on physician-assisted suicide. It will then outline the historical facts that surround *Glucksberg* as it served as the first litmus test for the constitutionality of PAS under the argument that it is a protected liberty interest under the Fourteenth Amendment. Lastly, it details the unanimous court decision as well as the opinion delivered by Chief Justice Rehnquist, which ruled that the PAS was not protected by the Due Process Clause nor was it a protected liberty interest. The second subsection discusses the Ashcroft Directive by examining the historical events leading up to the promulgation of the Directive as well as examining its details and its effects upon ODWDA. It will begin by discussing the aftermath of the *Glucksberg* decision and the failed attempts to repeal and criminalize ODWDA by the Oregonian people and Congress, respectively, through the Oregon Ballot Measure 51 of 1997 and the 1999 Pain Relief Promotion Act. It will conclude by examining the text of the Directive, which ruled PAS an illegitimate medical practice under the Controlled Substances Act of 1970 and permitted the prosecution of Oregonian doctors who carried out the procedure as defined by ODWDA. The final subsection will discuss *Gonzales v. Oregon* and its crucial impact in determining the outcome of the ODWDA saga. The paper will begin by examining the historical events surrounding the case, while primarily discussing legal victories by the State of Oregon in Federal District Court, the Circuit Court of appeals, and ultimately the Supreme Court in a 6-3 decision. Lastly, it will examine the *Gonzales* opinion written by Justice Kennedy, the current administrative deference precedent, and why the justices did not grant the Ashcroft Directive administrative deference.

The second section will examine the political variables of

administrative abuse, deference, and new federalism as lenses for analyzing the *Gonzales* decision through a review of the arguments of three scholars: Robin K. Chand, Stacy Tromble, and John C. Roberts Jr. It will begin with a transitional introduction that outlines the main question for this section: how are we to best examine the significance of the *Gonzales* decision? The section will then be broken into four subsections, with the first three dedicated to analyzing the lenses argued by each scholar and the fourth dedicated to determining which lens is most appropriate for explaining the *Gonzales* decision.

The first subsection will discuss Robin K. Chand's *Deconstructing Gonzales v. Oregon: When Political Agendas Yield to Rudimentary Notions of Federalism and Statutory Interpretation*, which argues that the lens of administrative abuse by General Ashcroft had the strongest influence on the ODWDA saga and ultimately was the determining factor in the Court's decision. It will begin by illustrating Chand's historical outline of General Ashcroft's predisposition towards an anti-PAS agenda, primarily due to his political actions as both the Governor of Missouri and a US Senator. Lastly, it will demonstrate that General Ashcroft's conduct in the promulgation of the Ashcroft Directive was less than reputable and portrayed an overt power abuse, as opposed to a legitimate interpretation of the Controlled Substances Act through the strong words of both Judge Robert Jones and Justice Kennedy.

The second subsection will analyze Stacy Tromble's *A Dialogue on Death and Deference: Gonzales v. Oregon*, in which she argues that the lens of deference is the most appropriate for analyzing the *Gonzales* decision because the case provides an important case study over the granting of administrative deference in the Supreme Court. It will begin by giving a historical outline of the current precedent of granting deference by the Court – *Chevron* deference – as well as demonstrating its highly objective manner for determining when an agency is granted deference. It will then discuss Tromble's argument that *Gonzales* is an unexpected and intriguing decision because it contradicts the recent tendency of the Court to grant a high degree of deference. It will also discuss the effects that individual ideologies have played in the expansion of granting deference, most notably Justice Scalia, who desires a broad expansion of *Chevron* deference beyond its current limitations. Lastly, it will demonstrate the validity of the deference lens by arguing that the exclusion of a federalism argument by the Court makes the *Gonzales* decision one best explained by deference.

The third subsection will discuss John C. Roberts Jr.'s *The Siren Song of Federalism: Gonzales v. Oregon*, in which he argues that the emergence of the new federalism political movement best explains the *Gonzales* decision. It will begin by offering an explanation of new federalism, a movement focused upon devolution, or giving powers from the federal to state governments, and its effect on the Supreme Court. It will then demonstrate that Roberts Jr.'s historical outline of the new federalism movement illustrates a realignment of focus by conservatives and liberals to the federal government and the states, respectively, in their pursuit of gaining power in social policy making. Lastly, it will illustrate Roberts Jr.'s argument that the ideological change of the justices, a product of new federalism, ultimately had a profound effect on the *Gonzales* decision because the encroachment on Oregon's autonomy by the Ashcroft Directive contradicts the ideals of new federalism.

The final subsection will discuss the validity of the lenses argued by Chand, Tromble, and Roberts Jr. on whether it is most appropriate for analyzing the *Gonzales* decision and ultimately determine the lens of administrative abuse that best encapsulates the decision. It will demonstrate that all three political variables play an integral role in influencing the outcome of the *Gonzales* decision, but Chand's argument best explains the outcome of a decision focused upon the overstepping of political boundaries by a federal agency. Lastly, the conclusion will discuss the aftermath of the ODWDA saga as well as the importance of maintaining the Brandeisian standard of permitting the states to be laboratories of democracy.

SECTION II: HISTORY OF ODWDA

The Oregon act was scheduled to be implemented on October 27, 1997 and received national scrutiny and outrage over Oregon's stance on the highly controversial issue, with the federal court system immediately becoming the battleground for ODWDA's existence. The challenges began with the 1994 case of *Lee v. State of Oregon* in which US District Court Judge Michael R. Hogan placed at first a temporary then permanent injunction on the law on the basis of violating the Equal Protection Clause, writing in his opinion that "it has lowered standards and reduced protections to a degree that there is little assurance that only competent terminally ill persons will voluntarily die."¹ The case worked its way up the appeals system to the Supreme Court, but was refused certiorari in 1997. *Lee's* failure did come with its successes, as it set the national spotlight on the Court for the upcoming case of *Washington v. Glucksberg* (1997), the first over physician-assisted suicide (PAS).

Glucksberg began as a challenge by Dr. Harold Glucksberg, as well as fellow physicians, terminally ill patients, and the non-profit Compassion in Dying, to overturn Washington State's ban on assisted suicide in the Natural Death Act of 1979 on the basis that assisted suicide was a liberty interest thus protected under the due process clause of the 14th amendment. While the Western Washington District Court ruled that the statute placed undue burden on the exercise of protected Fourteenth Amendment Liberty Interest and violated the Equal Protection Clause², the Ninth Circuit Court of Appeals ruled that "the statute did not deprive persons seeking physician-assisted suicide of constitutionally protected liberty interest and facial invalidation of statute was unwarranted."³ *Glucksberg* was granted certiorari on October 1, 1996 and, on September 26, 1997, the Court unanimously ruled in favor of Washington, with the majority opinion being delivered by Chief Justice Rehnquist, which served as the catalyst for political battle over PAS.

First and foremost, Chief Justice Rehnquist stated that the court did not find Washington State's ban on PAS to be a violation of the Due Process clause. Additionally, the court did not find it to be a protected liberty interest as argued by Glucksberg, stating "opposition to and condemnation of suicide - and, therefore, of assisting suicide - are consistent and enduring themes of our philosophical, legal, and cultural heritages."⁴ Rehnquist places his reasoning in the fact that earlier precedence states, "the Due Process Clause specially protects those fundamental rights and liberties which are, objectively, deeply rooted in this Nation's history and tradition"⁵ and because of the universal opposition

of both suicide and inherently assisted suicide, under no circumstances could PAS be defined as a liberty interest. However, Rehnquist held in his opinion that “throughout the Nation, Americans are engaged in an earnest and profound debate about the morality, legality, and practicality of physician-assisted suicide ... Our holding permits this debate to continue, as it should in a democratic society”⁶ thus invoking the Brandeisian precedent of making the states laboratories of democracy. Rehnquist’s opinion did deliver a strong blow in public opinion towards PAS, yet still left open a door through which PAS state legislation could further fight the battle for constitutionality.

The *Glucksberg* decision subsequently led to many legislative challenges to ODWDA, beginning with the Oregon Ballot Measure 51 of 1997, which sought to repeal ODWDA, but was defeated when only receiving 40.1% of the 1,112,105 votes casted. Congress became involved in 1999 when the House passed the Pain Relief Promotion Act (PRPA), which would bar physicians from prescribing medications that were permitted by ODWDA. However, a combination of Oregonian outrage, questions over the questionable effectiveness and intentions of the bill, and political strong-arming prevented PRPA from ever reaching the Senate floor. The already increasing tension between the federal government and Oregon reached a climax in 2001 when newly appointed Attorney General John Ashcroft filed the *Ashcroft Directive*, which sought to resolve the perceived failures of both the Judicial and Legislative branch by using the administrative powers of the Drug Enforcement Agency (DEA) to permanently end ODWDA.

The *Ashcroft Directive* was established on the conclusion of Ashcroft that after *United States v. Oakland Cannabis Buyers’ Coop (2001)* in which the Court “reaffirmed last term that the application of federal law regulating controlled substances is uniform throughout the United States and may not be nullified by the legislative decisions of individual States,”⁷ the Controlled Substances Act of 1971 (CSA) did hold that controlled substances may not be dispensed to assist suicide and henceforth could be regulated by the DEA. Furthermore, Ashcroft determined that assisting suicide was not a legitimate medical purpose as defined by the CSA and controlled substances could only be used for pain management⁸. This in turn permitted the DEA to prosecute Oregon doctors who engaged in PAS as part of ODWDA and demanded compliance out of all Oregon hospitals during investigations. Thus, the declaration of PAS as a violation of the CSA as well as the new powers delegated to the DEA demonstrated that the *Ashcroft Directive* was a full-scale administrative assault on ODWDA and escalated federal government-Oregonian tension to an all-time high.

The Ashcroft directive resulted in U.S. District Court Judge Robert Jones of Oregon filing an injunction against the rule until arguments could be heard in April 2002, providing the foundation for a battle in the courts. Both Judge Jones as well as the Ninth Circuit Court of Appeals ruled in favor of ODWDA, and the Court of Appeals filed a permanent injunction against the “interpretive rule” of Ashcroft. Subsequently, Attorney General Ashcroft filed a petition on behalf of the Department of Justice for the Supreme Court on November 9, 2004, which was granted in February 22, 2005. The collection of events in the federal courts, culminating in the Supreme Court, provided what proved

to be the showdown for the viability of ODWDA in *Gonzales v. Oregon (2006)*, and on January 17, 2006, the Court ruled in favor of Oregon in a 6-3 decision, with the majority opinion written by Justice Kennedy.

Gonzales is based upon a challenge on whether the Ashcroft’s interpretive rule is entitled to deference as established by previous court precedence. As cited by Kennedy, deference, or permission granting by the Court to administrative agencies, as defined by *Chevron USA v. National Resources Defense Council Inc. (1984)*, is “warranted only when it appears that Congress delegated authority to the agency generally to make rules carrying the force of law, and that the agency interpretation claiming deference was promulgated in the exercise of that authority.”⁹ The Court found that the interpretive rule did not meet *Chevron* deference, as “*Chevron* deference, however, is not accorded merely because the statute is ambiguous and an administrative official is involved ... To begin with, the rule must be promulgated pursuant to authority Congress has delegated to the official.”¹⁰ Furthermore, the Court found that “the specific respects in which he is authorized to make rules, however, instruct us that he is not authorized to make a rule declaring illegitimate a medical standard for care and treatment of patients that is specifically authorized under state law.”¹¹ Thus, the *Ashcroft Directive* was found to overstretch the delegated powers of the DEA under the CSA and that it could not prohibit doctors from prescribing regulated drugs for use in physician-assisted suicide, as authorized by ODWDA. Although the Kennedy opinion never mentioned the actual constitutionality of ODWDA, it permitted the continued practice of the legislation and prevented avenues through which administrative mandates could prohibit PAS, thus effectively allowing the practice to spread to other states.

PAS has been under extreme scrutiny for the past 20 years and has received challenges to its constitutionality and practice from all branches of federal government. However, through the precedence established in *Gonzales*, PAS has now spread to Washington and Montana and appears to now be a fixture within the United States. Thus, the story of ODWDA provides us with a highly intriguing modern case study of a battle between federalism and states’ rights, administrative power abuse, and administrative deference played out in the national media, the legislature, and most importantly, the courts.

SECTION III: ANALYZING THE DIFFERENT LENSES OF THE GONZALES DECISION

As previously stated, The Supreme Court’s decision in *Gonzales v. Oregon* was centered upon whether General Ashcroft’s interpretive rule of the CSA should be granted administrative deference. Although the narrow ruling did not directly address the constitutionality of PAS, it left one major question for political scientists: how are we to best examine the significance of the ruling? In its most basic sense, the ruling simply demonstrated that bureaucracies are subject to *Chevron* deference and are not permitted to be overzealous in their implantation of explicitly defined legislative statutes. However, when examining the broad scope of political variables that surround *Gonzales*, there is contentious debate over which lens is most appropriate for analyzing the decision in order to encapsulate the totality of the circumstances. The section will examine these different lenses as

well as their validity in best explaining *Gonzales* by discussing the arguments made by the scholars Robin K. Chand, Stacy Tromble, and John C. Roberts Jr.

The first lens for examining *Gonzales* comes from Robin K. Chand's *Deconstructing Gonzales v. Oregon: When Political Agendas Yield to Rudimentary Notions of Federalism and Statutory Interpretation* in which he argues that *Gonzales* was the product of administrative power abuse by General Ashcroft due to an overt political agenda. Similar to the other arguments, Chand provides a summary of ODWDA, the Ashcroft Directive, and the *Gonzales* decision, but places special emphasis on General Ashcroft's anti-PAS political agenda that predated his appointment to Attorney General in February 2001. Chand argues that Ashcroft's predisposition to PAS began during his tenure as Governor of Missouri in which he "sought the forced administration of medical care to a woman who was [left in a vegetative state] after a car accident," although the victim's family rejected the care¹². Ashcroft furthermore publicly disagreed with former Attorney General Janet Reno's unwillingness to use the CSA to undermine ODWDA, and "urged General Reno, an appointee of the rival [Democratic] party, to reconsider her finding [which] she refused."¹³ Thus, Chand's summary, which uniquely emphasizes Ashcroft's background, sets a solid foundation for explaining Ashcroft's actions as Attorney General.

Chand's analysis of General's Ashcroft's administrative abuse begins by examining the District Court battle immediately following the promulgation of the Ashcroft Directive. In the District Court decision, Judge Robert Jones of Oregon suggested a rebuke of the conduct of General Ashcroft, believing he had completely ignored the Oregon officials before acting and "lost the opportunity to evaluate carefully the scientifically conducted studies of the Oregon Act."¹⁴ Furthermore, Jones viewed the Ashcroft Directive as a "product of politics and not of an appropriate interpretation of the Attorney General's power under the CSA."¹⁵ Chand further argues that the Kennedy opinion in *Gonzales* implicitly touched on the political motivation of General Ashcroft as well, stating that "the problem with the design of the [Ashcroft directive] is that it cannot, and does not, explain why the Attorney General has the authority to decide what constitutes an underlying violation of the CSA in the first place."¹⁶ Ultimately, the will of the people overcame administrative abuse of General Ashcroft, as "[his] efforts to harness the will of Oregonians with an assault on their autonomy driven by politics, failed."¹⁷ Chand's argument does an excellent job of fully encapsulating the political motivations of General Ashcroft as a political variable that strongly affect the events leading to the apex of ODWDA and ultimately influencing the outcome of *Gonzales*. While Chand concedes that deference and new federalism both played integral parts in the decision, his well-formulated argument gives strong merit to employing the lens of administrative abuse for viewing the ODWDA saga.

The second lens we will examine is the lens of deference, which is employed by Stacy Tromble in *A Dialogue on Death and Deference: Gonzales v. Oregon*. Tromble argues that the most important aspect of the *Gonzales* decision is how it provides an important case study over the granting administrative deference by the Supreme Court. Before analyzing her argument, it is important to clearly outline the history of administrative deference in the Supreme

Court. As previously mentioned in Section I, the *Gonzales* decision was decided on the basis of determining if the Ashcroft Directive qualifies for *Chevron* deference, which is the current precedent used by the Supreme Court. The *Chevron* decision created a two-step approach to determining deference for administrative law: (1) asking if it is an ambiguous statute and (2) whether or not the agency's construction of that ambiguous statute is reasonable. Furthermore, *United States v. Mead Corp* (2001) further refined judicial deference by adding "*Chevron Step Zero*", which stated that two questions must be answered in the affirmative before applying *Chevron* deference: (1) has Congress delegated power to the agency to make rules with the force of law and (2) has the agency, in fact acted with such authority¹⁸. Thus, the Supreme Court's precedent on granting administrative deference is an objective test that explicitly defines the manner in which agencies can implement congressional statutes and is subject to review by the judicial branch.

While the Supreme Court's refusal to grant deference to the Ashcroft Directive appears to be an appropriate decision, Tromble argues that it is an unusual and important decision because it "represents a departure from the modern tendency of the Court to afford a high degree of deference in administrative rulemaking."¹⁹ Throughout the Court's final term in the twentieth century, the Court consistently sounded "a steady drum beat; a drum beat of deference,"²⁰ thus making *Gonzales* a peculiar Court decision. Furthermore, Tromble portrays the ideologies of the individual justices as having a profound effect on the recent expansion of deference, no more so than the conservative Justice Scalia. Scalia has shown a willingness "to expand *Chevron* deference beyond traditional notice-and-comment rulemaking, to any authoritative agency ruling including letters, decisions, and even no-action notices published in the federal register,"²¹ evidenced by his strong-worded dissent in *Gonzales*. For Tromble, what provides strong merit to the deference lens is the Court's noticeable exclusion of a federalism argument, as their "seeming reluctance to make an explicit federalism argument in favor of a sometimes excruciating dialogue on deference leaves one to wonder if the Court is hiding a few elephants of its own."²² Tromble's argument makes a strong case for the necessity of understanding the political variable of deference in the *Gonzales* decision because the reversal of the Court's recent expansion of granting deference further deepens the complexity that surrounds the ODWDA saga.

The last lens for examining *Gonzales* is argued by John C. Roberts Jr. in *The Siren Song of Federalism: Gonzales v. Oregon* in which he proposes that the emergence of new federalism best encapsulates the decision. Before examining Roberts Jr.'s argument, we must define new federalism and its relation to the ODWDA saga. New federalism, in this context, is the American political philosophy of devolution, which focuses upon transferring power from the federal to state governments. Triumphed by the Ronald Reagan presidency, new federalism sought to restore autonomy of the states and preserve the intentions of the federalists as well as the 10th amendment. This movement left a profound effect on the Supreme Court, as "[the] Courts 'new federalism makes for strange bedfellows ... [because] where once only conservatives invoked states' rights as a defense in court, liberals now throw the argument around."²³ Roberts Jr.'s argument relies upon a historical

analysis of the switch in the political parties in their approach to best controlling power in public policy making caused by new federalism. Liberals, for example, have been traditionally skeptical of states' rights claims because their nearly interrupted control over Congress for one hundred years allowed them to use federal power "to secure many of their most important achievements, including [FDR's] New Deal economic regulation and [LBJ's] Great Society and civil rights legislation."²⁴ Additionally, because of the use of state's rights by conservatives "to perpetuate discrimination against women, people with disabilities, and gays and lesbians,"²⁵ it becomes largely evident why liberals were initially opposed to viewing new federalism as an opportunity to enact and preserve liberal social policy at the state level. However, the emergence of new federalism caused a realignment in judicial ideology, as Justice Antonin Scalia began urging conservatives to "utilize the power of the federal government to achieve conservative ends, particularly in the area of deregulation"²⁶ and Justice William Breyer began urging liberals to "employ state courts in their fight for the protection of individual rights"²⁷. This realignment ultimately resulted in the *Gonzales* decision's implicit backing of states' rights, because the encroachment on Oregon's autonomy by the Ashcroft Directive strongly conflicts the ideology of new federalism. Roberts Jr.'s argument uses the unique approach of the new federalism lens to cast light on the importance of understanding the justice's ideologies for the *Gonzales* decision and the wide-sweeping effects of the political movement which ultimately gives strong merit to his case.

Chand, Tromble, and Roberts Jr. all do excellent jobs in arguing their respective lenses and provide unique insightful viewpoints into deciphering the complexity of the ODWDA saga. However, when evaluating which lens is most appropriate for analyzing the *Gonzales* decision, it is evident that the administrative abuse lens holds stronger merit than deference or new federalism. While all three lenses do stand as essentially political variables that ultimately influenced the decision, *Gonzales* was decided upon the basis that the Ashcroft Directive overstepped the power bestowed upon the Attorney General in the CSA and was not afforded deference. Chand's argument best explains why the power was overstepped by focusing on the General Ashcroft's predisposition towards a strong anti-PAS position and ultimately his dedication to using any political means in order to delegitimize the practice of PAS in the state of Oregon. Thus, General Ashcroft's administrative abuse is the most important political variable in influencing the *Gonzales* decision and understanding the ODWDA saga in the totality of its circumstances.

CONCLUSION

As is the case with social policy battles such as physician-assisted suicide, there are still plenty of future key statutes to be passed and landmark legal battles to undergo before the final chapters can be written on the experiment of PAS in the United States. For ODWDA, the *Gonzales* decision ensured that at least temporarily the Oregonian statute will operate without federal interference and has permitted Washington State and Montana to pass similar legislation. The ODWDA saga demonstrates the sheer complexity of the issues that controversial state social policy must face before, during, and after implementation and, most importantly, illustrated that key political variables such as administrative abuse, deference, and new federalism, can have a

profound effect on the development of a statute. While the role of state governments has diminished over the history of the United States, ODWDA demonstrates why it is imperative that the American political system maintains the Brandeisian standard of permitting the states to be the laboratories of democracy.

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Zoroastrian Dakhma-Nashini: A Case Study on Ritual Change

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Zoroastrianism has left a substantial mark on the world. As the oldest creedal, monotheistic religion, it “has probably had more influence on mankind, directly and indirectly, than any other single faith” (Boyce 1979:1). Much of today’s knowledge about Zoroastrianism is centered on this influence. However, there is a wealth of research available about the religion on its own terms; this paper will expand this collection of knowledge by exploring Zoroastrian death rituals. Today, Zoroastrians can be found all over the world, from North America to Hong Kong to East Africa (Migliore 2008:2). Unfortunately, this ancient faith is currently facing significant problems that threaten its continued existence (Migliore 2008:ii). According to a census from the Heritage Institute, there were only approximately 137,000 Zoroastrians worldwide in 2006 (Edujee). This paper will explore the effects of globalization, modernization, and secularization on Zoroastrianism, specifically looking at how these factors affect the death ritual, called the *dakhma-nashini*. I will provide a brief overview of the religion, outline the performance and function of the traditional funerary ritual, and then describe the general changes taking place in Zoroastrian communities that have affected the ways in which Zoroastrians perform their death rituals.

There is a rift among Zoroastrians in regards of to how to best confront these changes: should they be accepted as a necessity or should Zoroastrians fight to maintain their traditional beliefs and practices? Some Zoroastrians fear “dilution” of their religion and culture and therefore resist most change as a way of maintaining their distinct identity (Migliore 2008:37). Others, however, see the changes as a way to keep Zoroastrianism modern and relevant for practitioners today. This paper will explore this division, looking at the benefits and drawbacks of both ways of proceeding on the future of Zoroastrianism. Finally, I will explain how the changes observed in the *dakhma-nashini* ritual can be used as a means of understanding ritual change in general, and why this is an important concept of which scholars should be cognizant.

ZOROASTRIANISM: HISTORY AND BELIEFS

Zoroastrianism flourished between the sixth and seventh

centuries BCE, but Zarathushtra (or Zoroaster, as he is known in Western scholarship) probably began preaching in Eastern Iran some time between 1700 and 1500 BCE (Boyce 1979:2). Boyce suggests that he was a priest of an ancient “proto-Indo-Iranian faith,” a tradition from which he developed his ideas for Zoroastrianism. The proto-Indo-Iranians were most likely pastoralists who worshipped many gods and built their cult around fire and water (Boyce 1979:2-4). After Zarathushtra was made a priest at the age of fifteen, he continued to search for truth and enlightenment. Finally, at age thirty, a “Being” revealed himself to Zarathushtra and “led [him] into the presence of Ahura Mazda” (Boyce 1979:18-19). His fellow countrymen were not originally receptive to the new teachings of Ahura Mazda; he had to leave his tribe in order to find a king willing to convert to the new faith (Boyce 1979:31). Scholars believe that Zoroastrianism began in the east and then spread to Western Iran when the Median Empire was at its height between 612 and 549 BCE (Boyce 1979:49). From this point, Zoroastrianism gained more popularity until it became “the state religion of three great Iranian empires, which flourished almost continually from the sixth century BCE to the seventh century AC” (Boyce 1979:1).

Zarathushtra taught that Ahura Mazda, Lord Wisdom, is the highest deity and that he created the world and all the good things in it (Boyce 2008:9). Ahura Mazda’s adversary is Angra Mainyu, Hostile Spirit, who created death and evil in opposition of life (Boyce 2008:20-21). The Zoroastrian worship service is called the Yasna; it is performed every day by a priest in a fire temple and is essentially an “extremely elaborate purification rite” (Smith 1995: 1151). During the Yasna, various parts of the Avesta are read and prayers are recited (Boyce 1984:2). The Avesta, meaning “Injunction of Zarathushtra,” is the main source of Zarathushtra’s teachings (Boyce 1984:1). The most important part of the Avesta are the Gathas: a collection of seventeen hymns which are the only pieces of Zoroastrian literature directly attributed to Zarathushtra. Zarathushtra wrote them according to the teachings revealed to him by Ahura Mazda (Boyce: 1984:1). However, the Gathas are not explicitly clear in their teachings and meanings; the “keys to their interpretation are provided by the Younger Avesta and the Pahlavi Zand which clearly outline doctrines often only

alluded to in the Gathas” (Boyce 1984: 1). Younger Avesta is an umbrella term that refers to all of the Zoroastrian texts written in the Younger Avestan language (Boyce 1984:2). These texts include the Yashts, Pahlavi Zand, and Vendidad (Boyce 1984:2). The Yashts are hymns to lesser divine beings, and the Pahlavi Zand is an interpretation and translation of the Avesta written over time. The Vendidad, written in prose, is mainly concerned with purity laws. It is in this text that the proper means of the disposal of a corpse is described (Boyce 1984:65).

Purification plays a very important role in Zoroastrian society: it is inextricably linked to morality (Boyce 1979:45). Consequentially, Zoroastrians have numerous laws for maintaining and restoring purification (Boyce 1979:45). All uncleanness, including anything considered “harmful or repulsive” to mankind, is caused or created by Angra Mainyu, so it is the work of all Zoroastrians to combat it (Boyce 1979:43-44). Although killing these “*daevic*” beings was not a sin, death itself was “a great uncleanness.” According to Boyce, “The greatest pollution in death... was from the bodies of righteous people, for a concentration of evil forces was necessary to overwhelm the good, and these continued to hover round the corpse” (Boyce 1979:44). Therefore, Zoroastrians needed a way of disposing of bodies that would not pollute the sacred elements of earth, fire, or water, while at the same time ensuring the soul’s safe passage to the Chinvat Bridge.

The Chinvat Bridge is conceptualized as an actual bridge that souls must cross in order to enter heaven, hell, or *Misyan Gatu*, the “Place of the Mixed Ones” (Boyce 1979:27). The soul’s eternal resting place is determined by the person’s actions during his or her lifetime (Boyce 1979:27). All of a person’s good deeds are weighed on a scale against their bad ones (Boyce 1979:27). If the good outweigh the bad, then the soul is allowed to cross the Bridge into heaven. If not, the bridge becomes the width of a sword’s blade and the soul falls into hell (Boyce 1979:27). If the actions are perfectly balanced, the soul goes to *Misyan Gatu* (Boyce 1979:27). The scale and the bridge are guarded by three *Yazatas*¹ (beings worthy of worship): *Mithra* (Truth), *Sraosha* (Obedience), and *Rashnu* (Judge), the one who holds the scales (Boyce 1979:10, 27).

Traditional Funerary Rite

It is this combination of beliefs – in the hereafter and purification – that is expressed by the funerary rites still in practice today. As noted above, it is not the Gathas that detail these rituals. In the Gathas, Zarathushtra himself did not “yield [any] clues that would make him accountable for his later followers’ notions about innumerable ways of culturally corrupting the physical bases of life” (Pangborn 1997:126). Rather, an outline of the *dakhma-nashini* is found in the Vendidad, or the “Law against demons,” the book that holds all of the rules for avoiding pollution and restoring purity (Pangborn 1997:126, Boyce 1979:94). This text was most likely written during the Parthian period, which began around 246 BCE and lasted until the third century AD (Boyce 1979:81, 101). The Vendidad is a compilation of “traditions” possibly created when king Valakhsh proclaimed that each province must “preserve, in the state in which it had come down in (each) province, whatever had survived in purity of the Avesta and (its) Zand, and also every teaching deriving from it... whether written or in authoritative oral transmission” (quoted by Boyce

from the *Dinkard*² and Zaehner³ in Boyce 1979:81, 94). As texts from the Vendidad reveal, Zoroastrians believe that pollution is not just corporal; spiritual pollution is just as real and feared as physical pollution and must be accounted for in the rituals as well (Pangborn 1997:130). This paper will focus on the physical rites that surround disposal of the body as they have been more affected by changes⁴.

In order to prevent contact with “vulnerable good creations,” the concept of the *dakhma*, the Tower of Silence, was created. Generally located on the outskirts of town, the *dakhma* has a circumference of 300 feet⁵ (Boyce 1984:151). There are three rows of “exposed receptacles” called *pavis*; each row has the same number of receptacles so they become smaller towards the inside of the circle (Boyce 1984:151). The outside receptacles are used for men, the middle for women, and the inside receptacles for children (Boyce 1984:151). After death, the body is washed a final time using *gomez* (bull’s urine), which was first used because it was considered to be a powerful disinfectant (Dhalla 1994:56). This ritualized urine bath is called the *sachkar* (Gira et al 2004:514). After bathing, the *sagdid* ceremony is performed: a four-eyed dog (a dog with two spots by his eyes) is brought to look upon the corpse to ensure that it is dead (Gira et al 2004:510). It is thought that if the dog stared at the body, then the body was deceased, but if it refused to look at the body, then life is still present (Dhalla 1994:57). If the body is deceased, the body is put in a *gehān* (a coffin) and carried to the *dakhma* by family members, who hand the coffin off to *nasesālars* just prior to the entrance of the Tower (Gira et al 2004:510). *Nasesālars* are predetermined “professionals” who are the only people allowed inside the *dakhma* (Gira et al 2004:510). They remove the body from the *gehān* and place it in the appropriate receptacle. Once the body is in the *dakhma*, it usually takes less than an hour for vultures to completely clean the bones of flesh (Boyce 1984:151). After the bones are completely dry, they are dropped into a deep pit, also lined with stone, in the center of the Tower (Boyce 1984:151). Everyone involved in the funeral, including the *nasesālars* and those who walked behind the body from the place of death to the *dakhma*, must go through a standard purification ritual bath once they return home (Gira et al 2004:510).

Function and Meaning of the Death Ritual

Emile Durkheim highlighted the social aspect of rituals by proposing a theory of social functionalism that couched religion as a “social phenomenon,” whose aim is to strengthen the bonds of the community members by eliciting a feeling of “collective effervescence” (Bell 1997:24). Jonathan Z. Smith, another theorist of religion, argued that rituals serve an additional purpose: namely, that rituals function to enable people to make sense of, and organize a world prone to, chaos and meaninglessness (Bell 1997:12). Zoroastrian rituals function on both of these levels. The social aspect is particularly important for diaspora Zoroastrians, or Zoroastrians who live outside of the homeland of Iran or India. Both the prayer services and the ritual performance allow Zoroastrians to bond with their brethren who are participating with them, as well as with the people, past and present, who perform the ritual in their homeland. The purpose of this funerary ritual is to prevent sacred elements from being polluted by death, a creation of Angra Mainyu. It helps Zoroastrians to reinforce

their conceptualizations of life and death, and enables them to maintain order in their personal universe.

Pierre Bourdieu developed another ritual theory, the practice theory, where he understood ritual as a way to study how human activity enables people to create their own worlds (Bell 1997:78). He describes rituals as “not a matter of following rules” but “as strategic practices for transgressing and reshuffling cultural categories in order to meet the needs of real situations” (Bell 1997:78). For Zoroastrians, the *dakhma-nashini* is more than just a rite of affliction. It reinforces the notion that death is unclean while simultaneously unifying the community, setting them apart from non-Zoroastrians. Additionally, by holding onto their peculiar rituals, they are not assimilating into whatever other society they are living in. Death is fundamental; every society must deal with it. By refusing to adopt a means of corpse disposal other than through use of the *dakhma*, Zoroastrians publically reinforce the fact that they are part of their own separate culture.

The function of rituals is intertwined with a given society’s emphasis on either orthodoxy or orthopraxy. Orthodoxy focuses on the religion’s beliefs, while orthopraxy emphasizes the correct performance of a ritual (Bell 197:191). According to Catherine Bell, orthopraxy “seems to flourish in communities that value the common group identity” whereas orthodoxy is common in societies that seek to minimize the importance of such ties and “keep religious orientation from being subsumed into a particular political-social identity” (Bell 1997:191). In the introduction, I had discussed a rift among Zoroastrians due to differences in how people should confront the changes taking place within the community. This major divide in Zoroastrianism can be described as a division between those who value orthodoxy and those who value orthopraxy: some Zoroastrians understand Zoroastrianism primarily as a culture that is kept alive by the proper performance of rituals, while other Zoroastrians think of the religion primarily as a system of beliefs whose rituals can – and should – be updated in order to preserve the meaning behind them. Andrew Adkins described the orthopaxic community as “those who see Zoroastrianism as faith in the power of a set of traditional observances,” while the orthodoxic community is composed of “those who see [Zoroastrianism] as a moral philosophy based around the teachings of Zarathushtra” (Adkins 2012:8). Thus, the issue is not merely a discussion on how best to guide the community; Zoroastrians are grappling with a disagreement on the fundamental understanding of their religious tradition.

THREE CHALLENGES TO ZOROASTRIANISM: GLOBALIZATION, MODERNIZATION, AND SECULARIZATION

The recent changes due to globalization, modernization, and secularization are extremely important, but one should understand that this is not the first time Zoroastrianism has had to undergo change. For example, scholars believe that the Yashts were not written until 559-530 BCE. (Migliore 2008:18). Furthermore, it was during this period between 559-530 BCE that the religion’s polytheistic roots were brought back into focus. Then, between 226-652 CE, during the Sasanian Dynasty, the monotheistic traditions were restored and the Vendidad and Pahlavi books were written (Migliore 2008:19). Boyce states that the *dakhma-nashini* ritual “appears to have evolved relatively late.” This is supported by the way the procedure is found in the Vendidad. It was not

written until at least nine hundred years after Zarathushtra began preaching (Boyce 1984:65). It is this later Pahlavi evolution of Zoroastrianism that is practiced around the world today (Migliore 2008:19). Zoroastrianism has not been stagnant; it evolved and changed throughout each century. Nevertheless, modern Zoroastrians are concerned about change and keeping the purity of the religion. Today, there are three major factors threatening that purity: globalization, modernization, and secularization.

Globalization

As stated in the introduction, Zoroastrianism is now found all over the world. However, this is not the first time that Zoroastrians have sought new places to settle. Zarathushtra first founded the religion in Persia (modern day Iran), but a small population moved to Bombay, India (now Mumbai) in 719 AD in search of a more favorable place to settle after the rise of an intolerant Islamic government (Boyce 1979:166, Migliore 2008:21). The people who moved to India were called Parsis, meaning “from Persia,” while those who stayed in Persia began to call themselves Bahdinans, “those of the good religion,” or Zardushtians, meaning “followers of Zarathushtra” (Migliore 2008:21). While now everyone who follows Zoroaster’s teachings is called a Zoroastrian, the term “Parsi” is still widely used to identify Zoroastrians from India. The two groups did maintain contact with one another, but the distance and change in environment caused certain minor changes in the understanding and performance of some rituals (Migliore 2008:27). Consequentially, the distinction is still important to Zoroastrians.

Thus, interaction with other cultures is not a new phenomenon for Zoroastrianism. These contacts are important to study because different cultures present ideas that inevitably influence Zoroastrians, including the way they think and the way they understand and carry out their religion. For Zoroastrians, their religion became one of the primary ways in which they distinguished themselves and maintained their own identity. Ebaugh and Chafetz wrote, “Religion is the central element in the maintenance of ethnic identity which subsequently becomes even more important when speaking of second and following immigrant generations” (Migliore 2008:29). This is because religion is so closely tied with ethnic identity for immigrants that conversion is such a controversial issue for Zoroastrians: communities are divided between whether or not allowing outsiders to convert to Zoroastrianism also allows them into their Persian heritage and consequentially weakens their cultural identity. However, “The current leading source of concern worldwide in the Zoroastrian faith is membership in numbers” (Migliore 2008: 40-41). This begs the question “Should converts be allowed?” By the time Zoroastrianism spread from Eastern Iran to Western Iran, it had become part of the culture; it was no longer merely a religion (Migliore 2008:41). However, some Zoroastrians realize that there is an early precedent for conversion. Records prove that the Bahdinan community (Zoroastrians in Iran) responded “yes” when Parsis wrote to them and inquired about whether or not Hindu servants could convert (Migliore 2008:42). This issue is still a major point of contention. Some Zoroastrians believe that their claim to Zoroastrianism comes from their bloodlines, that their religion is inherently linked with their Persian background (Migliore 2008:37). For this group of Zoroastrians, typically

members of the traditionalist sect, outsiders should not be allowed to convert to Zoroastrianism. As Zoroastrianism spreads and becomes a global religion, the religion must contend with the notions that 1) many people want to become Zoroastrians and 2) that other cultures both influence and are influenced by the religion.

Modernization

Modernization has also proven to be a big problem for some Zoroastrians. For example, in 1851, Nairobi Feerdoonji created the Young Bombay Party and the Zoroastrian Reform Society to “fight orthodoxy” because he saw adherence to strict orthodoxy as preventing the Parsi community from achieving “progress and civilization” (Migliore 2008:28). Within the modernist sect, there is a reform movement that is pushing for a major overhaul in the religion, which would eliminate a majority of the rituals and return it to the simple religion of Zarathushtra (Nigosian 1996: 208). By reverting back to this basic monotheism of Zarathushtra, not only are the reformists claiming to practice the “real” Zoroastrianism, but they also believe they are able to assimilate better into modern culture because there are no rituals to inhibit their integration into society. As rituals and traditions have come under attack by reformists, “attempts [have been] made to curb excessive ceremonialism and discard beliefs considered to be superstitious and of obscure practices imbedded in their tradition” (Nigosian 1996: 209). One such change that people have proposed is to abandon the old Avestan language that the rituals are performed in; only a select few priests are actually able to understand it (Pangborn 1997:134). Thus, some Zoroastrians believe that rather than being meaningful, the ceremonies have become rote memorization and actions without meaning. Pangborn cites one Bahdinan man who said, “it is ‘petty’ to insist that prayers be said in a dead language, that corpses be disposed of only in *dakhmas* and to the accompaniment of ‘expensive religious ceremonies’” (Pangborn 1997: 135). Another change that has been suggested is to stop using *gomez*, bull urine, as a means of purification in favor of more modern cleaning techniques (Boyce 1984:160). Modernists would like to “[abandon] altogether such ritual acts as purport to supply religious remedy for physical pollution, and [utilize] modern science to clarify and separate the traditionally and confusedly overlapping categories of hygiene, morality, and religion” (Pangborn 1997: 134). Zoroastrians in modern societies are not the only ones who are calling traditions into question; even Zoroastrians in remote villages have begun to disregard the *dakhma* in favor of other forms of corpse disposal (Nigosian 1996:208). In the Western world, the problem is merely more apparent because there are so many changes that are being made or requested.

Another issue for religious communities created by the rise of modernization is individualization (Migliore 2008:48). Steve Bruce stated that modernization leads to individualization, which therefore leads people to become less dependent on their religious community. This in turn causes the religious community to lose its authority (Migliore 2008:45). Specifically, “Zoroastrians in the diaspora are becoming religiously indifferent due to their lack of constant background affirmation of beliefs and lack of religious socialization” (Migliore 2008:48). This religious indifference is a significant problem for Zoroastrians because,

as noted above, religion is often times the way that Zoroastrians retain their connection to their heritage. Thus, if they lose connection to their religious community, they also risk losing their connection to their cultural identity. Migliore found that fourteen percent of the community already consider themselves non-practitioners of Zoroastrianism (2008:49). Although that number might seem small, fourteen percent is significant when the community is tiny. Another problem with modernization and Zoroastrians becoming religiously indifferent is that the youth in the community are not as interested in participating in the religion (Adkins 2012:27). Young people are the future of the religion, and if they are not concerned with Zoroastrianism the future does not look very bright. Thus, modernization is leading to the demise of Zoroastrianism by weakening the bonds that tie the Zoroastrian community together and by negatively influencing Zoroastrian children away from their religion.

Secularization

Secularization, the “process by which religious worldviews are replaced with more scientific worldviews,” has proven to be detrimental to the Zoroastrian community (Bell 1997:198). Bell argues that the causes of secularization include cultural pluralism, individual rights, technological development, development of critical or scientific ways of thinking, and the separation of church and state (Bell 1997:199). For example, as India became increasingly secular, women gained more education and career opportunities and married and had children later in life (Migliore 2008:29-30). The National Commission of Minorities in India found that the number of births decreased from 223 in 2001 to 174 in 2006 (Bengalee 2007). According to the Heritage Institute, “by 2008 the birth to death ratio was 1:5 – 200 births per year to 1000 deaths” (Edujlee). When the death rate began to exceed, the birth rate and the population of Zoroastrians began to decline very quickly (Migliore 2008:29).

This internal division, the two different ways of understanding the religion, has had an impact on the way Zoroastrians physically cope with death. As mentioned above, it is up to the priest to decide how he wants to proceed in terms of allowing someone who has married a non-Zoroastrian to participate in rituals, including the *dakhma-nashini* (Migliore 2008:33). Often times Zoroastrian women who marry outside are prohibited from receiving a *dakhma* funeral, even if they have been involved in the other aspects of Zoroastrian religious life (Migliore 2008:33). In general, women are more affected than men with regard to the inconsistent policies of the global Zoroastrian community (Migliore 2008:34). Furthermore, many Zoroastrians are now becoming more lax in regard to when their ceremonies are performed (Migliore 2008:37). For instance, many liberal communities have asked priests to shorten the rituals and adapt them to the culture for whom they are being performed (Migliore 2008:37) This is partly due to the shortage of priests that communities around the world are facing, but is also partly in response to the way that their religious ideas and beliefs are changing.

Ethnicity, Culture, or Religion: A Change in What It Means To Be Zoroastrian

The issues of identity and conversion were problematic for religions in the past, too. For example, Judaism had to undergo

changes that have allowed “Judaicness” to transform into “Judaism,” in other words, from an ethnos to an “ethno-religion” (Cohen 1999:109). In his book *The Beginning of Jewishness*, Cohen addresses this transformation and explains the concept of identity mutability. He explains how although one cannot change one’s ethnic identity, the place of origin, one may change their religious and political identity. In the first century, Judaeans separated the notions of “politeia” and ethnicity; one’s way of life was no longer tied to one’s geographic origins (Cohen 1999:126). Zoroastrians must face the same question: Can they allow Zoroastrianism to change from an “ethno-geographic term to a cultural term,” and thereby invite outsiders into their religion (Cohen 1999:132)?

This question is central to the debate between modernists and traditionalists. Inter marriage is one of the biggest issues in Zoroastrian communities today in large part due to globalization and secularization (Migliore 2008:39). Should people marry outside the Zoroastrian community? If they do, should the spouse be allowed to convert? Are the children considered Zoroastrian? Are intermarried people still allowed to participate in Zoroastrian ceremonies? Unfortunately, there is not a central governing body for Zoroastrians all around the world to which all Zoroastrians look for advice, so the individual communities were “forced to make adjustments to their religion by their own authority” (Migliore 2008:36, Nigosian 1996:210). Traditional conservatives maintain that the ceremonies should be done the way they have always been done, people should not marry non-Zoroastrians, and conversion should be prohibited. Liberals, who make up about seventy percent of the community, recognize that the way they practice Zoroastrianism needs to change along with society (Migliore 2008:49). They are open to converts, including both the spouses of Zoroastrians and the various people who wish to follow the teachings of Zarathushtra (Migliore 2008:41).

RITUAL CHANGE

Ritual Change in the Past

Rituals are created in a certain context, which most likely differs quite significantly from the contexts in which they are being performed now. Thus ritual change has necessarily been dealt with in the past, even by Zoroastrians. Bell states that “rituals change as the conditions of the community change” (Bell 1997:251). For example, in his article “Archaeological Evidence of Zoroastrian Funerary Practices,” Dietrich Huff describes how the Tower of Silence evolved over time. First, it is important to note that throughout Zoroastrian history the term “*dakhma*” has been used to describe a myriad of tomb like objects (Huff 2004:596). The current style of *dakhma*, which consists of both an exposure site and a pit into which the clean bones can be placed, was first constructed “during the early Islamic centuries” (Huff 2004:619). Prior to the Islamic period, there is evidence of cavern-*dakhmas*, trough-*dakhmas*, and freestanding rock-cut tower-*dakhmas*, all of which were most likely used only as bone receptacles, meaning there were separate exposure sites. A cavern-*dakhma* was a hole, usually quite small, cut into the side of a mountain or rock. A trough-*dakhma* was a free standing stone coffin-like box that could have acted as an exposure site, but was also probably covered by a stone lid and used as a bone receptor. The dual-purpose *dakhmas* were not created before the Islamic period because “there was no

need for this combination,” probably because the Zoroastrians were of high social status and could do as they pleased (Huff 2004:619). The “exposure sites” were large, low platforms carved into the side of a mountain (Huff 2004:595). With the rise of a Muslim government, however, “Zoroastrians became a tolerated but clearly inferior caste of the society, and exposure [became] abhorrent for the ruling Muslim class” (Huff 2004:608). Furthermore, the mandated use of the *dakhma* for all Zoroastrians did not become tradition until at least the Sasanian period (Huff 2004:618). Evidence suggests that prior to this period exposure was reserved for the Magi, or priests, and that other Zoroastrians probably just kept the corpse away from fire and “humid and fertile soil” (Huff 2004:618).

Ritual Change in the Present

In order for rituals to remain efficacious despite changes, the changes must not impact the core purpose of the ritual. Bell states that for societies that emphasize orthodoxy, “ritual change may be rationalized more easily” because the rituals are sometimes considered of secondary importance to the doctrinal beliefs (Bell 1997:194). For example, if a ritual is done for the sake of the performance itself, then oftentimes communities can alter the story behind the ritual so that it is still significant for their society and recognizes the ritual as effective. Conversely, if the ritual is performed with a specific meaning or function in mind, then some scholars posit that the performance can be changed so long as the meaning behind it remains the same. As has been discussed above, the purpose of the *dakhma-nashini* activities is to prohibit pollution of sacred elements and to restore purity to unclean people. While most Zoroastrians recognize the social aspect of their rituals, the traditionalists are resistant to the idea of recognizing their religion as orthodox, and thus emphasize the performance of the ritual over the beliefs. However, it would behoove them to do so if they wish for the persistence of their religion. Archaeological evidence makes it apparent that Zoroastrians in the past were willing to change their rituals for the sake of preservation of faith and culture, and so too must Zoroastrians today.

Dealing with Death Today: Problems that Zoroastrians Are Facing

According to Nigosian, “Religious observances associated with death and the disposal of the corpse are among the most difficult for Zoroastrians to implement outside their homeland.” (Nigosian 1993:101) Consequentially, Zoroastrians have to either follow the practices of the community in which they are living or somehow adapt their own procedures so that these procedures may be done wherever they are. In lieu of *dakhma* ceremonies, Zoroastrians either bury their dead, careful of not sullyng the earth too much, or use electric cremation (Nigosian 1993: 101-102). The Zoroastrian community in Chicago, Illinois even bought its own cemetery plot in which to bury their dead (Adkins 2012:16). Scholars differ in their assertions about which method, cremation or burial, is preferred by Zoroastrians who cannot participate in a *dakhma-nashini*.

Even if they wanted to continue practicing the *dakhma-nashini* as it has been done in the past, Zoroastrians must face ecological problems that have arisen only in the past couple of

years. For example, the vulture population is on the decline due to diclofenac poisoning (Harris 2012:1). Diclofenac is a pain-reliever that, while very effective for humans, causes rapid kidney failure in vultures (Harris 2012:2). One response by the Parsi community has been to build mirrors around the *dakhma* to “create something akin to solar ovens” (Harris 2012:2). However, this technique is ineffective during the monsoon months (Harris 2012:2). Thus, Zoroastrians decided to proposition the government for help in creating a vulture aviary. The government has agreed to provide the funds and the birds, and the Zoroastrians will provide the feed in the form of their corpses (Harris 2012:2). This plan is conditional though: Zoroastrians must stop using diclofenac, at least when on their deathbed (Harris 2012:2). If the vultures continue to die from poisoning, the government “has promised to end the effort” (Harris 2012:2). Although this task might prove to be quite difficult, some Parsi community leaders are committed to ensuring that the drug is no longer used because they recognize the importance of “restoring” the *dakhma* funeral tradition (Harris 2012:2).

According to Migliore, “Dilution is expressed as the greatest fear of the orthodox,” both in regards to their bloodlines and religious practices (Migliore 2008:37). It is understandable that members of the Zoroastrian community want to hold strongly onto their traditions; traditions are familiar, safe, and effective. However, if the community wants to persist and survive so that future generations may take part in the celebration of Ahura Mazda, they need to be open to change, just as their ancestors were when Muslims gained control of Iran. As stated in the introduction, adaptation does not necessarily mean assimilation. Zoroastrians can retain their unique cultural heritage by teaching future generations about their past; change ensures that Zoroastrians will be around to educate people in a few generations from now. Mary Boyce describes the duty of members of a religion as upholding the core of the religion. She goes on to say, “To uphold a traditional practice merely because it is traditional is an insufficient reason” (Boyce 1984:160). Zoroastrians are obligated to make use of the various technologies that modernization has provided, including better forms of antiseptics that are cleaner than *gomez*.

Benefits and Dangers of Ritual Change

Ritual change is not a situation unique to Zoroastrianism. Change normally happens slowly and is accepted over time. Unfortunately, Zoroastrians do not have that luxury. However, people tend to ignore the evidence that proves rituals are, in fact, changing all the time. Anthropologist John D. Kelly describes the praxis and performance of ritual in his article, “From Holi to Dwali in Fiji: An Essay on Ritual and History.” He says that one should recognize that religion “culture is constructed, not inherited, by its bearers, and constructed in a historical field of extreme complexity” (Kelly 1988:41). Zoroastrianism, with its system of beliefs and various rituals, is a living system that is shaped by all of its participants. It is not something that is worn and then handed down from generation to generation, like a piece of jewelry that always fits the same way.

Furthermore, rituals, as a system of symbols and meanings that reinforce cultural notions, should change if they are no longer efficacious in or applicable to society. Clifford Geertz, in his

essay, “Ritual and Social Change” explains that ritual change is the product of a disconnect in the way people understand the world and the way they interact with it (Geertz 1957:33). Kelly describes how the Fiji Indians shifted their focus from Holi to Diwali because the latter “fitted the exigencies of various new contexts (urban life, ethnic tensions, etc.), and, more importantly, from the way it fitted the new devotional style” (Kelly 1988:51). The Indian Fiji people started emphasizing Diwali over Holi when they saw themselves as urbanites rather than as rural agriculturalists (Kelly 1988:51). Because the needs of the society changed, they chose a new ritual that better suited their new needs. Although Zoroastrians are not adopting a new ideology, Kelly’s main idea is still applicable. Long ago, with the rise of the Islamic government, Zoroastrians had to realize that they no longer had control of their homeland, that their practices were not accepted by mainstream society, and that they needed to adapt their practices so as to protect their dead. Huff noted that, “the aspect of security for the *dakhmas*...had turned precarious after the Islamic conquest” (Huff 2004:608). Now, Zoroastrians must recognize that they are no longer members of ancient Iran; rather, they are part of the modern, internationally connected world, and their religious practices need to fit into this world or else they will be lost irrevocably.

Although there are benefits of ritual change, there are also significant dangers that should be identified and properly addressed. Change can cause the rituals to lose authority and efficacy. Roy Rappaport suggests that unchanging, canonical features of liturgy legitimize the ritual’s authority; if the traditions are changed, so does the foundation upon which it was accepted. Furthermore, Barbara Myerhoff posed the idea that the “ambiguity” and mystery surrounding rituals allow us to use rituals as “a means of conceptualizing our society as a given and not a construct” (Bell 1997:224). Thus, if people begin to think of rituals as mere creations, they might lose their effectiveness. Another problem is that if rituals serve to establish a communal bond by evoking a feeling of collective effervescence, as Durkheim proposes, then the loss of the religious practices can sever that bond. If the rituals are lost or forgotten, the community members risk losing their connections to one another, or “religious socialization” as Migliore called it (Migliore 2008:48).

CONCLUSION

Ritual change is an important topic to study for many reasons. First, rituals are found in all societies, and one of their defining characteristics is invariance, meaning they do not change over time. By learning how and why rituals change, we can better understand society and human nature. Second, Ruth Benedict once said, “The purpose of anthropology is to make the world safe for human differences.” Religion can be one of the most important and influential subjects in a person’s life, so by understanding religion we can better understand people. In modern and post-modern discourse, one of the central ways in which we discuss alterity, the idea of “otherness,” is through the discussion of religion. Finally, as citizens of a global world, we should know about the major problems and goings-on facing other people. The *dakhma-nashini* ritual is an excellent way to answer this question of ritual change, because the changes that Zoroastrians must make in regard to their rituals are taking place rapidly in a transparent manner, thus

allowing us to clearly see, study, and appreciate them.

As has already been mentioned, ritual change does not only affect Zoroastrianism. Because the *dakhma-nashini* ritual is both central to the community as a purification ceremony and difficult to practice outside of the religion's homeland, it can be used as a lens through which we can understand the process and effects of ritual change on a society. We can see how it creates a division in the community, and how it forces the participants to think about which is more important: orthodoxy or orthopraxy. We can also see how ritual change is handled. It does not come easily, especially when people are forced to implement these changes within a relatively short time-span. The most important piece of information gleaned from this study, however, is that religions and rituals are resilient. Most of the time, people will find a way for their religion to persist, even if it means compromising on certain aspects of their ritual.

Today, while there are still Zoroastrians on both sides of the debate, most Zoroastrians are aligning themselves with the liberalists. According to Migliore, seventy percent of Zoroastrians identify themselves as liberal (Migliore 2008:49). Furthermore, she states that the United States, Canada, and Britain held the most members who were most likely to say that they were either Liberal or non-practicing, given the choice between identifying as orthodox, liberal, or non-practicing (Migliore 2008:49). However, for the sixteen percent who consider themselves orthodox and wish to continue participating in the *dakhma-nashini*, the Administrators of the Traditional Zoroastrian Mailing List have created "A Guide to *Dakhma* Services for Overseas Parsis Including Flying the Body or India" that details the procedures for sending a corpse to India for disposal in a Tower of Silence. Finally, it is worth noting that in a small sample population of a Zoroastrian community in Chicago, Illinois, most people interviewed believe that Zoroastrianism has a "brighter future in the United States than it does in India" (Adkins 2012:39). One participant even suggested that the Zoroastrianism of North America would become the dominant form as Zoroastrians move away from India and Iran (Adkins 2012:39). The population surveyed was fairly small so it may not be the best representation of Zoroastrianism in the West, but the results pose an interesting idea and definitely suggest that the Zoroastrian community in North America is worthy of further observation and study.

Zoroastrianism has a long, intriguing history. It has gone through periods of growth as well as times of persecution, and has managed to remain a significant part of the lives of many people for over three thousand years. The doctrines are still important today, and still provide Zoroastrians with a plausible worldview. If it didn't, the religion would have ceased to exist, and people today would not care about coming to a resolution on how best to proceed. The internal division is the result of two divergent ideas about what it means to be Zoroastrian, and most people are trying to do what they deem best for the religion. Unfortunately, those who refuse to accept that ritual change is a reality are dooming Zoroastrianism. The adaptation of the rituals, such as the purification rite of the *dakhma-nashini*, to modernization is not a change in the inherent meaning of ritual. Thus, the ideologies that people have held onto since Zarathushtra started preaching are not being changed in response to modernization, globalization, and secularization.

Religion and rituals play a vital role in society. They help to reaffirm social bonds, to reinforce cultural norms, and to provide a worldview and a way of coping with the unfamiliar. Additionally, rituals provide comfort and security by making people feel like part of a greater community. Consequentially, ritual change is a very important phenomenon to observe and understand. By understanding it better, we can understand the mechanisms that make religion work. We can understand why some religions work well, why some are abandoned in favor of others, and, finally, why religious traditions are forgotten completely. Zoroastrianism is a unique case because it has been around for so long, and many of its participants feel they are being forced to change. However, because the changes that Zoroastrians must make in regards to their rituals are taking place so rapidly and in a very transparent manner, they are an excellent way to embark on the study of ritual change.

FOOTNOTES

- ¹ For more information on the Yazatas, see Mary Boyce's *Zoroastrians: Their Religious Beliefs and Practices*.
- ² The Dinkard, or "Acts of the Religion," is a Zoroastrian theological text written during the Pahlavi period that presents "doctrinal arguments" (Boyce 1979:155).
- ³ Boyce references R.C. Zaehner's *Zurvan, a Zoroastrian Dilemma*, published in 1955. Zurvan is a small, heretical branch of Zoroastrianism that died out after the rise of Islam (Boyce 1979: 68, 70).
- ⁴ To learn more about the prayers that should be recited, see *Symbolism in Zoroastrianism* or "A Guide to *Dakhma* Services for Overseas Parsis Including Flying the Body or India" from The Administrators of the Traditional Zoroastrian Mailing List.
- ⁵ There is a set way to build and sanctify the Tower. This process is outlined in *Symbolism in Zoroastrians* by Dr. Dhalla on pages 60-61.

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Regime Support Across Asian Countries: A Test of Modernization Theory and the “Asian Values” Hypothesis

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Democracy has made major progress in Asia over the past few decades. Taiwan, South Korea, Indonesia and Mongolia are the most prominent democracies in the region. However, non-democratic regimes still loom large. North Korea maintains one of the most repressive and dictatorial regimes in the world. Myanmar took a major step forward toward democracy in 2011, but the military still plays a central role to guarantee “internal stability.” China and Vietnam have both integrated a one-party authoritarian regime with successful economic development, but democracy seems unlikely to emerge in the two countries. Rapid economic growth in non-democratic countries such as China and Vietnam is not coincidental. Singapore is another often cited case with a high living standard and a fully industrialized, developed economy, but political development is consciously resisted (Dalton and Ong, 2003). This phenomenon clearly does not function as Seymour M. Lipset proposed (1959). Lipset’s modernization theory argues that rising income, education and urbanization will lead to support for democracy and rejection of non-democratic regimes.

Why is there a high correlation between economic development and levels of support for non-democratic regimes in Asia? One explanation championed by former Singapore Prime Minister Lee Kuan Yew is a concept of “Asian values,” which is a particular form of Confucianism moral traditions. He justifies authoritarian regimes in Asia by arguing that East Asian societies have duty-based and community-oriented characteristics that promote harmony and consensus (Zakaria, 1994).

This “Asian values” proposition has drawn much criticism and debate. Asian political elites endorse “Asian values” because such values might be conducive to economic success by encouraging efficiency and a motivated labor force. In contrast, Dalton and Ong emphasize that strong authority interferes with the further development of democratic consciousness in the region (2003). Furthermore, some scholars are skeptical about whether such cultural traditions even exist and if they are truly inconsistent with democratic development (Kim 1994; Park 2011). Other researchers have debated this topic on philosophical grounds without quantitative analyses. While cross-national empirical quantitative studies focus more on democratic regimes, largely

lacking are findings on what values citizens hold across democratic and non-democratic regimes.

The current research subjects the “Asian values” thesis to an empirical test and examines some of its underlying assumptions. More specifically, this paper examines several critical questions: Are there traditional values across different countries in Asia? How much support do Asian governments enjoy from their public? Does modernization theory explain high levels of regime support in Asia countries? Or, do cultural differences (traditional values) explain high levels of regime support in the region?

Drawing on the Asian Barometer Survey data, I focus on four Asian countries in the region: Taiwan, Singapore, Thailand and the Philippines. Empirical analyses show that there are traditional values across these four Asian countries and they enjoy high levels of regime support from their publics. However, modernization theory as an explanation is not quite convincing. On the contrary, traditional values are the factor that contributes to regime legitimacy.

THE ASIAN VALUES DEBATE AND REGIME SUPPORT IN ASIA

The relationship among Confucianism, some forms of democracy and regime support has generated a great deal of controversy in recent decades. The “Asian values” concept introduced previously is a good example. After Lee Kuan Yew made his remarks on “Asian values,” the President of South Korea Kim Dae Jung (1994) and President of Taiwan Lee Teng-hui (1995) responded that Prime Minister Lee had confounded the Confucian traditions for his own self-interested purposes. This argument does not offer any inherent interpretive issues within Confucianism other than the contested nature of politics. Besides the debate among politicians, there is a similar theoretical debate in academia about the compatibility of Confucianism and democracy. Samuel Huntington (1996) believes that the rejection of individualism, the preference for harmony and cooperation over disagreement and competition, and the prevalence of a soft form of authoritarianism in East Asian society are all imbued with Confucian values. Contradictorily, social scientists such as Michael Freeman (1995) argue that Confucian traditions are pluralistic

and acceptant of multiple interpretations, so they can be used as a foundation for democracy and human rights. Furthermore, Inglehart and Welzel's (2005) human development theory argues that although cultural diversity does exist, autonomous choice is a universal human aspiration. Therefore, there is no difference between Western and East Asian countries.

Theoretical debates on the question of democracy and Confucianism are far from enough. Benefiting from the World Values Survey and Asian Barometer, I was able to find a number of empirical studies that have measured the relationship between these variables by employing data from the 2001-02 Asian Barometer Survey, Chang, Chu and Tsai (2005) study samples from mainland China, Taiwan and Hong Kong. Their results first state that Confucian values might be interfering with the further development of democratic consciousness in the three Chinese societies, which is consistent with Huntington's culture theory. However, they also argue that modernization will have a restraining effect on Confucian values. Moreover, they conclude that education will help to promote democratic consciousness. Substantial analytical research on cultural traditions and democracy consistently argues that modernization will facilitate the process of democratization. However, the fact that non-democratic regimes in Asia still loom large and enjoy strong support from their citizens contradicts this claim and requires further explanation. The level of support enjoyed by these regimes and the reasons behind it must be questioned because previous empirical research has been insufficient in answering them.

COUNTRY CASES

In reviewing the literature I have already touched on the country cases that this paper intends to examine. A more focused discussion of the four countries' political landscape will be presented in this section.

Taiwan

The "Third wave of democratization" that began in the early 1970s swept over Taiwan during the last decade of the 20th century. Taiwan accepted its baptism into this third wave of democratization through a "quiet revolution" without bloodshed (Lee Teng-Hui, 2005). Polity IV Country Report 2010 captures regime authority spectrum on a 21-point scale ranging from -10 hereditary monarchy to +10 consolidated democracy. It awards Taiwan 10 in democracy, 0 in autocracy and categorizes it as a full democracy regime type. In terms of its economic standing, according to the International Monetary Fund (2012), Taiwan has \$20,328 GDP (nominal) per capita and ranks 39th in the world. From a cultural perspective, Taiwan shares the same culture as mainland China and is strongly influenced by Confucianism.

Singapore

Singapore establishes representative democracy as its political system. However, it hardly qualifies as a genuine democracy. Freedom House ranks Singapore as "partly free" in its Freedom in the World report, Polity IV report (2010) awards Singapore 2 in democracy and 4 in autocracy which gives it -2 overall polity score and categorizes it as closed anocracy regime type. In terms of its economic standing, Singapore has \$51,162 GDP (nominal) per capita and ranks 11th in the world (IMF, 2012). On a cultural ground, Singapore shares the same culture as most Chinese communities such as Hong Kong, Taiwan, and mainland China,

and is strongly influenced by Confucianism.

Thailand

The influence of the military and popular support for the monarch have dominated the political history of modern Thailand. The military was forced to return to the barracks after violent protests and civilian rule was able to return to Thailand in 1992. Later in the 1992-2006 period, the military was seen generally accepting its position outside of the political limelight, despite the fact that the military still had significant influence. Polity IV report (2010) gives Thailand 4 out of 10 overall polity score with 5 in democracy and 1 in autocracy, and regards Thailand as open anocracy regime type. In terms of its economic standing, Thailand has \$5,678 GDP (nominal) per capita and ranks 93rd in the world. (IMF, 2012). From a cultural standpoint, Thailand is different from Taiwan and Singapore where the most common religion is Theravada Buddhism.

Philippines

The People Power Revolution that began in 1983 and culminated in 1986 is an example of a nonviolent revolution that led to the restoration of democracy in the Philippines. Despite the fact that peace in the Philippines continues to be threatened by Muslim rebels, Polity IV 2010 country report still awards it an 8 in democracy and 0 in autocracy, and categorizes it as a democracy regime type. From an economic perspective, the Philippines has \$2,614 GDP (nominal) per capita and ranks 126th in the world, according to the IMF 2012 report. On cultural ground, the Philippines is very different from Taiwan, Singapore and Thailand. More than 90% of the population in the Philippines are Christians.

Both Taiwan and Singapore have strong Confucian influences. Thus, if the "Asian values" theory is a valid argument, it is reasonable to expect evidence of strong attachment of the concept of "Asian values." Meanwhile, both Thailand and the Philippines have few Confucian influences, which provides a necessary benchmark for comparing contribution of "Asian values" to regime support.

DATA AND MEASURES

To analyze the possibilities and sources of regime support in these four countries, I use the dataset from the second wave of Asian Barometer, which was conducted from 2005 to 2008.

Dependent Variable

The dependent variable is measured with one question in the survey asking about the respondents' perception of their form of government. Although there are other similar questions in the survey, they focus more on people's opinions of their countries rather than governments. For the purpose of this research, I decide only to use one question as the dependent variable. Specifically, it asks if "[w]hatever its faults may be, our form of government is still the best for us." Those answering "strongly agree" or "somewhat agree" are coded as "1". Similarly, responses like "strongly disagree" or "somewhat disagree" are coded as "0". Answers such as "do not understand the question", "can't choose" or "decline to answer" are omitted for every variable in this research.

Independent Variables

Given the questions that I identified in the introduction, I classify selected survey questions into the following two major

sections, which are modernization theory and "Asian values" theory.

Demographic Modernization. To test the hypothesis of modernization theory, I include all demographics variables for four countries. The variables include gender, years of formal education, monthly household income quintile and urban residency. Responses of monthly household income quintile are coded on a scale of 1-5 where "1" indicates the lowest quintile. Age is also included to see whether a generational shift is taking place between the latter and earlier cohorts. It is worth pointing out that not every country was asked the same questions in the questionnaire. For example, the country of Singapore is simply one giant city. Thus, there is no question about urban residency in Singapore in the survey. Likewise, the survey does not ask any questions about years of formal education in Thailand.

"Asian Values Index." "Asian values" develop from Confucian moral traditions and consider the family as the fundamental unit of human organization. Therefore, I first consider self-sacrifice for family and filial piety as key Asian familial values. Second, I include three questions about interpersonal harmony since I see "Asian values" emphasized on interpersonal harmony such as aversions to interpersonal conflicts, especially conflicts with those whom they are familiar or interact with, such as neighbors, co-workers and teachers. Third, considering "Asian values" also advocate social harmony, which is a limited expression of

social differences, I select three questions as components of the new variable. Although both interpersonal harmony and social harmony may be seen as social values, it is worth noting that the former belongs to a person's immediate human environment while the latter pertains to one's more remote societal circumstance. Therefore, they should be distinguished. Last but not least, I view paternalistic rule by virtues to be one of Confucian political values. Thus, it should be included as a part of "Asian values."

Ten questions (see Appendix) are selected and classified into the above four categories, which are familial values, interpersonal harmony, social harmony and political paternalism. Those responding "strongly disagree" are coded as "1", "somewhat disagree" as "2", "somewhat agree" as "3" and "strongly agree" as "4". Then, I weighted these ten questions equally and added them up as a new variable named "Asian Values Index."

FINDINGS ON REGIME SUPPORT

The second wave of Asian Barometer survey data shows a rather high level of regime support in these four Asian countries. Table 1 showcases an overwhelmingly positive response to the question regarding whether the current political system is the best form of government for their nation. Among the four Asian countries surveyed, Singapore enjoys the highest support from its public, with 85.9% of the respondents agreeing with this statement. In contrast, the Philippines has the lowest level of regime support from its citizens with an opinion on the question at 52.8%. However it is still more than half of the respondents, which is relatively high compared to many other countries in the world. The difference of regime support between Taiwan and Thailand is not distinct: Taiwan enjoys a support rate of 68.5%,

Table 1: Regime Support for Four Asian Countries

	Strongly Agree or Somewhat Agree:			
	Taiwan	Singapore	Thailand	Philippines
Whatever its faults may be, our form of government is still the best for us	68.5%	85.9%	66.1%	52.8%

Source: East Asian Barometer, 2005-2008 Years

Table 2: Summary Statistics of Asian Values Index for Four Asian Countries

Country	N	Mean	St. Dev.
Taiwan	1252	2.52	0.29
Singapore	897	2.66	0.37
Thailand	1170	2.81	0.39
Philippines	1039	2.74	0.42

Table 3: Regime Support by Demographics and Asian Values Index for Four Countries

	Regime Support:			
	Taiwan	Singapore	Thailand	Philippines
(Constant)	-0.823* (0.494)	-1.752*** (0.595)	-2.240*** (0.347)	-1.914*** (0.322)
Age	0.002 (0.003)	0.011** (0.005)	0.006** (0.003)	0.001 (0.003)
Male	0.084 (0.080)	-0.421*** (0.119)	-0.042 (0.085)	-0.015 (0.082)
Urban	-0.010 (0.116)		-0.045 (0.117)	-0.124 (0.090)
Income Quintile	-0.015 (0.035)	0.086* (0.052)	-0.052 (0.040)	-0.062 (0.052)
Education in Years	-0.012 (0.014)	-0.006 (0.018)		0.009 (0.013)
Asian Values Index	0.542*** (0.153)	0.946*** (0.171)	0.927*** (0.114)	0.756*** (0.101)
Observations	1,099	822	1,019	996
Log likelihood	-673.897	-305.554	-604.213	-655.464
Akaike Inf. Crit.	1,361.794	623.109	1,220.426	1,324.927

Note: Entries are probit coefficients with standard error in parentheses.
*p<0.1; **p<0.05; ***p<0.01

Table 4: Regime Support by Demographics and Asian Values Index for Four Countries Combined

	Regime Support:
	All Countries
(Constant)	-2.216*** (0.326)
Age	0.004*** (0.002)
Male	-0.047 (0.043)
Income Quintile	-0.026 (0.019)
Asian Values Index	0.923*** (0.114)
Taiwan	1.184** (0.478)
Singapore	0.941* (0.522)
Philippines	0.182 (0.422)
Taiwan: Asian Values Index	-0.354* (0.182)
Singapore: Asian Values Index	-0.059 (0.195)
Philippines: Asian Values Index	-0.179 (0.151)
Observations	3,962
Log likelihood	-2,267.362
Akaike Inf. Crit.	4,556.724

Note: Entries are probit coefficients with standard error in parentheses.
*p<0.1; **p<0.05; ***p<0.01

and Thailand has a rate of 66.1%.

One interesting observation from Table 1 is that Singapore and Thailand, which are categorized as non-democratic countries (closed anocracy and open anocracy respectively), enjoy higher levels of regime support from their people than Taiwan and the Philippines, which are classified as democratic countries (full democracy and democracy respectively). More appropriately, taking economic factors into consideration, I compared Singapore with Taiwan and Thailand with the Philippines. It is easy to see that in both well developed countries, Singapore enjoys a much higher level of regime support as a non-democratic country (about 7.4% higher) than Taiwan does as a democratic country. The same is true in both less developed countries (about 13.3% higher).

EXPLAINING REGIME SUPPORT

Some multivariate analyses are necessary to test hypotheses identified as the explanation of regime support in the four countries. Since the dependent variable is binary, probit models by individual countries are adopted in this paper.

Modernization Theory Hypothesis

In order to test the validity of this hypothesis, I first introduce a baseline model that only includes socioeconomic and demographic variables.

The first six rows in Table 2 shows the results of the baseline model for the four countries. This is a way to test the modernization theory hypothesis, which claims that rising income, education and urbanization will lead to support for democracy and rejection of non-democratic regimes. Therefore, if the theory is valid, I should be able to find both positive and significant coefficients of the "urban", "income quintile" and "education in years" variables in Taiwan and the Philippines but both negative and significant coefficients of the same variables in Singapore and Thailand.

However, according to the results from Table 2, none of the five variables are significant at a 10% level in neither Taiwan nor the Philippines. Results from Taiwan, Thailand and the Philippines samples show that richer, more educated, and urbanized residents show no differences in probabilities of regime support compared to other residents from those countries. More specifically, the "income quintile" variable in Singapore is positive and significant, which means people with higher income are more likely to support non-democratic regimes. This result negates what modernization theory would have predicted. The "urban" variables for Taiwan, Thailand, and the Philippines produce no significant result, suggesting that once income, age, and gender variables are controlled, people in those countries who reside in urban areas have no differences with their rural counterparts in terms of regime support. The same holds true for the "education in years" variable in Taiwan, Singapore and the Philippines, which further weakens the validity of modernization theory hypothesis.

The "age" variables in both Singapore and Thailand have positive and significant coefficients, which clearly demonstrates that younger cohorts in these two countries show a declining likelihood of regime support. A line chart in Figure 1 demonstrates generational shift in the levels of regime support in the four countries. The levels of regime support are calculated using the average scores of the same question as the dependent variable but with different measurements. Specifically, "strongly agree" is coded as "4", "somewhat agree" as "3", "somewhat disagree"

as "2" and "strongly disagree" as "1." In addition, the levels are captured among the different birth cohorts of the sample, noted by the decades in which they were born. From the line chart, one can find that the governments of Singapore and Thailand enjoy higher levels of support than the governments of Taiwan and the Philippines. Moreover, descending levels of regime support within younger generations among four countries are not hard to observe. However, downward trends are not salient in Taiwan and the Philippines.

In conclusion, I am able to reject modernization theory hypothesis in the scope of these four specific countries.

Asian Values Hypothesis

Before I introduce the testing of the competing hypothesis regarding whether "Asian values" matters for the level of regime support, it is important to ask a question first: do "Asian values" really exist? Answering this question requires a close look at the "Asian Values Index," which is created by a sum of ten equally weighted survey questions that reflect core "Asian values." Table 3 provides summary statistics of "Asian Values Index" for four countries. The averages of "Asian Values Index" for four countries are above 2.5 and are significantly different from 0, suggesting that there are Asian values in the four countries. In addition, Taiwan has the lowest score, while Thailand has the highest score. Since "Asian values" develops from Confucian moral traditions, higher index means more traditional, while lower index suggests more modern in the cultural sense. That way, although Taiwan and Singapore are influenced by Confucianism, they are more culturally modernized than the Philippines and Thailand.

Figure 2 provides detailed information regarding generational shifts in the levels of "Asian values" across four countries, which are calculated using the average scores of "Asian Values Index" on a scale of 1-4. Consistent with the summary statistics, Taiwan has the lowest scores across generations, while Thailand has the highest index. In addition, descending levels of "Asian values" across generations in the four countries with the exception of a salient increase in Thailand from the 1930s to the 1950s are not hard to observe. Moreover, respondents from Singapore and the Philippines who are born from the 1950s to the 1980s hold relatively stable levels of "Asian values." Another important piece of information from the figure is that although the levels of "Asian values" are diminishing, they are unlikely to disappear in the near future.

Once I established the foundation of the "Asian values" hypothesis is established, I was able to introduce a complete model. Based on the underlying model, the "Asian Value Index" variable is included to test the effect of "Asian values" on possibilities of regime support.

Results from Table 2 strongly endorse the "Asian values" hypothesis. The "Asian Values Index" variables are significant at 1% level in all four countries, meaning that "Asian values" play an important role in contributions to likelihoods of regime support in the regions. Positive coefficients of the variables indicate that populations that hold stronger "Asian values" or, in other words, who are more traditional, are more likely to support their governments.

To be more straightforward, assume one 40 years old urban resided man with 12 years education and a third income quintile is chosen from Taiwan, Singapore, Thailand and the Philippines.



Figure 1 Generational Shift in the Levels of Regime Support across Four Countries

Note: the level of regime support is measured using the dependent variable question where: “Strongly agree” is coded as 4, “Somewhat agree” as 3, “Somewhat disagree” as 2, “Strong disagree” as 1.

Using results from Table 2, one can easily calculate the probabilities of supporting their governments are 71%, 82%, 57% and 45% respectively. This finding is consistent with the results from Table 1 and should not be surprising.

Countries Fixed Effects. Although a significant effect of “Asian values” on the possibilities of regime support is identified in each country separately, we still do not know whether the effects exist because of differences between individuals or because of differences between countries. To answer this question, I combine four countries’ datasets into one and include country dummy variables. In addition, interaction terms of country variables with “Asian Values Index” variable are also included in the model to see differences of “Asian values” effects on the possibilities of regime support across countries.

Results from Table 4 suggest that first, after controlling for countries’ fixed effect, the “Asian Values Index” variable is still both positive and significant, which demonstrates that stronger “Asian values” contribute more to likelihoods of supporting governments. Second, the “Singapore” and “Taiwan” variables are both positive and significant, meaning that citizens of Singapore or Taiwan are different from those of Thailand. Moreover, Singaporeans and Taiwanese are more likely to support their governments compared to Thailand people. There is no difference between people of Thailand and people of the Philippines. Third, the only significant interaction term “Taiwan: Asian Values Index” suggests that compared to Thai people, Taiwanese are more likely to support their government. However, this positive effect decreases with stronger “Asian values.”

The above analyses and results should be sufficient to answer the question raised at the beginning of the section. Differences on the levels of “Asian values” between individuals have positive effects on the possibilities of regime support. Meanwhile, being citizens of countries that are influenced by Confucianism (i.e. Taiwan and Singapore) also contributes positively.

DISCUSSION AND CONCLUSION

How much support do Asian governments enjoy from their

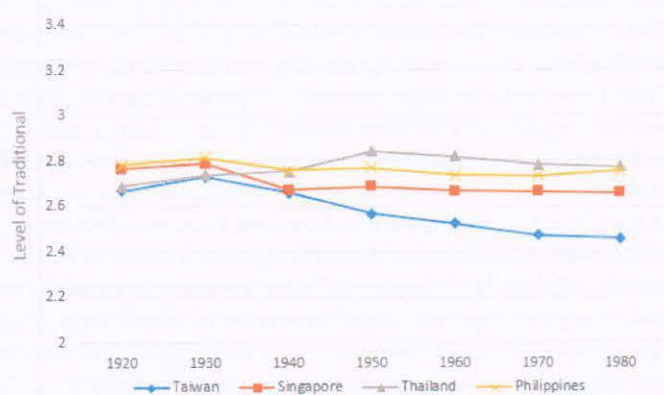


Figure 2 Generational Shifts in the Levels of Traditional Values across Four Countries

Note: the level of Traditional values is measured using the questions of “Asian Values Index” where: “Strongly agree” is coded as 4, “Somewhat agree” is 3, “Somewhat disagree” as 2, “Strong disagree” as 1.

publics? Could modernization theory explain high levels of regime support in Asia? Do “Asian values” even exist? How well does the “Asian values” theory explain high levels of regime support in the region? My empirical analysis concludes at least four major findings regarding the above questions. First, Asian governments enjoy high levels of regime support from their publics. More than half of all survey respondents support their current governments in each country. Second, modernization theory has a weak explanatory power on regime support for all four Asian countries. Third, “Asian values” widely exist in each of the four countries, across different generations. In addition, when “Asian values” are compared, there is a significant difference between the cultures influenced by Confucianism such as those of Taiwan and Singapore and the cultures not influenced by Confucianism like those of Thailand and the Philippines. Fourth, the “Asian values” theory has a strong explanatory power on the publics’ probabilities of regime support. More specifically, individuals who possess stronger “Asian values”, or are more traditional, in other words, are more likely to support their current government.

These findings have important policy implications. In order to maintain regime legitimacy and gain high levels of regime support, one Asian government could advocate preservation of traditional values. Governments of China and Singapore are good examples. The White Paper on Singapore’s Shared Values was presented to Parliament on January 5, 1991. It listed five “shared values” which could be summarized as first, nation before community and society above self; second, family as the basic unit of society; third, community support and respect for the individual; fourth, consensus, not conflict; and fifth, racial and religious harmony. Similarly, in March 2006, a concept of “Socialist Concept of Honor and Disgrace” was raised by Hu Jintao, general secretary of the Communist Party of China. It is an idea that is put forward to instill values of moral standards among the public, especially youngsters, in line with Chinese traditional values and modern virtues. These culture-related policies, to some extent, have made undeniable contributions to the high levels of regime support in both countries.

Overall, contemporary Asian societies are changing in a speed faster than we thought. Although socioeconomic and demographic variables do not adequately explain the possibility of regime support, it seems that rising income, education, and urbanization make ordinary people become increasingly critical consumers of political Confucianism. In other words, modernization could potentially alleviate one's traditional values, which makes people more critical of regime support. In that sense, affluent, literate and urban Asians may still be traditional in private life but not in public political life. However, this theory is worth testing and discussing further.

APPENDIX: SURVEY QUESTIONS

Familial Values

1. For the sake of the family, the individual should put his personal interests second.
2. Even if parents' demands are unreasonable, children should still do what they ask.

Interpersonal Harmony

1. A person should not insist on his own opinion if his co-workers disagree with him.
2. When one has conflict with a neighbor, the best way to deal with it is to accommodate the other person.
3. Being a student, one should not question the authority of their teacher.

Social Harmony

1. If people have too many different ways of thinking, society will be chaotic.
2. Harmony of the community will be disrupted if people organize lots of groups.
3. Open quarrels (criticisms) among politicians are harmful to society.

Political Paternalism

1. Government leaders are like the head of a family; we should all follow their decisions.
2. If we have political leaders who are morally upright, we can let them decide everything.

Note:

"Strongly agree" is coded as "4"; "Somewhat agree" is coded as "3"; "Somewhat disagree" is coded as "2"; "Strongly disagree" is coded as "1".

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k-Goldbach Decomposition For Polynomials

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One of the oldest open math problems is the Goldbach conjecture, which states that every even integer greater than 4 can be written as sum of two primes. In this paper, I will prove the polynomial version of the Goldbach conjecture: every polynomial with integer coefficients can be written in sums of two or more irreducible polynomials with integer coefficients. My proof is based on a similar proof given by Filip Saidak. Then I extend the same result to polynomials with coefficients in R , which is a PID (principle ideal domain) with characteristic $\neq d$, and at least k distinct prime ideals then any monic polynomials in $R[x]$ is k -Goldbach. Moreover, when $R = \mathbb{Z}$, we note some intriguing contradictory results on the number of decompositions of f into k irreducible polynomials.

To be concise, we introduce the following terminologies:

Terminology 1: Let R be a ring. We say a polynomial $f(x) \in R[x]$ is k -Goldbach if it can be written as sums of k number of irreducible polynomials.

Terminology 2: Given a positive integer k , A k -Goldbach decomposition of $f(x) \in R[x]$ is the decomposition of a monic polynomial into sums of k number of irreducible polynomials.

Definition 3: For a integer coefficient monic polynomial f with degree ≥ 1 , define $R(f; y)$ as the number of decompositions of f into 2 irreducible polynomials with coefficients bounded by y ($y > 0$).

RESULTS

Theorem 1: Given any positive integer k , any monic polynomial $f(x) \in \mathbb{Z}[x]$ with degree ≥ 1 is k -Goldbach.

Proof. Let $f(x) = x^d + F_{d-1}x^{d-1} + \dots + F_1x + F_0$ be such polynomial and let p_1 be a prime such that $p_1 \mid (F_{d-1} - (k-1))$. Such p_1 exists if $F_{d-1} - (k-1) \neq 0, \pm 1$; take any prime that divides $F_{d-1} - (k-1)$. If $F_{d-1} = k-1$, then find the next highest degree with nonzero coefficient and repeat the previous step. If $F_{d-1} - (k-1) = \pm 1$, then define $\bar{f}(x) = f(x \pm (k+1))$ and find the p_1 that divides \bar{F}_{d-1} . Now

define g_1, \dots, g_k as follows:

$$\begin{aligned} g_1 &= x^d + p_1 G_{1,d-1} x^{d-1} + p_1 G_{1,d-2} x^{d-2} + \dots + G_{1,0} \\ g_2 &= x^{d-1} + p_2 G_{2,d-2} x^{d-2} + p_2 G_{2,d-3} x^{d-3} \dots + G_{2,0} \\ &\dots\dots\dots \\ g_k &= x^{d-1} + p_k G_{k,d-2} x^{d-2} + p_k G_{k,d-3} x^{d-3} \dots + G_{k,0} \end{aligned}$$

where p_2, \dots, p_n are distinct prime from p_1 and $G_{i,d-1} \in \mathbb{Z}$ will be determined below. Note that $G_{1,d-1} = \frac{F_{d-1} - (k-1)}{p_1}$ is an integer.

Indeed, this is true because:

coefficient of x^{d-1} of $f(x) =$ sum of coefficient of x^{d-1} of g_1, \dots, g_k

Now consider the nonconstant, nonleading coefficients of f (the coefficient of x, \dots, x^{d-1}). For each $i \geq 1, j \geq 2$, we need to find $G_{1,d-j}$ that satisfies the diophantine equation

$$p_1 G_{1,d-j} + p_2 G_{2,d-j} \dots + p_k G_{k,d-j} = F_{d-j}$$

All the p_i are relatively prime, so the diophantine equation $p_1 G_{1,d-j} + p_2 G_{2,d-j} = C$ has infinitely many solution for any integer C . So

$$p_1 G_{1,d-j} + p_2 G_{2,d-j} = F_{d-j} - p_3 G_{3,d-j} - \dots - p_n G_{n,d-j}$$

have infinitely many solutions if we choose $G_{3,d-j}, \dots, G_{n,d-j}$ to be any integers. Hence the diophantine equation

$$p_1 G_{1,d-j} + p_2 G_{2,d-j} \dots + p_k G_{k,d-j} = F_{d-j}$$

has at least one solution. This shows there exists such decomposition for the nonconstant, nonleading coefficients.

We will now determine $G_{i,0}$ below. Note that $G_{i,0}$ are nonzero; otherwise, the polynomials will be reducible. By the Eisenstein criterion, the polynomials g_i are irreducible if p_i^2 does not divide $G_{i,0}$. Since p_1, \dots, p_k are relatively prime, there exists integers $G_{1,0}, \dots, G_{k,0}$ such that

$$\begin{aligned}
 G_{1,0} &\equiv p_1 \pmod{p_1^2} \\
 G_{2,0} &\equiv p_2 \pmod{p_2^2} \\
 &\dots \\
 G_{k,0} &\equiv p_k \pmod{p_k^2}
 \end{aligned}$$

So for integers M_1, \dots, M_k which are not divisible by p_i^2 for any i , we can rewrite $G_{i,0}$ as

$$\begin{aligned}
 G_{1,0} &= p_1 + p_1^2 M_1 \\
 G_{2,0} &= p_2 + p_2^2 M_2 \\
 &\dots \\
 G_{k,0} &= p_k + p_k^2 M_k
 \end{aligned}$$

In order for the constant term of g_1, \dots, g_k to add up to f , we need

$$p_1^2 M_1 + p_2^2 M_2 + \dots + p_k^2 M_k = F_0 - (p_1 + \dots + p_k)$$

Since the p_1, \dots, p_k are relatively prime, there exists infinitely many solutions for M_i . In here, you can make $G_{i,0}$ congruent to any nonzero element in $\mathbb{Z}/p_i\mathbb{Z}$.

I choose to use p_i for their congruence class to avoid new numbers in the proof. We have just shown that there exists a decomposition

of F_0 into $G_{1,0}, \dots, G_{k,0}$ such that $\sum_{i=1}^k G_{i,0} = F_0$ and p_i^2 does not divide $G_{i,0}$ for any i .

In conclusion, $f(x)$ is k -Goldbach.

Saidak proved an integer polynomial can be written in terms of the sum of two irreducible polynomials. It follows that you can write polynomials in any finite number of irreducible polynomials. However, I decided to give a direct proof. If the result holds for $f(x) \in \mathbb{Z}[x]$, is this true for $f(x)$ from general ring $R[x]$. It turns out when R is a nonfield PID, with characteristic $\neq d$, we can have the same result as in the integer case. However, we need some lemmas first:

Lemma 2: For any coprime ideal I_1, I_2 of R , $I + J = R$, I_1^2 is coprime with I_2^2 as well.

Proof. By Binomial Theorem:

$$(I + J)^4 = I^4 + 4I^3J + 6I^2J^2 + 4IJ^3 + J^4 = I^2(I^2 + 4IJ + 6J^2) + J^2(I^2 + 4IJ + J^2)$$

Hence $I^2 + J^2 = (I+J)^2 = R$ because $I+J = R$ (there exists element $a \in I, b \in J, s, t. a+b = 1$)

Lemma 3: Let R be a PID, then for any nonunit, nonzero element $a \in R, \mathbb{C}$ there exists a prime ideal (p) , generated by prime p , such that $a \in (p)$.

Proof. Given a nonunit, nonzero element a , there exists a maximal ideal M containing a . Maximal ideals are prime ideals so M is prime. R is PID, so there must exist a prime p such that $M = (p)$

We will use the same ideas as before when R is a ring with certain properties:

Theorem 4: Let R be a PID with characteristic $\neq d$ and contains at least k distinct prime ideals ($k \geq 2$, so R is not a field), then any monic polynomial $f(x) \in R[x]$ is k -Goldbach.

Proof: Let $f(x) = x^d + F_{d-1}x^{d-1} + \dots + F_1x + F_0$. Suppose $F_{d-1} - (k-1)$ is not a unit, choose p_1 such that $(F_{d-1} - (k-1)) \in (p_1)$. If $F_{d-1} - (k-1)$ is a unit, then perform a change of variable $f(x) = f(x+s)$, $s \in R$, such that the $d-1$ coefficient is nonunit, hence p_1 exists by previous lemma (Note: In here, I assumed the existence of $s \in R$. However, I did not figure out a detailed proof of the existence). If the characteristic of R is d , then the coefficient of $d-1$ term of $f(x+s)$ is $F_{d-1} + ds = F_{d-1}$. So we cannot shift the $d-1$ term to a nonunit element. Choose P_1, \dots, P_k to be coprime prime ideals of R . Define g_1, \dots, g_k as follows:

$$\begin{aligned}
 g_1 &= x^d + p_1 G_{1,d-1} x^{d-1} + p_1 G_{1,d-2} x^{d-2} + \dots + G_{1,0} \\
 g_2 &= x^{d-1} + p_2 G_{2,d-2} x^{d-2} + p_2 G_{2,d-3} x^{d-3} + \dots + G_{2,0} \\
 &\dots \\
 g_k &= x^{d-1} + p_k G_{k,d-2} x^{d-2} + p_k G_{k,d-3} x^{d-3} + \dots + G_{k,0}
 \end{aligned}$$

where p_i is a generator of P_i for each i . We will determine those $G_{i,d-j}$ below. By construction, we see that the coefficient of x^{d-1} of $f(x)$ is

$$F_{d-1} = p_1 G_{1,d-1} + k - 1$$

We can find such $G_{1,d-1} - 1 \in R$ since $F_{d-1} - (k-1) \in P_1$. Now consider the nonleading, nonconstant coefficient of f , that is the coefficient of x^{d-2}, \dots, x : for each $i, j \geq 1$, we need to find $G_{i,d-j}$ such that

$$p_1 G_{1,d-j} + p_2 G_{2,d-j} + \dots + p_k G_{k,d-j} = F_{d-j}$$

the prime ideals P_i s are relatively coprime: $P_i + P_j = R$. By definition, there exists $a, b \in R$ such that $ap_1 + bp_2 = 1$. Then there exists solution to $ap_1 + bp_2 = C$ for any $C \in R$. So the diophantine equation

$$p_1 G_{1,d-j} + p_2 G_{2,d-j} = C - p_3 G_{3,d-j} - \dots - p_n G_{n,d-j}$$

has at least one solution if we choose $G_{3,d-j}, \dots, G_{n,d-j}$ to be any element in the ring R . So there exists $G_{i,d-j}$ which satisfies the equations above. We will now determine $G_{i,0}$, the constant term of each g_i . By Eisenstein's criterion, each polynomial is irreducible if $G_{i,0} \notin P_i^2$ for each i . We can choose $G_{i,0}$ as follows:

$$\begin{aligned}
 G_{1,0} &\equiv p_1 \pmod{P_1^2} \\
 G_{2,0} &\equiv p_2 \pmod{P_2^2} \\
 &\dots \\
 G_{k,0} &\equiv p_k \pmod{P_k^2}
 \end{aligned}$$

So for M_1, \dots, M_k which are not in P_i^2 for any i , we can rewrite $G_{i,0}$ as $G_{i,0} = p_i + p_i^2 M_i$ for each i . In order for the constant term of g_1, \dots, g_k to add up to f , we need

$$p_1^2 M_1 + p_2^2 M_2 + \dots + p_k^2 M_k = F_0 - \left(\sum_{i=1}^k p_i + p_i^2 M_i \right)$$

Since the P_1, \dots, P_k are coprime, P_1^2, \dots, P_k^2 are coprime by lemma 2. So there exists at least one solution for M_i to the equation above. We have just shown that there exists a decomposition of F_0 such that the constant terms add up and each of the polynomials are irreducible. In conclusion, $f(x)$ is k -Goldbach.

We proved such decomposition exists in integer case. It is natural to ask how many decompositions there are when we bound the coefficients. We will focus our attention on 2-Goldbach case. Filip Saidak proved the following:

Theorem 6 (Saidak): If $f(x) \in \mathbb{Z}[x]$ is monic with $\deg(f) = d \geq 1$, then there exists a constant $A(f)$ depending only on d and the coefficients of $f(x)$ such that:

$$R(f; y) > A(f)y^d$$

as $y \rightarrow \infty$.

Theorem 1 implies that $R(f; y) \geq 1$ as $y \rightarrow \infty$. However, I found a different result on the same problem given by Mark Kozek:

Theorem 7 (Kozek): Under the same hypothesis of theorem 6, but $\deg(f) = d > 1$, $R(f; y)$ is asymptotic to $(2y)^{d-1}$.

If $d > 1$, then Saidak and Kozek's results violate each other. Kozek's proof was based on Saidak's paper: "We observe that Saidak's argument with slight modifications gives that for y sufficiently large: $c_1 y^{d-1} < R(f; y) < c_2 y^{d-1}$ where c_1 and c_2 are constants that depend on the degree and coefficients of the polynomial $f(x)$." However, I didn't find the "slight modification" from Saidak in the hypothesis of the decomposition problem. Neither did I figure out the reason behind the discrepancy between the two results on the same problem. I am currently working on this contradiction, and hopefully this can be resolved soon.

CONCLUDING REMARKS

We have shown that for any polynomial with coefficients in a PID is k -Goldbach. In other words, given any polynomial $f(x)$ with coefficient in R (PID), there exists irreducible polynomials $g_1, \dots, g_k \in R[x]$ such that it satisfies the equation $h(g_1, \dots, g_k) = f(x)$ where $h(g_1, \dots, g_k) = g_1 + \dots + g_k$. Notice that $h(g_1, \dots, g_k)$ is homogenous of degree 1. So we have shown there exists infinitely many solutions to $h(g_1, \dots, g_k) = f(x)$ for $h(g_1, \dots, g_k)$ homogenous of degree 1. It still remains unknown if there exists a solution to $h(g_1, \dots, g_k) = f(x)$ if h is homogenous of degree n ($n > 1$). i.e, does there exist any solution $h(g_1, g_2) = f(x)$ if $h(g_1, g_2) = g_1^2 + g_1 g_2 + g_2^2$? Or under what circumstances does the equation $h(y_1, y_2) = f(x)$ have a solution?

The twin prime conjecture is a conjugate problem to the Goldbach conjecture. We could consider the following twin prime problem in polynomial sense: does there exist infinitely many pairs of irreducible polynomial (f, g) such that $b = f - g$ where b is also irreducible and $f, g, b \in R[x]$ for some ring R . Aside from these new questions, I still need to find $s \in R$ in the proof of theorem 4.

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VIC Generations- A Model to Understand the Financial Market

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This paper discusses a newly developed model that has the strength to generate accurate results on any security in the financial market – the Momentum Regression Analytical Model. The model originates from a combination of econometrics methods on momentum hypotheses. We extend this model to another one, called VIC Generation, which we use to predict the future price of a security. The model originates from the goal of understanding the irrational behavior of investors in the financial market.

1. BACKGROUND

In the various markets that we have today, one can survive only by outperforming the average. However, the market has strong irrational behavior attached to it due to its random nature. Moreover, the past has taught us that irrational big market events can have a great impact on the price of stocks. For example, when Chipotle Mexican Grill had their IPO in January 2006 at \$22 per share, the price instantly became \$44 per share the next trading day. A more compelling example is, of course, the financial crisis.

The goal of our model is to take into account the irrational nature of the market. However, the model does not include big events such as mergers and acquisitions.

In order to understand our model, which we call Momentum Regression Analytical Model (MRAM), we first need to introduce some basic concepts that are well known in the field of financial investment. The first one is called Simple Moving Averages (referred to as SMA in the text). The SMA calculates different averages of the prices of the shares over a certain period of time. Starting from these averages, one can define a function, called Exponential Moving Averages (referred to as EMA in the text). The EMA is an attempt to define an exponential function in this context.

We expanded the SMA and EMA into the so-called Momentum Hypothesis. This is an essential tool for our MRAM model and one can think of it as a way to describe investors' irregular emotional changes in the financial market. We cannot prove the Momentum Hypothesis mathematically, but we will show some examples where it was successfully applied to estimate prices.

In this paper, we separate all of the investor emotions into four

different types: 1) rational bearish, 2) rational bullish, 3) irrational bearish, and 4) irrational bullish. These terms are classical and their meanings straightforward.

The paper is structured as follows: first we review the notions of SMA and EMA. In section 2 we introduce the Momentum Hypothesis, while in section 3 we define the Momentum Regression Analytical Model. The following sections will describe applications of the model with examples and results.

One last observation needs to be made: the Momentum Regression Analytical Model is a more emotional approach of the Momentum Hypothesis, rather than a complicated model built out of the Linear Regression Model.

1.1 Simple Moving Average (SMA)

Appel defined in [2] the concept of Simple Moving Average, which depends on the number of days an investor strategizes in the investment model. The most widely used models are SMA_5 , SMA_{12} , SMA_{26} , and SMA_{50} . The equation is given as follows:

$$\text{Definition 1: } SMA_n = \frac{1}{n} \sum_{i=1}^n x_i$$

In other words, SMA_n is the average of the price of a certain security over n days, so it gives an estimate of what happened in the past n days.

If one has only one SMA_n available, one can only say something about what happened in those n days. However, with several SMA_n , for different choices of n , one can extract more information. For example, if one knows SMA_{12} and SMA_{26} , the market is considered to be acting bullish if the price today is larger than SMA_{12} and SMA_{12} is larger than SMA_{26} . To understand the reason, we should think backwards. If a price is higher than it has been n days before, assuming a steady evolution, intuitively one should expect that the price should be higher than the averages of the price over n days. Generally, given a randomly distributed group of observations, a single observation in the group is pulling the average up if it is higher than the average. That is to say, if we have observed that the price is larger than short-period SMA_{n1} , and the short-period SMA_{n1} is larger than long-period SMA_{n2}

(for any n_1 smaller than n_2), then we are experiencing a market with bullish momentum, and vice versa, which leads to a known theorem [2].

Theorem 1: The market of a targeted security is experiencing bullish momentum if and only if for any $m < n, Price > SMA_m > SMA_n$; and vice versa.

1.2 Exponential Moving Average (EMA)

The EMA is a function that gives us an even better understanding of the market-moving pattern than the SMA does, because it not only looks at two different prices, but also uses a special exponential function in its equation. The idea behind it can be understood from the following example: Let us suppose that John's behavior represents the actions of most investors in the market. He is neither too smart, nor too foolish; he makes rational decisions, but he occasionally makes mistakes as well. If he wants to take a look at historical data, he would pay less attention to what happened recently. In other words, if he plans to calculate EMA over a relatively longer time period, he would pay less attention to today's closing price, and he would give a much higher percentage or weight to the historical price of interest. One's natural instinct would say that, given a steady evolution, what captures most behavior is not today's price, but what happened in the more distant past.

The EMA captures this idea and it is defined as follows:

Definition 2: $EMA_n = Price \cdot \frac{2}{1+n} + \left(\frac{1}{n} \sum_{i=1}^n Price_i\right) \cdot \left(1 - \frac{2}{1+n}\right)$ for any $n \in \mathbb{Z}_+$.

In words, this equation is weighing a certain SMA_n (for a given n) with a coefficient, which decreases as more time units are analyzed. This equation is more accurate at measuring market-moving patterns and it follows the same property as SMA.

Theorem 2: The market is experiencing bullish momentum if and only if for any $m < n$ and $m, n \in \mathbb{Z}_+$, $Price > EMA_m > EMA_n$; and vice versa.

To understand this theorem, let us go back to our example of average investor John. If John is holding a security that appears to be bullish today, that means there is another investor out there in the market who is willing to buy the share away from John at a price higher than what John originally paid. In this case, there are two prices. The first one is the one with which John purchases the stock. The second one is the one with which the other investor purchases stock from John. In order to make a profit, John needs to buy the stock of a security beforehand, so he can sell it later. If we are assigning exponential percentages to each of these two prices, there will be a bigger percentage assigned to the price John has purchased the stock for, and a smaller percentage assigned to the price (not including average) that John has sold it for to the other investor.

Now imagine we have a second trade after John has sold the stock, and we assign the probability exponentially to the price. It is obvious that if the price keeps going up, then there exists an extra investor out there who is willing to buy shares at a higher price than the seller paid for them. If this happens, the short

day EMA will appear to have a higher value than the long day EMA since we already assign smaller probability. The value being still bigger assures that the stock is maintaining positive growth and will be keeping its record to be traded at a higher price. The same reasoning can be applied if the price of the traded asset has decreasing evolution.

Note that if an investor plans to use EMAs as indicators to analyze the market, he will drop the analysis of SMA because the process of generating EMAs has already considered SMA.

2. MOMENTUM HYPOTHESIS

The Momentum Hypothesis is dependent on the difference of two SMAs or two EMAs. As described above, we know that SMA_n or EMA_n captures what happened in the past at a specific time or within a period of time, but it is only one number. In order to understand the momentum of the market, we will look at more than one pair of SMA_n and EMA_n . In the following text, we will discuss EMA_n rather than SMA_n because the calculation of EMA_n already takes SMA_n into account.

2.1 Moving Average Convergence Divergence (MACD)

The definition of Moving Average Convergence Divergence (referred to as MACD in the text) appears in Appel [2]. MACD is defined as the difference between two EMA_n values.

Definition 3: $MACD = EMA_m - EMA_n$ for any $m < n$ and $m, n \in \mathbb{Z}$.

The concept of MACD is important in financial investments, since not only does it measure the market momentum for the first time; it also encompasses the evolution of the momentum. This perspective will be frequently used throughout this paper. Based on Theorem 1 and Theorem 2, we can see that the bigger the MACD is, the more bullish the market can be. However, how bullish can the market be?

2.2 Momentum Hypothesis

The Momentum Hypothesis is essentially an extension of the idea of moving averages. It involves computing an exponential measurement on the MACD and then takes into account the behavior of the time derivatives of these measurements. Appel in [2] only briefly describes the process, so we exhibit here a thorough definition:

Definition 4: We defined Signal Line as applying an n - day exponential Moving Average on MACD.

$$EMA_n = MACD \cdot \frac{2}{1+n} + \left(\frac{1}{n} \sum_{i=1}^n MACD_i\right) \cdot \left(1 - \frac{2}{1+n}\right) \text{ for any } n \in \mathbb{Z}_+.$$

Definition 5: For any series of numbers (assume a chosen period of security prices) S_t in a certain time period t , if \exists two different time intervals $t_1 + t_2 < t$ s.t.

$$\begin{aligned} &\| \frac{dEMA_n}{dt_1} \| > \| \frac{dEMA_n}{dt_2} \| \text{ while } \| \frac{dSignal\ Line}{dt_1} \| \\ &> \| \frac{dSignal\ Line}{dt_2} \|, \\ &\text{then for } \epsilon > 0, \\ &\exists t_2 - \epsilon < t_3 < t_2 + \epsilon \\ \text{s.t. } &\| \frac{dEMA_n}{dt_3} \| > \left(\| \frac{dEMA_n}{dt_1} \| + \| \frac{dEMA_n}{dt_2} \| \right) * \frac{1}{2} \end{aligned}$$

Calculating the exponential measurement of the MACD implies first determining the SMA. In general, a 9-day period is used to determine EMA ($n=9$). The MACD is the difference between two different periods of EMA, which also exhibits the change across different historical time units. We consider it the main measurement of market momentum because it represents how the same group of investors alters the trading prices at two different times.

Economically, the EMA₉ on MACD is an accurate way to understand how different investors interact when they are at different times, and it takes the length of the time period into consideration. The longer the length between the two times we are comparing, the smaller the effect of the recent momentum on our decision, and the more accurate the result is expected to be.

Paraphrasing Benjamin Graham [3], most investors tend to act somewhere between rationally and irrationally. In other words, you can hardly ever find anybody who is completely rational or completely irrational. The market is like a guy who can be moody today and excited tomorrow; let's call him Mr. Market. He is an interesting guy, and the Momentum Hypothesis described in this paper will be your best tool in unveiling what is in Mr. Market's mind. Furthermore, the Momentum Hypothesis will work out better if the general evolution of the market is the one that influences Mr. Market's decision, and not some big player like the state or top companies that control the direction of the market.

3. INTRODUCTION TO THE MOMENTUM REGRESSION ANALYTICAL MODEL

The Momentum Regression Analytical Model is developed from the Momentum Hypothesis, and provides a way to understand and predict the momentum mentioned in the section above. We will show that MRAM can predict an outcome within 0.1% error if the market controls Mr. Market. The concept of market in this paper mainly refers to all the individual investors and those corporations that are not in the top three in their industries. In other words, MRAM is aiming to measure as wide a market as it can measure rather than considering a market that is controlled or moved by only a few big individuals or organizations. Historically, MRAM could not predict the financial crisis in 2003 and in 2008. However, the period between 2003 and 2008 appears to be accurate according to MRAM. So given a steady evolution, the MRAM gives a fairly accurate description.

Note that what makes the MRAM special is that it is not merely a model, it is a way of understanding and predicting momentum and it can be used on any model with sufficient amount of data.

3.1 Momentum Regression Analytical Model (MRAM)

Instead of giving a definition right away, let us first go through the process of creating the MRAM model. It is necessary to use second-hand data as original observations. For example, one can choose daily closing price of SP500 from 2007 to 2012.

Using the observational data, we generate SMA₁₂, EMA₁₂, SMA₂₆, EMA₂₆, MACD, MACD₉, Signal, and Delta where MACD₉ is the 9-day SMA on MACD and Signal is 9-day EMA on MACD, and Delta is the difference between MACD and Signal Line. In the real world, it is not required to create a model with the same day period as above. One can choose another number of days depending on the context.

After generating the different indices, we choose the variables we want to predict, shift that list of observation one cell above, and import the observations along with the indices calculated into STATA (a statistical software package). These will be the random variables to which we generate a linear-linear regression function. This is the first group of estimators. We will draw a second group of testable estimator with variables based on experience and compare the R² and Mean Square Error between two estimators. We also need to judge the result by omitting variables that do not satisfy the 95% confidence interval before we start to compare two groups of testable estimators. After we delete a group we choose a third group of testable estimator and re-run the regression again, and compare the R² and Mean Square Error. We repeat this method until we find a group of testable estimator that subjectively satisfies our condition.

After we have our regression model, we are able to generate a specific price based on the second-hand observations. In our example, as mentioned before, the second-hand observation is daily closing price from 2003 to 2013. The result of the calculations done above is an estimate of the closing price of next trading day. As one can imagine, with different choice of second-hand data, one can get predictions at a different time in the future. Choosing, for example, weekly closing prices from 2003 to 2013, then one can calculate the closing price of the following trading week. This process is the heart of the MRAM model. Furthermore, let us note that it is possible to use other indices as observation groups, such as Net Book Value, Earnings per Share, Quick Ratio, Chaikin's Volatility, Slow Stochastic, William's R Curve, and so on.

Our main goal with this procedure is to develop an objective approach subjectively, by analyzing irrational securities rationally. First of all, we need an objective approach because all methods need to make sense in their considerations. However, different periods of time used in the model have different characteristics so one needs to use his or her experience to choose which parameters are used to analyze the market.

The securities traded are marketable equities and are related to Graham's irrational Mr. Market. When we are analyzing securities, we are actually analyzing Mr. Market, who is assumed to be irrational. To get to know Mr. Market better, we need to be rational ourselves. When we observe different interactions among other investors, we should not follow them like the rest of the market tends to do. Instead, we should keep calm and think about what is happening before we make investment decisions.

3.2 Application with Momentum Regression Analytical Model

We will explain the different groups of tests based on different models developed from MRAM. The first two groups conducted are dependent on the variables from technical indices while the latter two conducted are from variables drawn from Berkshire Hathaway's financial statements from 1996 to now.

3.2.1 Application I

The first test in this paper is a group of observations based on daily closing price S&P 500. We collected the Closing Price of S&P 500 from January 5, 1970 to April 4, 2013 as our observation group (i.e. 10880 observations). As described from the previous part, we have calculated SMA₁₂, EMA₁₂, SMA₂₆, EMA₂₆, MACD,

MACD₉, Signal Line, and Delta (the difference between MACD and Signal Line). We generate a new observation column (T1) in our chart by shifting the Closing Price one cell up. The goal of this model is to predict what will happen in the next unit of time: in this case, the next day. We need to understand the relation between variables in the past and the corresponding closing price one day in the future. We can accomplish this goal by generating T1. In the first group of tests, we choose three factors as our independent variables: EMA₁₂, EMA₂₆, and Delta. Thus, we have the following table:

T1	Coefficient	STD Error	T-value	95% Confidence Interval	
EMA-12	1.2975	.0110	117.98	1.2759	1.3190
EMA-26	-0.2972	0.0110	-26.99	0.3188	0.2756
Delta	1.4559	0.0332	46.67	1.3948	1.5170
Constant	0.3138	0.1911	1.64	0.0608	0.6884

From the coefficient of the variables generated from STATA, we can generate the following equation:

$$\text{Estimated Price} = 1.2975 * \text{EMA}_{12} + (-0.2972) * \text{EMA}_{26} + 1.4559 * \text{Delta} + .3138$$

We can generalize the previous equation, and we have the following:

Momentum Regression Analytical Model 1:

$$\text{Estimated Price} = \alpha * \text{EMA}_{12} + \beta * \text{EMA}_{26} + \gamma * \text{Delta} + \epsilon \text{ while } \alpha, \beta, \gamma, \text{ and } \epsilon \text{ are constants.}$$

With an equation to help us understand the relationship between Price and EMA-12, EMA-26 and Delta, we can plug in the numbers from today's market movement. Thus, the following estimation of predicted price is calculated: Predicted Closing Price (for April 5, 2013, i.e. the following trading day after April 4, 2013) = $1.2975 * 1558.822 - 0.2972 * 1550.502 + 1.4559 * (-5.1776) + 0.3138 = \1554.5381 per share. Furthermore, we can check the closing price of April 5, 2013, which is \$1,553.28 per share, with an error at 0.081% (computed by $1554.5381 / 1553.28 - 1$ which means the predicted price is 0.081% away from the actual price, and it is the same throughout this paper). This looks like an accurate result.

However, with the knowledge of econometrics, we can make the result even more accurate! We can conduct a t-test for the coefficient of the Constant in the regression model. We set our null hypothesis as, "The coefficient of Constant is zero" and the alternative hypothesis as the opposite of The coefficient of Constant is not zero". We check the t-value, which is 1.64, which is less than 1.96 at 95% confidence interval. Thus, we cannot reject the null hypothesis. In this case, we can drop the constant in our equation. It turns out to be as follows: $1.2975 * 1558.822 - 0.2972 * 1550.502 + 1.4559 * (-5.1776) = \$1,554.2243$ per share. This will give us an error at 0.061%.

3.2.2 Application II

Although the previous results look promising, the MRAM model we just created cannot be used all the time. This is because,

as time passes, the investors will experience different financial behavior and their psychology will make them turn opposite the previous evolution. That is why we are introducing our second model based on MRAM.

For example, if we were on April 10, 2013, and kept using the previous model, we would generate a very inaccurate result. Let us run the regression model with EMA-12, EMA-26, and Delta as independent variables just as above. We will have the following:

T1	Coefficient	STD Error	T-value	95% Confidence Interval	
EMA-12	1.2978	0.0110	118.01	1.2762	1.3193
EMA-26	-0.2975	0.0110	-27.02	0.3191	0.2759
Delta	1.4545	0.0312	46.64	1.3934	1.5156
Constant	0.3078	0.1911	1.61	0.0669	0.6824

Then from the equation generated by MRAM, we will have $1.2978 * 1567.63 - 0.2975 * 1559.631 + 1.4545 * (-1.6713) + 0.3078 = \$1,568.0797$ per share. As we expected, the result is a lot different from the actual result, because the actual result is \$1593.37 per share. Not only did the estimator give a wrong direction of future price, it also produced a huge estimated error, an error that cannot even be covered from the model within 95% confidence interval. How do we solve this problem?

We introduce our second model developed from MRAM. Instead of predicting T1, we predict SMA-12 with one cell shifted above. That is to say, we want to set SMA-12 as our dependent variable, and predict the next trading day's SMA-12. We can then calculate backwards to get tomorrow's closing price. In order to do this we cannot keep using the same independent variables, but the same logic applies in all MRAM developed models. We are trying to predict SMA-12, which is why we need to use simple averages as our factors, so we want to treat SMA-26 and MACD9 (which is 9-day SMA on MACD) as our independent variables. Here is the regression model generated by STATA:

T1SMA12	Coefficient	STD Error	T-value	95% Confidence Interval	
SMA-26	0.9998	0.0001	8018.57	0.9996	1.0000
MACD9	1.0615	0.0055	193.83	1.0508	1.0723
Constant	0.2137	0.0959	2.23	0.026	0.4017

After we have our regression model developed from MRAM, we can calculate the future closing SMA-12, which is $0.9998 * 1557.383 + 1.0615 * 9.9877 + 0.2137 = \1567.8872 per share. Then we can calculate backwards to get the predicted closing price. We compute $1567.8872 * 12 - \text{SUM}(B10909 \text{ to } B10919) = \$1,600.0564$ per share. If we compare this predicted price with the actual losing price \$1,593.37, then we will have an error of 0.42%, which is less accurate from previous model but at least it gives us the right direction of the market moving trend. This also proves what was discussed before: that the less rational the market is, the less accurate MRAM can be.

The second model developed from MRAM gave us the following generalized equation.

Equation 2: $Estimated SMA_n = a * SMA_m + \beta * MACD_t + \varepsilon$ while a, β, ε are constants, and for any $n > m$ chosen subjectively.

3.2.3 Application III

One can get a sense why MRAM is so special: it enables us to connect various situations and build thousands of new individual models that stem from the original.

To extend the idea, the previous two applications can be helpful for analyzing individual stocks. However, one needs to make sure the situation is fully analyzed before applying the model. MRAM developed models that use technical indices as factors may not be suitable for steadily growing companies; but there is no need to worry. We will introduce a third model that will help us solve this aspect.

The third model includes a basic understanding of financial accounting. However, instead of using the logic provided by MRAM on closing prices, we use it on financial factors. From *Security Analysis*, the understanding of intrinsic value is introduced in connection to the concept of Net Book Value. Analyzed by Benjamin Graham, the definition of Net Book Value is as follows:

Definition 4: Net Book Value = Common Stock + Surplus - Intangibles

Definition 5: Net Book Value Per Share = (Common Stock + Surplus - Intangibles) / (Share of Common Stock Outstanding)

The definition of Net Book Value is not just an equation to calculate the intrinsic value of a company; it is rather a way of thinking about how much a company is worth. Benjamin introduced in [3] the idea of value investing by choosing lower price-to-book ratio companies, i.e. investing in value growth.

With this idea in mind, we are going to go through the process of how this third model is developed, and why it is important. The example we used depends on Berkshire Hathaway's annual and seasonal report started from 1996 up to 2011. Suppose we want to predict the price at the beginning of 2012, so we are putting ourselves back in time. We will create models based on information collected before and excluding 2012, and we will make a prediction about closing prices for the year 2012. We start by thinking about a company's book value. What factors affect a company's book value? The first thing that comes to mind is cash. For any individual organization, the money in pocket right now that is free for liquidation and for any utilization or re-investment is the core value. It is apparent to anyone that the more cash there is; the better the company stands financially. Furthermore, we want to consider Net Book Value as well. In this example, we calculated Net Book Value by computing (Retained Earnings + Capital Excess - Goodwill), but this equation may change when there are different companies. Thus, we have the regression model as below:

Note that PSMAUP means Price with SMA-3 updated and shift one cell up, CSMA3 means Cash with SMA-3 updated, and

PSMAUP	Coefficient	STD Error	T-value	95% Confidence Interval	
CSMA3	0.4039	0.1061	3.81	0.1916	0.6163
NSMA3	1.2339	0.1195	10.33	0.9947	1.4731
Constant	41948.68	2420.994	17.33	37102.54	46794.83

NSMA3 means Net Book Value updated with SMA-3. Thus, we have an updated estimated regression function for Price with SMA-3 updated. We can then calculate the future price by using 2011 Cash with SMA-3 updated and Net Book Value with SMA-3 updated. We compute $0.4039 * 39988.67 + 1.2339 * 56109.95 + 41948.68 = \$127,334.17$ per share. From the model, this means that 2012 Closing Price on a stock of Berkshire Hathaway is supposed to be \$127,343.17 per share. We check that the actual price is \$134,060 per share. Thus, we have an estimator with an error at 5.28%. Yet there is still a chance to increase the accuracy of this result.

However, there is another problem here. We treated the previous example a little bit differently than the first and second models developed from MRAM. The reason for this is that we are now selecting independent variables from a financial report, and the result will not only be a prediction, but rather how much the company is supposed to be valued by the market. We need to pay attention to the time difference.

The data used in this example has observations listed in time order. For each year, we have listed Q1 to Q3 and 10-K, but there is a time delay in the report. The company will not post Q1 specifically at the end of each quarter; there may be a one-month delay. In our example, Berkshire Hathaway posted 10-K the following year in March; thus we have a three-month delay. In other words, based on regression theory in the study of econometrics, the \$127,334.17 per share is actually the estimated price for June or July in the year 2012 for Berkshire Hathaway. If Berkshire Hathaway publishes the first seasonal report of 2012 at the end of June, the actual price is \$127,445 per share. Thus, we will have a result that is 0.087% away from the real number. In real financial market, a prediction three months in the future with an estimated price that is 0.087% away from actual price is very accurate!

Thus, it is apparent that we have moved away from Momentum Hypothesis and technical indicators already. This is why Momentum Regression Analytical Model is changing each time into powerful tools. By choosing different parameters, we can create all sorts of models. The last application we introduce will include the understanding of price-to-book ratio mentioned above. Looking at Berkshire Hathaway historical financial positions from annual reports from 2003 to 2012, we can draw the following table. As shown, annual price is presented with corresponding Net Book Value and Price-to-Book Ratio. Following the same logic, we shift the price one cell up in the column "Price+1". Next, we draw regression by choosing Net Book Value and Price-to-Book as parameters. This makes sense because Net Book Value does contribute to Price per share. The result shows a positive correlation because Berkshire's Net Book Value has been contributed and it is dependent on retained earnings. The more earnings a corporation can retain, the more the corporation will reinvest, and thus the more likely it will be to create value. Price-to-Book Ratio is another indicator. Graham (1934) explained that Price-to-Book Ratio tells investors how "expensive" a share is. Comparing this financial indicator to peers or to market, we can find more intriguing results. We thus introduce a two-factor model here.

Two - factor Hypothesis₁:

$$Price = \alpha * Net\ Book\ Value + \beta * \frac{P}{B} Ratio + \epsilon,$$

for some ϵ

$$\epsilon \in \mathbb{R} \text{ and } \frac{P}{B} \text{ refers to Price per Book Value.}$$

This model is unique in a way that it takes Net Book Value and P/B Ratio into account at the same time. What it explains is that we can understand a security or a particular portfolio's performance in the market by looking at Net Book Value and P/B Ratio.

With some understanding of the market or a simple comparison, one can even draw correlation between market value and value of a particular security. Thus, we can further assume a second hypothesis.

Two - factor Hypothesis₂:

$$R = \alpha * \frac{dNBV}{dt} + \beta * \frac{P}{B} + \epsilon,$$

for some $t \in \mathbb{Z}$ and $\epsilon \in \mathbb{R}$.

This model is a developed model from the first hypothesis such that it looks at the change of each parameter corresponding to the change of price, i.e. the return of a security. This is another powerful tool because it has the ability to take an imagined market opinion into account.

All these variations stemming from the MRAM model are called the "VIC Generation" model. Basically an investor can develop his own VIC generation depending on his or her own needs. One can choose parameters and even dependent variables subjectively.

perspective. It shows us a way one can build equations and models that can be used in the future to predict results that are fairly accurate.

In particular, we built different models from MRAM based on traditional investment. We collected independent variables from books and tried to find patterns between price and factors recorded in book, such as Total Assets, Net Earnings, and Retained Earnings etc.

4.1 Future Perspective

As a final remark, the methods described in this paper could assist the reader in their investment decision. When an investor has enough knowledge, he/she can develop his/her own model based on the Momentum Regression Analytical Model or VIC Generations.

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4. Graham, Benjamin. Dodd, David. *Security Analysis*. 1934 Version.

Date	Price	Price+1	Return	Net Book Value	Price to Book
2003-12	82,800	87,900	-	58,032	1.4268
2004-12	87,900	88,620	0.0616	65,457	1.3429
2005-12	88,620	109,990	0.0082	74,116	1.1957
2006-12	109,990	134,000	0.2411	85,434	1.2874
2007-12	134,000	93,400	0.2183	99,105	1.3521
2008-12	93,400	100,300	(0.3030)	105,305	0.8869
2009-12	100,300	120,450	0.0739	113,301	0.8853
2010-12	120,450	114,755	0.2009	136,727	0.8810
2011-12	114,755	133,000	(0.0473)	147,255	0.7793
2012-12	133,000	-	0.1590	161,502	0.8235
2013-12	-	-	-	174,840	0.9766

Price	Coef.	Std. Err.	T	P> t	[95% Conf. Interval -]	[95% Conf. Interval +]
Net Book Value	0.9855822	0.124862	7.89	0	0.6903305	1.280834
Price-to-Book	92767.46	17186.33	5.4	0.001	52128.24	133406.7
Const.	-97431.69	30862.1	-3.16	0.016	-170409	-24454.42

4. CONCLUSIONS

Investors can be suddenly moody or excited at any time, and their emotional state can influence their move on the market. Although economists assume that each human being in the market is rational, it is essential to understand that the main assumption in this paper is that market is irrational. And our model builds an objective approach to subjective phenomena and allows us to analyze irrational securities in a rational way.

Once an investor collects enough unbiased information for one corporation, he or she can conduct or develop a model from MRAM.

MRAM is not just accurate, but gives a completely new

