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ABOUT US
Established in 2016, the GW Undergraduate Review (GWUR) is the premier publication of research from undergraduate students at the George Washington University. Our mission is to promote undergraduate research on GW’s campus through events, workshops, and the publication of a peer-reviewed journal. Undergraduate researchers from all academic disciplines are welcome to submit to the journal, which is staffed by editors majoring and minoring across nearly twenty departments at GW. Our organization also publishes the Colonial Scope, an online news blog with a research focus. GWUR is entirely student-run and is supported by the Office of the Vice President for Research.

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Dear Reader,

On behalf of the Editorial Board, I am excited and honored to present the inaugural volume of the GW Undergraduate Review (GWUR). In Volume I, we are proud to publish original research spanning six academic disciplines conducted by seven talented undergraduate students at the George Washington University. Our authors take us from topics near and dear to GW — including congressional campaigns and George Washington himself — to other countries, and even other planets. The impressive quality of these publications speaks to the incredible talent and motivation of undergraduate students at our university.

Beyond publishing the journal, GWUR has been active in promoting undergraduate research on campus through our events and workshops. In the fall semester, we hosted researchers from the Smithsonian Institution, National Geographic, and the School of Media and Public Affairs for an interdisciplinary panel on science communication. This spring, we partnered with the GW Classics and Archaeology Club to host the first annual “Crash Course Research” seminar series. We have also held workshops on applying to research opportunities, scholarships, and conferences. Additionally, the Colonial Scope — our online news blog — has published articles on topics ranging from muons to medical ethics. As we continue to grow as an organization, I look forward to forming new partnerships with students and faculty, hosting even more engaging events, and continuing to encourage undergraduates to get involved in academic research.

This publication would not have been possible without the effort and dedication of many individuals. Thank you to the Executive and Editorial Boards for their tireless work ethic, motivation, and professionalism and to the Office of the Vice President for Research for their generous support of GWUR. Thank you to the authors for submitting insightful and meaningful work to the journal. Lastly, thank you to all of the professors, peers, and friends who have supported GWUR and its mission over the past year.

It has been a wonderful privilege to preside over this organization, and I am personally grateful to all who have helped in turning this idea into a reality. Moving forward, I am nothing but optimistic about the future not only of this journal, but of each and every student who has been a part of it. I hope that you enjoy reading Volume I as much as we have enjoyed watching it come together.

Sincerely,

Margaret C. Steiner
Founder, President, and Editor-in-Chief
The GW Undergraduate Review
# CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Association Between Aortic Vascular Inflammation by PET/CT and Aortic Distensibility by MRI in Psoriasis</td>
<td>1</td>
</tr>
<tr>
<td>PARAG SHUKLA, AMIT DEY, AGASTYA BELUR, JACOB GROENENDYK, YOUSSEF ELNABAWI, ADITYA GOYAL, JUSTIN RODANTE, LEONARD GENOVESE, MARK AHLMAN, MARTIN PLAYFORD, AND NEHAL MEHTA Clinical Medicine</td>
<td></td>
</tr>
<tr>
<td>Energy Materials Analysis for Additive Manufacturing by Selective Laser Melting</td>
<td>5</td>
</tr>
<tr>
<td>RACHEL GRAY, DEVIN JESSUP, AND SANIYA LEBLANC Materials Science</td>
<td></td>
</tr>
<tr>
<td>Detection of Exoplanets Using the Transit Method</td>
<td>10</td>
</tr>
<tr>
<td>DENNIS AFANASEV Astrophysics</td>
<td></td>
</tr>
<tr>
<td>“The Indian Method of Warring”: Wampum, Warfare, and George Washington’s Lessons in Frontier Diplomacy During the Seven Years’ War</td>
<td>15</td>
</tr>
<tr>
<td>ANNABEL G. LABRECQUE History</td>
<td></td>
</tr>
<tr>
<td>Asymmetric Campaign Advertising: Partisan Differences in 2014 Congressional Campaign Advertisements</td>
<td>23</td>
</tr>
<tr>
<td>DANIEL A. WETTER Political Communication</td>
<td></td>
</tr>
<tr>
<td>Examining the 2007 Redenomination of the Ghanaian Cedi on the Disinflation Process Using the Chow Structural Break Test and VAR</td>
<td>37</td>
</tr>
<tr>
<td>RIKI MATSUMOTO International Economics</td>
<td></td>
</tr>
<tr>
<td>The Role of Pension Funds in the Development of Capital Markets in Latin America</td>
<td>47</td>
</tr>
<tr>
<td>JUAN PABLO POCH Financial Economics</td>
<td></td>
</tr>
<tr>
<td>Meet the Staff</td>
<td>63</td>
</tr>
</tbody>
</table>
Association Between Aortic Vascular Inflammation by PET/CT and Aortic Distensibility by MRI in Psoriasis

PARAG SHUKLA1,2, AMIT DEY2, AGASTYA BELUR2, JACOB GROENENDYK2, YOUSSEF ELNABAWI2, ADITYA GOYAL2, JUSTIN RODANTE2, LEONARD GENOVESE2, MARK AHLMAN2, MARTIN PLAYFORD2, NEHAL MEHTA2
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ABSTRACT

Introduction:
Globally, 18 million people die from cardiovascular disease (CVD) annually, making it the leading cause of morbidity and mortality worldwide. In recent years, inflammation has been established as a key cause of CVD, but the effects of anti-inflammatory treatment on cardiovascular (CV) risk remains poorly understood. Psoriasis (PSO), a chronic inflammatory skin disease associated with increased CV events, provides an ideal clinical model to study the role of inflammation in CV disease. Aortic vascular inflammation (VI) by [18F]-fluorodeoxyglucose (FDG) PET/CT as well as aortic distensibility (AD) by MRI, are important markers of subclinical CV disease and have been shown to predict future CV events. Following subclinical markers, such as AD, enables physicians to make judicious treatment decisions before CV events such as stroke, myocardial infarction, or angina occur. Our study demonstrates a novel association between VI and AD in patients with chronic inflammatory disease.

Hypothesis:
A reduction in aortic vascular inflammation (VI), measured by PET/CT, will associate with increased AD, measured by MRI at 1-year.

Methods:
Consecutively recruited PSO patients (N=50) underwent whole-body PET/CT scans to quantify VI as target-to-background ratio (TBR). Descending aorta contours on MRI were traced throughout the cardiac cycle [Qflow, Medis] to measure AD. Longitudinal changes in aortic VI and AD were analyzed by multivariable regression.

Results:
The cohort was middle aged (mean ± SEM: 49.8 ±1.9 years), mostly male (56%), had low CVD risk, and mild-to-moderate PSO. At 1-year follow up, patients had a median improvement in PSO severity of 40% (p<0.001) with use of biological therapy (28/50 patients) while aortic VI decreased by 8% (1.81 ± 0.05 vs 1.67 ± 0.04, p<0.001) and AD increased by 10% (0.61 ± 0.03 vs 0.67 ± 0.04, p=0.04). Reduction in aortic VI was associated with an improvement in AD beyond traditional CV risk factors, statin use, and systemic/biologic PSO therapy (β =-0.36, p=0.04).

Conclusion:
Improvement in aortic VI in patients with psoriasis by PET/CT is associated with improvement in AD by MRI at 1-year, suggesting that treatment of inflammation may have a favorable impact on functional characteristics of the aorta. These findings further advance our understanding of the role of inflammation in CVD and the utility of MRI for inflammatory CVD risk prediction. Our novel findings can help improve the accuracy of CVD risk prediction, enable physicians to make evidence-based decisions, and decrease the global economic burden of cardiovascular disease on healthcare systems.

INTRODUCTION

Globally, 18 million people die from cardiovascular disease (CVD) annually, making it the leading cause of morbidity and mortality worldwide (Roth et al., 2017). In recent years, inflammation has been established as a key cause of CVD (Libby, Ridker, & Maseri, 2002), but the effects of anti-inflammatory
treatment on cardiovascular (CV) risk remain to be explored in detail (Lerman et al., 2017). Psoriasis (PSO), a chronic inflammatory skin disease, is associated with innate and adaptive immunity activation, both of which play important roles in PSO pathogenesis (Harrington, Dey, Yunus, Joshi & Mehta, 2017). Chronic inflammatory diseases such as psoriasis are associated with increased CV events, and provide an ideal clinical model to study inflammation and CV risk (Harrington, Dey, Yunus, Joshi & Mehta, 2017). Aortic vascular inflammation (VI) by [18F]-fluorodeoxyglucose (FDG) PET/CT as well as aortic distensibility (AD) by MRI, are important markers of subclinical CVD and have been shown to predict CV events (Abdelbaky et al., 2013; Redheuil et al., 2014). Macrophages are recognized as the cells that drive vascular inflammation thereby causing vessel damage (Libby, Ridker, & Maseri, 2002). FDG as visualized by PET-CT accumulates in the arterial wall proportional to the concentration of macrophages in the arterial wall and is associated with markers of CVD (Mehta et al., 2011a).

Aortic distensibility is a measure of the degree of stiffness of the aortic wall. Changes in subclinical markers, such as AD over time, enable physicians to make judicious treatment decisions before CV events such as stroke, myocardial infarction, or angina occur (Yonemura et al., 2005). Our longitudinal study demonstrates a novel association between change in VI and change in AD in patients with psoriasis at 1-year.

HYPOTHESIS

A reduction in aortic VI, measured by FDG PET/CT, will associate with increased AD, measured by MRI, at 1-year.

METHODS

Consecutively recruited PSO patients (N=50) underwent whole-body PET/CT and MRI scans to quantify VI as target-to-background ratio (TBR) and aortic distensibility respectively. Following patients’ overnight fast, whole body FDG PET/CT images were obtained at 60 minutes after IV administration of 10 mCi FDG in psoriasis. FDG PET/CT images of the aorta for our study were analyzed using an imaging software called Extended Brilliance Workspace (Phillips Healthcare). Two-dimensional regions of interest were drawn on axial slices of the aorta from the level of the aortic root to the level of the iliac bifurcation to obtain a maximal standardized uptake value (SUV

\[\text{max} \]) , thus quantifying vascular inflammation in vivo. Regions of interest were placed within the lumen of 10 continuous slices of the superior vena cava and averaged to produce one venous value. SUV

\[\text{max} \] values from each aortic slice were divided by the venous SUV

\[\text{mean} \] yielding a TBR (Mehta et al., 2011b; Naik et al., 2015). Descending aorta contours on MRI images were traced throughout the cardiac cycle [Qflow, Medis] to measure AD. A contour was created outlining the descending aorta for all of the images. A graph was then generated: time vs. area of the aorta and the largest area and smallest areas were recorded for each patient. Distensibility was calculated as \[\frac{[(\text{maximum area} - \text{minimum area}) \times 1000]}{[(\text{minimum area}) \times \text{(pulse pressure)}]} \] (Ohyama et al., 2016). Systolic and diastolic blood pressures, used to calculate pulse pressure, were measured on the day of the scans for all patients in the study. (Figure 1) Pulse pressure is the difference between the systolic and diastolic blood pressures. Longitudinal changes in aortic VI and AD were analyzed by multivariable regression.

RESULTS

The cohort was middle aged (mean ± SEM: 49.8 ± 1.9 years), mostly male (56%), and mild-to-moderate PSO (Table 1). Moreover, the cohort was overweight to obese and originally had low CV risk. At the 1-year follow up, patients had a median improvement in PSO severity of 40% (p<0.001) with use of biological therapy such as anti-TNF and anti-IL 12/23 (28/50 patients). In conjunction with improvement in psoriasis severity, aortic VI decreased by 8% (1.81 ± 0.05 vs 1.67 ± 0.04, p=0.001) and AD increased by 10% (0.61 ± 0.03 vs 0.67 ± 0.04, p=0.04). Furthermore, reduction in aortic VI was associated with an improvement in AD beyond traditional CV risk factors, statin use, and systemic/biologic PSO therapy (β=-0.36, p=0.04).

DISCUSSION

We demonstrate that vascular inflammation in the aorta is associated with deleterious consequences in aortic structure and function by simultaneous MRI. Specifically, improvement in aortic vascular inflammation was related to decreased distensibility in the aorta after adjusting for known CVD risk factors. These findings are especially significant given that AD and vascular inflammation either predicts CVD, or relate to its severity. Vascular inflammation has been shown to drive the formation, propagation and finally rupture of atherosclerotic plaques in injured blood vessels (Libby, Ridker, & Maseri, 2002). Moreover, VI is being increasingly recognized as a robust surrogate marker for vessel wall disease (Mehta et al., 2011a). The use of MRI permitted us to measure aortic distensibility, which has been associated with known CVD risk factors as well as prospective CV events. In a study of 1053 participants, Malayeri et al. linked AD to older age, hypertension, and current smoker status (Malayeri et al., 2008). Therefore, our use of AD provided a reliable surrogate for understanding how vascular inflammation may relate to early atherosclerosis. Inflammatory blood cells such as neutrophils, monocytes and macrophages play a critical role in vascular inflammation. Elements of the inflammatory
process inclusive of monocytes are involved in the early stages of atherogenesis from development of the fatty streak and growth of atherosclerotic plaque until plaque rupture (Libby, Ridker, & Maseri, 2002). Furthermore, monocyte-derived macrophages contribute to arterial stiffening through production of proteinases, resulting in abnormal elastin and collagen formation (Rajavashisth et al., 1999). Furthermore, VI can also lead to endothelial dysfunction and activation that can also contribute to the decrease of vessel distensibility (Kinlay et al., 2001). Treatment of psoriasis by anti-inflammatory therapy has been associated with decrease in vascular disease (Bissonnette et al., 2013); therefore, treatment should be accompanied by reduction in inflammatory blood cell characterization and thus aortic inflammation and stiffness.

**CONCLUSION**

Improvement in aortic VI in patients with psoriasis by PET/CT is associated with improvement in AD by MRI at 1-year, suggesting that treatment of inflammation may have a favorable impact on functional characteristics of the aorta. This longitudinal study’s findings further advance our understanding of the role of inflammation in CVD and the utility of MRI for inflammatory CVD risk prediction. Our novel findings can help improve the accuracy of CVD risk prediction, enable physicians to make evidence-based decisions, and decrease the global economic burden of cardiovascular disease on healthcare systems. However, larger studies are needed to validate our findings.

**LIMITATIONS**

We acknowledge certain limitations in our study, which include a small sample size and a single-center study design. The cross-sectional nature of our study does not enable us to establish causality, or correlate with incidence of cardiovascular events. Finally, we did not characterize inflammatory cells in the blood and thus are unable to show any mechanistic link between VI and AD.
REFERENCES


Energy Materials Analysis for Additive Manufacturing by Selective Laser Melting

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ABSTRACT
This research aimed to improve selective laser melting (SLM) of energy materials for thermoelectric power generation devices. Thermoelectric generators (TEG) are solid state devices that offer the potential for waste heat recovery in combustion and heat process systems. These devices are currently being manufactured using bulk material processing with many integration and assembly steps, leading to decreased product efficiency and high manufacturing costs. Selective laser melting is an additive manufacturing technique, when combined with semiconductive powder offers a solution to these manufacturing challenges.

INTRODUCTION
Thermoelectric generators are devices which convert waste heat from various heat systems into usable electricity. As seen in Fig 1, on average combustion and heat systems lose 66% of their energy to waste heat. Thermoelectric materials work via the Seebeck effect, wherein a temperature difference across the material causes electrical charge carriers to move, producing an electric voltage. Current advances in thermoelectric materials have not resulted in efficient and economically viable devices due to manufacturing challenges. The current manufacturing process, as illustrated in Fig 2, requires many steps before assembly. These steps not only create a time-intensive process, they also provide limited geometries (rectangular legs only) which fail to effectively capture waste heat from curved heat systems. The bulk material processing technique of dicing also causes 50% of the material to be wasted.

The additive manufacturing technique of selective laser melting, as depicted in Fig 3, eliminates the multi-step process currently required for making thermoelectric legs. The laser's ability to move in a range of patterns allows for a variety of geometric shapes, compatible with many heat sources, to be created. In addition, excess material can be recycled for use in the manufacturing of the next device (El-Desouky, Carter, Mahmoudi, Elwany, and LeBlanc, 2017).

In selective laser melting, a thin layer of powder is scanned over by a laser in a desired pattern, sintering the powder particles together. Another layer of powder is spread, and the process is repeated until the desired structure is formed. The remaining powder is then removed and recycled for the next device. This process, however, requires specific starting powder characteristics (desired particle distribution, and high levels of circularity and convexity).

FIGURE 1. Examples of heat and combustion systems which on average lose 66% of their energy to waste heat (Joly et al., n.d.)
Flowability is multidimensional and depends on many powder characteristics. Because of this, it is important to look at many measurements when assessing the flowability of a powder. These measurements include angle of repose, angle of spatula, compressibility, and cohesiveness or uniformity coefficient. These parameters are factored into a single flowability index (Schuck, Jeantet, and Dolivet, 2012). Flowability not only affects how powder spreads through a device, it also impacts the end TEG product. Powder parameters such as convexity, circularity, and particle size distribution all affect the density of the end TEG device. With a higher density, a TEG is more efficient and is more resilient to internal fractures. If particles are elongated and nonuniform, it leads to an increase in particle friction and possible particle interlocking which in return decreases flowability. These characteristics also decrease the final density as they can lead to uneven sintering and interlayer voids, which cause internal fractures (El-Desouky, Carter, Mahmoudi, Elwany, and LeBlanc, 2017).

The Spiering’s (Fig 5) and the Karapatis (Fig 6) requirements create a suitable size distribution for both flowability and density. The Karapatis requirement states that fifty percent of particles are ten times coarser than ten percent of the finest grains, and about twenty percent of the particles are in a one to twenty ratio. Spiering’s requirements state that effective layer thickness is at least fifty percent higher than the diameter of ninety percent of the powder particles and that there are a sufficient number of fine particles to fill the voids between the courser. Also, particles below 5–6μm in diameter will cause agglomeration which will decrease flowability and decrease the part density (Spierings and Levy, 2009).

\[
\frac{D_{90}}{D_{10}} \approx 5 \quad \frac{t_{\text{eff}}}{D_{90}} \approx 1.5
\]

**FIGURE 5.** Spiering’s requirements for suitable size distribution (Spierings and Levy, 2009)

\[
D_{90} < t_{\text{Layer}} \quad \frac{D_{50}}{D_{10}} \geq 10 \quad \frac{D_{90}}{D_{10}} \leq 19
\]

**FIGURE 6.** Karapatis requirements for suitable size distribution (Spierings and Levy, 2009)

### POWDER SPREADING

The creation of a powder spreading rig (PSR) was needed in the lab to automate the previous system of hand-rolling each powder layer in the SLM process, as well as to obtain repeatable powder layers. The design of the powder spreading rig was modeled after current SLM designs and utilizes a 3D printer.

The base plate at the center of the 3D printer acts as
the powder bed where sintering occurs. It uses the axial controls of the 3D printer to move downward in the z axial direction in increments desired, as small as 20μm. On the left side of the base plate is a box that houses the powder. The powder moves upward in the z axial direction by use of an additional motor which is controlled by an Arduino. The Arduino is programmed in C and allows for equal incremental movement as the base plate. On the right-hand side is a box that captures the excess powder, which can then be reused. The rolling system utilizes the axial controls of the 3D printer as well, and these controls were reprogrammed in G-code. All circuits are controlled either by a SDS card or through a USB cable. This allows the PSR to work in an inert gas bubble, which is necessary for many energy materials.

The PSR starts with the roller in the back-left hand corner. The powder is raised to the desired level and the roller begins moving along the positive x-axis and then along the positive y-axis. This rolls the powder onto the powder bed, pushing any excess powder into the right-hand container. The roller then retraces back along its path and pauses in its starting position, allowing the lasering to take place. Once the lasering is complete the PSR will lower by the same desired increment, and the process will repeat for the desired number of layers.

One problem that is foreseeable is the current desired layer size, which is 50μm. It is unclear whether the powders ability to flow will allow this small layer size.

**BALL MINING**

One method to improve flowability is ball milling. In this research, a high energy ball mill is used. Parameters such as ball to powder ratio, grinding speed and duration, as well as pause intervals are varied in order to find an optimal set of parameters. The combined centrifugal and centripetal force creates a powerful impact force, which should improve the overall shape of the powder, and potentially the flowability. The powder was milled in an argon atmosphere to decrease oxidation and was milled at room temperature. The powder will be analyzed based on the previously discussed flowability measurements as well as through an image analysis software.

**IMAGING**

To establish an imaging and analysis technique bismuth telluride, a semi conductive powder in the TEG field was used. To characterize the powder, light microscopy was utilized to produce images. A 10X magnification was found to be most effective in balancing the glare against particles with an appropriate focus of both large and small particles. Mounting the powder on the slides for imaging required 30.0 mL of ethylene glycol with 0.25 grams of bismuth telluride. This suspension was then spin coated onto glass slides at different speeds for various times.
Once the images were acquired, they were all processed through an ImageJ software derivative called Fiji Is Just ImageJ (FIJI) (Schindelin, Arganda-Carreras, Frise, et al., 2012). In the program, each image was converted to 8-bit greyscale and then its contrast was enhanced. Following this, a mask was applied over the image, inverting the look-up table (LUT) and producing a flat black and white image. Additionally, scale was applied to each image in microns. Utilizing the black and white image, the particles were then analyzed to obtain values for area, perimeter, Ferret's diameter, and convex hull perimeter. To obtain the convex hull perimeter, a plugin was applied to FIJI called “Shape Filter” (Wagner and Lipinski, 2013). A macro was utilized to automate the process and to help control for human error. An area threshold of 30 µm was established for each image, to remove particles which would be too small for effective use in SLM and which would interfere with program analysis methods. This process can be seen in Fig 8.

Magnesium silicide stannide is an off-the-shelf semiconductor powder with a high operating temperature. It was examined to determine its ability to be used in SLM. A set of data was first taken on un-ball milled magnesium silicide stannide to establish a preliminary set of data, for use in later comparison.

Circularity, which is a ratio of how elongated or circular a particle is, is set on a scale from zero to one. One being the most circular and zero being the most oblong. Unmilled magnesium silicide stannide averaged 0.6 in circularity as depicted in Fig 9. This number is relatively low and will need to be improved greatly before magnesium silicide stannide can be utilized in the SLM process.

Particle size distribution looks at the different sizes in particles that are represented in a sample. This measurement is based on Ferret’s diameter which is the longest diameter at any point on the particle. Unmilled magnesium silicide stannide had a wide range of particle sizes as seen in Fig 10. This range was between 5µm and 375 µm, with the average being 25 µm. The powder can go through a sieving process to extract the exact sizes as determined by the user.

Convexity is a ratio of how abstract a particle's parameter is. It is as well on a scale from zero to one: zero being very abstract with many sharp edges and points, and one being perfectly round and smooth. Unmilled magnesium silicide stannide averaged 0.9 in convexity as shown in Fig 11. This number is relatively high and should help aid the particles in flowing through the powder spreading system, however, could still be improved.

**MORPHOLOGY RESULTS**

Magnesium silicide stannide is an off-the-shelf semiconductor powder with a high operating temperature. It was examined to determine its ability to be used in SLM. A set of data was first taken on un-ball milled magnesium silicide stannide to establish a preliminary set of data, for use in later comparison.

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CONCLUSION AND FUTURE WORK

This work shows that FIJI is a free and robust software for use with examining powder morphology, providing results with a high degree of repeatability. Unmilled magnesium silicide stannide has mid-range values for circularity and relatively high values for convexity. These properties will reduce flowability and compromise powder bed density. More work will need to be done to improve these powder properties before magnesium silicide stannide can be used in the SLM process.

A procedure to ensure repeatability and reliability of the powder spreading rig in creating uniform layers of thickness will need to be developed. And a stronger relationship between flowability and powder morphology will need to be established before SLM can be implemented in the TEG manufacturing process.

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The researchers would like to thank Haidong Zhang and Michael Orrill for their expertise and help throughout the project. William Rutkowski and the machine shop for help building the PSR. Additional thanks go to the National Science Foundation for enabling the Nanotechnology Fellow’s Program with Award EEC-1446001.

REFERENCES

Detection of Exoplanets Using the Transit Method

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ABSTRACT
Differential photometry was conducted on the star GSC 3281-0800, a known host to exoplanet HAT-P-32b, using analysis software AstroImageJ. Measurements were plotted from a series of images taken during the transit, via ADU count given from an earth-based digital CCD camera. A definite light curve was established and more details about the properties of this exoplanet were discovered.

INTRODUCTION
Exoplanets are the planets found outside of the solar system. Since the first exoplanet was discovered in 1992, a number of methods for detection have been established. This research evaluates the star known as HAT-P-32 (also catalogued as GSC 3281-0800) and its exoplanet HAT-P-32b using the transit method.

When a planet passes in front of a star, the star becomes dimmer depending on the size of the planet. The data shows a dip in flux if a planet is transiting the star we are observing, as shown in Fig. 1 (Vanderburg, n.d).

The figure shows an ideal light curve. In a real-world light-curve, the data appears more mangled and with several systematic uncertainties needed to be subtracted. This research will demonstrate the transit method way of detecting exoplanets. A free software tool named AstroImageJ (Collins & Kielkopf, 2013) will be used to obtain the necessary data to demonstrate an observed light curve from raw images.

TRANSIT METHOD
This research was conducted using the transit method. This method relies on taking the light flux of the target star and comparing these values to other stars in the same patch of sky. The transit method is based upon several different processes that will be described throughout this paper. The most useful part of the transit method is that it may be done with a digital Charged Couple Device (CCD) earth-based camera. Based upon NASA's predicted exoplanet transit periods, a camera was set up and aimed at the target stars region of the sky and pictures before, after, and during an exoplanet's predicted transit.

These images are then used to generate a dataset of flux values for every frame taken during the session. A downside to the transit method is that it is only effective when observing so called “hot Jupiters,” which are planets that are large and close to the star during orbit and pass directly in front of our field of view from earth (Seager, 2008).

DIFFERENTIAL PHOTOMETRY
The transit method relies on differential photometry. The idea of differential photometry is to analyze the target star's flux during our imaging session and compare it to other stars in our target star's region of the sky. Specifically, the method is

FIGURE 1. Light curve when planet passes in front of a star.
concerned with ADU counts per pixel. An ADU (Analog to Digital Unit) count is the qualitative value of each CCD's charge output. Each pixel is impacted by a number of photons, which counts the charge and outputs it into a value. A large charge means more photons have hit the CCD pixel. Therefore, the flux may be observed from these images. However, a number of systematic uncertainties must be subtracted from the raw images obtained during the imaging session in order to accurately compare flux changes (Seager, 2008). Our data lies in the light frames, so we must calibrate the stack of images. Specifically, there are three different types of frames that need to be taken out in order to optimize our raw images. These are the bias, darks, and flat frames. Bias frames are caused by the CCD electronic signal readout during shots, dark frames are simply dark shots which can be obtained by covering the camera lens, and flat frames account for any dust smudges or inconsistencies on the camera lens itself.

APERTURE PHOTOMETRY

Before obtaining a dataset from the calibrated images, the aperture of the target and comparison stars must be calibrated. The purpose of this is to adjust for any uncertainties located in the aperture region, such as background sky noise. The aperture region is the bright outer rings of the actual star itself. It varies in size depending on the focal length of the camera. Typically, the aperture should be set within 20 pixels of the star, and its outer region (called the annulus) must be set to 30-40 pixels. Taking the annulus's values, they are set to the apertures region, thus cancelling out any underlying uncertainties that may affect our data output (Seager, 2008). Fig. 2 shows how this looks in AstroImageJ.

ANALYSIS OF HAP-P-32

758 raw images of the exoplanet HAT-P-32b predicted transit orbit on 2016/01/17 (center of transit as predicted by NASA (https://exoplanetarchive.ipac.caltech.edu) in Julian Date: 2457404.65827 were analyzed. AstroImageJ was used to calibrate the images, analyze the flux of the star HAP-P-32, and fit a model onto the data.

CALIBRATION

First, the necessary flat, bias, and dark frames used to negate the systematic uncertainties from the images were obtained.

Using AstroImageJ's image data processor, the image directories were inputted, and all 758 images were calibrated. These calibrated images were then saved to a new directory, separate from the original images. Then, they were arranged into a stack (from first to last) and input as a sequence into the program, resulting in the output shown in Figure 3.

These images were ready for differential photometry, once the aperture region was defined.

DEFINING THE APERTURE AND DIFFERENTIAL PHOTOMETRY

Now that the calibrated images were loaded into the program, the next step was to define the aperture region of our target and comparison stars. The apertures pixel range was set to the best estimate, resulting in 12 pixels for the star, 15 pixels for the aperture region, and about 35 pixels for the annulus. The software then calibrated the aperture by setting it to the annulus's ADU counts, to eliminate any uncertainties. Note that AstroImageJ automatically eliminates any faint stars in the annulus's...
**FIGURE 4.** Selected target and comparison stars

**FIGURE 5.** Resulting plots of HAT-P-32b and 3 comparison stars

**HAT-P-32b Light Curve Analysis**

Dennis Afanasev

- rel_flux_T1 (ARMASS detrended with transit fit) (RMS=0.35293) (normalized)
- rel_flux_T1 Transit Model ([P=2.15], [R_p/R*]=2=0.0215, a/R*=0.1, i=90.0, Tc=2457404.657026, [u1=0.3], [u2=0.3]
- rel_flux_C2 (ARMASS detrended) (RMS=0.02872) (normalized) x(0.5)
- rel_flux_C3 (ARMASS detrended) (RMS=0.45243) (normalized) x(0.5)
- rel_flux_C3 (ARMASS detrended) (RMS=0.0376) (normalized) x(0.5)

[Graph of light curve analysis with axes and data points]
region. Once this is done, the target stars and comparison stars were set. Several comparison stars and one target star were, resulting in the output shown in Figure 4. The program evaluated each image in sequence and plots the flux, resulting in the results shown in Figure 5.

PROPERLY PLOTTING THE DATA

It was necessary to specify the proper graph format in which the measurements will be displayed in the AstroImageJ plot Graphic User Interface. The beginning date of the observation was recorded in the Julian Date format and plotted along the X-axis, which was set to its representation of hours and minutes (2 decimal places.) The flux was plotted along the Y-axis. Each star's flux was normalized to points along the Y-axis of my choosing, for visualization purposes. Airmass is a set of data recorded along with the transit photo-shoot, determining atmospheric conditions and negating them from the data. It is considered an uncertainty.

ANALYSIS OF THE PLOTTED DATA

As seen on Figure 6, the target star (labeled as rel_fluxT1) encountered a 2.1% dip in flux as the exoplanet transits across. Notice the dispersion of the points in the target star in relation to the comparison stars. This was due to the possibility of a binary planetary system or random stellar fluctuations (Hartman, 2011). It may not fully be known exactly what the uncertainties are, but conclusions may still be drawn from the data. Notice a gap in the data at around 0.65 JD. This was due to low quality images in the calibrated stack, which had to be removed, perhaps because of faulty camera movement or other unknown technical errors. Note that the other stars' flux remains relatively linear, indicating that a large body must have passed in front of this star.

TRANSIT FIT

AstroImageJ automatically fits a model onto the data points, from which we may learn a number of things about the exoplanet. Firstly, the host star parameters must be specified, in particular the radius (as Rsun), mass (as Msun), and spectral type (F5V for HAP-P-32). From this information, a series of parameters are calculated from the shape of the light curve, such as time in transit and impact angle. These formulas were obtained from a study conducted by Seager and Mallen-Ornelas (Seager & Mallen Ornelas, 2003). Some assumptions were made for these formulas: the exoplanet's orbit is circular, and the light is from a single star. Periodicity of the planets transit is inputted manually. For HAT-P-32 it is 2.15 days. The following calculations use variables given from the input below.

\[ \Delta F = \frac{F_{\text{no transit}} - F_{\text{transit}}}{F_{\text{no transit}}} = \left( \frac{R_p}{R_*} \right)^2 \]

Where \( R_p \) is the radius of the exoplanet, and \( R_* \) is the radius of the host star. A result of 2.1% was obtained from this exoplanet, which is consistent with our light curve.

\[ \frac{a}{R_*} = \left\{ \frac{1 + \sqrt{\Delta F}}{2} - b^2 \left[ 1 - \sin^2 \left( \frac{t_T \pi}{P} \right) \right] \right\}^{1/2} \]

Where \( t_T \) is the total transit duration, \( P \) is the period in days, and \( \Delta F \) is the transit depth, and \( b \) is the impact angle of the transit. An amount in value of the host stars radius of 6.0993 was obtained for this respective exoplanet. Radius of the planet \( R_p \) is calculated from:

\[ R_p = R_* \sqrt{\Delta F} = \left( k^{1/2} \frac{\rho_*}{\rho_{\odot}} \right)^{\frac{x}{1-3x}} \sqrt{\Delta F} \]

Where \( k=1 \) and \( x=0.8 \) for main sequence stars.

A \( \chi^2 \) value (McHugh, 2013) is automatically calculated by the AstroImageJ software. For the target stars' model fit, it was a value of 1630.1119, obtained by:

\[ \chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \]

Divided by the number of data points, 752 (our Degrees of Freedom), resulted in a value of 2.17. This was not a perfect fit for the data. This was caused by the dispersion problem discussed earlier, which may possibly be due to the host star's high jitter (Hartman, 2011).
DISCUSSION

HAP-32B is a close orbiting, “hot Jupiter” planet. Further research would need to be conducted to establish the exact parameters of the star’s high jitter. The observations made in this study come within close range to a separate study published in the Astrophysical Journal (Hartman, 2011). Although the χ² fit is not perfect (with χ²/d.o.f.=2.17), these results can be justified by the linearity of the comparison stars’ flux.

This exoplanet is one of the largest known planets discovered. When first discovered in 2011, the results broke the theoretical limit of how large an exoplanet may be.

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“The Indian Method of Warring”: Wampum, Warfare, and George Washington’s Lessons in Frontier Diplomacy During the Seven Years’ War

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ABSTRACT

Any scholar and student of early American history is well aware that there is no shortage of literature on George Washington. In recent years, scholars have done well to point out that Washington, despite generations of academic and public deification, was just as human as his more easily forgotten contemporaries, a reality evidenced by his (in)famous military mishap in the inter-imperial hinterlands of eastern North America that started the first world war in 1754. Yet Washingtonian literature remains void of a key element of Washington's experience in Indian country: his experience with Indians. In a biographical history spanning four centuries, there is still yet to be seen a Washington biography detailing his experiences with his nearest foreign foes and allies. This research paper attempts to fill that void. This is not another study of young Washington’s experience in the British colonial militia, but rather a breakdown of the lessons he learned in warfare and diplomacy as a visitor in Native lodges, villages, and territories and how he applied these experiences to British colonial warfare and wartime politics. These lessons are best understood only when Native players are recast in their proper roles, as the kings, half kings, and queens of Indian country. This redistribution of political and historical agency and reconceptualization of monolithic narratives allows us to better understand the inseparability of colonial, early American, and Native American histories.

INTRODUCTION

In late April 1754, a pair of couriers trekked through the eastern Ohio country to a Mingo trading village just east of where the Allegheny and Monongahela rivers join to form the Ohio River. One Mr. Wart, a young ensign of British Captain Trent’s company, toted in his saddlebag a string of wampum. His escort, an unnamed Mingo man, carried a speech addressed to Tanacharison, or as his British contemporaries fondly referred to the influential Mingo leader, “the Half King.” “I desire, with the greatest Earnestness,” it read, “that you, or at least one of you, would come as soon as possible to meet us on the Road, and to assist us in Council.” As the Mingo escort read the speech aloud to the Half King, Wart presented the wampum. “I present you with these Bunches of Wampum, to assure you of the Sincerity of my Speech, and that you may remember how much I am your Friend and Brother. Signed, Washington, or Conotocarious.” Upon their first formal meeting months earlier, Tanacharison had bequeathed the nickname to a young George Washington like a family heirloom. Three generations earlier, another Colonel Washington of Virginia had earned the Algonquian term for “Town Destroyer” after his militia unit killed six Susquehanna and Piscataway chiefs in an attempt to thwart a colonial frontier rebellion.1 (Founders Online, Expedition to...

1 Tanacharison (also spelled “Tanaghariisson”) was originally adopted from a Catawba band into the Seneca tribe, one of the Haudenosaunee, or Six Nations Iroquois, nations of northeastern North America. Sometime around 1747, when his name first appears in the historical record, several bands of Iroquois had migrated to where Seneca territory meets disputed land known general as the eastern Ohio Country. The result was a sub-Haudenosaunee nation known as “Mingo,” one considered culturally and socially (although not always politically) exclusive from the core Six Nations. For the sake of this paper, I will refer to Tanacharison as a Mingo leader. For more on Tanacharison’s nationality and the Mingo people, see: Michael N. McConnell, A Country Between: The Upper Ohio Valley and Its Peoples, 1724-1774 (Lincoln, NE: University of Nebraska Press, 1992).

2 At some point during the events that led to Bacon’s Rebellion in 1676, Virginia militia colonel John Washington...
the Ohio, 1754: Narrative)

Early Americanists know well, of course, that in a poetic twist of historical fate, Washington eventually lived up to the title of “Town Destroyer” when he ordered American General John Sullivan to destroy dozens of Haunde- nosaunee (Iroquois) villages and starve Britain’s closest Indian allies out of their own country in 1779. In the context of Tanacharison and Washington’s relationship, however, the moniker did not carry the grim weight as it once had decades earlier and would reclaim decades later. In his early twenties, George worked hard to reverse his great-grandfather’s bloody backcountry legacy, airing on the side of diplomacy rather than demolition. Still the nickname stuck, appropriated by Washington’s various hosts and correspondents during the 1750s as an honorific title (“Conotocarious,” n.d). The permanency of “Conotocarious” in the minds and dialogues of Native leaders speaks largely to Washington’s early experiences in Indian country. The use of the nickname implied a sense of place the young Washington was to occupy in a world he had much to learn from. In English, “Town Destroyer” reminded Washington of his ancestor’s indiscretions, ones not easily forgotten. In Algonquian, “Conotocarious” reminded the young British officer of his place and purpose in foreign territory.

This highly contested area of eastern North America donned several names—and several more claims to its resources—throughout the eighteenth century. Shawnees claimed the territory between the eastern bank of the Wabash River and the western peaks of the Alle- geny mountains as their homeland, bequeathed by divine powers to the ever-powerful Chalahgawtha division of the Shawnee confederacy. The French poetically defined the rich region into which they injected fur-driven capital and Catholicism as the pays d’en haut, or “upper country.” The British adopted the Seneca term for “great river” or “large creek” and deemed the area simply as the Ohio country, a term still used interchangeably in the historical literature with “Indian country.” As the famous story goes, it was here, in Indian Country, that Washington started the first world war (Anderson, 2000). Fred Anderson, David Clary, Matthew Ward, and others have done well to demonstrate the importance of the Seven Years’ War in Washington’s excessively mythologized life (Anderson 2000; Clary 2011, Ward 2003).

Yet Washingtonian literature remains void of a key element of Washington’s experience in Indian Country: his experience with Indians. In a biographical history spanning four centuries, there is still yet to be seen a Washington biography detailing his experiences with his nearest foreign foes and allies. This research paper attempts to fill that void. This is not a study of young Washington’s experience in the British colonial militia, but rather the lessons he learned in warfare and diplomacy as a visitor in Native lodges, villages, and territories. These lessons are best understood only when Native players are recast in their proper roles, as the kings, half kings, and queens of Indian country who dictated local and international politics as much as distant European governors and sov- ereigns did. For Washington, who quickly found himself in the midst of one of the most contentious places and moments in eighteenth-century North American history, learning the political landscape of Indian country required learning the rules of ritualized exchange of words, wampum, and scalps won in war. In order to do so, the young George Washington had to leave his colonial titles—soldier, socialite, surveyor, and slaveholder—at the Virginian border, and instead adopt is Algonquian name: Conotocarious the Second.

A TOLERABLE KNOWLEDGE OF THE COUNTRY

Washington had familiarized himself with Indian country long before the beckoning of imperial war. On March 11, 1748, less than one month after his sixteenth birthday, an adolescent Washington set out on his first documented surveying expedition with his mentor George Fair- fax. After two weeks of following the eastern edge of the Shenandoah Valley northward, the survey party arrived at Thomas Cresap’s establishment on Patterson’s Creek, just south of Maryland’s Cumberland Gateway into the Alleghenies. It was here that Washington documented his first encounter with “thirty odd Indians coming from War over twenty years of experience in backcountry trade, Cresap had established a firm relationship with Lenape chief Nemacolin and the two worked together during the late 1740s and early 50s to secure passage via Patterson’s Creek into the Ohio country (Bailey, 1944). In his earliest account of Native Americans, Washington’s description of the Lenape war dance detailed only the peculiarities in their movements, making no mention of any verbal exchanges between members of the survey party and the
Lenape warriors. While Washington's isolated account of Native Americans is scant of meaningful political or cultural detail, it allows us to pinpoint his first exposure to Indian lands and peoples. He continued to survey for Fairfax, but makes no mention of any exchanges or encounters with Native peoples for another five years.

Washington's detailed 1753 narrative of his journey to the French commandant marks the beginning of one of his earliest yet most formative roles: emissary to Virgin-ia colonial governor Robert Dinwiddie. Dinwiddie tasked Washington to deliver a letter to French commanders at Fort LeBoeuf warning the French that their unwelcomed military presence in the Ohio country was sorely testing colonial borders, and in turn, London's patience with the French Empire. The task required the cooperation and assistance of influential Mingo and Lenape chiefs who maintained a watchful eye on the Forks of the Ohio and surrounding area. The expedition—led by Christopher Gist—approached the Forks on November 22. Washington spent four days summoning local chiefs to a council in order to gather information about French intentions in the Ohio country and secure safe passage to Fort LeBoeuf. On November 26, at a council at the trading establishment of Logstown, Shingas, a Lenape chief, and Tanacharison, a highly influential Mingo chief, accepted Washington's gift of wampum and, in return, promised the expedition protection along the Venango Path up to Fort LeBoeuf. Diplomatically inept as well as monolingual, Washington relied entirely on the advice of “Indian Traders” Barnaby Currin, John McGuier, Henry Steward, and William Jenkins, and translation skills of interpreter John Davison.4 (Founders Online, Journey to the French Commandant: Narrative)

The council at Logstown was the first of many exchanges between Washington and Tanacharison. Upon his departure from Fort LeBoeuf in January 1754, Washington recognized the necessity of Tanacharison's and Shinga's blessings, and that their allegiance would not be won easily, for the French had proven themselves far better versed in diplomatic manipulation than Washington cared to admit.5 But Washington would soon have little to worry about; likely due to promises of gifts and protection from colonial officials, Tanacharison quickly warmed to the British and facilitated their military occupation of the Forks region. When Captain Contrecoeur arrived with a French force from Fort LeBoeuf at the Forks on April 17, the Virginian militiamen responsible for constructing a new British fort promptly abandoned the site (Dixon, 2007). Upon the militiamen's departure, Tanacharison informed Contrecoeur that it was his own prerogative to establish what later became Fort Duquesne, and that he himself had laid the first log (Dixon, 2007). (Founders Online, Expedition to the Ohio, 1754: Narrative)

Few, if any, other Indian leaders in the Ohio country demonstrated the same devotion to the British cause that Tanacharison did. In November 1753, Washington and Gist had gone well out of their way to attempt to win the allegiance of Seneca Queen Alliquippa, but she, and later her successor and son, never formally pledged her tribe's commitment, and criticized the arrogance of British officers.6 Washington persisted in attempting to win the affections of other powerful Haudenosauanee leaders years into the war; in August 1756, Washington delivered a passionate speech to King Blunt and other Tuscarora chiefs, proclaiming, “Brothers, You can be no strangers to the many Murders & Cruelties, committed on our Country Men & Friends, by that False & Faithless people the French, who are constantly endeavouring to corrupt the minds of our Friendly Indians” and promising to “furnish them [with] Arms, Ammunition, Cloths, provision, and every necessary for War” (Founders Online, Speech to the Tuscarora Indians, 1 August 1756). Whether Washington made good on his promise to the sixth Iroquoian nation remains uncertain, but he was likely one of many courting the Tuscarora. The Seven Years’ War devastated the Haudenosauanee, as the Six Nations tore itself apart over political, religious, and personal disagreements and sent the confederacy spiraling into civil war. It was promises like Washington's that drove members of the same nation to lead attacks against one another.7

Both French and British officers tasked with maintaining the occupation of the Ohio country understood

4 Jacob Van Braam was also brought along as a French-to-English interpreter. Source: George Washington, “Journey to the French Commandant: Narrative,” (1753–54), in Founders Online.

5 Tanacharison agreed to accompany Washington to Fort LeBoeuf in order to return the treaty wampum he had previously exchanged with the French. Thus when Tanacharison arrived at the fort, the French commandant, Captain Philippe-Thomas Chabert de Joncaire, took Tanacharison's presence as a double cross. Joncaire hid his fury, and instead imbibed the Mingo chief with champagne until he was so drunk that he could not return the wampum belt they had previously exchanged, thus preserving the alliance for another several months. Source: H.W. Brands, The First American: The Life and Times of Benjamin Franklin (New York, NY: Anchor Books, 2000).

6 Kos Showeuya (Alliquippa's son) had a complicated relationship with General Edward Braddock, which shall be discussed later in this paper. Sources: Washington, “Journey to the French Commandant,” 1753; Matthew C. Ward, Breaking the Backcountry: The Seven Years' War in Virginia and Pennsylvania, 1754–1765 (Pittsburgh, PA: University of Pittsburgh Press, 2003), 40–42.

7 The Battle of Lake George is one particularly devastating example, during which Catholic Mohawk led French forces in ambushing a Mohawk-led British outfit. Source: Peter D. MacLeod, The Canadian Iroquois and the Seven Years’ War (Toronto, Ontario, Canada: Dundurn Press, 2012), 27-35.
that even the temporary assistance of local Indians required a constant amount of attention and plenty of gifts. Winning the war meant winning the favor of the Native leaders whose nations still occupied the lucrative buffer zone between French and British influence. Even so, if the political or economic interests of eager Europeans could not align with individual or collective Indian interests, even the most adept European courters went home empty-handed. Given the level of competition, it is no wonder Haudenosaunee, Ottawa, Shawnee, Lenape, and other influencers played coy; if European officers wanted to win, they had to pay for it. For those privileged enough to earn them, relationships between military officers and Native leaders in the Ohio country could be mutually beneficial—so long as the flow of guns, gifts, and wampum remained steady.

A STRING OF WAMPUM, & A TWIST OF TOBACCO

Prior to the eighteenth century, northeastern Native Americans used wampum in inter- and intra-tribal exchanges for its ritualistic, religious, and spiritual value. Throughout the 1600s, Dutch and English colonists stripped the beads of their sacrosanctity and began mass producing wampum as a form of legal tender in colonial–Native trade (Jacobs, 2009). Eventually mass production in colonies from Massachusetts Bay to Virginia spurred inflation; by the early eighteenth century, few colonial governments still recognized wampum as a legitimate form of currency (Jacobs, 2009). Removed of its enumerative value, wampum was used increasingly for its symbolic properties. Belt designs varied by nation as well as political circumstance; the Lenape–Pitt Treaty Belt exchanged at Shackamaxon in 1682 depicts two men shaking hands, while the Onondaga Two Row Treaty Belt exchanged with Dutch and English officials is a simple design consisting of two parallel strips of purple wampum (Jennings, 1995). While different in design, both belts physically convey sacred alliance. Peace and treaty belts also serve as an alternative method of communication that transcends linguistic barriers; the belt itself conveys a message, as does the way in which it is passed amongst individuals.

Washington mentions the powerful bead at least fifty times in his writings between 1753 and 1757, and consistently notes its ritualistic as well as political necessity in facilitating effective communication and establishing good intentions. Likely acting upon the advice of John Davison and Christopher Gist, Washington’s first action upon his arrival at Logstown on November 24, 1753 was to call on Oneida chief Monacatoocha, Tanacharison’s closest associate, and gift him two items: “a string of wampum” to be delivered to Tanacharison as an invitation to Logstown, and “a twist of tobacco,” a personal token of respect and gratitude meant for Monacatoocha himself.8 The next afternoon, Tanacharison arrived at Logstown for a private rendezvous with Washington and Davison. The Half King described the indifference the French commander at Fort LeBoeuf exhibited towards Tanacharison himself; when the Mingo chief proposed the French ought to negotiate with English over control of disputed territory, the Frenchman promptly shot the proposal down: “Where is my Wampum that you took away, with the Marks of Towns in it? This Wampum I do not know, which you have discharge’d me off the Land with; but you need not put yourself to the Trouble of Speaking for I will not hear you: I am not afraid of Flies or Musquito’s; for Indians are such as these.” The disrespect was enough to inspire Tanacharison to willingly provide Washington with a safe route to Fort LeBoeuf, as well as the location of two other newly erected French forts. The French commander’s words and Tanacharison’s resulting actions taught Washington a valuable early lesson: that the sharing of wampum meant little without respectful intent. (Founders Online, Journey to the French Commandant: Narrative, and Expedition to the Ohio, 1754: Narrative)

Washington’s superiors were slower learners when it came to understanding the personalized politics of Indian country during wartime. In April 1757, nearly three years into the Seven Years’ War, Washington’s aide-de-camp George Mercer wrote from Fort Loudon about a mishap with Cherokee warriors. Wauhatchet, a key Cherokee ally and head warrior, “would not receive the Wampum I offered him, as is usual, at the End of the Speech,” reported Mercer, “[he] immediately got up, & went out of the Council in a great passion, and told the rest of the Warriours they might speak to me, if they had anything to say.” The warriors had arrived at Fort Loudon earlier than expected to assist in his company’s movements, only to find that the gifts Dinwiddie had allegedly promised for their service were not there. One warrior, Youghtanno, assured Mercer that the Cherokee understood the captain nor Dinwiddie meant any disrespect. Wauhatchee, however, would not concede, telling Mercer that the governor’s apparent ignorance had cost the head warrior a considerable amount of respect amongst his fellow warriors. Mercer also expected a Catawba unit the next day, who were expecting gifts from the British as well. Mercer warned Washington, “if these Indians go home dissatisfied, we lose the Interest of the whole Nation.” Washington rushed the news to Williamsburg, but the seeds of Wauhatchee’s distrust of British officers had been sown long before his dramatic flourish at Fort Loudon, and

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8 Tobacco has been used as a symbolic gift exchanged among Native American peoples across the United States for hundreds of years. It is valued for its “medicinal” value, as it provides protection when burned and can also be used in peace pipes, another common ritual that varies by tribe and/or nation. Source: Jack Jacob Gottsegen, Tobacco: A Study of Its Consumption in the United States (1940), 107.
no amount of wampum could repair the damage done.  
(Founders Online, To George Washington from George Mercer, 24 April 1757, and To George Washington from George Mercer, 26 April 1757)

**FRENCH SCALPS AND FOUR HATCHETS**

While the mutual exchange of wampum often indicated relatively stable peace amongst nations, this act of alliance-building simultaneously created opportunities for acts of war. Starting in the 1720s and lasting through the end of King George's War in 1748, the British pursued a slow strategy in establishing an alliance with the Haudenosaunee. The process resulted in the creation of the Covenant Chain, a strong but short alliance between the British colonies and Haudenosaunee. The Haudenosaunee Two Row Wampum Treaty Belt made the alliance a sacred one, one that required cooperation and commitment from Iroquoian leaders, who promised to correct ambitious young men, and British leaders, who vowed to keep provocateurs and squatters out of Haudenosaunee country. While the Chain between the colonies and the Iroquois only lasted until 1755, it secured the buffer zone between New France and British America. In the broader context of the Seven Years’ War, the Covenant Chain helped to insulate western Pennsylvania, New York, New England and the Ohio country from French military influence. The Covenant Chain was somewhat of a gamble for the Haudenosaunee; committing to the British ensured a steady stream of gifts and military support, but it also removed the Six Nations of their ability to play the contending empires off one another for gifts, military support, and veneration. It was a skill the Haudenosaunee had mastered, and had subsequently sacrificed in consenting to the Covenant Chain. (Dixon, 2007; Jennings, 1995)

Many tribes of the Ohio country refused to take such a risk. In the early stages of the Seven Years’ War, British officers (including Washington) hastily dispatched wampum-laden interpreters to Mingo, Lenape, Cherokee, and Ottawa leaders, but the Ottawa depended too heavily on French munitions, while Cherokee leaders grew increasingly frustrated with British ignorance (McConnell, 1992; Anderson, 2000). The Mingo and Lenape proved stealthier in their attempt to extract goods, protection, and respect out of both empires; in retrospect, Washington’s suspicions about Tanacharison’s intentions before the outbreak of war are impressively acute. When Tanacharison joined Washington at Fort LeBoeuf in January 1754, the Half King lingered with the French longer than Washington felt was necessary (Founders Online, Journey to the French Commandant: Narrative). Washington’s worries eventually proved futile, as Tanacharison later demonstrated his willingness to play into British cause in killing Coulon de Jumonville at Great Meadows the following May—even if he only did so to further his own political goals.

Washington learned quickly that intertribal warfare was as personal as it was political. The unfolding of events at Great Meadows on May 27 and 28, 1754 provide an excellent example of where personal and political motivations in warfare both clashed and converged. Months of diplomatic protocol—the exchange of wampum, the bestowal of gifts, and name-giving—provided a sufficient amount of personal (and, by nature, political) attachment between Tanacharison and Washington (and, by extension, Dinwiddie). On the evening of May 27, when Tanacharison opted to send word of the enemy’s movements to Washington instead of Jumonville, Washington’s months of effort in the Ohio country proved successful. But there were still reparations to be paid; showing off a string of wampum and showing off a scalp were two entirely different acts. After Washington and Tanacharison’s men ambushed Jumonville’s outfit the following day and as Washington began to accept the French surrender, the Mingo warriors began killing and scalping the wounded French soldiers, much to Washington’s dismay. (Founders Online, From George Washington to Robert Dinwiddie, 29 May 1754)

But the scalps were as necessary to Tanacharison as a clean French surrender was to Washington. The French scalps, along with war hatchets, were sent to Monacattocha, who then set out to recruit warriors from the Lenape, Shawnee, and Seneca to join the British–Mingo forces at Great Meadows (Founders Online, From George Washington to Robert Dinwiddie, 29 May 1754). Leaders from all three nations refused, for reasons both personal and political. Take Queen Alliquippa as one example: in June 1754, just days after the ambush at Great Meadows, she allowed her son Kos Showeyha to attend council with Washington but refused to allow him to fight under any British officers’ command (Founders Online, From

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9 The Anglo-Cherokee War on the Virginian and Carolinian frontiers began in 1758, one year after Wauhatchee’s angry confrontation with Mercer at Fort Loudon, and lasted until 1761. The conflict cost the British men and resources and diverted colonial militias from fighting the French and helping to end the Seven Years’ War. Source: John Oliphant, Peace and War on the Anglo-Cherokee Frontier, 1756–63 (Baton Rouge, LA: Louisiana State University Press, 2001).

10 The circulation of hatchets among Ohioan/eastern nations was effectively the equivalent of a formal declaration of war, as much as the presentation/exchange of wampum was a formal declaration of peace, and is therefore bound with the ritualistic and political implications of scalping. See: George Washington to Robert Dinwiddie, 10 June 1754, in Founders Online; for more on the ritualistic and political implications of scalping in eastern Native America, see Margaret Haig Roosevelt Sewall Ball, “Grim Commerce: Scalps, Bounties, and the Transformation of Trophy-Taking in the Early American Northeast, 1450-1770,” University of Colorado, Boulder (2013).
George Washington to Robert Dinwiddie, 10 June 1754. One month later, Pennsylvania governor Robert Hunter Morris appointed Kos Showeyha and six other chiefs of various nationalities to accompany Braddock at the Battle of Monongahela the next summer (Ward, 2003). Kos Showeyha later resented his forced service to Braddock, confessing that “he was a bad man when he was alive; he looked upon us as dogs, and would never hear anything that was said to him” (Ward, 2003). Kos Showeyha continued to provide intel to Governor Morris for another year of the war, but refused to fight again under any British general who demonstrated that same “pride and ignorance [...] that came from England” (Ward, 2003).

From a European perspective, Washington’s actions at Great Meadows were one massive military blunder; not only had he allowed Mingo warriors to kill French survivors at will, the foolish young Washington later misinterpreted the terms of surrender and inadvertently admitted to murdering Jumonville after the British surrender at Great Meadows on July 4 (Anderson, 2000). Had the British colonies been better prepared to defend the Empire in 1754, Washington’s mistakes would have been warranted. Instead, the British spent seven costly years driving the French from eastern North America. From a Mingo or Oneida perspective, however, Washington was the British gift that kept giving. Through Washington, the British supplied a constant flow of wampum, gifts, and military protection into the Ohio country for half a year. Just one day before the warriors collected scalps as proof, Washington demonstrated some concern to the fate of the Anglo-Mingo alliance: “I must take the Liberty of mentioning to Your Honour the g[rea]t necessity there is for having goods out here to give for Services of the Indians,” he wrote to Dinwiddie on May 27th, “[as] they all expect it and refuse to Scout or do anything without—saying these Services are paid well by the French—I really think was 5 or 600 Pounds worth of proper goods sent [...] w[ou]ld tend more to our Interest” (Founders Online, From George Washington to Robert Dinwiddie, 27 May 1754). The 22-year-old’s appetite for an early military victory gave Tanacharison and Monacatoocha an opportunity to wave white scalps in the faces of powerful Haunde-nosaunee and Shawnee chiefs.

Washington recognized that as much as scalping was customary in Native war cultures, it was equally as functional as a scare tactic among European soldiers. “At [Fort Duquesne], [...] they have had frequent Alarms [that] several Men have been Scalp’d,” Washington wrote to his older brother, John Augustin, in July 1755, “but this only done with no other design than to retard the March; and to harass the Men” (Founder Online, From George Washington to John Augustin Washington, 28 June–2 July 1755). In 1756, upon arriving at the site of the Battle of Great Cacapon and discovering a dead and scalped Captain John Mercer, Washington himself sent a Lenape or Shawnee scalp to Dinwiddie along with a letter informing him of the seventeen total British casualties.11 Much like wampum, enemy scalps gradually transformed from ritualistic symbols to a currency or credit of sorts. In November 1756, Washington reported to Dinwiddie that he had instructed British interpreters and officers in South Carolina to delay Cherokee and Catawba warriors from travelling north to fight their longtime rivals, the Shawnee, because the British could not afford to pay the warriors back for their scalps. “Indian Goods are much wanted to reward the Catawbas, and encourage them to our Service,” Washington warned Dinwiddie on November 9, “In what manner are they to be paid for scalps? Are our Soldiers entitled to the reward like indifferent people? It is a tedious & expensive way to defer payment” (Founders Online, From George Washington to Robert Dinwiddie, 9 November 1756). Washington encouraged Dinwiddie to write Governor Lyttleton of these financial troubles, but both governors turned a blind eye. Six months later, Washington again reminded Dinwiddie of the army’s trouble with the Cherokee: “I therefore beg leave to recommend [...] that some person of good sense and probity, with a tolerable share of the knowledge of their customs, be appointed [the] power to reward [the Cherokee] occasionally as their services require: Pay them for scalps; provide them with Provisions, arms, clothing, [etc.]” (Founders Online, From George Washington to Robert Dinwiddie, 30 May 1757). Much to Washington’s annoyance, colonial governors and their subordinates in the backcountry never heeded his advice and gave the Cherokee enough reason to wage their own war against the British.

Washington’s frustrations with the military bureaucracy mounted quickly. Dinwiddie, Lyttleton, and other high-ranking colonial officials did not understand the war in Indian country as did officers, emissaries, or negotiators. Bureaucrats were not responsible for all the blame; having refused the advice of subordinated officers familiar with French and Indian tactics, General Braddock lost both the Empire’s foothold at the Forks of the Ohio and his life during his ill-fated 1755 expedition.12 In April 1756, Washington voiced his concerns in a powerful

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11 Occurring on April 18, 1756 near present-day Hampshire County, West Virginia, the Battle of Great Cacapon was a violent skirmish between Captain John Mercer’s company and Shawnee and Lenape warriors. At this point in time, Washington had attained the rank of colonel, and Mercer was one of his subordinates. In older sources, the battle was referred to as “the Mercer Massacre.” Sources: West Virginia Archives, “Biennial Report of the Department of Archives and History of the State of West Virginia” (West Virginia Archives: 1911); George Washington to Robert Dinwiddie, 3 May 1756, in Founders Online

12 The reasons for Braddock’s failure in the 1755 expedition are disputed amongst scholars of the Seven Years’ War, but the general’s dismissal of advice from officers, emissaries, negotiators, and other figures familiar with the colonial frontier is no doubt a
letter to member of the Virginia House of Burgesses John Robinson: “our Detachments, by what I can learn, have sought [French and Indian forces] diligently; but the cunning and vigilance of Indians in the Woods are no more to be conceived, than they are to be equalled by our people” (Founders Online, From George Washington to John Robinson, 7 April 1756 ). Washington warned Robinson, “Indians are only match for Indians; and without these, we shall ever fight upon unequal Terms.” To an extent, Washington's struggle with incompetent superiors was more exhausting than were his battles against Britain's Indian adversaries.

**UNUSED TO THE INDIAN METHOD OF WARRING**

When Dinwiddie first granted Washington the title of colonial emissary, the young ambitious Virginian had yet to truly earn it. Nearly two years later, a political system dictated by wampum, scalps, and interpersonal networking allowed Washington the opportunity to earn that title, and more. In October 1755, Washington invited Andrew Montour and the three hundred Indian warriors under his command to an informal rendezvous at Fort Cumberland: “assure them that as I have the chief Command I am invested with Power to treat them as Brethren & Allies, which I am sorry to say they have not been of late” (Founders Online, From George Washington to Andrew Montour, 10 October 1755). He then added “Recommend Me kindly to our good Friend [Monacatoocha] & others [and] tell them how happy it would make Conotocaurious to have an Opportunity of taking them by the Hand at Fort Cumberland, & how glad he would be to treat them as Brothers of our great King beyond the Waters.” That October, Washington was absorbed in a heated argument with Dinwiddie over Captain John Dagworthy's recent assumption of command over Fort Cumberland (Ferling, 2010). The Maryland militia commander's royal commission stripped Washington of his authority to command the fort, despite Washington's higher nominal rank. But when Montour and a force of three hundred warriors arrived at the fort, Dagworthy would be hard pressed to turn them away. More importantly, when Monacatoocha arrived at Fort Cumberland, he would be looking for only one person: his oldest friend in Virginia, Conotacarious. Monacatoocha was one of Conotacarious' last person-

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13 Both Tanacharison and Queen Alliquippa relocated their people to the Aughwick Valley to avoid increasing hostilities between French and British forces. Thanks largely to Monacatoocha, Tanacharison's warriors remained devoted to the British cause after the Mingo Half King died of pneumonia on October 4, 1754. The Seneca queen died from pneumonia as well on December 23, 1754. Source: McConnell, A Country Between.

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Asymmetric Campaign Advertising: Partisan Differences in 2014 Congressional Campaign Advertisements

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ABSTRACT

This preliminary study identified partisan differences in television advertisements for Senate candidates in 2014 and paves the path for further study of partisan differences in campaign advertising more broadly. Analyzing data gathered on all of the television advertisements aired for U.S. Senate candidates in 2014, this research finds distinct partisan styles emanating from both of the major political parties. In particular, the data suggests that candidates for the Republican Party used more cohesive messaging during the 2014 election cycle, while candidates for the Democratic Party advertised on a wider array of issues. These findings align with previous research on partisan asymmetry in the United States, and have important implications for future campaigns. Understanding how campaigns advertise to voters is one of the first steps to addressing growing polarization in Congress.

INTRODUCTION

Gardner: “Welcome to Yuma, Colorado – two hours from the big city.”
Gardner’s Daughter: “And a long way from anywhere else.”
Gardner: “In a place like this, you learn to get along.”
Gardner’s Daughter: “That’s how we do it here, dad.”
Gardner: “It’s too bad Washington doesn’t work that way. I’m Cory Gardner – I’ll be a Senator who solves problems instead of making them worse” (Cory Gardner for Senate).

Compare that 2014 television advertisement from Republican Representative Cory Gardner to this advertisement from incumbent Democratic Senator Mark Udall, running against him:

“There’s a reason why women and families are front and center in this campaign. It’s not just about respecting every woman’s fundamental rights and freedoms – it’s that everyone deserves a fair shot at success, with affordable student loans, equal pay for women in the workforce, and equal treatment when it comes to what men and women pay for their healthcare” (Udall for Colorado).

While those advertisements were just two of millions aired by candidates for Congress in 2014, they represent strategies utilized by candidates across the United States. Although both 30-second advertisements never mention party affiliation, there is a distinct partisan style employed in them. Gardner’s advertisement invokes conservative values like personal responsibility and family (such as his daughter’s role in the advertisement), while Udall’s advertisement clearly aims at women and mentions specific policies such as implementing “affordable student loans.” While these distinctions may register as inconsequential at first glance, they carry important implications for modern American politics.

The 2014 midterm elections are ripe for studying campaigns at the academic level because of their perceived importance at the time and their results. That year, President Barack Obama was completing the first half of his second term in office and reaching the end of his presidency. The last midterm election in 2010 featured a historic Republican takeover of the House of Representatives as Tea Party candidates across the country campaigned vehemently against the healthcare reform law, the Affordable Care Act (also known as Obamacare) (Best, 2010). This GOP wave slowed by 2012 when Obama was re-elected president and the Democrats maintained control of the Senate. At that point, Republicans focused on regaining control of the Senate, so they could more effectively obstruct the president’s agenda until his term ended in 2017. Their strategy, as reported in the Washington Post, was to “make it all about Obama, Obama, Obama,” since his approval rating was in the low 40s (Rucker & Costa, 2014). That strategy appeared to pay off on Election Day 2014, when Republicans captured the Senate, gaining nine
seats, and boosted their already-high House majority by an additional 13 seats. This had important policy implications for the Obama administration. Namely, it prevented the president from passing any landmark legislation and forced Obama to pursue other paths – like executive orders – when pushing his agenda (Korte, 2016).

This paper argues that there are distinct partisan styles used in television campaign advertisements which have consequences that potentially threaten American democracy. Accordingly, this paper will explore the communication strategies utilized by Republican and Democratic congressional candidates during the 2014 election cycle grounded in partisan asymmetry theory and in the context of the highly polarized environment. I will start by reviewing the history of polarization in Congress and the explanations scholars have offered for the extreme polarization we see today. One explanation – “partisan sorting” – will be key to this study as it positions elite discourse as the primary mechanism in which the broader American electorate “sorted” itself into the political parties along ideological lines (Levendusky, 2009). Partisan sorting is vital to understanding how campaign messages contribute to increasing polarization in Congress. I will then proceed to analyze political ideology in the U.S. and how it has impacted campaign rhetoric. One theory in particular informs how I will approach this study: partisan asymmetry. This theory, articulated most recently by Grossmann and Hopkins (2016), argues that political parties are “asymmetric” in that the electorate is made up of “ideological Republicans” and “group interest Democrats,” which inherently creates an advantage for the Republican Party. Other academic work involving ideology focuses on how the U.S. is “symbolically conservative,” yet “operationally liberal” (Ellis & Stimson, 2012). Most research surrounding contemporary campaign communication lacks this context when seeking to explain partisan messages, as scholarly work on campaign communication has largely focused on how candidates discuss issues. Two competing theories have emerged from this work: issue convergence and issue ownership. Issue convergence argues that candidates will campaign on a similar set of issues to win the voters in the middle who tend to decide elections (Sides, 2006). Issue ownership, however, argues that candidates will campaign on a distinct set of issues that their political party has an advantage on and will frame the remaining issues in ways aligned with their party’s rhetoric (Petrocik, 1996). Lastly, I will briefly explore the literature around political television advertising, the medium analyzed in this study.

In the sections that follow my literature review, I will propose a specific research design for answering my research question. I have conducted a pilot study that considers the following research question:

RQ: How did the television advertising of Republican and Democratic candidates differ in the 2014 election cycle?

After reporting the results of the pilot study, I will conclude with a discussion of how the pilot study’s results compare to the literature presented and the value they have in American political campaigns. Additionally, I propose a more complete study to build off this pilot study by adding more election cycles, House races, differentiating between primary and general election advertisements, distinguishing advertisements from specific candidates, and adding other sources of ideological analysis.

What present research on campaign communications lacks is how partisan campaign messages contribute to the polarization we see today and how they accentuate asymmetry in American politics. This research will consider the partisan differences in campaign advertising, discussing how candidates talk about issues, as well as the partisan style they use in their advertisements that convey information to voters. The results of this pilot study will inform academic understanding on how partisan asymmetry is operationalized in political advertising and will allow future candidates disappointed by the polarized environment to incorporate the findings into their campaign strategy.

LITERATURE REVIEW
Polarization and “Partisan Sorting”

A discussion of partisan campaign communication strategies should first begin with a background of the increasing polarization seen in Congress and the resulting mass partisanship. Scholars agree that Democrats and Republicans are polarized at high levels -- according to political scientists Keith Poole and Howard Rosenthal, Congress in 2015 was more polarized than it had ever been since Reconstruction in the 19th Century (The Polarization, n.d.). Poole and Rosenthal have developed a widely accepted measure of ideology called DW-NOMINATE, which spatially maps legislators in relation to each other based on their roll call votes. Most voting in Congress can be explained by the liberal-conservative dimension, although some voting can be explained by a regional dimension. Using Poole and Rosenthal’s DW-NOMINATE scores, it becomes clear that polarization has increased steadily since the 1970s. For example, the Democratic Party in the 92nd Congress (1971-1973) had a median ideology score (the “median member” of the party across both the House and Senate) of -0.33 (-1 being very liberal). In the 114th Congress (2015-2017), the Democrats’ score was -0.39. Republicans in the 92nd Congress had a score of 0.25 (1 being very conservative), while Republicans in the 114th Congress had a score of 0.49. The median Democrat was 0.58 away from the median Republican in the early 1970s on the DW-NOMINATE scale. In 2015, the median Democrat is separated by 0.87 from the median Republican – meaning the distance between the
parties increased by 33 percent over a period of 40 years.\footnote{The DW-NOMINATE data is accessible here: https://voteview.com/parties/all}

As noted in the previous data, Congress began the recent trend of polarization in the mid-1970s. According to Theriault (2008), the parties were highly polarized throughout the 19th Century and continued to polarize until the turn of the 20th Century. At that point, the parties began a trend of convergence that lasted through the 1930s, reaching its peak in 1952, and remained converged until 1972. Theriault points out that in the 93rd Congress (1973-4), most Republicans were more liberal than the most conservative Democrat, and more than a third of Democrats were more conservative than the most liberal Republican (Theriault, 2008). During this period known as the “Textbook Congress,” political party leadership in Congress was relatively weak compared to the committee system, in which conservative party chairs limited the partisan strategies Democrats could use. However, the mid-1970s brought change with the beginning of the post-reform Congress – three different measures of polarization all confirm that Congress has become more polarized since then, with similar levels of polarization seen in both the House and Senate (Theriault, 2008). Theriault outlines the four existing major explanations for increasing polarization: redistricting, constituent sorting, extremism of party activists, and procedural changes. He argues that these theories only effectively explain polarization when considered as a whole. To that end, Theriault seeks to integrate these theories into one model for Congressional polarization beginning with a change in constituencies (due to redistricting or sorting), leading to procedural change, and resulting in party polarization in both the House and Senate (Theriault, 2008). Importantly, his model gives credence to the idea that partisan sorting has contributed to increasing polarization.

What does partisan sorting refer to? At a basic level, the theory states that as elites have polarized, the political positions of the parties have become easier and more accessible for mass Americans to understand, resulting in voters sorting themselves along ideological lines. Ultimately, this means that most Democrats are liberal and most Republicans are conservative (Levendusky, 2009). In The Partisan Sort, Matthew Levendusky (2009) argues that elite polarization has resulted in voters adopting the same ideological views of their party’s elites. He says this sorting comes from conversion (“existing voters aligning their partisanship and ideology with one another”) and replacement (new voters who enter the electorate already sorted). Notably, Levendusky finds that when voters move from “unsorted” to “sorted,” most change their ideology to match their partisanship, as opposed to changing parties to match their ideology. For example, liberal Republicans are more likely to remain a Republican and become conservative, as opposed to becoming a Democrat to match their existing liberal ideology. Partisan sorting has essentially aligned voter ideology with party, which has made voters much more attached to their party both in and out of the voting booth (Levendusky, 2009). It should be noted that this theory relies almost exclusively on the view that voters look to elites for political positions because they do not take the time to inform themselves (Zaller, 1992; Campbell et al., 1980; Converse, 1964).\footnote{Levendusky (2009) defines elites as “politicians holding elected office who have some control over policy.”} Like Levendusky, I adopt this elite-driven approach for this study. Levendusky establishes elite discourse as the primary mechanism responsible for sorting voters, but he provides little in the way of campaign-based evidence for this. Instead, he points to the recent shift in campaign strategy focusing on mobilizing base voters rather than persuading swing voters as proof of campaigns responding to a partisan sort (Levendusky, 2009). Furthermore, my study would provide a more complete study of the effect of partisan sorting on campaigns by analyzing campaign advertising for ideological appeals.

The more recent theory of partisan sorting relies on an assumption that parties have relevance to voters. As Levendusky points out, most voters switch their ideology to match their partisanship, which would mean parties have greater relevance to voters. This stands in contrast to the academic consensus before the turn of the century that parties in America were in decline (Bartels, 2000). Hetherington (2001) takes on that consensus and argues that the recent trend of polarization among elites has clarified political positions for ordinary Americans, increasing “party importance and salience on the mass level.” Essentially, polarization at the elite level has translated to greater partisanship at the mass level. He finds that more Americans in the 1990s positively think about one party and negatively about another than in the 1950s and less hold neutral views of either party. Americans are also better able to explain why they like or dislike a party than they were in previous decades (Hetherington, 2001). Note that this increased partisanship among the public does not necessarily mean that the public is more divided when it comes to issue positions. Along these lines, Mason (2015) distinguishes between social polarization and issue position polarization and finds that the public is more polarized along the social dimension. Social polarization refers to “increased levels of partisan bias, activism, and anger,” and is the result of alignment between partisan and ideological identity. This alignment causes people to have stronger partisan identities, but the same level of polarization has not transferred to people’s issue positions. This results in a country that is bitterly divided despite there being agreement on many issues. Partisanship as a social identity means that a “partisan behaves more like a sports fan than like a banker choosing investments” – they “feel emotionally connected” to the party.
and defend it when it’s threatened (Mason, 2015). Notably, Mason (2015) concludes:

Thus, political identities are able to motivate social polarization in two ways – through the effects of partisan and through the effects of identity alignment. Even without any change in the distribution of issue opinions in the public, it is possible for the electorate as a whole to regard outgroup partisans with increasing prejudice, to be driven to take action against the outgroup party, and to feel anger in response to electoral challenges from the outgroup party (p. 141).

If this is the case, the best strategy for political campaigns would most likely involve activating these partisan identities through partisan language in their communications.

A discussion of polarization would be incomplete without mentioning its consequences for policy making. As one might expect, a polarized Congress results in less compromise and less coalition-building, which means less significant legislation passed. Research produced in 2007 found that as House polarization increased, the amount of significant laws passed decreased (McCarty, 2007). Moreover, this “polarization-induced gridlock” has meant that “public policy does not adjust to changing economic and demographic circumstances,” which can have negative impacts on policies like minimum wage and welfare programs (Barber & McCarty, 2015).

Overall, polarization increased in Congress from the end of the 20th Century into the 21st Century. This elite-level polarization has translated to partisan sorting at the mass level, aligning partisan identities with ideological identities, increasing the partisanship of voters, resulting in social polarization, and making major legislation harder to pass. This has important implications for studying modern campaign communication, but a further understanding of ideology in the U.S. is required before turning to the literature on campaign advertising.

### Ideology in the United States

Understanding how ideology operates in the U.S. is critical to informing our study of campaign communication as it forms the basis of partisan asymmetry. First, we must define the two major ideologies in America: liberalism and conservatism. In their book, *Ideology in America*, Christopher Ellis and James Stimson (2012) provide useful summaries of each. Liberalism centers around the idea of equality of opportunity – “life’s endeavors ought to result from intelligence, determination, discipline, and hard work, and not from the circumstances of one’s birth” (p. 3). Liberals believe that America’s class system prevents true equality of opportunity and that it is the government’s responsibility to assist the disadvantaged when necessary. To that end, liberals believe redistribution of wealth, public education, and proper government regulation can help bring about equality of opportunity for all.

On the other hand, conservatives place greater responsibility on the individual than the government, “believing that private citizens, operating without the encumbrances of government constraints, are more effective in motivating growth, innovation, and opportunity” (Ellis & Stimson, 2012, p. 5). They see a limited role for government in regulating the market, but a much stronger role in “promoting traditional values and enforcing social order” (Ellis & Stimson, 2012, p. 5). Thus, the primary factor separating the two ideologies is the role they believe government has in society. It follows that if America were primarily liberal or primarily conservative, we would have policies that reflected that preference. However, as they note, America is neither a nation of the left or the right.

Instead, Ellis and Stimson (2012) argue that America is a “nation of both the left and the right” as ideology in America represents a paradox: Americans are symbolically conservative, yet operationally liberal. Ellis and Stimson state there is an important difference between symbolic ideology and operational ideology. Symbolic ideology refers to “how citizens think about themselves,” while operational ideology refers to what citizens think the government should or should not do in terms of policy. According to Ellis and Stimson, Americans view themselves as conservative (“symbolic conservatism”), while at the same time preferring liberal solutions (“operational liberalism”). Ellis and Stimson present evidence based on more than 7,000 survey questions asked over a period between 1952 and 2010 that shows Americans, on average, hold liberal policy preferences. Using these data, the authors create a “public policy mood” metric, which reveals that between 1952 and 2009, an average of 58 percent of the public indicated support for liberal policies over conservative policies – proof of operational liberalism. At the same time, Ellis and Stimson analyze survey data from 1937 to 2006 and find a steady decline in the number of Americans self-identifying as liberal – from just under half of Americans in 1937 to about 35 percent in recent years. This decline coincides with a rise in conservative self-identification – in part because of changing associations of what the term “liberal” means. Throughout the years, liberalism became “charged with symbols of race and of racial riot and of protest,” associated with blacks, labor unions, urban unrest, and people on welfare (Ellis & Stimson, 2012). In other terms, symbolic liberalism has fallen out of favor for symbolic conservatism, while Americans have largely kept liberal positions on specific policies.

This trend has led some scholars to highlight the “partisan asymmetry” of American politics. In *Asymmetric Politics: Ideological Republicans and Group Interest Democrats*, Mark Grossmann and David A. Hopkins (2016) argue that the modern Republican and Democratic Parties represent distinct constituencies in the American public. The Republican Party, they write, “serves as the vehicle of a conservative ideological movement...marketing its broad critiques of government, building a supportive or-
ganizational network, and moving party doctrine toward the policy commitments of its right wing” (Grossmann & Hopkins, 2016, p. 14). In contrast, the Democratic Party “is a coalition of social groups that act as discrete voting blocs for candidates, constituencies for group leaders, and demanders of particular policy commitments” (Grossmann & Hopkins, 2016, p. 14). These differences have created asymmetric parties in that the support for them come from distinct sources: ideological and deeply held beliefs on the right versus distinct groups supportive of specific policies on the left. This asymmetry means the parties have pursued very different strategies in communicating, campaigning, and developing policy (Grossmann & Hopkins, 2016).

Grossmann and Hopkins outline the well-documented history surrounding the conservative movement and its success in fusing with the Republican Party. Three schools of conservative thought – cultural conservatism, libertarianism, and anticommunism and neoconservatism – combined to become a broader movement that fueled Barry Goldwater’s Republican nomination in 1964 and eventually elected Ronald Reagan president in 1980. Reagan’s presidency “sealed the conservative movement’s ascendance within the extended network of the Republican Party and the unchallenged adoption of conservative positions on economics, culture, and foreign policy as official party doctrine” (Grossmann & Hopkins, 2016, p. 90). While the Republican Party has clearly embraced conservatism, the Democratic Party has not done the same with liberalism as there is no comparable movement on the left. Instead, the Democratic Party has consisted of various social movements including civil rights, women’s rights, gay rights, environmental, and antiwar movements. These movements, while sometimes sympathetic to each other, never merged together into one broader liberal movement. The result is a Democratic Party backed by activists with distinct policy goals, rather than uniting ideological principles (Grossmann & Hopkins, 2016).

Furthermore, multiple studies prove these historical differences regarding partisan asymmetry. For example, an analysis of the content of presidential nomination acceptance speeches since 1948 found that Republicans were more likely to mention ideology, American imagery, and claim American exceptionalism, while Democrats were more likely to mention public policy, new policy proposals, social or interest groups, and specific demographic groups (Grossmann & Hopkins, 2016). A similar finding came from reviewing the party platforms – Republican platforms were more dedicated to the size and scope of government, while policy stances and specific group mentions made up more than 40 percent of the Democratic platforms (Grossmann & Hopkins, 2016). These findings also extend to Congressional candidates. One analysis found that Democratic pre-primary Congressional candidates were more likely than Republicans to receive endorsements from economic and identity interest groups, while Republicans were more likely to receive endorsements from single-issue and ideological interest groups (Grossmann & Hopkins, 2016). Grossmann and Hopkins also find partisan asymmetry in campaign messaging. They first note that only one Democratic presidential candidate won their nomination with a liberal ideological appeal (McGovern in 1972), while three Republican candidates won their nomination with a conservative appeal (Goldwater 1964, Reagan 1980, and W. Bush 2000). Moreover, they find asymmetry in presidential primary debate rhetoric. Republican candidates mentioned ideology or principle 56 percent of the time compared to just 26 percent of Democratic answers. At the same time, Democrats mentioned a social or interest group in 24 percent of their answers, compared to 15 percent of the Republican answers. Further, Democratic presidential campaigns were more likely to reference class groups than Republican campaigns in speeches from 1952 to 2012. Perhaps most important for this study, they reference data from 2013 that showed what Congressional candidates mentioned in their advertising from 1968 to 2012. Republican candidates were far more likely than Democratic candidates to mention size of government, with more than 30 percent of Republicans referencing the size of government, compared to less than 15 percent of Democrats. As expected, Democrats referenced specific issues and specific groups at a higher rate than Republicans. Further, Republican congressional candidates from 2000 to 2004 were more likely than Democrats to focus on ideology or personal values in their advertising, and data from 2010 and 2012 showed Republicans mentioning “liberal” or “conservative” at a far higher rate than Democrats, with zero Democratic advertisements mentioning either ideology in 2012 (Grossmann & Hopkins, 2016).

These findings, and the theory of partisan asymmetry broadly, form the basis for my research as I am interested in finding the differences between Democratic and Republican advertising. On the whole, partisan asymmetry— in line with research on ideology that suggests Americans are symbolically conservative, yet ideologically liberal—suggests Republicans are more likely to focus on ideological principles in their advertisements, while Democrats are more likely to mention specific policy proposals and specific groups in their advertisements. This leads to my first hypothesis:

H1: Republican advertisement airings will mention ideology more than Democratic advertisement airings.

Issue Convergence Versus Issue Ownership

With the research on polarization and ideology in the U.S. serving as a broad foundation, we can now narrow our scope to review the literature surrounding campaigns. There are effectively two schools of thought involving campaign research: issue convergence and issue...
ownership. Proponents of issue convergence argue that candidates tend to campaign on a similar set of issues, so they can win the so-called median voter (i.e. the voters in the middle that are believed to decide most elections) (Sigelman & Buell, 2004; Sides, 2006). Conversely, proponents of issue ownership argue that candidates campaign on issues they and their parties “own” (Petrocik, 1996; Ansolabehere, Snyder, and Stewart, 2001; Spiliotes & Vavreck, 2002; Arbour, 2014).

First, we will consider issue convergence. Sigelman and Buell (2004) look at whether presidential campaigns tend to campaign about the same issues or focus on issues that their party has some advantage on. Contrary to previous research which had seemed to confirm the latter, they found that opposing campaigns tended to speak about the same issues. Rather than avoiding issues that their party did not have an advantage on, candidates instead focused on the important issues of the day. Indeed, they found in a 40-year span of 11 different presidential elections that the Republican and Democratic candidates converged on three-quarters of the issues, and that closer elections meant the candidates were more likely to converge (Sigelman & Buell, 2004). Similarly, Sides (2006) reviewed candidate advertisements from House and Senate races in 1998, 2000, and 2002, analyzing the time devoted to various issues. He found they “tend to advertise on the same set of salient issues.” In this manner, candidates would “trespass” into issues the opposing party “owned,” but would do so in a way that was consistent with their party’s rhetorical strategies (Sides, 2006).

Issue ownership theory, however, is a more recent academic development. Petrocik (1996) develops a theory of issue ownership that states that parties “own” certain issues when they have a history and reputation for “handling” that problem. This means candidates will run on a certain set of issues that are “owned” by their political party (Petrocik, 1996). Since the late 1990s, several major studies have confirmed issue ownership. One of those came in 2001 when researchers found that U.S. House candidates from 1874 to 1996 “almost never” converged ideologically. Instead, they took positions consistent with their national party’s ideology, which means voters generally chose the candidate that most represented their views from those partisan choices. They note that there have been times when candidates showed more responsiveness to district interests (such as from the 1940s to the 1970s), but more recent elections have seen declining responsiveness (Ansolabehere, Snyder, and Stewart, 2001). It should be noted that their study was based on results from the National Political Awareness Test (NPAT), but more recent research has utilized other methods, coming to the same conclusion.

For example, Sulkin and Evans (2006) analyzed CQ’s Weekly Report’s “Special Election Issue” coverage of congressional campaigns between 1984 and 1996 and found “considerable diversity” in the issues candidates campaigned on. In terms of partisan differences, they found that Democrats have a larger agenda than Republicans. Specifically, the top four issues comprised of 40 percent of the Democratic agenda, while the top four issues for Republicans added up to 53 percent, suggesting greater uniformity in messaging among Republicans (Sulkin & Evans, 2006). Another method studied campaign advertising. Along these lines, Spiliotes and Vavreck (2002) looked at campaign advertisements in 1988 and found that candidates talked about different issues based on their party, confirming party divergence rather than convergence. For example, they found Republicans were 33 percent more likely to advertise about the economy than Democrats, while Democrats focused more on education and juvenile justice. Candidates in more competitive districts deviated more from this by mentioning certain issues more or less than their partisan colleagues (Spiliotes & Vavreck, 2002). Most recently, Arbour (2014) extended this research to include the specific frames campaigns used in advertising. Framing, as defined by Entman (2004), is when a campaign “[selects] some aspects of a perceived reality and make them more salient.” This means a campaign would highlight certain parts of their platform that are most acceptable to the voters, instead of trying to persuade voters to adopt their same positions. Arbour found that while candidates are willing to “trespass” into issues that the other party “owns,” both parties use distinct issue frames. In other words, Republicans frame issues differently than Democrats in ways beneficial to them. Both the partisanship of the candidate and the partisanship of the district influence the issue frames used by campaigns. For example, while both Democrats and Republicans discuss taxes, Democrats focus on taxes on the middle class and corporate tax breaks, while Republicans focus on valence issues surrounding taxes and how their opponent wants to raise taxes. Arbour believes that his data shows the “seemingly disadvantaged party” on certain issues uses a wider variety of frames because the party “lacks a more focused message” (Arbour, 2014). His findings appear to show that Republicans are more unified on messaging than Democrats (i.e. Republicans are more likely to use similar frames than Democrats), but Arbour does not specifically address this.

While there is no academic consensus on how campaigns message (issue convergence versus issue ownership), issue ownership theory is more compelling because research shows that even when candidates are discussing the same issues, they tend to diverge in terms of the frames they utilize, which are consistent with their party’s views (Arbour, 2014). Measuring the time candidates devote to each issue in advertisements misses the content of what they are discussing, and does not necessarily prove issue ownership to be a weak factor. As Arbour makes clear, even if a party does not “own” a certain issue, they can still campaign on it by using party-owned issue frames. For this reason, my second hypothesis is:
H2: The top five issues mentioned by Democrats will differ from the top five issues mentioned by Republicans.

Taken together, the research on ideology, partisan asymmetry, and issue ownership lead to my third and final hypothesis:

H3: There will be greater uniformity in issues and other phrases mentioned by Republicans than Democrats.

This hypothesis reflects the evidence that the Republican Party is a more ideological party than the Democratic Party, meaning Republicans derive a majority of their messaging from their overarching conservative ideology. Democrats lack an overarching theme in their messaging, instead supporting specific policies promoted by specific constituencies. If this is the case, then Democratic messaging will be more varied and diverse than Republican messaging.

Political Advertising on Television

Lastly, a brief discussion of what political campaigns do and how they advertise is warranted to demonstrate the importance of studying political advertisements. Political campaigns communicate information to voters designed to shape their opinions about candidates, bring up relevant issues and signal election importance (Bartels, 1993; Holbrook, 1996). Holbrook and McClurg (2005) developed a model for campaign mobilization that is dependent on three parts: partisan voters, campaign resource allocation, and voter environment. This model shows which voters are most likely to respond to campaign information and messaging. Crucially, they found that mobilization matters in the context of presidential campaigns and that mobilization is most likely to succeed with “core voters,” or people bound by their party identification (Holbrook & McClurg, 2005). Eric McGhee and John Sides (2011) extended this research and found that mobilization had an effect on voter turnout not just at the presidential level, but on down ballot races as well. Specifically, they found that “the more one party dominated the campaign, the greater the proportion of its supporters went to the polls” (McGhee & Sides, 2011). Notably, they found that other fundamental factors, including the economy and presidential approval, actually played less of a role than campaigns did in voter mobilization (McGhee & Sides, 2011). Thus, the research demonstrates that campaigns, through voter outreach and advertising strategies, have a large impact on mobilizing voters.

One of the more traditional ways of advertising to voters is through television, the medium used in this analysis. There are three foundational areas of research on political advertising on television: affect, enthusiasm, and advertisement tone. Extensive research has found that political advertising on television has influenced voters’ attitudes towards candidates, an important factor as attitudes, or affect, has been found to be an important factor in deciding who to vote for (Kaid, 2004). Another important angle of research has centered around voter enthusiasm, and how television advertisements can impact that. The findings show that political advertisements can impact views of candidates and tell voters what issues to think about, while also stimulating emotional response designed to spur interest and involvement in the campaign (Brader, 2006; Kim, Painter, and Miles, 2013). A third area of research has focused on advertisement tone, which has found that television advertising can be divided into candidate-positive and opponent-negative (Kaid & Johnston, 2001). Generally, this research has determined that negative advertisements may negatively impact views of a candidate, while positive advertisements elicit positive attitudes and effectively communicate issue positions to voters (West, 2013). The literature on advertising on television extends as far back as the mid-1970s when Atkin and Heal (1976) found a relationship between political advertising and radio and television with indicators like political knowledge and interest. More recent research on the 2008 presidential election revealed that television advertisements had significant effect on increasing Barack Obama’s overall vote share – and that television advertisements had a greater impact in 2008 than in 2004 (Franz & Ridout, 2010). This research demonstrates the important role political television advertisements have had in past elections. Considering the estimated $1.4 billion campaigns and outside groups spent on television advertisements in 2014, it appears campaigns still view television as a critical medium for messaging to voters, which is why it remains a critical medium to study campaign messages (Fowler & Ridout, 2014).

METHODS

My pilot study will analyze data on television advertising during the 2014 election cycle provided by the Wesleyan Media Project (WMP) (Fowler, Franz, and Ridout, 2017). WMP acquires this data through Kantar Media/CMAG, which is a private firm that utilizes “Ad Detectors” in every U.S. media market, as well as the national networks and cable networks. This system of detectors recognizes the “digital fingerprints” behind specific advertisements, and has been found to be “highly reliable in tracking the universe of advertisements aired.” Kantar Media/CMAG provides tracking data on both frequency and content.3 CMAG also codes basic variables, including the party affiliation of the favored candidate. WMP then codes the content of the advertisements, with project staff answering an extensive list of questions through an online platform. These codes include basic variables, such as who the favored candidate is and the location of the race. They also code more extensive variables like ad-
advertisement tone, whether the advertisement contrasts or promotes, whether the advertisement focuses on personal characteristics or policy matters, if the advertisement mentions or pictures certain people or objects, what emotional appeals an advertisement makes, what words or phrases and advertisement mentions, and what issues are mentioned. A sample of these advertisements are double-coded to shed light on reliability of each of the codes, but WMP cautions that these statistics can be misleading in circumstances where a characteristic is not observed in most advertisements.

WMP analyzed all television advertisements airings by House and Senate campaigns in the 2014 election cycle, coding them in several ways that will be useful in this study. This pilot study will analyze only the data provided for Senate advertisement airings. I will not distinguish between primary or general election advertisements, or whether a candidate or other group sponsored the advertisement. I will view the data in Stata 14, a statistics software provided by the Columbian College of Arts and Sciences at The George Washington University. After selecting the appropriate variables, I will run cross tabulations between the selected variables and party affiliation of the favored candidate. These variables include party label mentions, issue mentions, phrase/other mentions, advertisement tone (coded as promote, contrast, and attack), emotional appeal (coded as fear, enthusiasm, anger, pride, humor, or sadness), and advertisement focus (coded as personal characteristics or policy matters). This analysis will provide a preliminary look at advertisements aired in the 2014 congressional elections for Senate races.

RESULTS

The first two hypotheses for the pilot study are clearly supported by the results. Table 1 shows the amount of ideological mentions (whether an advertisement mentioned “conservative” or “liberal”) in all 2014 Senate advertisement airings. In total, 21.2 percent of Republican advertisement airings mentioned the terms “conservative” or “liberal,” while less than one percent (0.25%) of Democratic advertisement airings mentioned either term. Of the Republican advertisement airings, 14.4 percent of them mentioned “conservative,” and 6.8 percent of them mentioned “liberal.” Notably, not one of the 487,077 Democratic advertisement airings mentioned the term “liberal.” This supports the first hypothesis that more Republican advertisement airings mention ideology than Democratic advertisement airings.

Regarding party label, both parties showed surprising aversion to mentioning the party of both the favored and opposed candidates. Table 2 shows a similar pattern between both parties – the vast majority of advertisement airings do not mention party label at all, and if they do, they are more likely to mention the party label of the favored candidate.

The results also support the second hypothesis – that the top five issues mentioned by Republicans would differ from the top five mentioned by Democrats. Tables 3 and 4 show the top five issues mentioned in Democratic and Republican advertisement airings. The top five issues mentioned in Democratic advertisement airings are: taxes (22.3%), jobs/unemployment (21.2%), Social Security (14.6%), Medicare (14%), and education/schools (13.4%). For Republicans, the top five issues are: Afford-

<table>
<thead>
<tr>
<th>Mentioned in advertisement airings</th>
<th>Republican advertisement airings</th>
<th>Democratic advertisement airings</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Conservative”</td>
<td>74,107 (14.4%)</td>
<td>1,205 (0.25%)</td>
</tr>
<tr>
<td>“Liberal”</td>
<td>35,070 (6.8%)</td>
<td>0</td>
</tr>
<tr>
<td>Total ideological mentions</td>
<td>109,177 (21.2%)</td>
<td>1,205 (0.25%)</td>
</tr>
</tbody>
</table>

**TABLE 1.** Ideological mentions, by party

<table>
<thead>
<tr>
<th>Mentioned party label of candidate</th>
<th>Republican advertisement airings</th>
<th>Democratic advertisement airings</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>478,779 (92.9%)</td>
<td>449,827 (92.4%)</td>
</tr>
<tr>
<td>Yes, favored candidate</td>
<td>23,172 (4.5%)</td>
<td>17,878 (3.7%)</td>
</tr>
<tr>
<td>Yes, opposing candidate</td>
<td>9,802 (1.9%)</td>
<td>14,784 (3%)</td>
</tr>
</tbody>
</table>

**TABLE 2.** Party mentions, by party

---

4 Advertisement “airings” refer to every time an advertisement was aired on television. Note that this means an advertisement could be aired hundreds of times.
able Care Act/Obamacare (35.4%), jobs/unemployment (21%), deficit/budget (18.8%), taxes (13.9%), and government spending (13%). The only overlap here is taxes and jobs/unemployment, but the parties’ other top issues are distinct. Also included in the results is how much the opposing party mentioned the same issues. For example, while taxes was the top issue mentioned in Democratic advertisement airings (22.3%), it was the fourth-most mentioned issue (13.9%) in Republican advertisement airings. However, the contrast is starker on the Republican side. While their top issue was ACA/Obamacare, with more than a third of Republican advertisement airings mentioning it, less than two percent of Democratic advertisement airings (1.7%) mentioned ACA/Obamacare in their advertisement airings. These results show that the parties largely differed in the issues they focused on in their advertisement airings.

The results are less clear when it comes to support for the third hypothesis – that Republican advertisement airings would be more uniform in content and style than Democratic advertisement airings. This hypothesis relies on measuring uniformity, which can be done in multiple ways. For my study, issues and phrases mentioned provide indications of how similar advertisement airings are. First, top issues mentioned serve as one indicator of uniformity. Tables 3 and 4 show the top five issues mentioned in Democratic and Republican advertisement airings. By averaging the advertisement airings mentioning each of the top five issues, we gain a sense how prevalent the top five issues were for both parties. The average percentage a top-five issue was mentioned on the Republican side was 20.4 percent. This was 17.1 percent for Democrats, meaning the top five issues mentioned in Republican advertisement airings were mentioned more frequently than the top five issues in Democratic advertisement airings. This would seem to reflect the fact that Republican advertisement airings mentioned ACA/Obamacare more than a third (35.4%) of their advertisement airings, while the top Democratic issue (taxes) was only mentioned in 22.3 percent of their advertisement airings.

Second, we can analyze the top phrases mentioned as an indicator of uniformity. Tables 5 and 6 show the top five phrases (or people) mentioned (or pictured) in Democratic and Republican advertisement airings. The most mentioned phrases in Democratic advertisement airings were: Republicans (8%), middle class (6.8%), Democrats (5.8%), special interests (5.7%), and upper class/wealthy (5.6%). On the other hand, the five most mentioned (or pictured) phrases and people in Republican advertisement airings were: Barack Obama (54.4%), conservative (14.4%), liberal (6.8%), Senate Republican Leader Mitch McConnell (5.1%), and change (4.1%). First, all five phrases mentioned in Democratic advertisement airings were different from those mentioned in Republican advertisement airings – similar to the results regarding issue mentions. Second, more than half of all Republican advertisement airings (54.4%) mentioned Barack Obama. There is no equivalent on the Democratic side, where the top

<table>
<thead>
<tr>
<th>Issue</th>
<th>Mentioned In Democratic advertisement airings</th>
<th>Mentioned In Republican advertisement airings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxes</td>
<td>108,517 (22.3%)</td>
<td>71,648 (13.9%)</td>
</tr>
<tr>
<td>Jobs/unemployment</td>
<td>103,260 (21.2%)</td>
<td>108,143 (21%)</td>
</tr>
<tr>
<td>Social Security</td>
<td>71,064 (14.6%)</td>
<td>18,453 (3.6%)</td>
</tr>
<tr>
<td>Medicare</td>
<td>68,336 (14%)</td>
<td>46,185 (9%)</td>
</tr>
<tr>
<td>Education/schools</td>
<td>65,170 (13.4%)</td>
<td>25,566 (5%)</td>
</tr>
</tbody>
</table>

**TABLE 3.** Top 5 issues mentioned in Democratic advertisement airings

<table>
<thead>
<tr>
<th>Issue</th>
<th>Mentioned In Republican advertisement airings</th>
<th>Mentioned In Democratic advertisement airings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACA/Obamacare</td>
<td>182,678 (35.4%)</td>
<td>8,280 (1.7%)</td>
</tr>
<tr>
<td>Jobs/unemployment</td>
<td>108,143 (21%)</td>
<td>103,260 (21.2%)</td>
</tr>
<tr>
<td>Deficit/budget</td>
<td>96,957 (18.8%)</td>
<td>16,024 (3.3%)</td>
</tr>
<tr>
<td>Taxes</td>
<td>71,648 (13.9%)</td>
<td>108,517 (22.3%)</td>
</tr>
<tr>
<td>Gov’t spending</td>
<td>66,906 (13%)</td>
<td>9,692 (2%)</td>
</tr>
</tbody>
</table>

**TABLE 4.** Top 5 issues mentioned in Republican advertisement airings
phrase mentioned (Republicans) is only seen in 8 percent of Democratic advertisement airings. Using the same averaging technique discussed above regarding issues, it becomes evident that Republican advertisement airings were more likely to mention the same phrases (or people) than Democratic advertisement airings. A top-five phrase on the Republican side was mentioned an average 16.9 percent, while a top-five phrase on the Democratic side was only mentioned an average 6.4 percent. This becomes much closer when removing the Obama mentions – at that point, a top-four phrase is mentioned an average 7.6 percent in Republican advertisement airings. However, both results show Republican advertisement airings used more of the same phrases than Democratic advertisement airings. This result would also seem to indicate greater uniformity in Republican advertising.

Table 7 combines the issue and phrase mention data, showing the top five mentions by party. Notably, the top five Democratic mentions were all issues, while only three of the top five mentions were issues in Republican advertisement airings. Even more notable is the difference in the average times these top five phrases or issues were mentioned in the advertisement airings. Almost 30 percent (28.8%) of all Republican advertisement airings mentioned one of the top five Republican phrases or issues – meaning Republican advertisement airings were more than 10 percent more likely to include these than Democratic advertisement airings. This presents more evidence that Republican advertisement airings were more uniform in content than Democratic advertisement airings.

Taken together, these results confirm greater uniformity on the Republican side in terms of issues and phrases mentioned, thus supporting my third hypothesis. However, some caution should be taken with this conclusion. This measure of uniformity is very narrow in that it only captures mentions of an issue or a phrase or person. This data does not tell us much more than that – as in what candidates are saying about the issue or how they are using a phrase. For example, it would be assumed that most Democratic advertisements mentioning Republicans were negative, but this data only shows that they mentioned Republicans, not how they mentioned Republicans. Further study should look beyond issues and phrases for similar messages.

**DISCUSSION**

These findings clearly demonstrate a partisan difference in the campaign television advertising for Senate candidates in 2014. First, Republican advertisement airings were much more likely to mention ideology than Democratic advertisement airings, mentioning “conservative” or “liberal” in their advertisement airings more than 20 percent of the time, compared to almost no mentions in Democratic advertisement airings. Second, the top five issues mentioned differed by party, with only two issues – taxes and jobs/unemployment – coming in the
top five for both parties. Third, Republican advertisement airings were more uniform in content than Democratic advertisement airings, being more likely to mention a similar set of issues and phrases (and people) than Democratic advertisement airings.

These results align well with the literature on ideology, partisan asymmetry, and issue ownership. My finding that Republican advertisement airings were more likely to mention ideology than Democratic advertisement airings was unsurprising, given the extensive research that already exists on this. The Republican Party has embraced conservative ideology, while simultaneously attacking the liberal ideology (Grossmann & Hopkins, 2016). This has led, as Ellis and Stimson (2012) argue, to a symbolically conservative, yet operationally liberal country – one that is more likely to identify as conservative and appreciate the symbols of conservatism, but at the same time support liberal policies and programs. In short, the term “conservative” carries positive connotations, while “liberal” carries negative meanings. This was observed in the 2014 Senate advertising data. “Conservative” was mentioned in 14.4 percent of Republican advertisement airings and 0.25 percent of Democratic advertisement airings, while “liberal” was mentioned in almost seven percent of Republican advertisement airings and zero Democratic advertisements. While the data does not provide the context for these mentions, we can safely assume that most (if not all) mentions of “liberal” in Republican advertisements were negative, while a good amount of the “conservative” mentions in Democratic advertisements were most likely positive. It should also be highlighted that zero of the 487,077 Democratic advertisement airings mentioned the term “liberal.” That is a stark finding, and one that gives credence to partisan asymmetry – there is no Democratic equivalent to the conservative ideology. This leaves the Democratic Party significantly disadvantaged in messaging because the conservative ideology provides Republican candidates with broader themes to utilize like small government and individual responsibility. These overarching principles do not exist for Democrats.

My second finding that the top five issues mentioned in the advertisement airings differed by party also aligns with previous research. In particular, this finding supports issue ownership theory – that candidates tend to campaign on issues that they and their party have a known reputation for handling (Petrocik, 1996). The parties only overlapped on two of the top five issues: taxes and jobs. On these shared issues, we can be fairly certain that these advertisements employed different frames consistent with the candidate’s party (Arbour, 2014). The other three top-five issues mentioned in Republican advertisement airings were Obamacare, deficit/budget, and government spending, while the other three in Democratic advertisement airings were Social Security, Medicare, and education. Obamacare, deficit/budget, and government spending all qualify as size of government care, and education are all specific policies for specific groups, which also aligns with partisan asymmetry and the idea of operational liberalism (Grossmann & Hopkins, 2016; Ellis & Stimson, 2012).

My final finding of greater uniformity in Republican advertisement airings is perhaps the most interesting to consider. Indeed, the data shows that Republican advertisement airings mentioned the top five Republican issues or phrases an average of 28.8 percent of the time, while Democratic advertisement airings mentioned the top five Democratic issues or phrases an average of 17.1 percent of the time – more than a 10 percent difference. Two of the top mentions in Republican advertisement airings were the phrases Barack Obama (54.4%) and conservative (14.4%), while all five of the top mentions in Democratic advertisement airings were issue-based. This reflects Grossmann and Hopkins’ (2016) research that showed Democrats were more likely to campaign on specific issues, while Republicans were more likely to campaign on personal values and ideology. The top two mentions in Republican advertisement airings were Barack Obama (54.4%) and his signature healthcare law, Jobs/unemployment

| Top 5 issues and phrases mentioned, by party |

<table>
<thead>
<tr>
<th>Republican advertisement airings</th>
<th>Democratic advertisement airings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention</td>
<td>Amount (%)</td>
</tr>
<tr>
<td>Barack Obama</td>
<td>280,203 (54.4%)</td>
</tr>
<tr>
<td>ACA/Obamacare</td>
<td>182,678 (35.4%)</td>
</tr>
<tr>
<td>Jobs/unemployment</td>
<td>108,143 (21%)</td>
</tr>
<tr>
<td>Budget/deficit</td>
<td>96,957 (18.8%)</td>
</tr>
<tr>
<td>“Conservative”</td>
<td>74,107 (14.4%)</td>
</tr>
<tr>
<td>Average</td>
<td>28.8%</td>
</tr>
</tbody>
</table>
ObamaCare (35.4%). Of the Republican advertisement airings mentioning Obama, 94 percent portrayed him in a disapproving fashion. This would confirm The Washington Post’s reporting that the GOP strategy was to “make it all about Obama, Obama, Obama.” In this sense, Republican messaging among Senate candidates in 2014 was far more cohesive than Democratic messaging. A majority of the half-million Republican advertisement airings mentioned Obama, and more than a third mentioned Obamacare. Comparatively, Democratic advertisement airings were much more spread out among what issues they mentioned, perhaps reflecting poor strategy and coordination emanating from party leaders.

This suggests Republicans were effective at framing the election as a referendum on Obama because they made him the salient issue for voters. In other words, Republicans could link their Democratic opponents to Obama, making voters’ disapproval for the president the salient issue when they cast their ballots.

The uniformity finding also confirms the existence of partisan asymmetry in 2014 campaign advertising — Republicans were more unified around ideological considerations, while Democrats campaigned on various policies for specific groups. Three of the top five mentions in Republican advertisement airings were about size of government or conservatism itself. All of the top five mentions in Democratic advertisement airings were about specific issues, and all of the top five phrases mentioned in Democratic advertisement airings were groups. Indeed, the top five phrases mentioned in Democratic advertisement airings were: Republicans, middle class, Democrats, special interests, and upper class/wealthy. These results are exactly in line with what partisan asymmetry would have us expect: ideological Republicans and group interest Democrats (Grossmann & Hopkins, 2016).

Although this study cannot determine exactly the impact message uniformity had on the results of the election, it would be logical to conclude that having a more cohesive message helped the Republicans. In other terms, voters hearing the same message over and over from one party, while hearing mixed messages from the other party would certainly have an impact on how voters came to their decisions.

I would argue that we cannot consider these results without a discussion of the growing polarization at the elite levels of this country and the resulting partisan sort. These findings demonstrate a distinct partisan difference in advertising based on ideology, issues mentioned, and message uniformity. This difference in advertising is important because it is a manifestation of elite polarization, which clarifies partisan positions for voters and leads to the partisan asymmetry in the current political climate. Partisan sorting theory suggests that voters match their ideology to fit the views of their party (Levendusky, 2009), but this becomes problematic if only one party sends ideological cues. It means Republicans would hold much stronger partisan views than their Democratic counterparts and would translate to greater allegiance and emotional connection to the Republican Party (Mason, 2015). Combined with increased uniformity in messaging, you have an extremely powerful political party and an asymmetric political system. Despite many other components, this shows how campaign advertising must be considered as one of the mechanisms increasing polarization in Congress. A form of elite discourse, political advertising is one of the explanations for partisan sorting at the mass level, which has continued the cycle of increasing polarization in Congress. Campaign advertisements, like the ones studied here, contribute to polarization through their asymmetric partisan messaging.

My pilot study has several limitations that my proposed study would seek to minimize. Most prominently is the lack of generalizability of these findings. My pilot study’s findings only extend to campaign advertising for Senate races in 2014. My proposed study would add three more election cycles, as well as advertising data from House races. It would also distinguish between advertisements aired during the primary versus the general election, and whether the advertisement was sponsored by the candidate or an outside group, such as a super Political Action Committee (PAC) or party committee. This would increase the generalizability of the findings, so they can be more useful in determining trends in advertising. Additionally, my pilot study did not differentiate data based on individual candidates. For that reason, I could not make any claims that “Republicans did this” or “Democrats did this.” I could only say that “Republican advertisement airings did this” or “Democratic advertisement airings did this.” While it may seem like an inconsequential distinction, the findings may have been skewed by candidates with more advertisements than others. Distinguishing advertisements based on candidates would allow me to make broader claims, such as “In 2014, Republican candidates devoted 34 percent of their advertisements to ObamaCare.” Another limitation of my pilot study came from the WMP data I analyzed. This data only allowed for certain words or issues to be analyzed, without any context or information about how those words and issues were framed. My proposed study would address this limitation by adding a component to study these advertisements in more depth. This would consist of conducting an additional content analysis on a random sample of advertisements, yielding more detailed data.

Finally, my proposed study would add a layer of other measures to provide greater depth of analysis. Specifically, DW-NOMINATE ideological scores would position each incumbent candidate in terms of their ideology, which would show trends in advertisements based on ideology, rather than party affiliation. For instance, do more conservative Republicans advertise similarly to their more moderate counterparts? Cook Partisan Voter Index (PVI) scores would position each candidate in...
terms of their district’s partisan leanings, which would show trends in advertisements based on the composition of voters in a district. For example, do candidates running in swing districts moderate their advertisements more than candidates running in more stable districts?

CONCLUSION

This preliminary study identified partisan difference in advertisements for Senate candidates in 2014 and provides a basis for further study of partisan differences in campaign advertising more broadly. More specifically, it confirmed that partisan asymmetry exists in political advertising, which has implications for future campaigns. Studying partisan difference in campaign advertising is important given increasing polarization at the elite level and growing partisanship at the mass level. Understanding how campaigns advertise to voters in a more polarized environment is one of the first steps to addressing asymmetric partisanship and reducing polarization in Congress.

This study highlights how message cohesiveness and utilizing partisan strategies in advertising accentuates asymmetry in American politics and contributes to greater division in Congress. While we can only speculate how these partisan differences impact the electorate, it would be logical to conclude that greater uniformity in messaging is an effective strategy in winning elections, and perhaps was a factor in the Republican takeover of the Senate in 2014. In this case, Republican advertising was heavily focused on President Obama and his major legislative accomplishment, the Affordable Care Act, while Democratic messaging was more spread out amongst various issues. This suggests that parties should pursue more cohesive messaging in their advertising. It also exemplifies the effectiveness of linking down-ballot candidates to an unpopular president. This means part of the Republican advantage in 2014 came from their out-party status (as in they did not have control of the White House). Thus, it would be easier for a party to be unified in their messaging due to their opposition to a president. In this case, Democrats had a more difficult task standing by the same agenda as President Obama’s, leading to less cohesive messaging coming from Democratic candidates broadly.

My findings have several troubling implications for American politics. First, the partisan asymmetry observed in campaign advertising translates to an apparent Republican advantage in messaging that stems from their ideological backing. Democrats simply do not have the same ideological foundation (at least symbolically) to pull from in formulating their messaging. This, in turn, results in less uniform messaging, which creates a disadvantage when advertising to voters. Our two-party system requires two highly competitive political parties, but this may be eroded if the Democratic Party continues to message in the way it does. The Democratic Party should make it a long-term priority to rebrand the term “liberal,” and look for ways to incorporate this ideology into their messaging. If Democrats continue to let Republicans define the term “liberal,” Republicans will enjoy an advantage on this front. Second, the findings support issue ownership theory, which means candidates are talking about a distinct set of issues. A strong democratic system relies on a robust debate of the issues, but these findings suggest that candidates are not engaging in this type of debate — instead, they are essentially talking past each other and to completely separate audiences. In other words, candidates are appealing to their partisan base, rather than the “median voter.” This encourages more partisan candidates to run for office, and will only increase polarization in Congress further. Third, while uniformity in party messaging may be an effective strategy in winning votes, this could threaten democracy. The reason lies in how voters come to their decisions at the ballot box. If a voter hears the same messaging coming from all of the candidates in one party, they may miss differences between individual candidates. For example, a Republican candidate using similar messaging coming from other Republican candidates may have more extreme issue positions, but voters would not be able to detect this from the advertising. Of course, it becomes the responsibility of the media and the opponent to inform the voters of this discrepancy, but it remains a concern.

Further research on this topic should consider the impacts of partisan differences in advertising on voters, and seek to definitively link campaign advertising to polarization. First, while this study establishes partisan difference in advertising, it does not determine how these differences impact voters. This could include conducting experiments that test the effectiveness of these kinds of messages on voters. Second, this study discussed how campaign advertising can lead to polarization, but did not establish any causal link. Future research should consider how campaign advertising relates to increased polarization in Congress. Broadly speaking, more research is needed on campaign communication because there is a void in that area of political research.

REFERENCES

Examining the 2007 Redenomination of the Ghanaian Cedi on the Disinflation Process Using the Chow Structural Break Test and VAR

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KEYWORDS: International macroeconomics, monetary policy, inflation, Ghana, redenomination, VAR model

ABSTRACT

Ghana has experienced high and variable rates of inflation over the past 40 years. While this is no longer the case, inflation remains stubbornly elevated relative to economies of similar size (Magnus & Fosa, 2011). Conventional disinflation policies involve countercyclical monetary policies, reducing fiscal expenditure, and comprehensive economic and political reform. These policies in turn can be bolstered by a currency redenomination; when the nominal value of all prices is reduced. A number of countries such as, Turkey (in 2005), Romania (in 2005), Belarus (in 2006 and 2016) have pursued this strategy, including Ghana (in 2007). The question of whether currency redenomination is an effective qualitative tool in the disinflation process is important because of its potential as an important tool for countries struggling with high and variable rates of inflation. Unfortunately, existing literature has been deficient, and no appropriate techniques have been employed to examine this question. Thus, the goal of this paper is to examine the impact of the Ghanaian currency redenomination in 2007 on the disinflation process using appropriate statistical techniques; the Chow Test and Vector Autoregression (VAR), then evaluate whether it may be an effective policy option for monetary authorities.

This paper employed monthly time series data from January 2000 to September 2017 provided by the Bank of Ghana. The results gathered in this paper showed that the Chow Test found a structural break before and after the date of redenomination. However, the bifurcated vector autoregression VAR(3) was inconclusive as to whether the policy itself directly affected the disinflation process. These results suggest that further research is needed to evaluate the potential of currency redenomination as a qualitative tool in the disinflation process.

Originality/value – This paper is one of few studies which has investigated the impact of currency redenomination, especially in Africa and Ghana specifically.

INTRODUCTION

Over the past 40 years, Ghana has experienced high and variable rates of inflation. Inflation is no longer as high compared to the politically turbulent 1970's and 1980's, yet remains stubbornly elevated compared to economies of similar size (Magnus & Fosa, 2011). Countries that suffer from high inflation must consequently deal with undesirable economic outcomes such as increasing uncertainty associated with a firm's expected profits, variable patterns of household saving and investment, and decreased purchasing power (Adom, Zumah, Mubarik, Ntodi & Darko, 2015). This problem persists even if the country is already on the disinflation path. Conventional disinflation solutions may involve reducing fiscal expenditure and restrained monetary policies. In other scenarios, disinflation policies may require a reduction in the monetization of government debt, fiscal consolidation, and comprehensive economic and political reform. The policies in turn can be bolstered through the redenomination of a currency when the nominal value of all prices is reduced. A number of countries such as, Turkey (2005), Romania (2005), Belarus (2006, 2016) have pursued this strategy, including the country in question, Ghana (2007). This raises the question of whether currency redenomination is an effective qualitative tool in the disinflation process. Specifically, the goal of this paper is to examine the impact of the Ghanaian currency redenomination in 2007 on the disinflation process using the Chow Test and Vector Autoregression, then evaluate whether it may be an effective policy option for monetary authorities.
As noted in the introduction, Ghana has had a history of high and variable rates of inflation. Inflation is the continual increase in the price level of goods and services in the economy, responding to variables like inflation expectation, money supply, growth in output, and government deficits. The quantity theory of money ("QTM") as expressed by the equation of exchange, \( MV = PY \), where \( M \) is money supply, \( V \) is the velocity of money, \( P \) is the price level, and \( Y \) is real GDP, indicates that: 1) changes in the money supply lead to proportional changes in the price level; where \( P = \frac{M \times V}{Y} \) shows constant money velocity and GDP; and 2) the inflation rate, \( \pi \) is the growth rate of money supply minus the growth rate of aggregate output \( \pi = \% \Delta M - \% \Delta Y \) (Mishkin, 2016). These implications of the quantity theory of money are evident in long run data, but not in short run data. Therefore, this paper will use time series data over the long run: January 2000 to September 2017. Additionally, the estimated coefficients of M2 growth are close to one in countries marked by high money growth and inflation (Maroney, 2002). This implies that in an economy experiencing elevated inflation, the changes in the money supply lead to an approximate proportional change in the price level. It is also important to note that money growth may hit inflation rates with a lag, which suggests the need to include autoregressive distributed lag components in the analysis.

**Graph 1.** Graph 1 depicts poor monetary policy transmission before the 2002 Bank of Ghana Act 612 (shown with a vertical line), with significant spreads between the Inter-Bank Weighted Average ("IntBkWAve") and the BoG Monetary Policy Rate ("MPR").

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**INFLATION AND GHANA**

The Bank of Ghana ("BoG") initially announced the public notice stating their intent to redenominate the Cedi in June 2007. The BoG Public Notice (2007) released the following statement:

The Bank of Ghana is planning to redenominate the current cedi by setting ten thousand cedis to one new Ghana Cedi (GH¢), which will be equivalent to one hundred Ghana Pesewas (Gp). That is \( 10,000 = \text{GH}¢1 = 100 \text{Gp} \). New notes and coins will be issued to replace the existing notes and coins over a period of at least 6 months (p.1)

This announcement followed substantial economic and political reforms. In January 2002, the Bank of Ghana Act...
612 was passed by the Parliament of Ghana. BoG Act 612 gave operational independence to the central bank, established an implicit inflation targeting (“IT”) framework, and created the Monetary Policy Committee (“MPC”) to oversee monetary policy (Burkel, 2008). The independence aspect of the law authorized the BoG to employ any measure available to achieve its primary objective of price stability (Bank of Ghana, 2015). Following the BoG Act 612, the MPC implemented institutional and operational reforms, such as accountability and transparency mechanisms to enhance the effectiveness of monetary policy (Bank of Ghana, 2015). Graph 1 depicts poor monetary policy transmission before the 2002 Bank of Ghana Act 612 (shown with a vertical line), with significant spreads between the Inter-Bank Weighted Average (“IntBkWave”) and the BoG Monetary Policy Rate (“MPR”). In May 2007, the BoG formally announced a full-fledged inflation targeting framework as their monetary policy strategy, with the redenomination policy following soon thereafter (Addison, 2008).

LITERATURE REVIEW
Redenomination in Theory

Existing literature that addresses the theoretical and practical aspects of redenomination includes: Impact of Currency Redenomination on Inflation Case Study Turkey (Žídek & Chribik, 2015), A Tale of Two Cedis: Making Sense of a New Currency (Dzokoto, Young, & Mensah, 2010), The National Currency Re-Denomination Experience in Several Countries: A Comparative Analysis (Ioana, 2009), and Dropping Zeros, Gaining Credibility? Currency Redenomination in Developing Economies (Mosley, 2005). As stated previously, redenomination means that the face value of banknotes and coins in circulation is changed. Through redenomination, all prices in the economy are reduced by the same nominal value. Theoretically, no market subject is directly affected (harmed or advantaged) by the process and is usually accompanied by issuing of new banknotes and coins (Žídek & Chribik, 2015). Currency redenomination is often considered to be a part of broader economic and political reforms. Specifically, redenomination can be seen as part of an effort by the central bank to communicate across a new set of standards and commitments to establish confidence in the economy, build credibility, and facilitate the disinflation process.

There are two primary ways in which redenomination can facilitate such efforts by the central bank to control high and variable inflation. Firstly, the redenomination can be implemented at the end of the necessary reforms, to symbolize the commitment of the central bank authorities. Thus, the new currency would simply serve as a reminder to individuals and market participants of the central bank’s commitment to price stability. Necessary policies preceding the redenomination would include institutional reforms such as increasing the statutory independence of their central bank (Mosley, 2005). For example, in preparation for its entry into the European Union, Romania’s central bank in 2005 portrayed its currency redenomination process as demonstrating that “the days of hyperinflation are over and the new currency will help keep things that way” (BBC, 2005) Thus, in Romania, redenomination was used at the end of a macroeconomic stabilization process, indicating to the ECB authorities that Romania was ready to enter the European Union.

Secondly, the currency redenomination can be implemented concurrent to the disinflation process. The principle for employing redenomination during the disinflation process is the assumption that the Money Illusion Effect may influence inflation expectation. The Money Illusion Effect refers to a “tendency to make biased judgments about the real value of transactions on the basis of their nominal values” (Dzokoto et al., 2010, p.521). Mosley (2005) hypothesizes such an effect may complement the disinflation process because the lower nominal value convinces citizens that a return to high inflation is unlikely. Explicit commitments to specific macroeconomic targets, in conjunction with redenomination may improve the effectiveness of the monetary authorities. In economic theory, efforts to influence market actors through commitments regarding future monetary policy are called “forward guidance” (Kuroda, 2017). Policies intended to influence expectations are considered important qualitative tools by economists. For example, John Richard Hicks, considered one of the most influential economists of the 20th century, identified concepts such as “forward-looking monetary policy” and the “announcement effect” (Kuroda, 2017). Today, the idea that central banks can increase the effectiveness of monetary policy by influencing inflation expectation and demonstrating their strong intention to achieve price stability forms a theoretical pillar of qualitative monetary policy in many countries (Kuroda, 2017).

Additionally, currency redenomination is also viewed as a policy for the government to reassert monetary sovereignty. If citizens lose confidence in their national currency, they may begin to use foreign currencies that are perceived as more credible (Mosley, 2005). A loss in a currency’s credibility could affect both a government’s legitimacy and ability to conduct monetary policy. If widespread foreign currency substitution (commonly dollarization) exists, the central bank may no longer control the money supply, rendering it unable to provide lender of last resort functions (Mosley, 2005). Currency redenomination, then, is a method by which governments can attempt to reverse certain currency substituting behavior: if citizens are confident that the new redenominated currency will hold its value, they may be willing to shift from using foreign currencies to the domestic (Mosley, 2005).
Redenomination in Practice

Approximately 50 countries have implemented redenomination as part of an economic reform process over the last 85 years (Ioana, 2005). The first country to ever conduct redenomination was in 1923 Weimar-era Germany, which cut 12 zeroes to combat hyperinflation (Ioana, 2005). Typically, when redenominating, countries will place “New” in front of the name of their currency, before dropping after several years of use. This policy was adopted by many countries such as Belarus, Bulgaria, Poland, Turkey, and Russia. In other countries such as Argentina, Israel, and Brazil, different names were assigned to the new currency in order to avoid confusion with the old currency (Ioana, 2005).

In 2005, the Turkish monetary authorities implemented the exchange rate of one New Turkish Lira (YTL) for 1 million of (old) Turkish Lira. The decision to redenominate the currency was presented as part of a structural economic reform package backed by the International Monetary Fund (Ioana, 2009). There was a transitional period until January 2008. As Žídek and Chribik (2015) indicate, the impacts of redenomination were obvious; credibility of the New Turkish Lira increased, accounting statements were simplified, and general handling of the currency was easier for all market subjects. The nominal value of the New Turkish Lira became comparable with other currencies 1 EUR = 1.6361 YTL, 1 USD = 1.3448 YTL. Additionally, following the redenomination, inflation in Turkey stayed in single digits or close. The successful redenomination process was followed by implementation of the explicit inflation targeting framework in 2006. Žídek and Chribik (2015) concluded that the process of redenomination had several consequences in Turkey. Apart from improving daily cash operations with the currency and enhancement of the accounting systems, there was an additional psychological impact. Redenomination helped the monetary authorities convince the international market participants that the central bank was committed to price stability. Žídek and Chribik (2015) used econometric techniques to show that the redenomination process in Turkey had an impact on disinflationary development, by revealing a structural break in the inflationary trend in the country. Additional case studies include Israel (1985) and Ukraine (1996). Israel suffered severe hyperinflation, reaching 485.8% in November 1984, prior to the economic stabilization program. A short while after the economic stabilization program, the redenomination of the currency was enacted, and inflation stabilised to manageable levels thereafter (Ioana, 2009).

Overall, the success of redenomination is varied. In some cases, the timing of redenomination is correct and succeeds in reducing high levels of inflation. In other cases, governments are not able to rein in inflation immediately after redenomination, and they may take multiple attempts at currency reform (Mosley, 2005). Argentina (after the Peso Crisis) and Brazil during the 1980s and early 1990s exemplify this pattern (Mosley, 2005).

REDENOMINATION IN GHANA

In the case of Ghana, the BoG implemented their decision on July 2nd, 2007 to redenominate the old cedi by setting ten thousand cedis to one new Ghana Cedi (GHC). New notes and coins were issued to replace the old ones, with both in physical circulation together over a period of 6 months. After the transition period, the old notes and coins ceased to be legal tender, however citizens were still able to exchange them for new notes and coins at any commercial bank or at the Bank of Ghana (Bank of Ghana, 2007). Some of the reasons that the Bank of Ghana cited for redenomination were: 1) difficulties in maintaining bookkeeping and statistical records (due to the large number of zeros in most transactions); 2) strain on payment systems such as ATMs; 3) high transaction costs at the cashiers, and; 4) problems with accounting software (Dzokoto et al., 2010). Commercial banks also faced high costs during cash-based transactions because of the large quantities of notes necessary for the process. Due to the low values of the notes, Ghanaian bank customers often had to face the additional prospect of carrying suitcases and bags filled with cash to conduct larger purchases and deposits. Thus, the main objectives of the currency redenomination outlined by the Bank of Ghana include a reduction in transactions costs and risks of carrying large volumes of notes, simplification of accounting records, reduction in volume and time of transactions, facilitation of the use of vendor machines and car parking meters, and improvements in the efficiency in payments systems (Bank of Ghana, 2009). Furthermore, Ghana News Agency (2006) reported on December 4th, 2006, that Dr. Paul Amoako Acquah, the Governor of the Bank of Ghana at the time, stated:

The redenomination will free the economy to do business in the most efficient way, based on the cedi as a means of exchange; and with continued commitment to prudent and disciplined economic policies, would serve as a store of value for all, both within and outside the banking system.

The statement from the BoG Governor implies that the currency redenomination was used in conjunction with explicit commitments to prudent macroeconomic policies in order to improve the effectiveness of central bank policies. However, the redenomination also faced significant opposition. Critics of Ghana’s redenomination predicted that the prices of goods and services would increase rather than decrease as a consequence of changing the nation’s currency, which was in contrast to the BoG official stance regarding price changes (Dzokoto et al., 2010). The Bank of Ghana anticipated that some price rounding would occur, but expected it to be negligible (Bank of Ghana, 2007). There were also concerns that the
process would be an outright failure like in Zimbabwe, force price increases due to rounding up of prices by street vendors or cause substantial confusion particularly in demographics that lacked basic financial or mathematical literacy (Dzokoto et al., 2010).

Nevertheless, ex post analyses and reports suggest that Ghana’s re-denomination exercise has been largely successful. The Post-Redenomination Survey of Banks, Consumers And Retailers (2009) report based on a survey conducted by the Research Department of the Bank of Ghana suggested that most of the objectives of the currency re-denomination had been achieved. The report was conducted to ascertain the extent to which the expected benefits of the re-denomination exercise has been effectuated over two years after its implementation (Bank of Ghana, 2009). Among the 20 out of 24 banks that responded to the survey, the consensus was that the most of the Bank of Ghana’s objectives have been achieved (Bank of Ghana, 2009). For example, out of the 16 commercial banks operating ATMs, “13 said efficiency had improved ‘very much’ whereas 3 (18.8 %) indicated that they had not seen much improvement in efficiency” (Bank of Ghana, 2009). Additionally, respondents to the survey enumerated that “some of the benefits of the re-denomination were small volumes, faster transaction, faster counting of money, reduction in the overall risks of carrying large sums of money, reintroduction of the culture of using coins etc” (Bank of Ghana, 2009). From the perspective of banking processes and daily transactions, the currency re-denomination was arguably successful. However, the question remains on whether re-denomination itself contributed to the disinflation process in Ghana as well.

DATA EXPLANATION

For the examination of the impact of the 2007 Ghanaian currency re-denomination on the disinflation process, the Chow Test will be conducted on time series data provided by the Statistical Department, Bank of Ghana. The statistical software Stata was used for the time series data analysis. Data entering the models were adjusted for a monthly time series. For clarity, the variables used will be presented in Table 1 along with characteristics, explanation, and the source.

During the statistical analysis, the possibility of measurement error in data was taken very seriously as it would threaten the internal validity of the analysis. Measurement error in data is a risk as it may lead to regression coefficients that do not represent the true betas. The Bank of Ghana Act 612 (2002) specifically stipulates that one of the primary responsibilities of the Monetary Policy Committee is to provide credible and reliable statistical data and advice necessary for the formulation of monetary policy (Bank of Ghana, 2015). The Bank of Ghana made it a priority to assemble a detailed data set on the economy in “all the major macroeconomic sectors of the economy including the latest data on the budget, monetary data, inflation data, and external sector data” (Bank of Ghana, 2015). Moreover, the Bank of Ghana recognized the lack of quarterly GDP data published by the Ghana Statistical Service, the agency with the primary responsibility to publish such data. Therefore, the Bank made an effort to assemble its own data to construct a “Composite Index of Economic Activity” that incorporated data on retail sales, port activity, new vehicle registrations, and job vacancies (Bank of Ghana, 2015).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIEAReal</td>
<td>Composite Index of Economic Activities (real)</td>
<td>Bank of Ghana</td>
</tr>
<tr>
<td>INF-YOY</td>
<td>Overall Inflation</td>
<td>Bank of Ghana</td>
</tr>
<tr>
<td>M2</td>
<td>Broad Money (M2) (GHC’m)</td>
<td>Bank of Ghana</td>
</tr>
<tr>
<td>MPR</td>
<td>Monetary Policy Rate (%)</td>
<td>Bank of Ghana</td>
</tr>
</tbody>
</table>

| TABLE 1. |

STATISTICAL FRAMEWORK AND ANALYSIS

As the currency re-denomination was a major change in macroeconomic policy, there is most likely a discrete break in the macroeconomic data at a definite date. This study adopts a similar statistical analysis as Žídek and Chribik (2015) to test whether the re-denomination process caused a structural break in the data. The Chow Structural Break Test will be conducted to determine whether non-stationarity arises from a break in the coefficients of the population regression function due to the currency re-denomination (Stock & Watson, 2011). However, the macroeconomic time series data were suspected to be non-stationary, with a stochastic trend (Stock & Watson, 2011). To verify non-stationarity, the augmented Dickey-Fuller test for a unit root was applied.

As shown in Table 2, the augmented Dickey-Fuller test at four lags indicated non-stationarity in the case of the three variables, mpr, lniciereal, and lnm2; the variable infyooy did not indicate non-stationarity at the 5% level. Accordingly, a standard OLS estimator using the time series data would have a non-standard distribution, potentially leading to biased estimators, inefficient forecasts, and misleading inferences (Stock & Watson, 2011). Consequently, the stochastic trend in the time series data was eliminated using the first difference of the series to achieve stationarity.

The modified time series data were again tested using the augmented Dickey-Fuller test at four lags. The MacKinnon approximate P-value for Z(t) shown in Table 3 indicates that the null hypothesis H_0 of non-stationarity is rejected at the 5% and the 1% critical value. After con-
firming non-stationarity, the Chow Test was conducted. To conduct a Chow Test on the effect of redenomination, a relatively standard regression model was prepared:

\[ \text{infyoy}_t = \beta_0 + \beta_1 \text{dln}(m2)_t + \beta_2 \text{dln}(cieareal)_t + \beta_3 \text{d}(mpr)_t + \mu_t \]

Where \( \text{infyoy} \) = overall inflation, \( \text{dlnm2} \) = percentage change in broad money (GHC' million), \( \text{dlncieareal} \) = first difference of the Composite Index of Economic Activities (real) growth, \( \text{dmpr} \) = first difference of the Bank of Ghana monetary policy rate, \( \mu \) = residual, and \( t \) = months. This basic time series regression model will enable the use of the Chow Test. It is important to note however, that the coefficients of this model do not capture the linear interdependencies of the redenomination hypothesized in this paper. The null hypothesis of “no break” can be tested using a binary variable interaction regression, as the date of the hypothesized structural break is known (Stock & Watson, 2011). Let \( \tau \) denote the hypothesized break date of July 2007, when the Bank of Ghana implemented the currency redenomination process, and let the data be bifurcated so that \( \text{denom} \) \((\tau)\) is a binary dummy variable that equals 0 before the break date and 1 after. Then the regression including the binary break dummy variable and all interaction term is:

\[ \text{infyoy}_t = \beta_0 + \beta_1 \text{dln}(m2)_t + \beta_2 \text{dln}(cieareal)_t + \beta_3 \text{d}(mpr)_t + \gamma_0 \text{denom}_t + \gamma_1 \text{denom}_t \ast \text{dlnm2}_t + \gamma_2 \text{denom}_t \ast \text{dlncieareal}_t + \gamma_3 \text{denom}_t \ast \text{dmpr}_t + \mu_t \]

If there is no structural break, then the regression function is the same over both parts of the bifurcated sample data set, so the terms involving the binary break dummy variable, \( \text{denom} \), do not enter the equation (Stock & Watson, 2011). That is, under the null hypothesis \( H_0 \) of no break, \( \gamma_0 = \gamma_1 = \gamma_2 = 0 \). Under the alternative hypothesis \( H_A \) of break, the regression function coefficients are different before and after the break date \( \tau \). Thus, the hypothesis of a break can be tested using the F-statistic that tests the null hypothesis that \( \gamma_0 = \gamma_1 = \gamma_2 = 0 \) against the alternative hypothesis that at least one of the \( \gamma \)’s are nonzero (Stock & Watson, 2011).

The resulting P-value of the Chow Test for a break in July 2007 is zero to four decimal places, \( \text{Prob}>F=0.0000 \). This means the null hypothesis \( H_0 \), which says the stochastic trend in inflation (\( \text{infyoy} \)) is the same for the bifurcated dataset, can be rejected. Based solely on the Chow Test however, it is not possible to say that redenomination was unequivocally, the cause of the break. Nonetheless, the obtained test result shows at the 5% level that there is a structural break in the bifurcated data and thus, the currency redenomination may have impacted the overall disinflation process.

To further examine the redenomination, another statistical technique known as Vector Autoregression (“VAR”) was used. A VAR provides a better understanding of the linear interdependencies among multiple time series. A VAR is a set of \( k \) time series regressions, in which the regressors are lagged values of all \( k \) series (Stock & Watson, 2011). The VAR model captures the overall inflation rate in Ghana, which is expressed by the variable, \( \text{infyoy} \). This study adopts a simplified version of the VAR model specified in Žídek and Chribik (2015): where the model is a set of five time series regressions with lagged values, \( \text{infyoy} = \text{overall inflation rate}, \text{dlnm2} = \text{percentage change in broad money (GHC’ million)}, \text{dlncieareal} = \text{first difference of the Composite Index of Economic Activities (real) growth}, \text{dmpr} = \text{first difference of the Bank of Ghana monetary policy rate}, \mu = \text{residual}, \) and \( t \text{ = months}. Here,

<table>
<thead>
<tr>
<th>ADF Test</th>
<th>infyoy</th>
<th>mpr</th>
<th>Inciareal</th>
<th>Lnm2</th>
</tr>
</thead>
<tbody>
<tr>
<td>with Constant</td>
<td>0.0334</td>
<td>0.3602</td>
<td>0.4530</td>
<td>0.3425</td>
</tr>
<tr>
<td>with Constant &amp; Trend</td>
<td>0.0248</td>
<td>0.7723</td>
<td>0.0000</td>
<td>0.5562</td>
</tr>
</tbody>
</table>

**TABLE 2.**

<table>
<thead>
<tr>
<th>ADF Test</th>
<th>dmpr</th>
<th>dlncieareal</th>
<th>dlnm2</th>
</tr>
</thead>
<tbody>
<tr>
<td>with Constant</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>with Constant &amp; Trend</td>
<td>0.0002</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

**TABLE 3.**
the VAR will be conducted on the bifurcated dataset, for both the sample before and after the redenomination. Then, by comparing the coefficients from the VAR for the two samples, the effects of the redenomination can be examined.

To construct a robust VAR model, the optimal number of lags to include in the regression was estimated using VAR lag selection procedures on Stata (Židek & Chribik, 2015). Figure 1 depicts the Stata analysis conducted to determine the number of lags chosen to minimize the Final Prediction Error (“FPE”) and Akaike Information Criteria (“AIC”). The estimated lag length with the lowest value of information criteria was three. The equation with overall inflation \( \inf_y \) as the dependent variable was used. The results of the bifurcated VAR(3) model are shown in Figure 2.

The results of the bifurcated VAR(3), show that the coefficients for lags are different between the two datasets. In the pre-redenomination VAR, a one percent change in the first lag (L1) of the inflation rate, \( \inf_y \), relates to a 1.07% increase in the inflation rate in the current period. However, in the post-redenomination VAR, a one percent change in the first lag (L1) of the inflation rate \( \inf_y \), relates to a 1.44% increase in the overall inflation rate in the current period. Several of the other variables such as the \( \dmpr \) and \( \dlnm2 \) are significantly different when comparing between the pre-redenomination VAR and the post-redenomination VAR. For example, the \( \dmpr_{-1} \) has a coefficient of 0.67 pre-redenomination and a coefficient of 0.19 post-redenomination. Thus, the results show that the coefficients of the VAR pre-redenomination and post-redenomination are significantly different. Conducting a Granger causality test allows us to jointly test the significance for all the lags for each variable in the bifurcated VAR. Granger causality means that if a variable X, Granger-causes Y, then X is a useful predictor of Y, given other variables in the regression (Stock & Watson, 2011). A Granger causality test is administered by testing the null hypothesis that the estimated coefficients on the lagged values of each variable are jointly zero (Stock & Watson, 2011). Failure to reject the null hypothesis is equivalent to failing to reject the hypothesis that a variable does not Granger-cause the dependent variable. Figure 3 shows the results of the Granger causality test for the pre-redenomination VAR.

The first is a Granger causality Wald test that the coefficients on the three lags of \( \dlnciareal \) are jointly zero. As the \( P > \chi^2 \) is 0.038, the null hypothesis that \( \dlnciareal \) does not Granger-cause overall inflation \( \inf_y \) can be rejected at the 0.05 level. This means that \( \dlnciareal \) is a useful predictor of \( \inf_y \), given the other variables in the regression. Additionally, the \( P > \chi^2 \) of 0.038 shows that past lags of \( \dlnciareal \) appear to contain information that is useful for forecasting changes in the inflation rate, beyond that contained in past values of \( \inf_y \) (Stock & Watson, 2011). However, the Wald test that the coefficients on the three lags of \( \dlnm2 \) are jointly zero show the null hypothesis cannot be rejected. Overall, the \( P > \chi^2 \) is 0.021, thus the null hypothesis that all the variables do not Granger-cause overall inflation can be rejected.

Figure 4 shows the results of the Granger causality test for the post-redenomination VAR. For the post-re-
Vector autoregression

<table>
<thead>
<tr>
<th>Equation</th>
<th>Pares</th>
<th>RMSE</th>
<th>A-r sq</th>
<th>chi2</th>
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Vector autoregression

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**FIGURE 2.**

Granger causality Wald tests

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<th>df</th>
<th>Prob &gt; chi2</th>
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**FIGURE 3.**

Granger causality Wald tests

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<td>9</td>
<td>0.215</td>
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</table>

**FIGURE 4.**
denomination VAR, the first, second, and third Granger causality Wald test show that the null hypotheses cannot be rejected at the 5% level. As these null hypotheses were not rejected, the post-redenomination VAR is not statistically significant, and the variables jointly do not conclusively Granger-cause overall inflation, \( \infyo \).

Thus, in examining the bifurcated VAR, it can be stated that the coefficients were nominally different. However, the Granger causality test showed that the post-redenomination VAR was statistically insignificant, therefore, inconclusive as to whether the autoregressive distributed lag components had any information that is useful for forecasting changes in the overall inflation rate.

**DISCUSSION**

As outlined in the introduction, the goal of this paper was to examine the impact of the Ghanaian currency redenomination in 2007 and determine whether the process contributed to the disinflation process. According to the Bank of Ghana’s own survey, the process of redenomination had several consequences. Aside from the ease in day-to-day transactions, the Ghanaian banking sector experienced simplification of accounting records and reduction in transactions costs and risks of carrying large volumes of notes. Furthermore, Ghanaian banks also reported experiencing facilitation of the use of vendor machines and car parking meters, and improvements in the efficiency in payments systems (Bank of Ghana, 2009). Additionally, redenomination may have contributed to the disinflation process by helping the monetary authorities convince the market that the central bank was committed to reducing inflation. To examine the impact of redenomination on the inflation rate, two statistical analyses were used. A Chow Structural Break Test was conducted to determine whether a structural break existed in the time series variable for overall inflation. The resulting P-value of the Chow Test for a break in July 2007 was zero to four decimal places, \( \text{Prob} > F = 0.0000 \). A P-value less than 0.05 meant the null hypothesis \( H_0 \), which says that the regression function coefficients are the same before and after the break, was rejected. Based solely on the Chow Test however, it is not possible to say that redenomination is the direct cause of the break. Moreover, it is clear that the Chow Test alone will not allow for the currency redenomination to be distinguished from other government and central bank policies. Therefore, a bifurcated vector autoregression was also conducted to examine the dynamic causal effect of redenomination. Examining the output of the bifurcated vector autoregression, all of the coefficients were significantly different pre-redenomination and post-redenomination. However, the Granger causality test showed that when testing the post-redenomination VAR, the null hypothesis was not rejected. This meant the lags of each variable did not Granger-cause the overall inflation and thus, was inconclusive as to whether the autoregressive distributed lag components had any information useful for forecasting changes in the overall inflation rate. While the significantly different coefficients for the pre-redenomination and post-redenomination was promising, the statistical insignificance was discouraging. Thus, it can only be concluded that while the Chow Structural Break Test found a structural break in inflation before and after the redenomination, the bifurcated vector autoregression, VAR(3), was inconclusive as to whether the policy itself directly affected the disinflation process.

Furthermore, it is important to note that the implementation of the May 2007 Inflation Targeting framework and the June 2007 redenomination are only a month apart. Thus, it is extremely unlikely that the effects of the IT framework and the redenomination on disinflation can be separated by solely looking at time series data. A better approach to examine the impact of redenomination, as a qualitative tool in the disinflation process, is to study countries that have introduced a formal inflation targeting framework. The effect of redenomination can then be isolated by examining whether countries that have conducted both redenomination and inflation targeting saw a faster shift of expectations towards the inflation target. These conclusions indicate that economists should devote more attention to the potential of currency redenomination as a qualitative tool in the disinflation process. Further empirical examination of currency redenomination may lead to better tools in the future for countries struggling with high and variable inflation rates.
REFERENCES


The Role of Pension Funds in the Development of Capital Markets in Latin America

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ABSTRACT

Over the past two decades, Latin America has stood out as one of the regions with most promising economic fundamentals and potential among emerging markets. Nonetheless, its track record of economic development has lagged in comparison to other developing economies – especially in the Asia-Pacific region – which points to, among various issues, to an underdevelopment of stable and widespread capital markets. The increasing incorporation of capital markets into financial systems historically dominated by banking systems in Latin America facilitates the process of raising and allocating capital while minimizing transaction costs, mitigating risk through diversification, and improving accessibility to economic actors. This paper analyzes the role of pension funds in the development of capital markets in Latin America as both financial intermediaries and institutional investors with distinguishing characteristics and advantages. I use a series of ordinary least squares regressions to test the effect of the growth on pension fund assets in the growth of stock and bond markets while controlling for entity and time fixed effects, and macroeconomic and demographic factors. The results are both positive and statistically significant for both sets of regressions, despite the differing country-specific circumstances. I conclude that the constructive role of pension funds in Latin American capital markets can promote the enhancement of financial systems overall and contribute to the efficient and equitable economic development of countries across the region. Further, I suggest policies that could be implemented to achieve these objectives.

INTRODUCTION

Economic development is connected, at any of its stages, to the movement of funds between economic actors that have excess resources and seek return opportunities and other actors who require these resources to finance their productive projects or future expenditures. This is the reason for the existence of financial systems, which regardless of their sophistication, fulfill this purpose to some extent. Nonetheless, the efficiency of these transactions – not only regarding the speed at which they take place, but also the increased access to participants with different appetite for risk and return, and to firms with various financing necessities – facilitates the path towards broad economic development.

Even though capital markets in developed nations have become established to the point of experiencing diminishing marginal returns, in emerging markets they represent the evolution of finance from systems traditionally dominated by bank credit. Yet, lower levels of development in emerging markets imply higher risk than that of advanced economies in terms of the certainty that domestic or foreign investors will be able to make a profit on their investments. Thus, the main feature of capital markets in developing economies is that, on average, they offer a higher rate of return than those in developed countries to compensate for the higher risks and volatility. However, in order to transition to a system in which a greater amount of funds is available at a lower cost of capital for firms and households to nurture a country's economic development, there needs to be an increase in the size and number of market participants that demand the securities and provide the funds. This is the case of Latin America, one of the most mentioned emerging economic regions in the world since the 1990s. Nevertheless, it is a region that despite its strong fundamentals and economic potential, has lagged behind industrialized countries and comparable developing country blocs, especially in transitioning to a more efficient system to capture and allocate funds.

This paper will analyze the role of pension funds in the development of capital markets in Latin America, specifically by observing the effect of growth in pension fund assets in the expansion of stock and bond markets in the region. Section II provides an overview of Latin America's macroeconomic environment and characteristics of capital markets during the past two decades. Section III develops the conceptual framework of the importance of capital markets in addition to banking systems in the development of emerging economies, as well as the specific advantages offered by bond and
stock markets. Section IV explores the role of pension funds as both financial intermediaries and institutional investors, as well as the particular characteristics that define them as key players in the demand side of capital markets vis-à-vis other investors. Section V provides an executive summary of the data with the corresponding descriptive statistics, and Section VI builds up from the former to determine the variables studied, and to structure the econometric models and relevant controls used. Section VII analyzes the results of the regressions, and Section VIII discusses possible explanations for these, as well as the validity and limitations of this research. Finally, Section IX concludes and highlights important policy implications for the future development of capital markets across the region.

OVERVIEW OF CAPITAL MARKETS IN LATIN AMERICA

During the 1990s, Latin America seemed to be one of the most attractive emerging markets for economists and investors given its strong macroeconomic fundamentals and leading structural reforms (De la Torre, Gozzi & Schmukler, 2007). Compared to other emerging markets such as East Asia, Latin America seemed to have an edge over these in the process of economic development, especially regarding capital markets. Notwithstanding, throughout the past two decades, such promising trend has reversed, and the relative lag of the region has prevented it from living to the expectations set forth during the 1990s. In the study of the development of capital markets in emerging economies, Stallings and Studart identify three main factors that hinder such process: lack of macroeconomic stability, weak institutional framework, and the presence of international markets as attractive substitutes to domestic finance (Stallings & Studart, 2006).

In terms of macroeconomic performance, Latin America has experienced a historically positive GDP growth trend, yet characterized by periods of high volatility as well as considerable differences among certain countries (World Bank, 1991-2016). The region showed a record of stable growth throughout most of the 1990s, only suffering considerable declines following the 1994 Mexican currency crisis and the 1998 Asian financial crisis, which were caused by massive capital outflows from emerging markets. Between 2001-2003, this trend temporarily stalled driven by economic phenomena such as the 2001 Dot-Com bubble as well as non-economic events such as 9/11, which rattled the global investment sentiment. However, Latin America’s Golden Age began soon after that following a surge in commodity prices, driven mainly by a larger demand for oil by China, the US, and other industrialized nations around the globe. During 2008-2009, the Great Financial Crisis struck the region and led to an overall contraction of GDP, yet the impact was assimilated differently in each country, with some like Argentina and Mexico posting contractions close to 5% of GDP, and others like Colombia and Peru faring over 1% growth. The “Oil Bonanza” peaked in 2010-2011, and reached its end in 2014, following the detrimental slump of crude prices from over $110 per barrel to under $40 per barrel, and the region has experienced a significant slowdown since.

Historically, the region has been characterized by being a highly inflationary environment – especially during the 1990s – and, although some countries have managed to improve their controls during the recent years, there are notable exceptions of high inflation and even hyperinflation (World Bank, 1991-2016). On average, fluctuations in the regional inflation rate tend to follow suit with each period's growth to a moderate extent. Nonetheless, even though the economic data for the region displays some correlation with region-wide and global phenomena, economic indicators at the individual country level experience significant variability from the regional aggregates. Such differences are even more accentuated when observing the record of inflation for each country, which seems to be more influenced by domestic economic conditions and sentiment, as well as political cycles and changes in policy.

Despite the volatility of growth and inflation rates throughout the last two decades, the region's overall savings rate has shown a lower relative sensitivity to the volatility in the former benchmark macroeconomic indicators (World Bank, 1991-2016). During the aggressive growth of the “Oil Bonanza,” the overall gross domestic savings rate depicted an increase of around 3% as a share of GDP to 23% – except for Chile’s and Peru’s savings rates, which increased by as much as 15% and 8% respectively. The Great Financial Crisis led to a temporary dip in the overall savings rate close to 20%, yet it recovered most of its previous gains shortly after in 2011. Nevertheless, following the peak and end of the Golden Age, the aggregate savings rate followed the decrease in the overall GDP growth rate by falling nearly as low as 17%, yet the near 2% drop in overall inflation was not nearly as prominent.

The slight increase in the savings rate during the Golden Age can be attributed in part to the spike in GDP growth rates, as these also imply that household incomes increased, and individuals were willing to separate a larger portion of their income into their savings. Furthermore, they saw prices continue rising at a steady pace, and, with their incomes growing at a faster rate, households’ purchasing power rose, enabling them to set aside additional savings. Another feature that may have driven an increase in the savings rate is the reduction of income taxes, which, was possible in part due to an increase in government revenues from high-priced commodities. Once again, this further increased households’ disposable incomes and allowed them to save a larger portion of it. Overall, a higher savings rate implies that there is a larger
supply of loanable funds in the economy, and, with governments running small or no fiscal deficits while their countries preserved their position as net exporters, such supply would be available at relatively competitive costs for participants in the demand side.

Despite the favorable expansionary conditions of the Golden Age, the reversal in the savings rate during the last six years can also be explained by the fluctuations in the macroeconomic benchmark indicators. The decline in commodity prices caused a substantial cut in the value of oil and overall commodity exports of many Latin American countries, whose GDP composition relies more heavily on net exports than that of industrialized countries with more developed domestic consumption and investment components. This decline in GDP growth rates had two major implications. First, it represented a negative shock to household incomes, coupled with a strong multiplier effect product of previous expansionary policies and reductions of automatic stabilizers (e.g. lower taxes). Secondly, it significantly exacerbated the governments' fiscal deficits given the lower exporting revenues, and countries' overall trade deficits due to the decline in the value of their exports. Furthermore, these deficits were intensified by the depreciation of their local currencies, which also deteriorated each country's purchasing power internationally.

The effect of the former implication on the savings rate – along with a relatively sustained inflation – was negative, as households' purchasing power was eroded, and they had to spend a larger portion of their income to sustain their standard of living. Moreover, the increase in inflation in the case of Brazil and Colombia implied that the real return on their savings declined, holding nominal interest rates constant, which created a disincentive to save. The effect of the latter implication was that governments not only had to draw from the private supply of loanable funds to finance their deficits, but that they also had to engage in contractionary fiscal reforms in order to increase their tax revenues and compensate for the budget hole left by their lower export revenues. Higher taxes implied a reduction in households' disposable income that further magnified the impact of lower GDP growth rates and was reflected on their lower savings level. Overall, lower savings rates and higher government deficits significantly reduced the supply of loanable funds in Latin American economies, increasing the costs of capital for firms and borrowers, and complicating the development of stable capital markets.

In terms of the quality of the institutional framework, Stallings and Studart's findings point out that most Latin American countries have not had consistent periods of high government effectiveness and regulatory quality, along with an inefficient and often-politicized implementation of the rule of law and weak control of corruption (Stallings & Studart, 2006). The institutions resulting from different legal traditions and their enforcement of property rights, private contracts, and investor protection laws "shape the willingness of savers to invest in firms, the effectiveness of corporate governance, and the degree of financial market development" (Thorsten & Levine, 2014). The aggregate of these institutional factors determines the ease in the conduct of business in these countries, and thus the confidence that market participants both in the demand and supply sides place on the orderly behavior of financial systems. In developed and industrialized countries, the robustness of these parameters generates no detrimental expectation that investors' capital will be confronted by an institutional risk that was not priced when entering the market.

The issue with the lack of institutional quality in emerging markets is not only that the supply of funds by both domestic and international sources is restricted by aversion of these risks, but that, in order to enter the market, investors demand a higher compensation to face those additional risks caused by poor institutions. For instance, as mentioned by De la Torre, Gozzi and Schmulker, premature financial liberalization without a minimum level of "institutional strength in terms of the legal and regulatory framework, supervisory capacity, and accounting and disclosure standards is likely to exacerbate distortions in financial markets" (De la Torre, Gozzi & Schmulker, 2007). Thus, if there is a restricted supply of funds and higher costs of capital to price additional risks, then the development of capital markets is hindered from a fundamental standpoint. Additionally, this creates a further incentive for the propagation of bank credit as a substitute of capital markets, as banks are able to offer financing to a higher degree of certainty to counterparties in financial markets through rigorous background checks and contracts, but at greater transaction costs. This, along with banks' relationship building with clients, explains in part the propagation of bank finance in the region, which increases the overall costs of funding due to higher transaction costs and overweighting of certain behavioral factors that hinder the development of capital markets.

Finally, access to the international financial markets can represent a further hindrance for the development of domestic financial markets, both on the side of borrowing firms and individuals, and on the side of lenders and investors. Regarding the former, borrower-issuers can find a substitute to the domestic loanable funds and capital markets abroad in countries that offer more competitive costs of capital, reducing the domestic demand for funds, and thus the supply of debt and equity issuance (Stallings & Studart, 2006). On the other hand, lenders-investors with higher risk aversion may prefer to purchase securities abroad and face a lower institutional and market risk. The main downside of this approach is that, by increasing their activities in the international market, participants are exposed to currency risk, which in the case of Latin American countries, presents high levels of volatility. Such volatility does not imply that they will by
default experience losses when they liquidate their international positions, but that the variability can significantly increase the value at risk of their investments or the size of their financial obligations as issuers of paper. Therefore, this disadvantage does not originate from the existence of an undesired possibility, but on the higher probability that it will occur, and the uncertainty associated with predicting the final outcome.

**IMPORTANCE OF CAPITAL MARKETS IN ADDITION TO BANKING SYSTEMS**

The development of domestic capital markets does not imply an eradication of banks, yet their existence and orderly function in addition to established banking systems proves to be beneficial to financial market participants on the demand and supply sides, as well as to the overall economic development of a country. This section initially discusses the advantages of capital markets overall: the availability of an alternative to bank credit, the provision of new savings and investment instruments for lenders, and a lower dependence on foreign capital flows. Next it will elaborate on the advantages specific to bond markets, which include establishing a market interest rate, preventing overconcentration of risk on the banking sector, and facilitating the conduct of monetary policy. Following the advantages of the bond market, the next subsection covers those of the stock market, which include the availability of higher risk-return instruments, and higher liquidity than the bond market. The final subsection provides an overview of fundamental reforms of financial and capital markets in emerging economies that enable their efficient development.

**Advantages of Capital Markets**

The availability of an alternative to bank credit in capital markets increases the competitiveness of financial markets overall by leading to lower costs of capital, and a higher number of participants in both the supply and demand of funds. From a demand standpoint, capital markets can be seen as a substitute to bank credit as they provide an additional source of funds for firms and households. Therefore, as the users of funds pursue the least costly alternative to raise capital, suppliers of funds need to lower their offered costs of capital in order to compete with the relatively less expensive alternatives. Furthermore, competitiveness in financial markets is intensified by the fact that capital is hardly a differentiable product, which forces participants to compete mainly on price. Finally, capital markets are designed in a way that they can reduce the need for financial intermediation, which contributes to lowering transaction costs and thus investors’ required rates of return.

In terms of the composition of capital markets, these enable access to funds to a larger group of firms and households with more diverse levels of risk, as they are able to raise capital directly from investors without a bank’s intervention (Leaven, 2014). Banks tend to have a threshold for the amount of credit risk of their borrowers and thus may refuse to provide funds to borrowers with lower credit worthiness. Nonetheless, primary capital markets solve this accessibility issue by incorporating specific risks into the price of the securities issued by a given entity, until it is attractive enough for the marginal investor to purchase them. Furthermore, the structure of the market as a centralized exchange for stocks or over-the-counter networks for bonds facilitates the process of finding such investors.

Additionally, capital markets provide a larger range of savings and investment instruments different from bank deposits that are better able to match a broader spectrum of risk appetite of savers and investors (Stallings & Studart, 2006). The greater variety of instruments in the market allows investors with more risk-seeking behaviors to pursue higher returns, while improving their ability to diversify their portfolios and manage risk (Narayanaswamy, Blitzer & Carvajal, 2017). For instance, domestic capital markets offer a natural hedge against inflation and currency risks for local-currency investors (Leaven, 2014). Another important feature that stems from the broader spectrum of risk preferences is the greater availability of long-term financing, as heterogeneous investors have different investment horizons and thus tolerance for maturity risk. Even though this is a characteristic of investors in the supply side, it improves firms’ and households’ ability to manage their own exposure to interest rate and maturity risk in the demand side (Leaven, 2014). In such a way, firms and households are better able to match the maturities of their financial and non-financial assets with those of their financial obligations. Likewise, they can match their fixed- and variable-return assets with a proportional mix of fixed- and variable-payment liabilities, avoiding the possibility of a credit crunch due to changes in interest rates.

Even though foreign financing and investment contribute to the development not only of financial markets, but also of overall economies, there are dire consequences related to a reversal of foreign capital flows and systematic deleveraging by international investors (Leaven, 2014). Massive foreign capital outflows generate downward pressures on the local currency, as investors’ demand for it declines while the relative demand for foreign currencies rises. Due to the depreciation of the local currency, firms with foreign financial obligations experience considerable increase in the value of such liabilities and their associated payments, risking their default. Therefore, given that domestic capital markets provide an additional alternative to international finance, they may reduce the relative international exposure of a country, and thus mitigate the adverse effects of foreign capital outflows. Moreover, robust domestic capital markets shield...
a country's economy against contagion of international crises, as both local sources and users of capital are able to reduce their sensitivity to international risk by participating in the domestic market.

**Advantages of Bond Markets**

In the same way as the equilibrium price is defined in any market, a market-determined interest rate is the point in which borrowers' marginal willingness to pay equals lenders' marginal cost to supply a given quantity of loanable funds. Beyond a mathematical exercise, the market-determined interest is derived from the confidence and expectations of market participants shaped by their own assessment of the available information that will affect their future returns. Hence, the more information that such entities have access to, the better they will be able to price the risks and opportunity costs of investment alternatives, and the lower the possible discrepancy between their expectations and actual outcomes. Even though most modern economies have government-controlled policy rates that influence broad market conditions, the market-determined interest rate provided by the local bond market absorbs this information along with various other factors that are not accounted for by a policy rate. Furthermore, in the case of bank credit, lending rates are the product of the risk-return assessment of the parties involved in a loan contract. Yet, even though both may have access to private information about each other, they may not be able to price their opportunity cost accurately without the information provided by the market-determined interest rate (Stallings & Studart, 2006).

From a risk-management standpoint, bond markets prevent the overconcentration of credit and its associated risks in the banking sector, and such risk sharing mitigates the impact of an eventual banking crisis in the entire financial system (Leaven, 2014). The main advantage of distributing credit risk between bank and non-bank institutions is that in the event of large systematic defaults, the ripple effect of this shock is alleviated by their different sensitivity to systematic risk. Through capital markets, non-bank firms can get exposure to credit risk, so the adverse repercussions of credit events are shared by more entities, and the systematic shock is reduced as they are able to absorb smaller shares of the credit losses without defaulting. Furthermore, firms outside the banking industry, usually under less regulatory scrutiny, may be better able to cover these losses through their own operating cash flows, and even face less restrictions to raise capital to reduce their leverage. Additionally, the presence of capital markets facilitates the use of financial derivatives to further manage risk and increase risk-sharing opportunities (Leaven, 2014).

Finally, bond markets support the conduct of monetary and fiscal policy by improving the transmission mechanism, allowing governments to better finance their deficits, and providing them information about macroeconomic conditions (Leaven, 2014). First, a higher number of instruments through which the government can conduct open market operations and asset purchases allows the monetary authorities to gauge the strength and scope of such policies. Whether through conventional or unconventional monetary policies, having the ability to intervene in the markets of additional instruments accomplishes a more accurate and efficient effect of these measures overall. For instance, as mentioned by Leaven, long-term bonds facilitate the currency sterilization process – central bank's intervention of the exchange rate without affecting the monetary base and domestic interest rates using offsetting transactions involving foreign reserves and domestic financial assets – because relying on short-term instruments tends to drive up short-term rates and increase inflows into such investments (Leaven, 2014).

In addition, the bond market allows governments to finance their deficits without resorting to foreign borrowing or financial repression through their own domestic debt issuances (Leaven, 2014). By doing so, governments avoid being exposed to currency risk, which, as in the case of private borrowers, could experience a significant increase in the value of their foreign financial obligations due to exchange rate volatility. Additionally, it prevents them from resorting to financial repression such as raising taxes or placing restrictions on capital mobility, which would have adverse effects not only in the financial sector, but also in the real economy. The main limitation that arises from governments financing their deficits through capital markets is that they start competing against the private sector for funds, and the resulting greater overall demand will raise the real interest rate for loanable funds. Furthermore, if the deficit financing is not coupled with a reduction in government expenditures, leading to consistently higher real interest rates, it may end crowding out the private-investment component of GDP in the long run.

The bond market also provides monetary authorities with information about macroeconomic conditions relevant to their conduct of policy (Leaven, 2014). Governments favor using bond markets – and capital markets in general – to monitor investor and market expectations, as they better enable them to anticipate the behavior of the real economy, which is harder to gauge on a regular basis. This feedback process not only allows them to have a clearer picture of the state of the overall economy, but it also empowers them to implement forward guidance in an attempt to manage investor expectations, and check their reactions to policy changes.

**Advantages of Stock Markets**

The main benefit of stock markets is that they provide an investment alternative with unlimited upside for in-
vestors with risk-seeking behavior (Stallings & Studart, 2006). Unlike bonds, the return on stocks is not capped at the interest rate, because shareholders have claims over the residual cash flows of a company after the claims to other stakeholders, including creditors, have been fulfilled. Furthermore, stocks offer voting rights that allow investors to influence the company's management to their best interest. Nonetheless, even though stocks offer limited liability to shareholders, they have the last claim over a firm's assets in the event of bankruptcy, and, unlike bondholders, are more likely to lose their entire investment. From the firms' perspective, stocks can be favorable for firms with unstable cash flows, as they are not legally bound to payout dividends to shareholders and would not put them in a default scenario as a missed interest payment would.

Alongside the higher upside, stock markets are relatively more liquid than those for bonds, as the centralized-exchange dynamic allows investors to move their positions more easily. The faster execution of transactions in this market reduces by default investors' exposure to market risk, and even country and currency risk in the case of international investors, as they can liquidate their positions before suffering unforeseen losses. Furthermore, it may provide information about macroeconomic and financial conditions more frequently than debt markets to market participants and regulators, yet to the expense that such data may have some distortions associated in part with irrational investors.

**Structural Reforms**

The evolution of capital markets – and financial systems in general – into modern drivers of investment and economic growth is fueled by cycles of financial innovation and crisis, yet is formally established through structural reforms to the financial system. Even though governments officially implement these reforms, they are often championed by and designed with the help of private entities. Overall, such transformations of the financial system have aimed to create a balance between empowering of private-sector participants with particular interests and attenuating the level of government intervention. However, there are countless nuances and variations to this reform mix on a country-by-country basis in Latin America, yet, on average, moving towards such general trend. This subsection provides an overview of the fundamental reforms of financial markets in emerging economies that enable their efficient development: financial liberalization, privatization, opening of the financial account, and pension reform (discussed in Section IV).

Financial liberalization constitutes the core structural reform to the financial system and sets the foundations for the rest of free-market reforms. Stallings and Studart define it as “the partial or complete elimination of government-imposed restrictions on domestic financial behavior, so that economic agents can make their own decisions with regards to volume, price, timing, and purpose of financial transactions” (Stallings & Studart, 2006). To this effect, they identify a dual purpose for such reform: first, to signal the government's commitment to the private sector's involvement in the market, and, second, to provide market participants with the appropriate legal framework and practical tools to do so. Even so, financial liberalization cannot be identified as an outcome, but rather as a means towards nurturing higher investment and economic growth, and broad access to finance for all economic actors, without compromising financial stability.

Paradoxically, these may create a scenario of conflicting goals for market participants and regulators, which has spurred a still ongoing debate on the optimal mix of liberalization and government intervention. This suggests that the issue of liberalization must be addressed and gauged at different dimensions, including the speed and extent of the implementation process, the country's institutional strength, and the accompanying regulatory and macroeconomic policies (Stallings & Studart, 2006). Most economists agree that a gradual implementation to the point in which the government's role focuses on prudential supervision rather than imposing a political agenda on the market facilitates successful liberalization. However, this is contingent not only on a country's institutional tradition, but also on the enhancement or preservation of institutional strength after liberalization to avoid distortions in the conduct of business.

This raises the issue of the timing of reforms, as not all emerging markets have the minimum institutional robustness and small developing economies have little control over international conditions that may influence the outcome of such reforms (Stallings & Studart, 2006). Therefore, governments in developing countries must implement changes to financial regulation in such a way that it adheres to international standards, especially when dealing with principal-agent problems, information asymmetries (i.e. adverse selection and moral hazard), and conflicts of interest (Stallings & Studart, 2006). Additionally, further strengthening of institutions can be achieved through private monitoring, such as disclosure of material information, and external auditing and ratings (Stallings & Studart, 2006). Finally, as mentioned in the first section, macroeconomic stability proves to be a significant determinant of the development of capital markets, thus, by transitivity, it grounds the success of liberalization. Hence, governments need to support this process by promoting real growth and price stability, moderate deficits, and competitive exchange rates, as well as appropriate regulatory reforms that reduce uncertainty in the market.

One of the main reforms that stems from financial liberalization is privatization, which follows the premise of
lower government involvement in financial markets by transferring firm ownership to the domestic and even foreign private sector. In the scope of capital markets, privatization has two main implications: it allows new firms to enter the marketplace and forces them to obtain funds within the private sector, consequently, creating an incentive for them to increase their profitability. Regarding the former implication, new private firms must recur to financial innovation and create attractive instruments for private investors with different risk profiles in the absence of government fiscal revenues (Stallings & Studart, 2006). This implies that private firms’ core incentive in profit maximization, not only because it will allow them to generate a return to all its stakeholders, but also it will better enable them to raise funds from new investors. Capital markets serve as a device to augment the effects of the privatization by both facilitating the movement of funds through trading instruments, and improving the disclosure of information relevant to investors.

In a similar manner to the case of financial liberalization, Stallings and Studart propose a debate regarding the optimal mix of privately-owned financial institutions, and publicly-owned ones. Public banks can contribute to greater financial stability and access to finance for low-income households and small businesses, given that they may not have a strictly profit-maximizing mandate and are influenced by governments’ equity goals (Stallings & Studart, 2006). For instance, they may be more willing to extend credit countercyclically and mitigate the impact of economic recessions (Stallings & Studart, 2006). Nonetheless, following political motives may drive them to pursue inefficient projects that will hinder the process of financial and overall economic development. On the other hand, given the profit-maximizing incentives of private banks, they will most likely pursue efficient projects and incur in financial innovation (Stallings & Studart, 2006). However, financial innovation may come at the expense of stability and need for further regulation, as well as less equitable access to finance. Stallings and Studart’s findings point out that, given strong institutions, any financial system can function successfully, yet, controlling for institutional characteristics in Latin America, mixed-ownership systems (e.g. Chile) are more efficient than “pure” ownership structures (Stallings & Studart, 2006).

Another branch of financial liberalization is the opening of the financial account, which allows the movement of financial resources from capital-abundant countries to capital-scarce ones, where there is a higher expected return (Henry & Lorentzen, 2003). In turn, the domestic economy would have access to relatively lower costs of capital, leading to higher investment and real economic growth. Financial account liberalization is another reform that faces constant debate, as the reversal of foreign capital flows can exacerbate domestic banking crises and breed currency crises. Notwithstanding, the consequences of this phenomenon reflect different impacts in debt and equity markets, which invite the partial and gradual implementation of such reform. In the case of debt markets, systematic deleveraging can lead to subsequent liquidity crunches and defaults, given that firms are required to service more expensive foreign financial obligations and find difficulties raising sufficient funds (Henry & Lorentzen, 2003). Equity manages to count this scenario as firms have full discretion concerning their dividend policy, and such risk is already priced and accounted for through higher returns under stable macroeconomic conditions. Furthermore, in the case of developing financial markets, foreign institutions bring new technology and are able to improve overall productivity, while complementing domestic firms, which tend to have greater knowledge about their local market (Stallings & Studart, 2006).

ROLE OF PENSION FUNDS AS INSTITUTIONAL INVESTORS

One of the latest and most innovative transformations in financial systems is the liberalization of pension systems. Such pension reforms involve “a transition from unfunded, publicly-managed, ‘pay-as-you-go’ pension systems to privately-managed, fully-funded, defined contribution systems of individual accounts for beneficiaries” (OECD, 2008). Even though these reforms mainly sought to provide more reliable sources of retirement income while reducing the fiscal drain, it empowered pension funds and other contractual savings institutions (e.g. insurance companies) with sufficient capital to have a material impact on financial markets (OECD, 2008). In the scope of capital markets, pension funds not only became notable participants in the demand side of securities markets – as new sources of funds – but also contributed to their stability given their institutional investment mandates. Chile led Latin America with the first transformation of its pension system to fully-funded private schemes in 1981, and was followed throughout the 1990s by Colombia, Mexico, Peru, and Argentina to different extents – Brazil uses a public scheme for mandatory pensions, but offers complementary voluntary pensions that are managed privately (Stallings & Studart, 2006). This section starts by defining the role of pension funds as both financial intermediaries and institutional investors, as well as comparing the different pension–fund schemes and their incentives towards the economic actors affected by them. The rest of the section discusses the main characteristics of these new participants on the demand side of capital markets: provision of long–term funds, enhanced diversification, economies of scale, and relationship with banks as both substitutes and complements.

Pension funds can be defined as financial intermediaries between contributors (sources of funds) and firms (users of funds), as well as institutional investors with
large—enough pools of capital that allow them to invest at a large scale. Their role as financial intermediaries can be explained through the nature of their liabilities: they enter into a contract in which they are able to collect funds from contributors, usually through their employer sponsors, and are obligated to pay them an annuity upon retirement or even disability (Davis, 1995). While they accumulate funds, they continue to behave as intermediaries by investing in securities and other financial assets of firms, thus mobilizing funds from their sources to their users. On the other hand, even though pension funds’ role as institutional investors is tightly linked to their intermediation function, it can be better explained by the nature and size of their assets. Their ability to pool massive amounts of funds enables them not only to make sizable investments with a material impact on the market, but also to manage such assets following a rational investment mandate and benefiting from diversification and economies of scale.

Pension funds exist mainly under two schemes, defined benefit and defined contribution, which “differ in the distribution of risk between the member and the sponsor,” and thus in the expected return for the member (Davis, 1995). In the defined benefit scheme, the employer sponsor – and, indirectly, the pension fund administrator – agrees to pay a predetermined annuity to its affiliated employees based on a percentage of their salary and other employment-related considerations established in the contract (e.g. seniority). Therefore, contributors end up trading present wages for future retirement income, while the sponsor guarantees a specific retirement annuity and return, and thus undertakes investment risk as it must fulfill such liability regardless of the actual return on the pension fund’s investments (Davis, 1995). On the other hand, in the defined contribution plan, members make fixed contributions to their pension provider and their future benefits depend on the market return. Although this scheme may offer a higher return for beneficiaries, it does not have the same risk-sharing features as defined benefit systems, and thus does not provide the same guarantees on future retirement income (Davis, 2003).

As mentioned above, liberal pension reform in Latin America oversaw a transition towards defined contribution systems motivated by employers reducing the risk of their pension liabilities, as well as providing a wider variety of pension products for individuals with different risk profiles. The latter feature was developed further in the case of Chile, where beneficiaries no longer contribute to a solidarity fund, but rather own their individual capitalizations, allowing pension fund providers to penetrate a broader customer base (Rodriguez, 1998). Additionally, defined contribution schemes allow for further labor mobility, as employer sponsors no longer hold pension liabilities that prevent workers from changing jobs (Davis, 2003). Beneficiaries’ higher degree of control over their own capitalizations in defined contribution plans enables pension funds to better match the risk preferences with their portfolios’ risk. In turn, the greater and simultaneous diversification of both beneficiaries and securities may contribute to the development of emerging capital markets, as in the case of Chile (Rodriguez, 1998).

Characteristics of Pension Funds and Influence in Capital Markets

The long-term nature of pension fund liabilities allows them to invest in long-term assets with higher returns, which increases the supply of long-term funding in capital markets reflected by the increase in demand of instruments with such maturity. This not only mitigates the market’s volatility, but also allows pension funds to employ immunization strategies by which they reduce their exposure to interest rate risk by matching the timing of their investment cash flows and their annuity payments to beneficiaries. Furthermore, pension funds, unlike banks, may have a lower volatility of net flows from their members as the funds cannot be withdrawn prematurely on demand and the future benefits are contingent to the fulfillment of the monthly contributions (Davis, 1995). Finally, since long-term investments tend to be more illiquid, this creates an incentive for the funds’ stakeholders to rebalance their own portfolios to match their liquidity needs (Impavido & Mussalem, 2000). Such behavior, as mentioned by Impavido and Mussalem, “is likely to reinforce the demand of contractual savings institutions for market-based instruments,” which results in further financial intermediation by pension funds through capital markets (Impavido & Mussalem, 2000).

Pension funds offer an enhanced level of diversification at the stakeholder level and at the overall portfolio level. Regarding the former, they allow for significant risk sharing not only among investors, but also among contributors, due to the sheer number of economic actors involved. Therefore, in the event of a sizable loss, its impact would be diluted in such way that it represents only a relatively minor loss at the individual level. On the other hand, the ability of pension funds to pool massive amounts of capital allows them to invest in securities and other financial assets inaccessible to non-institutional investors. This not only grants them access to a broader variety of securities with low correlation among them, but also enables them to purchase indivisible assets with imperfect correlation with the market (Impavido & Mussalem, 2000). Efficient diversification leads to lower exposure to idiosyncratic risk and even less sensitivity to systematic risk, which may be appealing to more risk-averse investors and contributors, thus increasing the funds under management and granting access to a wider variety of investments in capital markets.

Another benefit derived from pooling large amounts of funds is the resulting economies of scale at both op-
erational and portfolio management levels. From an operational standpoint, pension funds face lower costs to access the market as they can mobilize large amounts of capital in a single transaction, which reduces the average cost per unit of capital transacted. From a portfolio management perspective, pension funds are better able to provide professional management of individuals’ funds, acquiring and processing information more efficiently as institutional investors (Davis, 1995). Therefore, as they expand their contributor base, the implicit transaction and information costs per stakeholder are diluted, thus, indirectly, reducing the costs to access securities markets for individual economic actors.

Considering that pension funds compete for households’ savings, they provide a substitute to long-term deposit products offered by banks. Given their higher-yielding portfolios, pension funds offer a greater return on the contributions and may attract individuals pursuing such returns away from lower-yielding bank deposits. This transfer of savings is limited to individuals’ risk preferences and liquidity needs. However, as mentioned previously, individuals can benefit from pension funds’ efficient diversification and risk-sharing features, while adjusting their holdings of more liquid assets (e.g. cash, demand deposits) in their own portfolios (Impavido, Mussalem & Tressel, 2003). Furthermore, pension contributions provide tax privileges or deferrals at the personal-income level that are not applied to regular savings, incentivizing further contributions – not to mention the various tax advantages at the corporate level (e.g. on capital gains) (Davis, 1995). Such increase in competition has positive spillover effects and efficiencies in capital markets, as it reduces the spread between lending and deposit rates in the loanable funds market, and thus between deposit rates and overall costs of capital in primary markets (Meng & Pfau, 2010).

Even though pension funds compete against banks to capture deposits and provide long-term funding, and may be in a stronger position to provide higher returns on savings and extend financing for longer maturities, banks can also benefit from such features in their entire capital structure. In the cases of both debt and equity, pension funds can provide funding to banks via long-term securities. This eases banks’ short-term financial obligations and allows them to adjust their asset holdings towards higher-yielding investments with longer maturities. For instance, pension funds can help to lower banks’ credit risk by reducing their financial leverage through equity investments, and, if done in a systematic manner, may improve stability in financial markets overall (Impavido & Mussalem, 2000). Additionally, pension funds’ equity investments may have positive spillover effects, as their position and behavior as institutional investors can contribute to improving corporate governance and minority shareholder activism, as well as foster financial innovation and modernization (Meng & Pfau, 2010).

**DATA**

This paper seeks to determine the role and impact of pension funds on the development of capital markets in Latin America, focusing on the cases of Argentina, Brazil, Chile, Colombia, Mexico, and Peru between 2002-2016. Stock market capitalization and bond market value as percentage of GDP are used as proxies for capital market development, while pension fund assets as a percentage
of GDP indicate the relative size of pension funds with respect to each country’s economy. Macroeconomic variables sampled include nominal GDP, real GDP growth rate, inflation rate, savings rate, real interest rate, GDP per capita, and real effective exchange rate. As nominal GDP was sampled in current US Dollars to facilitate comparability, the real effective exchange rate is included to account for fluctuations in exchange rates that may have influenced the nominal GDP figures. Real GDP growth and inflation rates serve as indicators of overall macroeconomic health, whereas savings rate and GDP per capita provide further insight on consumer behavior and wealth. The real interest rate serves as a proxy to measure the overall real return on financial markets, which, along with the savings rate and GDP per capita, may influence the net flows into the financial system. Demographic variables such as median age and size of the labor force may provide further insight on individuals’ contributions to the pension system, as well as possible outflows of annuity payments as the median age rises and the labor force shrinks. Finally, data on domestic credit and external debt as a percentage of GDP serve to measure the effect of domestic and international substitutes to local capital markets.

The countries sampled represent over 86% of the region’s GDP, and, despite the differing political developments and institutional frameworks, these conform a representative set of comparable countries (IMF, 2016). Even though Venezuela accounts for nearly 6% of the region’s GDP, there is a lack of reliable macroeconomic and pension data, not to mention that the events of the past 15 years have turned the country into a macroeconomic outlier. The time period studied was determined based on the availability of reliable pension fund data for all the countries studied, while attempting to have a balanced panel dataset for most countries. Data collected on Brazil, Colombia, and Mexico resulted in balanced panels, while data from Argentina, Chile, and Peru resulted in

TABLE 2. Sample Means for Selected Variables by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Periods</th>
<th>PFA (%)</th>
<th>Bond (%)</th>
<th>Stock (%)</th>
<th>GDP (US$m)</th>
<th>GDPPP (US$m)</th>
<th>Growth (%)</th>
<th>Inflation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2002-2007</td>
<td>10.66</td>
<td>44.29</td>
<td>23.58</td>
<td>202.21</td>
<td>5,194.26</td>
<td>8.75</td>
<td>9.45</td>
</tr>
<tr>
<td>Brazil</td>
<td>2002-2006</td>
<td>19.91</td>
<td>36.91</td>
<td>50.17</td>
<td>1,626.91</td>
<td>7,086.06</td>
<td>2.51</td>
<td>6.83</td>
</tr>
<tr>
<td>Chile</td>
<td>2003-2016</td>
<td>83.38</td>
<td>16.87</td>
<td>108.27</td>
<td>196.08</td>
<td>11,439.44</td>
<td>4.99</td>
<td>5.26</td>
</tr>
<tr>
<td>Colombia</td>
<td>2002-2016</td>
<td>14.69</td>
<td>27.70</td>
<td>41.33</td>
<td>241.90</td>
<td>5,255.75</td>
<td>4.27</td>
<td>4.78</td>
</tr>
<tr>
<td>Mexico</td>
<td>2002-2016</td>
<td>11.10</td>
<td>30.81</td>
<td>32.16</td>
<td>1,017.52</td>
<td>8,752.04</td>
<td>2.36</td>
<td>4.09</td>
</tr>
<tr>
<td>Peru</td>
<td>2003-2016</td>
<td>17.26</td>
<td>20.57</td>
<td>45.51</td>
<td>337.80</td>
<td>4,653.78</td>
<td>5.50</td>
<td>2.90</td>
</tr>
<tr>
<td>Total</td>
<td>22.21</td>
<td>25.46</td>
<td>26.41</td>
<td>426.00</td>
<td>7,406.10</td>
<td>4.03</td>
<td>4.74</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3. Standard Deviations for Selected Variables by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Periods</th>
<th>PFA (%)</th>
<th>Bond (%)</th>
<th>Stock (%)</th>
<th>GDP (US$m)</th>
<th>GDPPP (US$m)</th>
<th>Growth (%)</th>
<th>Inflation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2002-2007</td>
<td>9.14</td>
<td>22.88</td>
<td>2.83</td>
<td>81.82</td>
<td>1,483.83</td>
<td>6.41</td>
<td>3.51</td>
</tr>
<tr>
<td>Brazil</td>
<td>2002-2016</td>
<td>1.69</td>
<td>3.73</td>
<td>20.10</td>
<td>739.82</td>
<td>3,552.33</td>
<td>3.28</td>
<td>2.69</td>
</tr>
<tr>
<td>Chile</td>
<td>2003-2016</td>
<td>5.60</td>
<td>7.57</td>
<td>22.43</td>
<td>200.00</td>
<td>2,545.69</td>
<td>2.38</td>
<td>2.05</td>
</tr>
<tr>
<td>Colombia</td>
<td>2003-2016</td>
<td>4.91</td>
<td>12.52</td>
<td>19.60</td>
<td>101.25</td>
<td>2,027.57</td>
<td>1.64</td>
<td>1.79</td>
</tr>
<tr>
<td>Mexico</td>
<td>2002-2016</td>
<td>3.80</td>
<td>23.97</td>
<td>9.81</td>
<td>800.55</td>
<td>1,195.93</td>
<td>2.43</td>
<td>1.77</td>
</tr>
<tr>
<td>Peru</td>
<td>2003-2016</td>
<td>3.53</td>
<td>11.84</td>
<td>14.71</td>
<td>53.53</td>
<td>1,608.10</td>
<td>2.41</td>
<td>1.13</td>
</tr>
<tr>
<td>Total</td>
<td>11.48</td>
<td>16.59</td>
<td>31.90</td>
<td>670.21</td>
<td>3,479.44</td>
<td>2.83</td>
<td>2.61</td>
<td></td>
</tr>
</tbody>
</table>
unbalanced panels after accounting for outliers in macroeconomic variables. The lack of pension fund data in Argentina from 2008-2016 is due to the renationalization of the pension system in 2008 (Barrionuevo, 2008).

The data on pension fund assets are from the OECD Institutional Statistical Yearbook, OECD Global Pension Statistics, International Federation of Pension Fund Administrators, and national regulators. Stock market capitalization and bond market value data are from the World Development Indicators and the Bank for International Settlements. Macroeconomic and demographic data were retrieved from the World Development Indicators, the IMF International Financial Statistics, and the Federal Reserve Bank of St. Louis.

Descriptive statistics on pension fund assets, bond market value and stock market capitalization are provided in Table 2 and Table 3, along with selected macroeconomic, financial and demographic variables. Table 2 shows that, relative to GDP, countries with large stock markets tend to have smaller bond markets, which may account for the substitute relation between both markets. Furthermore, on average, the countries with larger stock markets appear to have a larger amount of domestic credit as a percentage of GDP, which may indicate a complementary relationship between credit and equity. Chile presents a particular case among the countries sampled, as it shows mean values of pension fund assets, stock market capitalization, and domestic credit relative to GDP (60.38%, 108.27%, and 95.35% respectively) that are significantly higher than the overall sample means (22.25%, 52.61%, and 48.32% respectively). However, it has a smaller bond market value relative to GDP (16.87%), ranking fifth among the countries sampled. Finally, even though there seems to be no strong correlation between pension fund assets and savings rates, countries with higher variability in their savings rate as measured by its standard deviations (see Table 3) seem to have more pension fund assets relative to GDP.

ECONOMETRIC MODEL

This paper tests whether the growth of pension fund assets has contributed to the development of bond and stock markets in Latin America. For this purpose, two separate sets of log-log regressions are estimated for each of the markets studied using OLS. A log-log specification is used to account for nonlinearities among the data, as well as to facilitate the interpretation of the results for the effect of growth of pension fund assets (PFA) in the growth of Bond and Stock. Furthermore, it is expected that the relationship of PFA with Bond and Stock is positive, while showing signs of convergence at lower growth rates due to diminishing returns to scale as both markets and overall economies develop. The models for Bond and Stock were performed independently of each other in order to avoid multicollinearity issues, as empirical evidence shows that bond and stock markets tend to have an inverse correlation. Macroeconomic covariates include nominal GDP, real GDP growth rate, inflation rate, savings rate, GDP per capita (GDPPC), GDPPC², and real effective exchange rate (REER). Demographic covariates include median age and labor force size, and covariates accounting for alternatives of capital markets include net domestic credit and external debt. Effects of political risk, institutional strength, and tax regimes are captured by country fixed effects (Countryi,t), while cyclicity is captured by year fixed effects (Year).

Five models are estimated for each set of regressions. Model 1 is a single regression model of the effect of the relative growth of PFA on the relative growth of Bond and Stock respectively. Model 2 accounts for macroeconomic, financial, and demographic variables, along with controls for alternative sources of funds. Model 3 adds controls for country fixed effects. Model 4 adds controls for cyclical to Model 2 using year fixed effects. Model 5 controls for all the fixed effects from the previous models.

Note: Table shows results from ordinary least squares regressions. Heteroskedasticity-robust standard errors are shown in parenthesis. *, **, and denote significance at the 10, 5, and 1 percent level.
This approach traces the variation of the coefficient on the relative growth of PFA as additional controls were included in each regression. Moreover, this demonstrates whether the coefficient is consistent with the paper's hypothesis on the role of pension funds in the development of Latin-American capital markets. Model 5 is the base specification as it controls for all of the observed variables, and it is summarized below for Bond and Stock:

\[
\text{Log(Bond)} = a_0 + a_1 \text{Log(PFA)} + a_2 \text{GDP} + a_3 \text{Growth} + a_4 \text{GDPPC} + a_5 \text{GDPPC}^2 + a_6 \text{Inflation} + a_7 \text{Savings} + a_8 \text{Interest} + a_9 \text{Age} + a_{10} \text{Labor} + a_{11} \text{Credit} + a_{12} \text{External} + \delta \text{Country} + \beta \text{Year} + \delta \text{FE} + \epsilon
\]

\[
\text{Log(Stock)} = b_0 + b_1 \text{Log(PFA)} + b_2 \text{GDP} + b_3 \text{Growth} + b_4 \text{GDPPC} + b_5 \text{GDPPC}^2 + b_6 \text{Inflation} + b_7 \text{Savings} + b_8 \text{Interest} + b_9 \text{Age} + b_{10} \text{Labor} + b_{11} \text{Credit} + b_{12} \text{External} + \delta \text{Country} + \beta \text{Year} + \delta \text{FE} + \epsilon
\]

where \( \epsilon \) and \( \delta \) account for all other factors that influence the growths of bond and stock markets respectively. The main parameter for the regression on Bond is \( a_1 \), which quantifies the marginal relative change of increasing PFA by one percentage point in a country's bond market value. Likewise, the main parameter for the regression on Stock is \( b_1 \), which quantifies the marginal relative change of increasing PFA by one percentage point in a country's stock market capitalization.

**RESULTS**

Results for the sets of regressions for bond market value and stock market capitalization are presented on Table 4 and Table 5 respectively. The results from both sets of regressions support that the growth of pension fund assets has a positive effect on the growth of bond market value and stock market capitalization as a percentage of GDP of the countries sampled. Even though the results from the base specification were only statistically significant for stock market depth, the inclusion of macroeconomic controls in Model 2 substantially improved the significance of the main parameter for both regressions, as well as the models' fit to the data.

Even so, after adding country and year fixed effects in Model 5, the magnitude of the coefficient was greater for stock market capitalization than for bond market value, while also increasing a higher level of statistical significance. For instance, a one percentage point increase in pension fund assets relative to GDP, on average, leads to a 0.744% increase in stock market capitalization as a percentage of GDP at a 1% significance level. On the other hand, a one percentage point increase in pension fund assets relative to GDP, on average, leads to a 0.645% increase in bond market value as a percentage of GDP at a 10% significance level. Additionally, after implementing such controls in Model 5, the bond market regression's \( R^2 \) increased from 0.6385 to 0.9423 (with an adjusted \( R^2 \) of 0.9013), and the \( R^2 \) for the stock market regression rose from 0.8925 to 0.9820 (with an adjusted \( R^2 \) of 0.9691), while remaining jointly statistically significant at the 1% level for both models.

By introducing country and year fixed effects, it was also possible to determine the correlation between these control variables and the main parameter for bond and stock markets, and to avoid misestimating the coefficient due to omitted variable bias. For instance, after including such fixed effects, the elasticity of pension fund assets in the bond market value regression decreased by 0.371 from Model 2 to Model 5, while the same coefficient decreased by 0.367 in the stock market capitalization regression between the respective models. This shows that there was a significantly positive correlation between country-specific factors (e.g. institutional quality, corporate governance), year-specific factors (e.g. cyclical), and the parameter of the growth of pension fund assets in both capital markets that introduced a positive omitted variable bias.

While some of the main macroeconomic control variables discussed in the literature were statistically significant for both sets of regressions, they displayed correlations with the dependent variables as expected.
The coefficients on real growth and inflation rates were positive for both bond and stock markets, yet were only statistically significant at the 10% level for bond market value. This is expected, as stock market capitalization and bond market value tend to grow with real GDP, as well as with asset prices – bonds and stocks can be used as instruments to hedge against inflation. However, the coefficient on nominal GDP was negative for both bond and stock markets – and only significant for stock market capitalization at the 1% level – as, in the same way as GDP, they tend to experience diminishing marginal returns as they grow larger. The coefficient on GDP per capita was negative and significant at the 1% level for both markets, showing that countries with a high level of economic development as measured by GDP per capita, on average, tend to be less risky than countries with low GDP per capita. Therefore, lower risk implies a lower rate of return on the market, which results in a lower growth rate of capital markets. Furthermore, the coefficient on GDP-PC² is negative and significant to the 1% level for both markets, which implies that such reduction of risk and ensuing decrease in market returns experiences diminishing marginal returns. This implies that the negative effect of GDP per capita on the growth rate of bond market value and stock market capitalization is attenuated at higher levels of GDP per capita.

Additional financial indicators were also significant for most of the regressions and showed correlations with the dependent variables as expected in the literature. The parameter of savings was negative for bond market value and positive for stock market depth, yet only statistically significant at the 1% level for the latter. This may indicate that, on average, there is a higher allocation of savings in stocks than in bonds, which is reflected by a greater size of stock markets relative to GDP in countries with high savings rates (e.g. Chile, Peru), and a lower development of bond markets relative to GDP in countries with low savings rates (e.g. Brazil, Colombia). The coefficient on the real interest rate was negative for both markets, but only significant at the 5% level for bond markets. This is expected, as higher real interest rates increase the costs of capital at which the future cash flows from these securities are discounted, which reduces their present valuations and the overall value of the entire bond and stock markets. Finally, the coefficient on the real effective exchange rate (REER) is positive and significant to the 1% level for stock and bond market depth, which may reflect the effect of an increase in the demand for local currencies by foreign investors accounting for differences in purchasing power. This implies an increase in the demand for domestic assets, including, to some extent, a higher demand for financial assets as well.

Most of the covariates accounting for demographic factors behaved as expected in most of the regressions, yet there were few instances in which these displayed signs of statistical significance. The parameter of median population age was positive for bond market value and negative for stock market capitalization. Even though the age parameter may reflect the effect of higher risk aversion in older populations by increasing their holdings of debt securities and reducing their positions in equities, it was not statistically significant in either of the base specifications. The coefficient on labor market size was positive for stock market capitalization and negative for bond market value, yet only statistically significant at the 5% level for the latter. Pension fund assets were expected to grow as the size of the contributing labor force increased, and, by transitivity, this had a positive effect on both bond and stock market depth. Nonetheless, the relationship between the size of the labor force and bond market value may reflect additional variables that are not studied in this particular model.

Finally, the controls accounting for alternative sources of funds to domestic capital markets showed expected correlations with the dependent variables, yet were only statistically significant in few cases. The coefficient on domestic credit was negative for bond market value and positive for stock market capitalization, yet was not statistically significant in either of the models. Notwithstanding, the negative correlation between domestic credit and bonds may reflect a substitute relationship, while the positive correlation between the former and equities may reflect a complementary relationship. The parameter on international debt is negative for both markets, yet it was only statistically significant at the 5% level for bond market value. This negative relationship may indicate that, on average, international debt is a substitute source of funds to domestic capital markets.

**DISCUSSION**

The evidence reported in Section VII shows that pension funds have had a material and significantly positive effect on the development of bond and stock markets in Latin America’s largest economies. Even though there are country-specific circumstances that may influence the magnitude of pension funds’ impact on domestic capital markets, the positive trend holds after controlling for these variables using entity fixed effects. Such positive influence on the depth of capital markets translates into greater overall financial development, which has the potential to accelerate emerging markets’ process towards economic development. Therefore, this suggests that the benefits derived from robust and efficient pension systems may have positive spillover effects in the broad economy, which creates incentives for governments and economic agents to invest in and develop such systems. This section draws from the findings to provide two possible explanations for the beneficial role of pension funds in the development of capital markets through their participation in primary and secondary markets. Subsequently, it exposes the study’s limitations by reviewing its
internal and external validity.

Primary markets are the markets for issues of new securities in which firms and other users of funds supply paper to investors and other sources of funds on the demand side. Therefore, this is the only instance through which firms are able to directly raise funds from investors in exchange for securities with different risk-return characteristics. The participation of pension funds in this market represents a significant increase in the demand for new issues and thus in the supply of funds for the issuing firms. Furthermore, given pension funds’ ability to pool funds from individuals, who may have no access to these securities markets, it allows to move an even larger portion of capital between economic actors, often in sizable transactions with material effects on the price of securities. Therefore, an increase in pension fund’s financial and total assets via primary bond and stock markets contributes to their growth, while the rising integration of economic actors via the intermediation of pension funds fosters higher financial development.

On the other hand, even though transactions in the secondary market involve only the owners of the securities and not the issuers of such securities, issuing firms still benefit from price appreciation. As pension funds increase the demand for securities in secondary markets, their prices start hiking, especially due to the material effect of pension funds’ transactions. Despite not receiving any of the proceeds directly, higher valuations of these securities in secondary markets have a positive spillover effect in primary markets for firms, as they are able to raise a larger amount of capital per new issue. However, this benefit is limited by the fact that new issues exert dilutive pressures on the prices of existing securities and may lower the valuation of future issues. This implies that there is a window of opportunity for firms to reap such benefits, yet it still holds that an increase in pension fund assets contributes to the growth of bond and stock markets, even via secondary markets.

**Internal Validity**

The magnitude of the main parameter from both regressions declined as country and year fixed effects were incorporated. This implies that there was a positive correlation between these previously unobserved variables and the main coefficient, which, after being accounted for, introduced no further omitted variable bias to the results. Nonetheless, though the models from both regressions suggest that this positive effect is statistically significant, there may exist limitations on the magnitude of the main parameter regarding the measurement of the impact of institutional quality and corporate governance.

As mentioned in Section II, countries with a high level of institutional quality – in terms of the effectiveness of regulation and enforcement to ensure the proper conduct of business – have shown to achieve, on average, higher levels of financial development. For instance, Stallings and Studart use an index of institutional quality, which, as an independent variable, shows a positive relation with the development of capital markets and financial systems overall (Stallings & Studart, 2006). Moreover, in the context of this study, institutional strength may contribute not only to the growth of pension fund assets, but may also magnify the beneficial effects of pension funds on capital markets in countries with strong institutions. As such inefficiencies are mitigated in the market, pension funds and other institutional investors are better able to allocate their investment capital in a wider range of securities, meaning that they would supply funds to a broader spectrum of participants that could be discarded in poor regulatory environments. Furthermore, this follows from De la Torre, Gozzi and Schmulker’s hypothesis on the negative repercussions of premature financial liberalization, as suboptimal regulatory institutions may cripple the effect of pension reforms and pension funds’ investments in the growth of capital markets (De la Torre, Gozzi & Schmulker, 2007).

Similar to institutional quality, corporate governance has displayed a positive relationship with the growth of capital and financial markets as an independent variable. Likewise, it would most likely accentuate the impact of pension funds in financial development, as greater reliability on such private norms would increase the confidence of institutional investors to engage in a wider variety of investments in the market. Nonetheless, the limitations pertaining to the accurate measurement of such effect may be even greater than those of institutional quality, as corporate governance is a characteristic that can vary among different firms in a single country. Therefore, the effect captured by the controls implemented in this study and even other indexes that weigh different criteria may provide information on the average level of each of the countries sampled. Nevertheless, unlike institutional quality, corporate governance may not present trends with the same level of persistence within specific industries and even more so across entire countries, as a centralized authority does not strictly determine such norms. Even though broad institutional quality may shape firm-specific corporate governance, such structures are designed, within the scope of the law, to accommodate to the best interest of companies' stakeholders.

**External Validity**

The high level of fit of the base specifications to the data, as measured by their R² and adjusted R², suggests that they can serve to forecast the growth of bond and stock markets in other populations using the growth of pension fund assets. For instance, such analysis could be applied to smaller and, on average, less developed countries in Latin America to predict the performance of their own capital markets. However, despite showing a strong forecasting power, these models would be subject to a group of countries that, on average, may have consid-
erably different domestic macroeconomic features, not to mention the contrasting political circumstances and institutional framework. Another feature to consider would be the existence of financial reforms that shape the dynamics of capital markets and financial systems in terms of private-sector participation, ownership, access to international finance and involvement of institutional investors.

Finally, this study's external validity could be tested by measuring the role of other institutional investors such as insurance companies and mutual funds in the development of Latin American capital markets. Though pension funds tend to have the largest share of financial assets among non-bank financial institutions, insurance companies and mutual funds also hold a considerable portion of these assets (Heng, Ivanova, Mariscal, Ramakrishna & Wong, 2016). In the same way as pension funds do, insurance companies pool funds from policy holders and invest in long-term assets, while they are contractually bound to provide an annuity or lump-sum payment in the event of a claim. These are closely related to pension funds, yet differ mainly on the nature of their liabilities. The value at risk of their claims can be extremely high, especially if they provide unlimited coverage. Consequently, insurance companies tend to overweight safer and more liquid assets than pension funds as the value and timing of their disbursements is hard to predict (Davis, 2003). Therefore, it would be expected that the growth of insurance company assets relative to GDP also contributed to the growth of stock and bond markets in Latin America, yet having a greater impact on the latter.

On the other hand, although mutual funds also hold significant pools of capital, they “seek to offer an enhanced risk-return profile and greater liquidity to individual investors” (Davis, 2003). Unlike long-term contractual savings institutions, mutual funds have less restrictions on their holdings and offer investors the possibility to redeem their fund certificates at their net asset value (open-end funds) or allow them to trade fund shares on exchanges (close-end funds). Thus, although these investment vehicles follow different mandates to cater various investor risk preferences, they tend to hold a larger portion of liquid assets ranging from money market instruments to equities (Davis, 2003). Therefore, the growth of mutual fund assets may contribute to the growth of capital markets in Latin America, yet it would be constrained by the higher liquidity preferences of these funds and their investors. This would imply that mutual fund assets may have a greater effect in markets for more liquid assets (e.g. equities), yet it would also suggest the need of other measurements of financial development other than market depth.

**CONCLUSION**

This study shows that, given the constructive role of pension funds in Latin American capital markets, this subset of institutional investors can serve to promote the growth and enhancement of financial systems across the region and make it live to its economic expectations. Despite having a greater average impact on stock market capitalization than on bond market value, the positive effect of pension funds on the growth of these markets is evident. Given that most of the largest Latin American economies have liberalized their financial systems to an important degree, most of the power to boost financial development lies on the hands of the private sector.

Nonetheless, governments and regulators can design policies that align such private interests with long-term macroeconomic goals. Acknowledging the role of pension funds in capital markets, governments should create such policies addressing the main sources of growth of pension fund assets: funding and investment returns. Tax incentives at the personal-income level and tax deferrals on pension liabilities for corporations may increase their contributions to pension plans on both defined benefit and defined contribution schemes. On the other hand, regulators could allow pension funds to design their investment strategies with less statutory limitations on asset allocations, as these may generate inefficient results. The decrease in regulatory scrutiny can be compensated by increasing their own invested reserve requirements, which use shareholder money instead of contributions, aligning their risk-return incentives by sharing more risk with contributors. This demonstrates that despite most countries’ steps towards economic liberalization, the interaction between private and public sectors remains crucial to the fulfillment of financial and economic development objectives.

Though Latin America's economic deceleration and even recession are recent phenomena, these are – to a significant extent – the product of decades of economic underdevelopment. Compared to other emerging markets, the region’s strong economic fundamentals ranging from diverse resource endowments to growing populations and human capital do not indicate a lack of potential for development. Instead, as suggested by De la Torre, Gozzi and Schmulker, this circumstance can be attributed to faulty reform sequencing and even incomplete or restraining reforms in some cases (e.g. Argentina) (De la Torre, Gozzi & Schmulker, 2007). Within the scope of this paper, most Latin American countries have missed the opportunity to evolve from traditional bank-centered finance into modern financial systems combined with robust capital markets. Capital markets play a determinant role in the road to financial development, and greater financial development is necessary to boost real economic activity. Thus, it can be said that capital markets are essential to the evolution of emerging markets into advanced economies, and leveraging on pension funds and their qualities can make a difference for Latin America in this process.
REFERENCES


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Margaret Steiner is a sophomore from The Woodlands, Texas majoring in Applied Mathematics with minors in Biology and Economics. Her research interests include biostatistics, bioinformatics, and computational biology. Margaret is an undergraduate research assistant in Dr. Keith A. Crandall's lab in the GW Computational Biology Institute, where her work has focused on a retrospective study of the HIV epidemic in D.C. She has also spent the past two summers at the University of Texas School of Public Health studying statistical methods for the identification of rare genetic variants associated with birth defects under the direction of Dr. Michael D. Swartz. Margaret is a member of the University Honors Program and an alumna of the Elizabeth J. Somers Women's Leadership Program.

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Logan Bartholomew is a sophomore in the Columbian College of Arts and Sciences and University Honors Program hailing from East Louisville, Kentucky. Majoring in Chemistry with minors in Biology and Mechanical Engineering, his research focuses on antibiotic development to combat malaria, tuberculosis, and anthrax. An Undergraduate Research Assistant in the Dr. Cynthia Dowd lab in GW's Chemistry department with the NIH, he employs organic synthetic techniques to discover novel compounds to inhibit the non-malevonic pathways of those pathogenic organisms causative of the aforementioned diseases. Outside of his academic pursuits, Logan serves as the Vice President of Phi Delta Theta, is an Undergraduate Learning Assistant, and a member of both the TEDx FoggyBottom conference team and GeorgeHacks 2018 competition.

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Isabel is a junior from Colorado majoring in History. Her research interests include cultural revival in post-genocide contexts, historical reconciliation, and collective memory. Isabel has studied Holocaust commemoration in fourteen European museums with the support of the GW Undergraduate Research Award and researched the Troubles in Northern Ireland at Trinity College Dublin where she was the class valedictorian. Having previously interned at the U.S. Holocaust Memorial Museum and Galicia Jewish Museum in Krakow, she is beginning to research comparative approaches to mass atrocity commemoration in Cambodia and Poland. At GW, Isabel is a member of the University Honors Program and enjoys studying American Sign Language.

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Cecelia Chisdock is a junior from Harding, Pennsylvania majoring in Archaeology and Biological Anthropology with a minor in Biology. She is currently a research assistant for Dr. Kendra Chritz at the Smithsonian National Museum of Natural History, working on stable isotope analysis of fauna from the Smithsonian–Roosevelt African Expedition. Areas of interest include bioarchaeology and osteology, primarily using skeletal remains as indicators of ancient lifeways. On campus, she is Vice President of the Classics and Archaeology Club as well as Treasurer for Delta Iota Gamma.

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Morgan is a freshman from Phoenix, Arizona double majoring in Sociology and International Affairs. Her love for research started in high school, where she tried on subjects ranging from evolutionary biology to astrophysics. She now intends to pursue independent research on the construction of International Affairs programs in U.S. higher education and the role that educational rhetoric plays in subsequent policy formation. Her other research interests fall under the umbrella subject of global capitalism, whether as a framework for social relations here in the United States or as both a means and end to diplomacy. Morgan spends her time on campus painting with watercolors, writing descriptive prose, and advocating for Palestinian human rights with Students for Justice in Palestine.

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Olivia is a sophomore from Minneapolis, Minnesota majoring in History and Communications with a minor in Journalism and Mass Communication. Olivia has researched the involvement of the Sonderkommando Unit at Auschwitz-Birkenau during the Holocaust, as well as the representations of racial relations at GW’s campus. At GW, Olivia serves as a writer for The Rival GW, is a member of GW Women in Business, and a member of the Executive Council for Sigma Kappa sorority. In the past year, Olivia interned at The John F. Kennedy Center for Performing Arts in the marketing and advertising department working on community outreach.

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Sam Tiratto is a junior from Middle Tennessee majoring in History with a minor in Sociocultural Anthropology. Sam has had research experience working with labor unions in Washington, D.C. and Baltimore. His research centers on communities of resistance in America with a projected thesis covering the Illinois Chapter of the Black Panther Party and their work in coalition building in civil rights-era Chicago. He is a member of GW’s Progressive Student Union.
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