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ECONPress is a publication for undergraduate compositions in economics. We publish twice a year at the end of each fall and spring semesters. ECONPress invites the highest quality submissions from undergraduate students in various economics related disciplines. It provides a forum for the undergraduate economics community to engage in active discussion and debate about the topics, theories, and applications they've learned in the classroom.

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Letter from the Editors

Dear Reader,

Thank you for your interest in reading this second issue of ECONPress, Northeastern University's undergraduate economics journal. ECONPress is a biannual publication whose mission is to provide a forum encouraging and promoting active engagement in discussions and debates on topics regarding economics in an academic environment.

Within these pages, you will find the best undergraduate economic research that was submitted in the fall semester, 2010.

The potential of undergraduate research is astounding. The questions asked by the students published here reverberate through the core issues of society. The students featured here are the future economists studying savings behaviors, economic growth, property rights, poverty, and financial modeling. As colleagues of esteemed academics, we are proud and extremely honored to have reviewed their work. It is a privilege to present their work to you.

In the years to come, ECONPress will develop into a forefront of undergraduate economic research in the nation. In this vein, ECONPress encourages active debate on the subjects and positions taken in these papers. Now in its second issue, ECONPress is still in its infancy. Its members have significant ambitions of promoting economics in the undergraduate community. ECONPress is also always in need of students willing to invest their time to contribute to and improve the publication. ECONPress and the individuals involved in it represent the beginning of a movement towards the challenge of academic achievement among students of economics.

Until then, enjoy the research presented in this publication. We hope it inspires you to further pursue subjects in economics and to submit your papers for an opportunity to be published in the ECONPress.

Thank you,

Franco Solleza   *Alec Loudenback*

Ryan Siegel   *Marie Lekkas*

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The Editorial Board of ECONPress

Poverty in the United States

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The War on Poverty was declared by the Johnson administration in the 1960s after a slew of analysts, journalists, and politicians rediscovered and began to publicize the persistence of poverty in the United States.[1] In Lyndon B. Johnson's initial State of the Union message to Congress and the nation in 1964 reported that his administration "today, here and now, declares unconditional war on poverty in America. …Our aim is not only to relieve the symptoms of poverty, but to cure it, and above all, prevent it."[2] Despite such fervent views however, the issue of poverty persists within our own communities and extends far past the boundaries of our neighborhoods. These poverty-stricken people are often labeled as outcasts, pushed out into the inner-city ghettos and physically and emotionally detached from the broader affluent population in all regions of the country. This trend has changed dramatically in current discussions of poverty to the suburbs, which I will touch upon in a latter portion of this paper. However, it is evident that poverty does not have definitive resolutions, but initiatives to eliminate and reduce poverty are widespread. These initiatives vary in the degree of implementation in different regions, groups, races, and in the level of opportunity that the underprivileged poor too often fail to obtain. Poverty analysts in the United States hold differing views on how best to combat such a malicious form of human degradation and this paper will illustrate the perspectives present in the discussions of poverty reduction in the United States to depict and adequately narrate such a contentious issue that is filled with abundant discord.

Michael Harrington's influential book, *The Other America: Poverty in the United States* received critical acclaim in the early 1960s. He was a prominent left-wing social activist and one of the most well known socialists of his time.[3] His magnum opus was the basis of a series of initiatives to combat poverty that were first adopted by President John F. Kennedy. During his 1960 campaign he came face to face with poverty in West Virginia and after reading Harrington's lengthy book review in *New Yorker* magazine by Dwight McDonald, he ordered a formal study on poverty to create antipoverty initiatives that would serve as his platform for his 1964 presidential campaign.[4] President Johnson was briefed on Kennedy's study and decided to implement the issue nationwide, thus creating the War on Poverty.

In Harrington's introduction to his book, he contends, "the poor are increasingly slipping out of the very experience and consciousness of the nation."[5] His introduction outlines and gives reasons for the persistence of poverty by identifying large groups of people that are affected by poverty more so than others, such as dispossessed workers, minorities, the farm poor, and the aged. Throughout his introduction, he implicitly refers to those in poverty as the "other America" and begins to draw a subtle picture of who those people are by explaining that "the poor existed in the Government reports; they were percentages and numbers in long, close columns, but they were not part of the experience."[6] There are no faces or personality to the numbers because they are virtually neglected by the government reports. In essence, he mentions this bit of anecdotal information to depict poor people as being invisible, part of separate culture, and essentially removed from mainstream society due to a lack of political representation in Congress.

Furthermore, he makes a distinction between contemporary and Depression-era poverty. He highlights the main differences and presents the information as a narrative and uses this background information to set up a bleak picture of contemporary poverty. In the 1930s, poverty was widespread and was politically recognized. In contrast, the poor of contemporary society, have no political recognition in Congress, are subjugated to the pressures of having skilled labor and suffer from an aura of invisibility that stems their opportunities for betterment. Harrington notes that the poor cannot help themselves as a result of their circumstances. This can be said in two different ways as noted by Harrington, which essentially summarizes their plight: "The poor are caught in a vicious cycle; or, The poor live in a culture of poverty."[7]

Harrington is flabbergasted by a lack of initiative on the issue. "In a nation with a technology that could provide every citizen with a decent life, it is an outrage and a scandal that there should be such social misery."[8] He uses powerful and invoking language that aims to prod vigorous action among the American public and concludes with statements that give the voiceless a voice, and the powerless an opportunity to conjure feelings of resentment from the affluent to those that are often neglected. "My standard of comparison is not how much worse things used to be. It is how much better they could be if only we were stirred."[9] Harrington's book merely serves as an introduction to the issue and as a background for how the issue of poverty has developed from his initial understanding of the problems facing the less fortunate in this country. It is important to summarize his findings because his thinking influenced policymaking in the past, even though it seems to have little effect on the policies of today.

In the United States, the prevailing picture of poverty is not pretty nor is it pleasant to paint. There are three fundamental arguments for the causes of poverty held by Americans; they are listed as followed: Flawed Character, Restricted Opportunity and Big Brother. Each argument has its unique view and varies in its individual characteristics. They can be divided into two more general and broad categories that help define these viewpoints a bit further. These views identify poverty as a personal failing or as a structural failing.[10] The Flawed Character theory falls into the personal failing category and the Big Brother and Restricted Opportunity theories fall into the structural failing category. Americans believe that the causes of poverty are due to personal defects (i.e. poor work ethic) or are institutional (i.e. inefficient job market) in nature.

The Flawed Character blames the poor for their unfortunate circumstances and contends that poverty is due to a lack of effort and poor work ethic. This is solely based on the theory that increased human capital as a form of education is why people in society "get ahead."[11] This argument supposes that everyone begins with a certain set of abilities that can be developed and expanded through the attainment of skills, education, and training programs that are honed properly to progress upwards in the economic ladder. Furthermore it is assumed that human capital is rewarded in the marketplace and that these investments are evidenced by the huge disparities in income between those with a college degree and those with a high school diploma.[12] This is the most dominant view held by most Americans as evidenced by the following statement: Polls reveal that 70-80 percent of American believe that anyone who is poor can get rich by working hard.[13]

Those that dissent with the Flawed Character view argue that poverty is a result of Restricted Opportunity. This view contends that the poor live in cycles of poverty due to circumstances that are beyond their control.[14] People who hold

this view often note that those immersed in poverty do not always have the same access to jobs, good schools and incomes. This is exacerbated by the fact that the poor experience discrimination more often than the non-poor on the basis of sex, race, and income class.[15] This is further evidenced by geographical differences within the United States where poverty is more concentrated and therefore more prevalent among the working adult population. Levels of concentrated poverty vary among different regions (South vs. Northeast) and within cities where there are stark differences between suburban and central areas. Historically the South has experienced levels of poverty far greater than the Northeast region. In 1959, The U.S. Census Bureau identified a poverty rate of 35.4 percent in the South, which was 2.1 times as high as that in the rest of the nation.[16] The poverty rates in the South have been reduced dramatically, but its prevalence still remains the highest rate in the country.[17] However, there is a note of caution that must be taken into account when reporting these figures because it is more important to know how these data were collected and measured rather than the numbers themselves. This will be a topic I discuss in a latter part of the paper.

As mentioned earlier, poverty also varies among race, particularly within cities. While only 12.1 percent of all poor persons residing in metropolitan areas lived in a high-poverty neighborhood in 2003, poor blacks (23%) and Hispanics (22%) were considerably more likely than whites (7.3%) to be housed in a high-poverty urban neighborhood.[18] Furthermore it is important to note that in addition to proportional differences in poverty rates across cities, joblessness rates within these cities and neighborhoods are influential factors in explaining the Restricted Opportunity view. In his influential paper, William Julius Wilson has argued that high joblessness rates are more concentrated

in neighborhoods experiencing poverty and have a bigger impact on the working adults of those communities.[19] All these facts attribute to higher poverty rates and reaffirm the Restricted Opportunity view, that the cause for poverty is due to factors that are beyond individuals' control as it is influenced primarily by geographical, racial, and a general lack of jobs within highly impoverished neighborhoods.

Lastly, the third view of causes of poverty is the Big Brother argument. It blames the government for destroying incentives for stable families and economic self-sufficiency.[20] This view argues that the government is responsible for influencing the decisions of individuals through racial quotas (i.e. college admissions), welfare benefits, and high taxes. These policies establish perpetual relationships with these benefits and create a "blight of dependency."[21] Welfare benefits discourage workers from working longer hours and public assistance programs may influence decisions to get married, have children, and move to other areas because the incentive to work is virtually eliminated by the variety of social safety nets that the government provides.

Throughout my readings I came across a persistent trend that had an effect on poverty; it occurred to me that there was a consistent link with inequality and poverty, yet the perspectives varied greatly in all academic fields. The next part of this paper will try to summarize and create a nuanced picture of the discord by carefully examining a series of articles that all deal with inequality in some manner. In an attempt to narrate these articles I have purposefully pitted their arguments against each other to create a dynamic and balanced picture of the effects inequality has on poverty in general and how it can be applied to the United States. Each article begins with some background information about the author that is followed by a recapitulation of its main point and

a bit of analysis to emphasize the authors' points.

Martin Feldstein was chief economic adviser to President Reagan and former president of the National Bureau of Economic Research, and currently serves as an adviser to President Obama on the President's Economic Recovery Advisory Board.[22] He has written a substantial amount of literature in the field of macroeconomics and is currently the George F. Baker Professor of Economics at Harvard University.[23] In "Reducing poverty, not inequality," Feldstein uses his own, nuanced examples to explain a prominent theory in economics, the Pareto principle, to defend his argument against a focus on inequality rather than one that is a discussion solely on poverty. The Pareto principle stipulates that a change in policy is good if it makes someone better off without making anyone else worse off. His article, published in *The Public Interest,* a neoconservative journal,[24] presents his view on the issue and he writes that, "Not everyone will agree with me…[I] stick to the basic interpretation of the Pareto principle that if the material well-being of some individuals increases with no decrease in the material well-being of others, that is a good thing even if it implies an increase in measured inequality."[25] In other words, if everybody's income goes up, why should it matter if inequality is up too? In a discussion of poverty, Feldstein reinforces his argument that the focus should be on poverty not inequality. His reasoning contends that those in poverty *choose* to be in poverty and even if they think they are making the most rational and logical decisions to work or not work, they are essentially wrong, they "choose poverty in error."[26] Furthermore he adds to his conclusion by offering a bit of advice, "A policy of 'tough love' that forces such individuals to enter the world of work for an extended period of time may be the best way to overcome this problem."[27]

Branko Milanovic is Lead Economist in the World Bank research department, working on income inequality and poverty and is currently a visiting professor at the School for Advanced International Studies at John Hopkins University.[28] Milanovic rejects Feldstein's argument that the discussions of poverty and inequality should be two different discussions that do not have any relevance to each other. He cites Feldstein's article written in *The Public Interest* to give a background for the topic he will refute in his article, "Why We All Care About Inequality" published in the journal, *Challenge*. Milanovic uses the same examples used in Feldstein's article, but instead of embracing Feldstein's arguments, makes a mockery of them. For example, "Let us suppose that Feldstein's fairy gives me $20,000 and each of the other participants is variously given between 25 and 75 cents."[29] Feldstein's argument would stipulate that everyone is better off because no one lost anything and in fact everyone gained even though one individual gained a disproportional amount. Milanovic goes on to argue that those receiving 25 or 75 cents feel worse, not better - as Feldstein would suggest - "because people always compare themselves to (what they hold to be) their peers. Thus income they receive is not only a means to acquire more goods and services, it is also a tangible recognition of how society values them."[30] Therefore Milanovic concludes contrary to Feldstein that inequality is important in the discussion of poverty because it is a social expression of their own self worth relative to their peers.

Milanovic concludes that people are sensitive to studies of inequality because it raises concern for its acceptability within a population and in particular makes the general population wary and more perceptive of their incomes relative to those above or below their respective income thresholds. He makes a final and strong statement against Feldstein and

economists who argue in favor of dismissing inequality: "Drawing a sharp differentiation between poverty and inequality, as is done by some economists, is a way of deflecting attention from the issue of inequality, rather than giving equal attention to both poverty and inequality."[31] The author suggests that any discussion about poverty should and must include an equal discussion about inequality. Thus inequality and poverty are implausible and inextricably linked to each other.

Robert H. Frank is a prominent research economist and is the Henrietta Johnson Louis Professor of Management and a Professor of Economics at Cornell University's S.C. Johnson Graduate School of Management and is currently a contributor to *The New York Times* "Economic View" Op-ed column.[32] In his book, *Falling Behind*, he details the harms of inequality in the United States and explains how disparities in income force them to spend more on housing instead of other important categories of spending such as food and durable goods. Frank suggests, "having more income" (more money) and "being better off" (more wealth) do not have exactly the same meaning.[33] This indicates that the changes in the distribution of income have imposed psychological costs on middle-income families because they are willing to spend more money on houses that are bigger relative to their peers. Having more income in absolute terms increases their earnings, but it does not account for greater relative spending on housing as Frank suggests. They are not better off because the extra income is merely redistributed towards costs in housing. This is the same notion that Milanovic argues in his article; people's decisions are influenced by the way in which society views them. However, Frank's emphasis lies in his use of graphs in conjunction with language to convey the same message that Milanovic portrays using language alone. Frank's representation of the same idea clearly shows

where the income is being distributed to (housing) and whether earners at the top or bottom of the tax brackets receive the increases in income.

By presenting a story of the development of income and wealth disparities in the United States since 1945 Frank intends to show the gradual increase in inequality that has forced people to spend more on housing. "Income and consumption growth were balanced across income categories during the three decades fallowing World War II…[and] that pattern began to change at some point during the 1970s."[34] Frank suggests that the divergence was a result of lower tax rates imposed by the Reagan administration on those earning relatively high incomes. George H.W. Bush continued Reagan's trend of low tax rates on the rich even though he increased rates as a result of weak economic performance towards the end of his tenure. This trend continued throughout the Clinton years, which "increased the earned income tax credit[s] for working families with low incomes." [35] However, George W. Bush's tax cuts reversed the trends by reducing the tax rates for those in the top 1 percent of earners. This change drastically altered the disparities in income and effectively changed the manner and the amount each individual received from the "economic pie."

Frank's conclusion notes that the examples cited that resulted in increases of inequality are not entirely clear. It could be a result of Reagan's tax cuts or George W. Bush's enormous incentives for the rich; however, the reasons are not entirely precise. This finding is ambiguous, but as Frank suggests, it is possible to draw some conclusions: "the distributions of income and wealth have become much more concentrated during the last several decades [and] those in the [lower and] middle of the income and wealth distributions have lost ground relative to those at the top, despite the absolute increases in

their income and wealth."[36]

Edward Wolff and Ajit Zacharias are senior scholars at the Levy Economics Institute of Bard College. Their findings suggest that inequalities in wealth and income are drastically different when Americans' well being are accounted for and measured using available data. The authors discuss how income and wealth are measured presently and provide alternate measures of income and wealth that give better representations of the problems associated with representing data that excludes either wealth or income in any form of analysis. This is consistent with Milanovic and inconsistent with Feldstein's argument. Their research is fully detailed and offers distinctions between Money Income (absolute) and Wealth-adjusted income (relative)[37] as Frank also makes a point in mentioning. The authors then detail and analyze their findings by noting the disparities in wealth and income with a combination of graphs and language that supports their conclusions, within ethnic and racial groups and within different age groups. Wolff and Zacharias' conclusion states, "Income and wealth are not interchangeable as indicators of economic status or well-being. Rather, wealth is an additional dimension of well-being, over and above income,"[38] thus reinforcing Frank's distinction between income and wealth (i.e. having more income vs. being better off). It is important to note that throughout the analysis there is no explicit mention of poverty, but there are inferred implications from analyzing their research when used as insight into income disparities of the poor and the causes of their plight.

In the next part of this paper, I would like to discuss the recent trends of poverty and offer some insight into the "Suburbanization of Poverty" and try to address an important question, "Why hasn't the Obama administration had a serious policy debate to address poverty despite

making it one of his campaign promises?" In addition, I will focus on two papers dealing with poverty measurement in the United States as a means for analysis and perhaps a better understanding towards effective solutions.

Every four years, poverty comes to the forefront of the political debate and after votes are cast, the issue is shelved and hardly addressed in politics. Our current president, Barack Obama stated at the 2008 Democratic National Convention, "One in eight Americans lives in poverty today all across our country, in our cities, in our suburbs, and in our rural communities…Working together, we can cut poverty in half within ten years. We will provide all our children a world-class education, from early childhood through college." (Obama 2008). Yet, the economy, healthcare and a focus on foreign policy (most notably Iran and Israel) have dominated the decision-making priorities of the President, with no mention of poverty.

Each region in this country has a unique set of industries that keep its local economies afloat and we must cater to those differences to come up with better measurements of poverty as they relate to family income. The status quo in regards to poverty status determination has been limited to either "income or consumption" (Caner and Wolff 2004) and "usually family income is assumed to represent the amount of resources that a family has the right to use." (Caner and Wolff 2004) This is an absolute measure of poverty that the U.S. uses to determine whether a family (or individuals for that matter) is in poverty. A myriad of problems arise with poverty measurement that in part influence our perceptions of the magnitude of importance we as a society put on family income as a means for a better life.

The questions that must be asked are:

Why has it been so difficult to improve the official measurement of poverty in the United States?

Which policies and measurements can be used to address the problem effectively?

Rebecca Blank of the Brookings Institution offers some of her own insight stating, "Poor people under the headcount measure can become poorer without any significant changes in the methodology of the headcount measure because it does not address the depth of economic need." (Blank 2007) And finally, it's important to note, "Poverty reduction policy in the U.S. has so far focused on income maintenance. While government programs created under this policy benefited many families, they did not do a very good job of making the poor self-sufficient." (Caner and Wolff 2004) Once policy makers heed the advice of these academics we can use the data on family incomes in a more meaningful manner that addresses the needs of the poor effectively and sufficiently to eradicate poverty.

Rebecca Blank identifies three main problems that consistently bar any chance of the U.S. towards better measures of poverty. First, and probably most important is the fact that Executive Office of the President is in charge of the official poverty measure.[39] Since the president is in charge of this measure it makes it difficult for statistical agencies to give adequate input because the OMB will have to change the manner in which the poverty measure is calculated. This could prove to be a costly political move that can cost the White House (Republican or Democrat) votes during election years. Thus, delegating the responsibilities of the poverty measure to statistical agencies is the best solution to poverty statistics, but given the influence of politics it seems unlikely that the current trend will change according to Blank. Second, the longer that the poverty

measure remains unchanged, the harder it is to influence the Poverty Income Guidelines.[40] There are 82 federal programs that use the official poverty rate[41] and it becomes difficult to change the measure because it will change eligibility standards for those needing assistance. In addition, changing the poverty measurement becomes increasingly problematic because the longer the statistic remains unchanged the more exacerbated the potential changes become when updating occurs.[42] Lastly, Blank argues that poverty as it stands today is a vague definition and because there are underlying assumptions about poverty, it becomes difficult to come to a consensus on a poverty measurement in the first place.[43] This discrepancy allows individuals to be "influenced by their sense on where they want [the poverty measurement] to end up"[44] and it creates a problem because everyone involved in the decision-making process will be driven by whether the changes increase or decrease poverty rates rather than creating an improved measurement in the first place!

Blank offers a couple of solutions to the problems of poverty measurement and uses evidence from other countries such as the E.U., which focus their poverty thresholds on relative measures instead of absolute measures. This works as a better determinant of poverty because it eliminates completely the debates associated with setting thresholds and how to implement them for an entire population. However, the relative measures used by the OECD and the E.U. have limitations to their effectiveness against poverty because the "relative measure [is] based on share of median income," which makes it, "harder to make progress against poverty, since the poverty threshold rises as incomes rise."[45] Finally, Blank concludes that despite her efforts to enact change on these thresholds over the years, there is sufficient reasoning for the lack of initiative on the issue because there are limi-

tations to *any* poverty measure and that "working to change the current OMB directive is not the appropriate place to expend effort and that the current poverty measures are imbedded in a political agency which has many reasons to avoid change."[46]

In "Asset Poverty in the United States, 1984-1999" authors Asena Caner and Edward Wolff argue that assets in the U.S. are important determinants in poverty measurement and can be a lot more significant and vital to an individual's well-being than income alone. In addressing this problem, the authors devise their own measure of poverty to include an inclusive asset poverty line that is defined as, "A household or a person considered to be 'asset poor' if the access that they have to wealth-type resources is insufficient to enable them to meet their 'basic needs' for some 'period of time'."[47] Caner and Wolff come to the same conclusions about poverty measurement that Blank does in noting that the poverty measure is outdated, irrelevant, and that the typical variables chosen to determine poverty remain on the whole to be primarily focused on income or consumption habits.[48] They note that there are problems with focusing primarily on income because families always find some ways to maintain a relatively constant level of consumption through the use of their own asset holdings and in-kind benefits, such as government food stamps to help them through difficult times.

Caner and Wolff also bring to light an important phenomenon consistent among most families in the U.S. U.S. families use home equity as assets more than any other asset and conduct their study using the criteria for asset poverty and take out home equity out of their net worth to give a more accurate picture of the poverty thresholds in this country. Thus by excluding home equity from net worth, they found that poverty rates increased

by almost 15 percentage points.[49] When this finding is compared with the official poverty rates, a bleak reality emerges; asset poverty is two to four times as high as income poverty.[50] This is an important finding because the current measurements do not take assets into account when determining poverty rates. If we assume that assets are a necessary component of well being, then we can conclude that our current statistics are no longer sufficient in trying to solve the problems associated with poverty.

Now I will shift my attention to recent trends in the geography of poverty and how it has shifted away from the inner city, metropolitan areas to the suburbs. In the most recent Brookings Metropolitan Policy Program paper, it is noted that from 2000-2008 suburbs were home to the largest and fastest growing poor population in the country, growing approximately 25 percent, almost five times faster than the primary cities and ahead of the smaller metro areas.[51] This trend has resulted in suburbs housing the largest share of the nation's poor. The finding is staggering because of how quickly the shifts in poverty have completely redrawn the poverty maps in the country. In 2000, it was clearly evident that the largest share of the nation's poor lived in the primary cities within the largest metropolitan centers, however by 2008 suburbs became the most poor, gaining almost 2.5 million individuals in less than a decade.[52]

In addition, it is important to note that the growth in poverty was not evenly distributed and was mainly concentrated within the suburbs, with the highest rates of growth occurring in the Midwest. Florida and the Western cities were some of the first areas to see increases in poverty within the suburbs and unemployment within these areas increased significantly between 2007 and 2008. However, the large metro areas of New York City, Washington, D.C., Los Ange-

les and Riverside saw their poverty rates decrease in the suburbs *and* the primary cities suggesting that the strong regional economies offset the displacement of the poor in the suburbs. Despite this positive finding, the decreases are more likely to be temporary given the economic downturn in 2008. Interestingly, while the poor now call the suburbs home instead of the primary cities, they are less likely to taken advantage of food stamps due to real eligibility requirements, a lack of knowledge regarding these in-kind benefits and a lack of access to these resources. Only 32 percent of the suburban poor received food stamps while 39.2 percent of their counterparts in the primary cities took advantage of the benefits.

This recent trend presents a policy dilemma for Washington. Historically, the poor have resided within the primary cities and thus, policies and resources to combat poverty have been funneled towards helping those in the inner cities. However, the recent trend towards the "suburbanization of poverty" presents a difficult problem for policymakers because primary city poverty still remains at the forefront of the poverty challenge, yet stakeholders, policymakers, and service providers must adapt their strategies to address the needs of the suburban poor.[53]

As evidenced by the articles and the different perspectives held by Americans it is obvious to note that poverty is a hotly debated issue that is widespread in the U.S. and has its effects on a myriad of people throughout the country. As evidenced by the articles and their author's viewpoints the solutions to poverty are not clear and there are many dissenting views that argue in favor of some policies versus others. However, there seems to be an overwhelming focus on the effects inequality has on the majority of the underprivileged population in the United States. The recent change in the geography of poverty presents an overwhelming

task for policymakers, as they are forced to shift their resources towards the suburbs when historically they have been allocated to the inner cities. Finally, unless there is a common threshold for poverty measurement that focuses its attention towards more accurate measures that combine income with consumption or health and education, the problems of poverty will remain at a standstill and no effective progress will be made.

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Autoregressive multifactor APT model for U.S Equity Markets

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Abstract

Arbitrage Pricing Theory is a one period asset pricing model used to predict equity returns based on a multivariate linear regression. We choose three sets of factors – market specific, firm specific, and an autoregressive return term to explain returns on twenty U.S. stocks, using monthly data over the period 2000-2005. Our findings indicate that, apart from the CAPM beta factor, at least five other factors are significant in determining time series and cross sectional variations in returns. The times series regression establishes factor loadings and the cross sectional regression gives the risk premiums associated with these factors.

I. Introduction

Stock prices change due to changes in supply and demand of the asset. However, this supply and demand is influenced by expected future prices of the stock by investors. Therefore, an increase in stock price generally follows good news. According to the efficient market hypothesis, expected news is already priced into the asset. Therefore it is only the unexpected news that causes a change in the stock price. This, along with mean-reversion, which is explained later, is the basis of this paper, where we regress changes in

market specific factors and firm specific factors onto the returns of an asset. Market efficiency is defined by how much asset prices incorporate readily available information. If the markets are efficient, no investor can out-profit the market as all information is already embedded in the asset price. According to the Random Walk Theory, stock prices evolve continuously as a consequence of intelligent investors competing to discover relevant information. However, due to long term economic growth the expected return is generally positive over time. The overall trend is positive and there tend to be random price changes about the trend, which reflect the unsystematic flow of information[1].

Several asset pricing models can be used to explain equity returns. The Capital Asset Pricing Model (CAPM) by Markowitz, Sharpe and Miller[2], and the Arbitrage Pricing Theory (APT) by Ross[3] are the most commonly discussed and tested models. The CAPM has its basis in construction of an efficient 'market portfolio' that maximizes return, given a level of risk. The expected return of an individual security is a function of its risk covariance with the market.

The relationship is formally given by:

$$E(R_i) = R_f + \beta_i \big(E(R_m) - R_f \big)$$

Where $E(R_i)$ is the expected return of the security, R_f is the risk free rate of return, R_m is the market rate of return and β_i is the sensitivity of the expected excess asset returns to the expected excess market return. The CAPM is a one factor model with the risk premium, $\big(E(R_m) - R_f \big)$ being the only factor. Following the empirical failure of the CAPM model, Fama-French extended the CAPM model to include two more factors- Firm Size and Book -Value to Price, to enhance the fit of the model[4].

Arbitrage pricing theory belongs to a different category of models. According to APT, expected return on assets can be modeled as a linear function of various factors. The most prominent APT model was a multi-factor model developed by Stephen Ross in 1976. In this paper we combine the traditional macroeconomic factors of the APT, with firm specific variables and one lagged return term to linearly model equity returns. The factors are selected a priori, and not by using statistical methods such as principal component analysis and factor analysis. We have selected 20 stocks, 10 large cap and 10 mid cap, from the U.S. equity markets for this study. We then take the monthly logarithmic excess return on each stock for a period of six years, from January 2000 to December 2005. Then, the beta coefficients of each of the factors are estimated by running a linear regression using the OLS approach. It is important to note that according to the APT, the stock price would react only to unanticipated changes in factors. So, the absolute value of the factors is of no use to us. We use the monthly logarithmic return on each factor. Also, we do not use advanced methods like GARCH or filters like Kalman or Wiener, to determine the unanticipated change in variables. After running a separate linear regression for each of the twenty stocks, we have twenty sets of beta coefficients. Then, following the traditional approach to test pricing models, we run a cross sectional regression based on these twenty sets of beta coefficients, with the mean of asset returns over the sample period as the dependent variable. Each coefficient resulting from this cross sectional regression gives the estimate of the 'risk premium', that is, the reward the investor gets for bearing that factor's risk. Below is the list of the independent variables used in the regression analysis.

Market Specific Variables

• *Inflation (CPI)*

• *Money Supply (MS)*

• *Industrial Production (IND)*

• *Oil Prices (OIL)*

• *Risk Premium (RPREM)*

• *A broad market index (SP500)*

• *Size Factor (SMB)*

• *Exchange rate (EXR)*

• *Yield Spread (YSP)*

Firm Specific Variables

• *Number of shares traded (TRAD)*

• *Price to Earnings ratio (PE)*

• *Market Capitalization (CAP)*

Autoregressive term:

• *One month lagged return (LAG)*

These are the independent variables in the model, with the monthly return on equity being the dependent variable. The next chapter discusses the theoretical background of the APT and choice of factors whilst reviewing previous literature and research on the arbitrage pricing theory. Then, in Chapter 3, we discuss the linear regression model in greater detail, the problems associated with choosing such a model to test APT and explaining the importance of each variable in our regression. Chapter 4 provides an empirical analysis of the data. In Chapter 5, we explore the results of the regression, analyzing the significance of the model factors.

II. Theory and literature

The arbitrage pricing theory was de-

veloped by Ross in 1976. It states that the return on equity is governed by a factor structure. According to Ross, if equilibrium prices of assets offer no opportunities for arbitrage over static portfolios of these assets, then the expected return can be modeled as a linear function of the factors[5]. Any well diversified portfolio is exposed only to factor risks. If the portfolio is well diversified then the error term of the portfolio return is given by:

$$\tilde{u}_P = \sum_{i=1}^{n} w_i \, \tilde{u}_i$$

where w_i is the weight of each asset in the portfolio. Assuming $\tilde{u}_1, \tilde{u}_2, \tilde{u}_3, \dots, \tilde{u}_n$ are uncorrelated, then $\tilde{u}_P$ is equal to zero. This implies that the idiosyncratic risk is diversified away and the portfolio is only exposed to factor risk. This is the basis of the APT model. APT also assumes that in an efficient market, arbitrage profit opportunities are swiftly eliminated by market participants and an investor cannot make an additional profit without taking on additional risk. This is in accordance with the law of one price.

A formal statement of the APT is given below:

$$(R_{it}) = a_i + \beta_{i1}F_{1t} + \cdots + \beta_{iJ}F_{Jt} + \varepsilon_{it}$$

Or in matrix notation:

$$r = \mu + \beta F + \varepsilon$$

Where r is an (n x 1) matrix containing the asset returns, F is a (k x 1) matrix of the factors in the model, β is a (n x k) matrix of the factor loadings (beta coefficients), and ε is a (n x 1) matrix containing the error terms.

Factor Selection

The theory explicitly does not list any factors. Therefore it is up to the researcher to identify the factors appropriate to the end goal. For example, a country might have specific risk factors that are exclusive to that market. According to Berry et al., the factors structure should be chosen in guidance with following properties[6]

• *Only the unexpected changes in the factors should influence the asset prices*

• *The factors should be justifiable on economic grounds*

• *The time series movements of factors explain a significant portion of the times series movements of the return on assets.*

• *The residual terms that are not explained by the factors should be more or less uncorrelated.*

There are primarily three methods to determine the factor structure[7]. The first method consists of an algorithmic analysis of the estimated covariance matrix with purely statistical methods like factor analysis and principal component analysis. In the second approach, the researcher is guided by factor and or principal component analysis but chooses factors based on his subjective judgment. This method has been widely used in the past, most famously by Fama and French in 1993. The third approach is purely subjective in nature and the researcher relies on intuition to pick factors and then estimate their coefficients and see if they are statistically significant. This approach has been implemented by Chen, Roll and Ross in 1986. Most empirical work on APT is based on factor analysis and principal component analysis. However, Upton finds that the conventional factor analysis method used to determine factors has its limitations as it does not allow for economic significance of the factors derived[8].

Literature review

In 1978, Gehr conducted the first test of the APT using factor analysis on 41 in-dividual companies from the U.S. equity markets using 30 years of monthly data[9]. Only one factor was found to be significant over the 30 years. Roll and Ross used maximum likelihood factor analysis for 1260 firms to test five macroeconomic factors. They found four of the five to have significant risk premiums. Trzinka(1986) also finds that there are five macroeconomic factors that are dominant in explaining U.S. equity returns[10]. Greenwood and Fraser (1997) found three factors for Australian markets[11]. According to Cheng, who tested the APT for the UK market, most information about equity returns is embedded in the market beta factor[12]. Cagnetti tested both the CAPM and the APT model (using factor analysis) on Italian equity markets and found that APT had better explanatory power in all cases[13]. Chen used daily return data from 1963-1978, dividing the study into four sub-periods, and also found that the APT performs better than the CAPM. He however found that the firm size does not contribute additional explanatory power[14].

Korajczyk and Viallet performed time series tests of the CAPM and APT[15]. They used monthly stock returns from France, Japan, United States and the UK for a period from 1969 to 1983. The number of firms with return data varied from 4211 to 6692. Over the sample, the statistical tests provided at least some evidence against both APT and CAPM. The APT, however, seemed to perform better than CAPM.

It is also important to note that market efficiency may vary across countries. For example, most developing countries do not have efficient markets and flow of information is significantly slower. Pricing models would not be as successful in a relatively inefficient market.

Strengths and weaknesses of the APT

The basis for the CAPM model is a mean variance efficient market portfolio. Following Roll's critique[16], which states that such a market portfolio is unobservable and the proxies used in testing the model are insufficient, CAPM cannot be truly tested. The arbitrage pricing theory relaxes this assumption of this market portfolio. Therefore CAPM can be considered as a special case of the Arbitrage pricing theory where the only factor influencing asset returns is the market portfolio.

Strengths

1. The model gives a reasonable description of risk and risk characteristics of assets

2. Unlike the CAPM model, there is no need to measure the market portfolio correctly. This evades Roll's critique.

3. It may be very useful in hedging as it identifies particular risk factors as opposed to a market portfolio.

Weaknesses

1. The APT does not specify the factors and therefore, unlike the CAPM, there is no uniformity across various APT models

2. Factors can change over time rendering the model less useful

3. Factors may vary across firms, therefore a different model might have to be constructed for each firm

4. Estimation requires more data. This can especially be the case when there are several significant factors explaining returns.

Another criticism of the APT model from a statistical point of view is that, since APT can be considered an extension of the CAPM model and includes the CAPM beta, its R-squared value cannot

be less than that of the CAPM model. And as you add more regressors to the APT model, the R-squared will either remain the same or increase, but never decrease.

Applications of the APT

The linear factor structure model of the APT is widely used by investment professionals for risk management purposes[17]. If the stock price significantly differs from what is predicted by the model, it might imply that the security is either undervalued or overpriced. Therefore, the investment manager can profit by going long or short on the security respectively. These models also give asset managers the ability to decompose the sources of risk in the fund and identify which set of factors are most powerful for the fund. Securities and instruments covered by the risk models include equities, fixed income, ETF's, derivative securities and currencies.

The APT has been used to calculate the cost of capital[18]. Elton, Gruber and Mei (1994) used the APT to find the cost of capital for electrical utilities for the NY State Utility commission. Bower and Schink (1994) also used a multifactor model to propose a cost of capital for the commission. However, the commission decided to use the CAPM. APT has also been used to evaluate money managers (Jensen 1968), where the managed fund's returns are regressed on the various factors[19].

III.The Model

Guidelines proposed by Gujarati and Porter[20], have been kept in mind while selecting an econometric model for empirical analysis of the APT theory. The model is consistent with the APT theory which proposed a multifactor linear model. The parameters are expected to be consistent over the sample period. Therefore unless

we experience a 'breakpoint', such as a strong economic or political event that disrupts parameter constancy, we can make predictions using the model. The model is also encompassing of almost all the previous models. This model is capable of explaining results of the CAPM model as well as the general macroeconomic APT model. To our knowledge, no other model has combined macroeconomic factors with firm specific factors and an autoregressive term to help explain equity returns. This model, in a sense, integrates the CAPM model, the multifactor APT model and autoregressive equity models.

This study uses the methodology proposed by Fama-Macbeth(1973)[21]. First we choose 10 large cap stocks and 10 medium cap stocks and take their monthly logarithmic returns over the period of the study. Then, for each of the equity the following algorithm was applied:

• Derivation of descriptive statistics for the variables Return(RET), Number of shares traded(TRAD), P/E Ratio(PE) and market capitalization(CAP).

• Multicollinearity was tested for using auxiliary regressions for each variable in the model.

• Presence of heteroscedasticity was checked using White's test.

• Autocorrelation was investigated using the Breusch-Godfrey Serial LM test.

• Both Autocorrelation and Heteroscedasticity were corrected using Newey West HAC consistent covariances method.

• Linear regression using the OLS methodology was run.

• A histogram for the residual was produced for analysis.

We have four firm specific variables and nine market specific variables. The regression equation is:

$$R_{it} =$$
$$\beta_{0i} + \beta_{1i}TRAD_t$$
$$+\beta_{2i}PE_t + \beta_{3i}CAP_t$$
$$+\beta_{4i}LAG_t + \beta_{5i}CPI_t$$
$$+\beta_{6i}MS_t + \beta_{7i}IND_t$$
$$+\beta_{8i}OIL_t + \beta_{9i}RPREM_t$$
$$+ \beta_{10i}YSP_t + \beta_{11i}SP500_t$$
$$+ \beta_{12i}SMB_t + \beta_{13i}EXR_t$$
$$+\varepsilon_t$$

Where TRAD is the number of shares traded, PE is the P/E ratio, LAG is the security's return lagged by one month, CPI, MS, IND, OIL refer to the log return on Consumer Price Index, M3 money supply, Industrial Production and Oil prices respectively. RPREM, YSP, SP500, SMB, EXR are the returns on risk premium, yield spread, Standard and Poor's 500 index, return on small cap index minus large cap index and return on exchange rate respectively. After running this regression, we obtain 20 sets of beta coefficients.

In the last stage, the coefficients found in the previous regression are used as independent variables and are regressed against the mean of stock returns to estimate the risk premium associated with each factor. This is a cross sectional regression. The regression equation is:

$$\bar{R}_i =$$
$$\gamma_o + \gamma_1\beta_{1i} + \gamma_2\beta_{2i} + \gamma_3\beta_{3i} + \gamma_4\beta_{4i}$$
$$+ \gamma_5\beta_{5i} + \gamma_6\beta_{6i} + \gamma_7\beta_{7i} + \gamma_8\beta_{8i}$$
$$+ \gamma_9\beta_{9i} + \gamma_{10}\beta_{10i} + \gamma_{11}\beta_{11i}$$
$$+ \gamma_{12}\beta_{12i} + \gamma_{13}\beta_{13i} + \varepsilon_i$$

where $\bar{R}_i$ is the mean logarithmic return

on the asset I over the sample period. β_{1i} to β_{13i} are the security's sensitivity to the factors in the regression and γ_1 to γ_{13} are the reward for bearing these risks. The coefficients of regression, γ_{ij}, are the same for all securities as they are estimated using a cross sectional regression.

Problems with regression

A linear regression makes the following assumptions about the stochastic disturbance term:

1. The residual terms have a zero mean

2. The variance of the errors is constant and finite

3. The errors are independent of each other

4. The error terms are normally distributed

5. There is no relationship between an error term and the corresponding X value

If the error terms are uncorrelated and homoscedastic, then the coefficients of regressions are BLUE, that is, best linear unbiased estimators- their average value, $E(\hat{\beta}_i)$, is equal to the true value of $\hat{\beta}_i$ and they have minimum variance in the class of all such linear unbiased estimators.

If these assumptions are violated we face the problem of methodology. If the first assumption, that the mean of error terms is equal to zero, is violated then we obtain a biased estimate of the intercept term. However, the intercept term is not of much importance to us in this study. Also the slope coefficients remain unaffected.

If the variance of the error term is not constant, then it is said to be heterosce-

dastic. The estimators are no longer BLUE. As we expect some outliers in our data and some of the regressors might be skewed, presence of heteroscedasticity is expected. If the bias is negative, then the estimated standard errors would be smaller than they actually are, and the t-statistic would be overestimated. White's test has been done to ensure accuracy of conclusions. However, since some of the X variables are ratios of the dependent term, we may also suffer from the problem of 'spurious correlation', as proposed by Karl Pearson[22].

The third assumption, that there is no autocorrelation, can also have significant impact on the accuracy of estimators. If autocorrelation exists, then the regression coefficients will have underestimated standard errors. The Durbin-Watson statistic is the most commonly used test for this problem. If the value is two, we can assume that there is no autocorrelation. If it is zero, then there is perfect positive correlation and if it is four, then perfect negative correlation exists. To test Durbin Watson's null and alternate hypothesis, the following decision rules have been established, using d_L and d_U as the critical bounds:

No autocorrelation if $d_U \leq d \leq 4 - d_U$;
Positive autocorrelation if $d < d_L$;
Negative autocorrelation if $d > 4 - d_L$

However, since our regression contains an autoregressive variable, we cannot use the Durbin-Watson test. We use the Breusch-Godfrey(Serial LM) test to detect autocorrelation. Fixing autocorrelation is difficult in our case as the model may be mis-specified, that is, we might have omitted some important variables, or have an incorrect functional form. This is a certain weakness of the APT model as the model itself does not specify the factors. Also, we omit examination of GARCH and ARCH autocorrelation from this study. As we deal with economic

time series, we expect sluggishness or inertia or 'momentum' and therefore some degree of autocorrelation. Also the time series may not be stationary, further contributing to autocorrelation.

Also, since we are dealing with firm specific and macroeconomic variables, trends of which are highly interdependent, we may also suffer from the problem of multicollinearity. This in turn would make the t ratios insignificant. In this study we primarily use two methods to detect multicollinearity- correlation matrix and auxiliary regressions.

The fourth assumption, regarding the normal distribution of disturbance terms, can be verified informally using graphical analysis and formally using the Jarque-Bera test of normality. If the p-value of the JB statistic is sufficiently high, we do not reject the normality assumption.

In this paper, we chose not to use Chow's breakpoint test as the sample period 2000-2005 did not experience any significant macroeconomic fluctuations. After the dot com crash in March 2000 the economy experienced a period of steady growth. Also, we chose not to use Ramsey's RESET test to investigate model misspecification as the structure specification proposed by the APT theory- a linear multifactor model, is consistent with the model used in this paper. This paper tests and evaluates APT only.

Variables

The following section lists and explains the importance of all the regressors used in the model. Unless stated otherwise, all variables have monthly periodicity.

1. Number of shares traded (TRAD)

This refers to the number of common shares traded monthly, listed on national

stock exchanges and over the counter for companies in the NASDAQ system. The number of shares traded is used as a proxy for the liquidity of the firm's stock. According to modern finance theory, only systematic risks affect a risky asset's returns. However, it has been shown that liquidity is a very important component of asset returns. Chordia and Swaminathan find that trading volume is a significant determinant of the lead-lag patterns observed in stock returns[23]. Less liquid stocks generally offer investors higher returns because of a liquidity premium that the investor must be compensated with. The expected sign of the coefficient is negative. An increase in liquidity should lower asset returns.

2. Price to Earning Ratio (PE)

This is defined as:

$$P/E \ Ratio = \frac{Price \ per \ share}{Annual \ Earnings \ per \ share}$$

A high P/E ratio implies that investors are paying a higher price for one unit of earning compared to a lower P/E ratio stock. Normally, stocks with higher earnings growth are traded at a P/E higher compared to the industry average. It is important to note here that a company's P/E ratio alone does not carry much interpretable information. One must compare a company's P/E to the industry or sector average. This also implies that the P/E ratio contains information about the industry sector, as companies belonging to a particular sector tend to have similar P/E's. P/E ratio is a proxy for the market's expectation of growth in the company's stock. Holding everything else equal, a high P/E would imply increase in stock price in the future. Therefore, the expected sign of this factor's coefficient is positive.

3. Market Capitalization (CAP)

Is defined as:

$$Market \ cap = (price \ per \ share) \times (number \ of \ shares \ outstanding)$$

According to Jeffrey and Artemiza's research, shares outstanding have a strong predictive ability of stock returns[24]. The numbers of shares outstanding changes with events such as IPO issues, exercise of stock options Kand warrants, stock mergers/splits, share repurchase. Generally speaking an increase in market cap implies growth of a company. Therefore the expected sign of this factor's coefficient is positive.

4. Previous month's return (LAG)

We expect a mean reversion of an asset's return; i.e. the stock return is expected to rise in the future when it is currently at a low level relative to the mean and expected to fall when high. Research by Poterba and Summers(1988) supports this as they found negative correlation in stock returns[25].

Also, extremely high levels of stock returns are caused by temporary events whose effect fades over time, and extremely low levels of returns are not sustainable as the drift of a stock price is positive in the long term due to economic growth. Because of mean reversion, the sign of this variable's coefficient is expected to be negative. For example, if unexpected positive news causes a stock to rise by 10% in a month, the next month's return would be expected to be negative. Hence the negative sign of this variable's coefficient. The return on the asset is measured by taking logarithmic monthly returns.

5. CPI (CPI)

Changes in the consumer price index are used as a proxy for unanticipated inflation. The relationship between unexpected inflation and stock returns in the United States is inconclusive .Bodie 1976, Jaffe and Mandelker 1976, Fama and Schwert found that the relationship was significantly negative while Pearce and Roley 1985, Hardouvelis 1988 found that there was no significant relationship[26]. It is interesting to note that studies done in 1976 were following the oil embargo in the United States while in the late 1980's the country did not have to face such a crisis. Therefore the relationship between the dependent and the independent variable might have changed over time. However, the sign of the variable's coefficient is still expected to be negative. Following IMF's guidelines, the CPI has been lagged by two months, so as to allow for its effect to be incorporated in stock prices. The change in CPI is measured by log returns. Data from the source was obtained in seasonally adjusted form

6. Money Supply (MS)

M3 money supply has been used as a proxy for this variable. The reason for choosing M3 over M2 is that M3 also includes institutional money market mutual fund balances and large time deposits. The relationship between money supply and stock prices has been studied in several markets. A strong positive correlation between money supply and stock market returns has been observed historically[27]. However, many argue that changes in money supply are caused by changes in overall level of the markets. In either case, the expected sign of the variable is positive. For instance, an increase in stock prices provides an incentive to liquidate long term deposits. The money liquidated is then used to buy assets. Therefore the demand deposits tend to increase, increasing the M1 money supply. If this is the case, then money supply is not a good predicting factor in our model even

though it might be statistically significant in explaining stock returns. However, it should also note that stock prices only respond to changes in the money supply in the long run. Therefore observing such an effect might be out of scope of this study's sample period. The variable has been lagged by two months. The change in money supply is measured by log returns. Data from the source was obtained in seasonally adjusted form.

7. Industrial Production (IND)

A strong relation between industrial production and stock market returns has always been noted. The index has been used by economists to forecast future GDP levels and performance of the economy[28]. Ilan Cooper and Richard Priestley investigated the relationship between future stock returns and unrevised industrial production[29]. They concluded that industrial production significantly predicts U.S stock returns and the R-squared for the regression was 0.02, 0.05 and 0.11 at monthly, quarterly, and annual time horizons respectively. It should be noted that the R-squared value was significantly higher for yearly stock returns as compared to monthly returns. This might again indicate that short term changes in the industrial production index do no produce an immediate change in an asset's returns. The expected sign for this variable is positive. The variable has been lagged by two months. The changes are measured by monthly log returns and the data was obtained in seasonally adjusted form.

8. Price of Oil (OIL)

Oil being the most crucial commodity and a basic input for most industries should significantly affect stock returns. However, the expected sign for the coefficient of this factor should depend on the industry. Oil companies should generally profit from an unanticipated increase in

oil prices and other firms should exhibit lower stock returns. Other firms, whose costs increase with an increase in oil price, should be negatively affected by an increase in oil prices. The changes are measured by monthly logarithmic returns on oil prices.

9. Risk Premium (RPREM)

This is the difference between a BAA bond yield and an AAA corporate bond yield of the same maturity, also more precisely known as the credit spread. It is defined as:

$$Monthly\ change\ in\ risk\ premium =$$
$$\log\left(\frac{Y_{BAA(t)} - y_{AAA(t)}}{Y_{BAA(t-1)} - y_{AAA(t-1)}}\right)$$

where $Y_{BAA(t)}$ is the yield on a BAA bond, and $y_{AAA(t)}$ is the yield on an AAA bond.

It reflects the additional yield an investor can earn from a security whose credit risk is greater compared to a safer security. Generally BAA bonds offer higher yields than AAA bonds as they have a greater risk of default. Gomes and Schmid found out that credit spread is an important determinant of economic fluctuations[30]. They show that credit spreads forecast recessions by predicting future movements in corporate investments. A very simplistic analysis of supply and demand shows that the expected sign of this variable would be negative. As the risk premium increases, riskier bonds offer higher returns to investors. As riskier bonds can be considered a substitute for equities, investors rebalance their positions by selling equities and buying these riskier bonds. This implies a decrease in demand of equities and therefore a drop in returns. However, the firm's debt-equity and asset exposure may also play a significant role in determining the final outcome of this variable's effect.

10. Yield spread (YSP)

Yield spread refers to the difference between the short term bond yield and the long term bond yield. For this study, the yield spread has been calculated by subtracting the three month Treasury bill yield from the ten year Treasury bond yield. The absolute value of the yield is not of use, as we are only concerned with the unanticipated changes in the yield spread. So the changes in the yield spread are measured as:

$$Monthly\ change\ in\ yield\ spread =$$
$$\log\left(\frac{Y_t - y_t}{Y_{t-1} - y_{t-1}}\right)$$

where 'Y' is the yield on a 10 year bond and 'y' is the yield on a 3 month treasury bill. Modi and Taylor find that interest rate term spreads have significant power in predicting real economic activity[31]. As stock prices generally go up with real economic growth, the expected sign for this variable would be positive. However, we firmly believe that the effect of a relative increase in long term interest rates would affect different companies differently so the final effect of this variable would be very firm specific.

11. Market return (SP500)

For this study, the return on the S&P 500 has been used as a proxy for the market return. This factor derives from the CAPM model where it is the only independent variable. The coefficient of this variable, conventionally called the beta in the CAPM model represents the ratio of the change in asset's return to the change in market return. For example, if beta is equal to 1.5, and the market portfolio goes up by 10 percent, then the security's return is supposed to go up by 15%. Since in most cases, both the security return and market return move in the same direction, the expected sign of the variable's coefficient is positive. It is measured as

Table 1: Descriptive statistics for Macroeconomic variables

	CPI	MS	IND	OIL	RPREM	YSP	SP500	SMB	EXR
Mean	0.102088	0.273161	0.036148	0.496803	0.238255	25.70285	-0.098306	0.443715	0.096347
Median	0.094562	0.250266	0.032931	1.055057	0	-3.721655	0.137452	0.39928	0.044062
Maximum	0.593879	0.876467	0.589788	7.093691	18.29307	2100	4.009572	6.31115	2.689773
Minimum	-0.165626	-0.080619	-0.758001	-8.232355	-6.775178	-388.8889	-5.062187	-5.669317	-1.894616
Std. Dev.	0.11095	0.191532	0.231526	3.417962	3.78153	254.662	1.917815	1.655234	1.087512
Skewness	0.951116	0.754189	-0.456204	-0.525854	1.45724	7.60218	-0.263111	0.038579	0.394464
Kurtosis	7.056664	3.918263	3.678733	2.751857	8.804214	62.9738	2.97415	6.735693	2.406201
Jarque-Bera	60.22502	9.355241	3.879496	3.502993	126.5493	11484.09	0.832732	41.88406	2.925011
Probability	0	0.009301	0.14374	0.173514	0	0	0.659439	0	0.231655
Sum	7.350355	19.66758	2.602688	35.76981	17.15436	1850.605	-7.07802	31.94745	6.937015
Sum Sq. Dev.	0.874003	2.604596	3.805916	829.4552	1015.298	4604544	261.1392	194.5258	83.97049
Observations	72	72	72	72	72	72	72	72	72

Table 2: Descriptive statistics for equities

AIG	RET	TRAD	PE	CAP
Mean	-0.033138	1.35E+08	26.12665	1.75E+11
Maximum	9.277767	4.25E+08	40.38406	2.30E+11
Minimum	-8.118831	58245600	11.85315	1.29E+11
Std. Dev.	3.160159	64616625	8.278533	2.37E+10
Jarque-Bera	2.591896	389.9816	3.434464	0.882857
Probability	0.273638	0	0.179562	0.643117
Sum	-2.385949	9.70E+09	1881.119	1.26E+13

Apple	RET	TRAD	PE	CAP
Mean	0.620392	3.31E+08	-1.584574	1.49E+10
Maximum	16.24991	9.21E+08	300.2	6.08E+10
Minimum	-37.41074	1.42E+08	-897.5	5.14E+09
Std. Dev.	7.700862	1.66E+08	194.8105	1.30E+10
Jarque-Bera	177.9457	34.72328	342.5119	55.60186
Probability	0	0	0	0
Sum	44.66826	2.38E+10	-114.0893	1.07E+12

Bank of America	RET	TRAD	PE	CAP
Mean	0.367509	2.98E+08	12.0476	1.21E+11
Maximum	6.936762	4.38E+08	16.84667	1.90E+11
Minimum	-11.03352	1.47E+08	8.285788	6.51E+10
Std. Dev.	2.926499	53519770	1.836343	3.82E+10
Jarque-Bera	28.7894	18.58175	6.501112	9.091472
Probability	0.000001	0.000092	0.038753	0.010612
Sum	26.46061	1.78E+10	867.4269	8.70E+12

Cisco	RET	TRAD	PE	CAP
Mean	-0.687996	1.34E+09	15.6069	1.75E+11
Maximum	14.27531	2.78E+09	211.8151	5.33E+11
Minimum	-19.87876	7.36E+08	-642	7.65E+10
Std. Dev.	6.186377	3.76E+08	146.7937	1.17E+11
Jarque-Bera	8.615105	55.09843	485.6581	49.87143
Probability	0.013466	0	0	0
Sum	-49.53571	9.68E+10	1123.697	1.26E+13

Citi	RET	TRAD	PE	CAP
Mean	0.090543	2.98E+08	15.77563	2.28E+11
Maximum	9.558974	7.25E+08	22.56039	2.81E+11
Minimum	-6.270865	1.85E+08	10.40351	1.50E+11
Std. Dev.	3.146323	78993220	2.837541	2.77E+10
Jarque-Bera	0.910864	472.0188	2.816639	7.924344
Probability	0.634174	0	0.244554	0.019022
Sum	6.51913	2.15E+10	1135.845	1.64E+13

Devon Energy	RET	TRAD	PE	CAP
Mean	0.806003	53707383	26.85313	1.15E+10
Maximum	11.51748	88471600	485.3333	3.05E+10
Minimum	-12.87411	12555000	-62.96053	3.02E+09
Std. Dev.	4.488956	17215748	93.46608	7.20E+09
Jarque-Bera	2.142319	1.238467	809.9796	12.01911
Probability	0.342611	0.538357	0	0.002455
Sum	58.03221	3.87E+09	1933.425	8.31E+11

Eagle Materials	RET	TRAD	PE	CAP
Mean	0.689687	4456304	13.16346	9.25E+08
Maximum	8.778143	22692600	20.31482	2.15E+09
Minimum	-14.37868	660000	3.952595	4.21E+08
Std. Dev.	4.194841	4535336	4.70933	4.72E+08
Jarque-Bera	21.53264	51.63004	6.989616	12.7505
Probability	0.000021	0	0.030355	0.001703
Sum	49.65749	3.21E+08	947.7692	6.66E+10

Exxon Mobil	RET	TRAD	PE	CAP
Mean	0.200558	2.68E+08	17.8436	2.88E+11
Maximum	8.882261	5.53E+08	36.59539	4.05E+11
Minimum	-5.37748	1.86E+08	9.751736	2.15E+11
Std. Dev.	2.263325	74776377	5.633573	4.43E+10
Jarque-Bera	20.46898	74.57261	16.82574	6.385007
Probability	0.000036	0	0.000222	0.041069
Sum	14.44015	1.93E+10	1284.739	2.07E+13

Goldman Sachs	RET	TRAD	PE	CAP
Mean	0.183655	72119937	15.13056	4.37E+10
Maximum	11.46546	2.05E+08	22.1201	5.92E+10
Minimum	-10.29924	18720600	10.1414	3.16E+10
Std. Dev.	4.217134	27250249	3.064161	6.93E+09
Jarque-Bera	2.378414	161.2869	3.236464	1.836417
Probability	0.304463	0	0.198249	0.399234
Sum	13.22316	5.19E+09	1089.401	3.14E+12

Helix Energy	RET	TRAD	PE	CAP
Mean	0.884552	16230872	31.74353	1.07E+09
Maximum	14.91335	39016418	67.14286	2.82E+09
Minimum	-11.90935	5232800	16.43192	4.75E+08
Std. Dev.	5.252635	7781705	11.23892	5.60E+08
Jarque-Bera	2.069027	16.21773	8.961227	44.7045
Probability	0.355399	0.000301	0.011326	0
Sum	63.68776	1.17E+09	2285.534	7.72E+10

monthly log returns on the SP500 index.

12. Size factor (SMB)

Fama-French discovered, in their three factor model that smaller firms generally exhibit higher returns[32]. Of course, these higher returns are a result of additional risk, that is, higher standard deviation of returns. This factor was found to be significant in explaining equity returns in past researches and therefore has been included in this model. It is defined as

$$SMB =$$
$$return\ on\ small\ cap\ market\ index -$$
$$return\ on\ large\ cap\ market\ index$$

The large cap index used in SP500 and the small cap index used is SP600 small cap.

13. Exchange rate (EXR)

We use the Euro-Dollar rate as a proxy for this variable. Firms are affected by a change in exchange rates either directly, if they engage in foreign trade, or indirectly, if the firm inputs and outputs are affected by exchange rates. Although there is no theoretical or empirical consensus on the relationship between two variables, Hwang in 1999 found that stock prices

do not have a significant impact on exchange rate but currency devaluation has a significant positive impact in the long run but an insignificant negative effect in the short run[33]. Hwang concluded that the depreciation of the Canadian Dollar led to more competitiveness of the export market and increases the stock prices of the firm in the long run. However, in explaining a particular firm's returns we do not have an 'a priori' sign of the variable as a firm's exposure to exchange rate varies vastly.

IV. Data

Monthly data over the period of six years, from January 2000 to December 2005 was collected for each variable. It might have been better if we performed this study used weekly or even daily data, but only monthly data is available for some variables used. We would have risked a structural change in the model if we chose a longer observation period. According to Brealey et al (2006), five years is the recommended length of data to use in most financial analysis[34]. Firm specific data- returns, market capitalization, shares traded, P/E ratio was obtained from COMPUSTAT North America.

Macroeconomic data was obtained from the Federal Reserve. No value for any variable was dropped from the study as we believe outliers are an essential feature of equity markets. Wherever applicable (Money Supply, Industrial Production and CPI), the data was obtained seasonally adjusted.

For firm specific variables (P/E ratio, Market Cap, and number of shares traded), the absolute value of the variables is relevant to the study. Market Cap is measured in Dollars while P/E ratio and number of shares traded are unit-less. For the rest of the variables, changes in the variable are important, as they represent the unanticipated component. Therefore, we have taken monthly logarithmic returns

for these variables except for two cases- Yield Spread and Risk Premium. These time series contained negative values, so we had to take percentage returns. We preferred logarithmic returns over percentage returns as: *i)* log returns are time additive. For example we can sum all the monthly returns over the sample period, obtain the net return on the equity for the sample period. This would not have been the case if we took percentage returns. *ii)* they render the time series stationary. A log transformation also helps in reducing heteroscedasticity as it compresses the scale in which variables are being measured. For these reasons log returns are preferred by academics for stochastic time series modeling.

Table 2 (cont.): Descriptive statistics for equities

ITT	RET	TRAD	PE	CAP		Qlogic	RET	TRAD	PE	CAP
Mean	1.227936	9693528	27.40813	1.36E+09		Mean	-0.542686	2.51E+08	60.33419	4.25E+09
Maximum	12.74924	33127500	47.88889	2.84E+09		Maximum	31.61911	8.50E+08	283.6364	1.14E+10
Minimum	-23.60892	2653800	12.5	2.95E+08		Minimum	-37.19015	53812412	18.38346	1.76E+09
Std. Dev.	6.537628	6341753	6.351333	7.18E+08		Std. Dev.	11.60186	1.76E+08	55.12047	1.91E+09
Jarque-Bera	25.95442	142.7773	9.673374	5.349323		Jarque-Bera	12.25896	27.85503	110.0464	58.87579
Probability	0.000002	0	0.007933	0.06893		Probability	0.002178	0.000001	0	0
Sum	88.4114	6.98E+08	1973.385	9.79E+10		Sum	-39.07336	1.81E+10	4344.061	3.06E+11
Landstar	RET	TRAD	PE	CAP		Thor	RET	TRAD	PE	CAP
Mean	1.238989	10350931	19.13437	1.09E+09		Mean	1.002042	5388768	14.71998	1.06E+09
Maximum	8.227113	22104664	33.73684	2.51E+09		Maximum	11.69535	12086800	23.51815	2.27E+09
Minimum	-6.463345	4500800	9.033401	3.75E+08		Minimum	-9.760433	711200	6.857639	2.37E+08
Std. Dev.	3.467012	3391173	6.502631	6.20E+08		Std. Dev.	5.258212	3470247	4.464848	6.55E+08
Jarque-Bera	1.37601	34.75185	3.735433	10.06302		Jarque-Bera	1.778736	4.182331	2.883226	6.655411
Probability	0.502578	0	0.154476	0.006529		Probability	0.410915	0.123543	0.236546	0.035875
Sum	89.20719	7.45E+08	1377.675	7.83E+10		Sum	72.14704	3.88E+08	1059.838	7.66E+10
Microsoft	RET	TRAD	PE	CAP		Tractor	RET	TRAD	PE	CAP
Mean	-0.484382	1.51E+09	36.48688	3.09E+11		Mean	1.55795	7888573	17.56236	8.62E+08
Maximum	14.85351	2.57E+09	59.69101	5.57E+11		Maximum	23.93731	19941858	32.68605	2.20E+09
Minimum	-18.27847	9.68E+08	21.43443	2.31E+11		Minimum	-9.987294	1128800	3.853627	65338437
Std. Dev.	4.938777	3.49E+08	9.28001	5.67E+10		Std. Dev.	6.308861	4539397	7.795955	6.67E+08
Jarque-Bera	18.58086	20.47608	3.553486	155.476		Jarque-Bera	6.419819	2.587547	5.407027	6.577587
Probability	0.000092	0.000036	0.169188	0		Probability	0.04036	0.274234	0.06697	0.037299
Sum	-34.87552	1.09E+11	2627.055	2.22E+13		Sum	112.1724	5.68E+08	1264.49	6.21E+10
Oshkosh	RET	TRAD	PE	CAP		Trimble	RET	TRAD	PE	CAP
Mean	1.089229	8920475	16.47434	1.41E+09		Mean	0.543391	17665072	3.025691	9.38E+08
Maximum	7.408803	26602800	21.59633	3.30E+09		Maximum	20.39972	43739400	47.99143	2.09E+09
Minimum	-13.94134	3232400	10.20487	4.41E+08		Minimum	-26.89386	6026700	-233.3333	2.84E+08
Std. Dev.	3.695104	3538872	3.141077	8.69E+08		Std. Dev.	6.812867	7932448	54.28628	5.61E+08
Jarque-Bera	37.84504	178.5028	3.86972	9.81333		Jarque-Bera	31.89519	21.32368	263.7292	8.346226
Probability	0	0	0.144445	0.007397		Probability	0	0.000023	0	0.015404
Sum	78.42446	6.42E+08	1186.152	1.02E+11		Sum	39.12412	1.27E+09	217.8498	6.75E+10
Pool Corp	RET	TRAD	PE	CAP		Walmart	RET	TRAD	PE	CAP
Mean	1.19613	7821494	20.66995	9.83E+08		Mean	-0.235263	1.96E+08	30.74739	2.30E+11
Maximum	10.05464	24834539	28.2126	2.05E+09		Maximum	6.296168	4.46E+08	45.2	2.76E+11
Minimum	-7.33792	2229188	13.19665	2.74E+08		Minimum	-10.1251	1.06E+08	17.05058	1.82E+11
Std. Dev.	3.459748	3403025	3.691608	5.20E+08		Std. Dev.	3.004809	58969446	7.655109	2.04E+10
Jarque-Bera	0.075705	189.7712	3.39615	7.815207		Jarque-Bera	4.173206	82.61836	2.49679	0.563662
Probability	0.962855	0	0.183036	0.020089		Probability	0.124108	0	0.286965	0.754401
Sum	86.12133	5.63E+08	1488.236	7.08E+10		Sum	-16.93893	1.41E+10	2213.812	1.66E+13

Table 3: White's Test results

Sample: 2000M01 2005M12			
Included observations: 72			
Dependent Variable: RESID^2			
		Obs*R-squared	Prob. Chi-Square(13)
AIG		9.342494	0.7466
Apple		10.45848	0.6561
Bank of America		15.75414	0.2627
Cisco		25.7096	0.0186
Citi		24.15633	0.0297
Devon Energy		13.08586	0.4412
Eagle		38.68956	0.0002
Exxon Mobil		14.92326	0.3122
Goldman Sachs		9.281426	0.7514
Helix		19.38477	0.1116
ITT Educational		9.978375	0.6957
Landsystem		6.100992	0.9424
Microsoft		31.14239	0.0032
Oshkosh		15.71025	0.2651
Pool Corp		11.17489	0.5962
Qlogic		17.4448	0.1798
Thor		19.32342	0.1134
Tractor		13.00182	0.4477
Trimble		44.246	0
Walmart		5.819734	0.9525

Descriptive Stats: Macroeconomic variables

Table 1 presents the descriptive statistics for the macroeconomic variables. All variables exhibit a positive mean return except for the SP500 index. Also, the sum column represents the net change over the sample period. It shows that the SP500 index declined by about 7%. The small cap index minus big cap index factor increased by about 31%, which means that small cap stocks clearly outperformed big cap stocks over the time frame. Industrial production, oil prices and SP500 returns exhibit a negative skewness which implies that they have a long left tail. Only four factors- SP500, Oil, Industrial production and Exchange rate are relatively normally distributed as indicated by the p values of Jarque Bera statistic. However, it should also be noted that the rest of the variables might have been distributed normally if we dropped outliers from the dataset. For example, with a mean of 25.7, the yield spread has minimum and maximum values ranging from -388.88 to 2100. Histograms of theses macroeconomic variables show that the variables which are not distributed normally have significant outliers.

Descriptive Stats: Equities

Table 2 presents the descriptive statistics for monthly data for each of the twenty equities. Except for QLogic, Cisco, Microsoft and Wal-mart, all other equities had positive monthly returns. There was a huge range of the net return over the six year period. Small cap firms had very high net returns with as much as 112% for Tractor Supply and 89% for ITT Educational Services. Technology stocks, on the other hand displayed severely negative returns- (-34)% for Microsoft and (-49)% for Cisco. This is because of the NASDAQ crash in early 2000. Apple, despite being a tech stock showed very impressive returns. This shows that firm specific factors can be very influential while determining a stock return. Most stocks had a standard deviation of 3-6% with the exception of 11% for QLogic. 9 of the 20 stocks were distributed normally as indicated by the p-values of the JB statistic. Again, due to outliers the other 11 stocks failed the JB test. P/E ratios for nine stocks were distributed normally and only three stocks' market capitalizations were distributed normally.

It should be noted that in previous researches on equities, the Kolmogorov-Smirnov test has yielded better results as a normality test than the JB statistic. That is, more equities and regressors qualify for normal distribution under the Kolmogorov-Smirnov test.

V. Regression results

Using the White's Test to check heteroscedasticity we observe that only 5 stocks exhibit heteroscedasticity as the chi-square for 13d.f and a P=0.05 is 22.36. It should be noted that we had to exclude the cross terms from the White test, as with 13 regressors we would have consumed all degrees of freedom. Table 3 shows the results of the test.

As our regression contained an autoregressive term, we could not use the Durbin Watson test to test autocorrelation. Therefore, a Breusch-Godfrey Serial LM test with two lags was used. At P=0.05 only 5 stocks suffered from Au-

Table 4: Breusch-Godfrey Serial LM Test results

Dependent Variable: RESID		
Sample: 2000M01 2005M12		
Included observations: 72		
	Obs*R-squared	Prob. Chi-Square(2)
AIG	0.010536	0.9947
Apple	0.360006	0.8353
Bank of America	3.820715	0.148
Cisco	2.947367	0.2291
Citi	2.296884	0.3171
Devon Energy	19.20338	0.0001
Eagle	5.820558	0.0545
Exxon Mobil	1.126201	0.5694
Goldman Sachs	8.263797	0.0161
Helix	0.438955	0.8029
ITT Educational	7.385988	0.0249
Landsystem	1.072203	0.585
Microsoft	2.205253	0.332
Oshkosh	0.423754	0.8091
Pool Corp	2.960268	0.2276
Qlogic	1.677333	0.4323
Thor	1.456663	0.4827
Tractor	2.492622	0.2876
Trimble	6.974237	0.0306
Walmart	6.779263	0.0337

tocorrelation. Both autocorrelation and heteroscedasticity have been correction using the Newey-West method of all of the equities. This decreases the standard error of the estimates and hence increases the t-values. Table 4 shows the Serial LM test results.

According to Gujarati & Porter, a high R-squared and low t-values for regressors is a classic feature of presence of multi-collinearity[35]. We however, do not suffer from such an occurrence in most cases as shown later in the regression results. Also, after conducting auxiliary regressions(for each variable) for each equity, we found out that the R-squared for the auxiliary regression was almost always less than the R-squared for the overall regression. Both these factors indicate that multicollinearity is not a significant problem. We chose not to analyse the correlation matrix as with 13 regressors it cannot give us an accurate picture of multicollinearity. The matrix, however, is attached for reference.

Table 5 contains the regression results for all of the twenty equities. In comparison with most other multi-factor models, our model explains the equity returns very well. R-squared values range from about 27% for Landsystem to about 74% for Goldman Sachs. The average R-squared value for all the 20 equities is 46.8%.. Two firms- Landsystem and Trimble fail the F-test at 95% confidence level, which tests for all the beta coefficients being zero at the same time. However, they pass the test at 90% confidence interval. The t-values are indicated under each of the regression coefficients. Since we have 14 regressors, one intercept term and 72 observations, the t-values for 58 degrees of freedom are - 1.67 at 95% confidence interval and 1.29 at 90% confidence interval. We choose to do a one tailed test as we have strong directional sense of the hypothesis a priori. 10 out of the 20 equities showed normal distribution of the residual term at P=0.05. Again, the presence of a few outliers may entirely disrupt the normality assumption.

Table 5: Time Series regression results

	C	LAG	TRAD	PE	CAP	CPI	MS	IND	OIL	RPREM	SMB	SP500	EXR	YSP	r-squared	F-Test
AIG	1.017	-0.2106	-2.10E-08	-0.0675	2.55E-11	-1.386	-1.2343	2.38749	-0.268	-0.026	-0.5951	0.63518	-0.5801	-0.000394	0.597854	6.6328
	0.363	-2.8022	-4.109244	-1.2024	1.62231	-0.7281	-0.8698	1.77945	-3.251	-0.472	-3.1228	3.78365	-1.8618	-0.651347		0
Apple	-3.03	-0.0352	-3.86E-09	-0.001	1.94E-10	-5.0387	8.08146	1.08104	0.109	-0.17	0.76807	2.00041	1.86521	-4.62E-05	0.388199	2.83093
	-1.49	-0.3324	-0.325891	-0.4451	1.41231	-0.6728	2.79012	0.30355	0.363	-1.121	2.30415	5.49738	2.08713	-0.024644		0.00333
Bank of America	-3.82	-0.3754	-8.80E-09	0.606	-8.71E-12	6.68591	-1.6942	-0.6675	0.089	0.0609	0.06441	0.77835	-0.1602	0.000721	0.43685	3.46093
	-1.35	-2.521	-1.5571	2.78118	-1.25731	1.80056	-0.8792	-0.4729	1.057	1.0099	0.25442	4.71299	-0.4127	1.080512		0.00054
Cisco	0.966	-0.0241	-9.21E-10	-0.0019	4.56E-13	-5.8124	1.59758	1.35197	-0.015	-0.226	0.05846	2.04834	-0.0511	-0.005072	0.548108	5.41147
	0.337	-0.1862	-0.466342	-0.573	0.10965	-1.3609	0.4674	0.63242	-0.07	-1.587	0.10641	8.29624	-0.0887	-4.563326		3E-06
Citi	-3.26	-0.1091	3.64E-10	0.28329	-2.81E-12	2.95231	-2.0981	0.70139	-0.104	-0.024	-0.2655	1.12697	-0.3227	-0.000504	0.683377	9.62948
	-1.16	-1.5229	0.07451	2.90624	-0.33049	1.29078	-1.1928	0.68166	-1.613	-0.277	-1.6788	7.13033	-1.521	-1.225734		0
Devon Energy	4.362	-0.2787	-1.16E-07	0.00622	2.31E-10	1.59955	-2.1952	3.20589	0.364	0.2322	0.4664	0.99942	0.03302	0.001117	0.453774	3.70639
	1.975	-3.9566	-3.097609	1.33369	3.1368	0.29295	-1.0715	1.56454	1.924	1.2875	1.03994	4.47489	0.09096	1.907943		0.00027
Eagle	-0.9	-0.148	-2.91E-07	0.19589	2.58E-09	2.42692	-7.4493	-2.7449	-0.205	-0.018	0.16253	0.43386	-0.7506	0.002323	0.370525	2.62617
	-0.42	-1.249	-1.793574	1.51167	1.93922	0.58031	-2.1705	-2.4232	-1.009	-0.23	0.25238	1.97122	-1.3724	2.949872		0.00604
Exxon Mobil	-3.93	-0.1504	-1.58E-08	0.03253	3.02E-11	-2.2464	-1.906	-0.1058	0.054	0.0148	-0.2349	0.4343	-0.1088	0.000153	0.439809	3.50279
	-1.49	-1.6499	-4.327219	0.7302	3.30506	-0.848	-1.6595	-0.0975	1.071	0.1969	-2.3159	3.29553	-0.5206	0.284245		0.00048
Goldman Sachs	-18	-0.2343	1.65E-08	0.3929	2.56E-10	-3.363	1.14008	2.53614	-0.083	-0.229	0.27542	1.14054	0.65572	-0.002608	0.740595	12.7376
	-4.37	-3.1951	1.390657	3.1624	4.38272	-1.1412	0.7303	1.99384	-0.89	-2.023	1.667	8.06594	2.49367	-3.555324		0
Helix	-2.86	-0.2064	-2.61E-07	0.07637	5.95E-09	-9.0014	-0.7376	4.63868	-0.053	0.2441	0.64518	1.32907	0.26958	0.003321	0.474786	4.03317
	-1.19	-2.6432	-2.525854	1.60772	3.49017	-1.6522	-0.3488	1.65333	-0.28	1.7308	1.45087	4.18805	0.5097	4.695692		0.00011
ITT Educational	-5.08	-0.353	-3.89E-07	0.40864	-8.82E-10	4.79136	0.62836	-0.5402	-0.102	-0.267	0.20339	1.01491	-1.4654	0.004749	0.389357	2.84476
	-1.29	-3.4497	-2.205861	3.00021	-1.06236	0.69402	0.12009	-0.2054	-0.499	-2.046	0.36499	3.30878	-1.7899	3.491131		0.0032
Landsystem	-2.15	-0.194	1.71E-08	0.21069	-1.62E-09	6.22684	0.5708	-0.7889	0.052	0.0141	0.76228	0.41746	0.75037	0.001117	0.273574	1.68023
	-0.78	-2.0129	0.123411	1.4667	-1.15118	1.43814	0.18854	-0.3457	0.407	0.2157	3.77971	2.22998	1.49993	1.175543		0.08999
Microsoft	-2.11	-0.2528	3.14E-12	-0.0245	8.25E-12	-5.2088	2.60626	-1.7384	0.095	-0.083	-0.5442	1.49697	0.24091	0.004352	0.474278	4.02496
	-0.48	-2.7767	0.001893	-0.4542	0.60758	-1.0025	0.73881	-0.647	0.484	-0.588	-1.6066	4.61316	0.3571	4.488269		0.00011
Oshkosh	-4.44	-0.2012	-2.94E-07	0.65639	-1.23E-09	-11.185	1.65864	0.98431	-0.148	0.0347	0.19215	0.73904	-0.0261	0.000526	0.44677	3.60299
	-1.19	-1.6501	-2.40923	2.48177	-1.92	-2.5572	0.76873	0.69698	-1.333	0.5417	0.58124	3.26047	-0.0671	0.511342		0.00036
Pool Corp	-8.46	-0.1549	4.97E-08	0.68748	-4.70E-09	0.10622	0.10302	1.7114	-0.27	-0.141	0.23626	0.7317	-0.6318	-0.000955	0.470173	3.9592
	-2.31	-1.5211	0.447166	3.33842	-2.99753	0.02312	0.05542	1.14459	-2.449	-1.619	0.70149	3.35046	-1.8443	-1.287593		0.00013
Qlogic	-12.7	-0.1644	1.12E-08	-0.0424	2.50E-09	-4.5464	6.09556	0.34307	0.173	-0.57	1.4769	3.03811	-0.3493	-0.01212	0.555704	5.58028
	-2.22	-1.6171	1.882885	-0.5515	1.11143	-0.4335	1.0402	0.09387	0.45	-1.868	1.49627	4.34511	-0.2512	-6.938682		2E-06
Thor	-3.88	-0.0916	-4.18E-07	0.5291	7.95E-11	1.94979	-2.7403	-1.4746	-0.48	-0.18	0.72571	0.82342	-0.2814	0.000918	0.457677	3.76519
	-1.77	-0.6926	-1.78408	3.65291	0.07953	0.35713	-0.7514	-0.6565	-2.113	-1.727	1.92068	2.4437	-0.5403	1.091419		0.00023
Tractor	-4.13	-0.1334	-9.96E-08	0.69151	-7.21E-09	0.64063	1.49526	-2.8654	-0.171	0.0193	0.98041	1.48592	0.89835	0.003366	0.356171	2.46816
	-1.03	-1.0209	-0.636292	3.52772	-4.18183	0.08932	0.31835	-0.8928	-0.777	0.1842	2.40684	4.50204	1.13051	1.923946		0.00958
Trimble	1.382	-0.1627	-1.03E-07	0.01252	-1.31E-10	8.24733	0.58431	0.18996	0.176	0.193	0.38241	1.86865	0.66548	-0.000741	0.29095	1.83074
	0.317	-1.3991	-0.41658	0.94015	-0.08837	1.18892	0.12456	0.06328	0.876	0.8145	1.07697	3.27268	0.78775	-0.27556		0.05949
Walmart	-16.2	-0.3135	-2.12E-09	-0.1079	8.77E-11	3.72308	-1.9437	-2.6222	-0.155	0.0851	-0.3778	0.24335	-0.315	-0.000376	0.515467	4.74637
	-2.77	-4.2751	-0.379149	-1.2847	3.0807	1.5873	-1.0029	-2.4744	-1.788	1.4229	-1.8551	1.355	-0.9491	-0.418214		1.6E-05

Shaded t-statistics indicate significance at 95% confidence level(one tailed). Highlighted t-statistics indicate significance at 90% confidence level(one tailed).

The market index, SP500 was found to be significant at 90% confidence interval for all the 20 equities. This implies that this factor is the single-most important factor in explaining equity returns. Also, all the coefficients were positive, which implies that all the equities grow with an increase in the SP500 index. The LAG variable was found to be significant for 15 equities which confirm the phenomenon of mean reversion on a monthly basis of equity returns as signs of the coefficients for all 15 are negative, in accordance with our expectations. This means, for example that if the return for this month of an equity is positive, the expected re-

turn, holding everything else constant, is negative. This is a very important result in finance, especially in developing trading strategies. The TRAD variable, which stands for the number of shares traded per month was found to be significant for 11 stocks, with the sign of the coefficient (negative) according to our expectation for 9 out of these 11 stocks. Apart from decreased returns due to increased liquidity, this negative sign could also mean that high trading only occurs when institutional clients short sell a company stock anticipating a decrease in its value. PE was significant for 13 stocks with all of them having the sign of coefficient (posi-

Table 6: Cross sectional regression results

Dependent Variable: MEAN				
Method: Least Squares				
Date: 04/29/10 Time: 10:13				
Sample: 1 20				
Included observations: 20				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.932674	0.149496	6.238805	0.0008
LAG	1.490578	0.531143	2.806359	0.0309
TRAD	-699549.5	636265.2	-1.099462	0.3137
PE	0.480085	0.247751	1.937775	0.1008
CAP	-46873115	27099985	-1.729636	0.1344
CPI	0.021144	0.010524	2.009128	0.0913
MS	0.069449	0.038636	1.797508	0.1224
IND	0.07	0.029916	2.339933	0.0578
OIL	0.148173	0.287839	0.514777	0.6251
RPREM	0.712142	0.552392	1.289196	0.2448
SMB	0.827659	0.134288	6.163301	0.0008
SP500	-0.47733	0.101117	-4.720564	0.0033
EXR	-0.220417	0.144357	-1.526881	0.1776
YSP	78.09481	18.77606	4.159275	0.0059
R-squared	0.972343	Mean dependent var		0.485755
Adjusted R-squared	0.912419	S.D. dependent var		0.658397
S.E. of regression	0.194847	Akaike info criterion		-0.237178
Sum squared resid	0.227792	Schwarz criterion		0.459834
Log likelihood	16.37178	Hannan-Quinn criter.		-0.101114
F-statistic	16.22625	Durbin-Watson stat		2.076932
Prob(F-statistic)	0.001302			

Shaded t-statistics indicate significance at 95% confidence level(one tailed).

tive) as we expected. The market cap factor showed mixed results- it was positive for large cap companies and negative for mid cap companies. This might imply that as the mid cap companies grow in size, holding everything else equal, their returns tend to lower. This explanation is also in accordance with the multistage dividend discount model which says that firms in their infancy have an above average growth rate. Money supply was the least significant of regressors in the time series regression. It is interesting to note that OIL had positive signs oil producers like Exxon Mobil and Devon Energy, and negative for rest of the firms. Thor industries, which are a vehicle manufac-turer, displayed a strong negative t-value for the Oil prices factor. As expected, the SMB factor was positive for mid cap firms and negative for large cap firms. The factors, Yield Spread, Risk premium and Exchange rate had mixed signs. This could an indication that theses factors depended on the company's structure and business. For example, a firm holding large amounts of U.S. currency would suffer and have lower returns if the Exchange rate dropped. So this firm would have a positive sign of the EXR variable. Therefore, the variables YSP, EXR, and RPREM factors give us an insight of the individual firm's structure. This could especially be useful for hedging purposes

where the manager needs to identify individual factors instead of an overall market performance.

With the factor coefficients obtained in the time series regression, we performed a cross sectional regression. The results of the regression are shown in Table 6. Mean returns of the 20 equities was the dependent variable and the factor coefficients, the independent variables. This regression yielded a very strong R-squared value of 97.2%. 9 out of the 13 factors were statistically significant at a 90% confidence interval using a one tailed test. 9 priced factors in the model provide us with an exceptionally well explanation of cross sectional average returns. However, it is important to note that the set of significant factors are different for the two regressions. CPI, MS, IND, YSP were significant in the cross sectional regression but significant for only a few firms in the time series regression.

VI. Conclusion

According to Fama, an asset pricing model cannot be expected to completely describe the actual markets. If the model contributes to a greater understanding of the market, it is considered to be a success. In this study, the average R-squared value for 20 equities was about 46%. This can be considered a very good result compared to Chen (1985) in the US stock market (results ranging from 4% to 27.8% in different sub-periods from1963 to 1978) and Cheng (1995) in the UK (11% in the period January 1965 -December 1988)[36]. We conclude that the autoregressive factor combined with the macroeconomic and firm specific factors are successful in explaining a significant proportion of equity returns. The cross sectional results are extremely promising. The empirical aim of this study was to find out the effectiveness of the APT in explaining American

equity returns and identifying significant factors. At least six factors- LAG, TRAD, PE, CAP, SMB, SP500 were found to be significant for more than half the equities in the study. 9 of the 13 factors were significant for the cross sectional regression. The rest of the regressors were significant for some equities and not for the others. Therefore it is important to note that the individual structure of the company cannot be ignored, as proposed by the CAPM model, while creating an asset pricing model.

An average R-squared of 46% means that only about half the variance in returns is explained by the independent variable and the other half is noise. Events such as announcement of a new CEO, charges of fraud against the firm, which have a very significant impact on asset prices cannot be properly priced in any of the variables in this model. If the sole aim is to predict returns, advanced contemporary models such as ones using neural networks, which continuously adapt to changing market conditions and 'learn' from daily news might be way more accurate in explaining monthly returns.

To improve our model's forecasting ability, better measures of rate of change could be used like the GARCH and Kalman/Weiner filter. As we have a large number of independent variables in the model, principal component analysis could have be used as a guide in determining factors more accurately. Also as short term stock prices are believed to follow a random walk path, yearly returns over a larger period of time could have been used instead of monthly returns. Our sample size of 20 firms might not guarantee robustness of the model over the entire U.S. equity market. It could also be the case that the relationship between the dependent and the independent variable might not be linear. However, in testing for non-linear relationship we leave the realm of the Arbitrage pricing theory.

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Pro-poor Savings and Microfinance: Prospects and Progress

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Abstract

Microfinance has become one of the touted development initiatives among the international donor community, garnering a UN honorific "Year of Microcredit" in 2005 and a Nobel Prize for microfinance practitioner and proponent Muhammad Yunus in 2006. Critics of the microfinance movement suggest, however, that an emphasis on credit for the global poor is misplaced, and that true financial independence requires access to safe and effective means of accumulating savings as well. The following paper constitutes a literature review and critical examination of global microfinance institution (MFI) practice regarding deposit collection among the global poor, as well as of the theoretical obstacles that individuals below the poverty line might face in saving on their own. Results (largely anecdotal or theoretical, but bolstered by a growing number of empirical studies) suggest that the global poor not only are capable of accumulating considerable savings relative to income, but in many cases are incredibly eager to adopt innovative savings products that facilitate such accumulation through various restriction mechanisms to combat time inconsistency and self-control dilemmas. As such, MFIs should note this largely untapped stakeholder demand for savings products as a complement to microcredit as an additional tool toward development.

Since Muhammad Yunus and his Grameen Bank catapulted the issue of financial services for the global poor to international attention, the primary focus among development practitioners has been on microcredit, the practice of extending small loans to the poor at low interest. Critics of microcredit, however, voice concern at microfinance institutions (MFIs) saddling the poor with debt. Many economists have begun to examine promotion of savings as a more effective means of alleviating poverty. This paper examines the place of savings in pro-poor financial initiatives. Section I examines the ability and desire of the global poor to save out of their meager incomes. Section II translates this knowledge into an examination of savings products both extant and potential designed to serve the world's poorest. Section III examines a puzzling result of introducing savings mechanisms to poor clients in the phenomenon of simultaneous borrowing and saving. Section IV concludes.

I. The financial lives of the poor

There are those who scoff at the very idea of promoting savings products among the poor. If we adopt Rutherford's (2000) "popular and useful" definition of a poor person as "someone who doesn't have much money", it is easy to see the logic behind such naysayer's arguments. That is, since the poor have so little income by definition, it is not unreasonable to assume that most live "hand-to-mouth," consuming any income immediately in acquiring subsistence necessities. However, recent investigations into the financial activities of the poor suggest that we cannot characterize the majority of poor households in this way. In a survey of 13 developing countries spanning Africa, East and Southeast Asia, and Latin America, Banerjee and Duflo (2006) find that the poor (the authors use the standard

definition—those whose consumption fall below $1.08 per day are "extremely poor" and those spending less than $2.16 per day are "poor"; these are simplified to $1 and $2 per day levels) typically spend between 56 to 75 percent of income on food items, while discretionary spending on alcohol and tobacco (which alone accounted for 8.1 percent of expenditures in Mexico, for instance) and on festivals such as weddings or religious feasts contributed significantly to household budgets. The surveys of poor households conducted by Rutherford (2000) and Collins et al (2009) further corroborate that a hand-to-mouth view of the global poverty situation is inaccurate—even the poorest generally have some small portion of their incomes, however irregular, that are not immediately consumed on essential expenses.

Much of this discretionary spending in fact reveals the ability of the poor to accumulate substantial lumps of money out of irregular and small incomes. Both Collins et al (2009) and Banerjee and Duflo (2006) highlight the astonishing ability of the surveyed poor to build lump sums out of savings (in excess of 10% of annual income in many cases) to finance expensive durables purchases (e.g. televisions) or to buy provisions for elaborate festivals as mentioned above. Rutherford (2000) recounts the many informal ways by which the poor manage to build these "usefully large sums" as he calls them. Rutherford specifically emphasizes three mechanisms by which the poor accumulate these sums: rotating savings and credit associations (ROSCAs), credit cooperatives and "borrowing to save," the latter referring to the practice of simultaneous saving and borrowing in order to convert small savings at regular intervals and commit funds toward a particular purchase. [For additional discussion on simultaneous saving and borrowing see the third section.] Rutherford also recounts the activities of deposit collectors who charge interest for

safeguarding client savings, whereas savers in the developed world receive interest on their deposits. All of these mechanisms attest to the potential for savings among the world's poor, as well as the lengths to which the poor are willing to go to save up for expenditures deemed worthwhile.

And yet, there is little evidence of the poor saving on such a global scale for long-term progress out of poverty or to hedge against risks such as weather disasters or health shocks that perpetuate the poverty cycle. The poor tend to rely on expensive informal sources of credit in cases of immediate need, instead of accumulating savings to be drawn down in the case of negative shocks to income. As is so often the case, leading answers to the issue of savings among the poor boil down to the nature of individuals and the environment (i.e. the financial resources available to them and certain cultural factors) in which they find themselves.

There is considerable consensus among behavioral economists and experimental psychologists that humans have a "natural tendency to prioritize the present over the future" (Karlan 2010). Seminal articles on the effects of time on decision-making (Laibson 1997, O'Donaghue and Rabin 1999) label this tendency present-biased preference, or hyperbolic discounting. Laibson defines the hyperbolic-discounting individual as "characterized by a relatively high discount rate over short horizons and a relatively low discount rate over long horizons. This discount structure sets up a conflict between today's preferences, and the preferences that will be held in the future." Similarly, O'Donaghue and Rabin summarize present-biased preferences in the following manner:

When considering trade-offs between two future moments, present-biased preferences give stronger relative weight to the earlier mo-

ment as it gets closer [….] Relative to time-consistent preferences, a person always gives extra weight to well-being now over any future moment, but weighs all future moments equally.

Standard models of time discounting do not typically model preferences in this manner, mostly due to sheer complexity. Instead, the standard discount model is exponential: preferences are in essence constant, varying proportionate to time. In contrast, the hyperbolic model implies a sharp division in preferences between the present and the future. This division is inherently subject to individual perceptions of time horizons, namely the timespan that one considers to be within the "present" versus "the future."

This is essentially a model of temptation, then. The rational individual recognizes that future welfare can be maximized by sacrificing current consumption, but is distracted by immediate needs and incidental demands. Discretionary consumption spending such as on alcohol and tobacco accounts for a significant share of income across the globe, and the poor are no exception: to add to the Mexico statistics quoted above, Banerjee and Duflo's (2006) survey revealed that a full 6.8 percent of income among the extreme-poor rural Indonesian cohort and 4.1 percent of the Papua New Guinea cohort was spent on alcohol and tobacco. This is not, of course, to revive anachronistic suggestions that the poor mismanage their money disproportionate to their less-impoverished peers by "squandering" it on goods such as alcohol or tobacco. Rather, these purchasing patterns simply illustrate the salience of present-biased preferences among the poor to the same degree as they prevail among virtually all humans: most people know the long-term detriments of tobacco use or the long-run gains to diverting money away from alcohol and toward nutrition or investments—gains

that would be amplified among the poor according to classic diminishing marginal returns arguments—but present-biased preferences favor the short-run gains of alcohol and tobacco use over the uncertain future. Given the heightened uncertainty that haunts the livelihoods of the poor, it is unsurprising that present-biased preferences disincline long-range savings just as individuals in developed countries often fail to save adequately for the future (Laibson 1997). However, the poor pay a higher premium for short-sighted tendencies, in that unanticipated negative shocks set the poor back significantly more than their rich counterparts. The well-off can mortgage assets or secure formal credit loans to ease such shocks, but the poor must rely on informal credit in emergency situations that is considerably more expensive than loans from formal sources (Ray 2003).

However, it seems that the poor also overcome these biases in saving toward "lumpy durables" (to use Gugherty's term) and seasonal festivals. Karlan (2010) suggests that saving toward such an explicit goal, as opposed to general risk-aversion savings for the unknowable future, brings a tangible aspect to savings activities that is otherwise lacking. Gugherty (2003) supports this postulate in her accounts of single-item ROSCAs that facilitate accumulation of member savings toward a particular purchase, usually a durable good such as a radio or sewing machine—the explicit savings goal, a concrete representation of future welfare should the individual successfully build up savings, counters bias toward the present. Furthermore, experimental psychology has illustrated the general tendency for individuals to weigh losses more heavily than proportional gains (Karlan 2010). Funds deposited into an "un-named" savings account are easily conceptualized as a loss in foregone consumption—passed-up cigarette or modest festival preparations loom large, whereas gains of non-

explicit savings goals are ethereal at best. Given a general aversion to loss, explicit savings goals facilitate a cognitive swap, allowing clients to conceptualize failure to save as "lost" welfare in the foregone goal to counter the weight of foregone consumption. Loss aversion, then, Karlan suggests, is a powerful motivator for such explicit savings activities.

The poor also utilize frequent reminders to save in the form of regular pay-ins to ROSCAs or daily rounds from deposit collectors, a service for which, as discussed above, the poor are more than willing to accept a negative interest rate. These frequent reminders serve two purposes. First, when combined with the logic of loss aversion, reminders keep the tangible goal of savings in the forefront of the individual's mind and maintain the urgency of avoiding loss of that future utility. Second, frequent reminders and collections make it easier to keep cash-on-hand to a minimum, which further decreases the temptation of impulsive purchases or giving money to demanding acquaintances (Karlan 2010). Such commitments to small regular savings reflect a self-awareness of temptation that O'Donaghue and Rabin (1999) label "sophistication," and, if the purchases of lumpy durables and participation in expensive festivals are any indication, represent an effective means of overcoming present biases.

II. Savings products and the global poor

The informal strategies that the poor use to overcome their obstacles to saving are slowly being incorporated into financial development practices as a general consensus grows around savings products as crucial adjuncts to microlending. This section examines various savings products already offered in prominent MFIs,

as well as explores empirical arguments for the adoption of particular savings product innovations on a wide scale.

Rutherford (2000) outlines the central role of pro-poor financial institutions as follows: "Good financial services for the poor are those that do this job in the safest, most convenient, most flexible and most affordable way." Each of these attributes is integral in its own right. First, pro-poor savings products must be secure: the poor have certainly developed effective mechanisms of accumulating lump sums, as described above. What is lacking in most of these strategies, however, is a guarantee against degradation in value or outright theft of precious savings. Unregulated informal deposit collectors offer an invaluable service when honest, but can devastate a wide clientele when corrupt. In the same way, negative shocks can eliminate the value of savings stored in livestock, crops or hard assets such as jewelry, and correlated hardship can wreak havoc on savings arrangements such as ROSCAs. Second, MFIs must offer convenience. Among the many reasons that the poor do not bank with formal institutions is the administrative burden. Illiteracy, lack of official identification documents, and the psychological, economic and time strain of visiting a bank branch all stand between the poor and formal savings. Standard MFI practices such as group meetings and financial literacy training could go a long way toward encouraging savings among the global poor. Thirdly, poor savers require flexibility in spades, for reasons already discussed—in order to smooth consumption and cushion the negative shocks to which they are alarmingly vulnerable, the poor need quick access to their savings. At the same time, the poor require flexibility in terms of financial products that allow them to credibly commit to savings goals. The final requirement, affordability, goes almost without saying: MFIs must find ways to offer savings products

at low- or no-cost (perhaps even with a positive monetary incentive as in developed economies).

It is logical to begin with that most well-known of MFIs, Grameen Bank of Bangladesh. Beginning in 2002, the Grameen II system has put an increased emphasis on savings, but in the short term and for long-run security (Yunus 2002). Grameen borrowers have three accounts under the new system: a personal savings account from which withdrawals are permitted at any time, a special savings account from which no withdrawals can be made for the first three years, and a pension deposit account which is obligatory for borrowers with loans exceeding 8000 taka ($138 USD). Just as under the previous "classic" Grameen system, all members must save 5 percent of their initial loan amount at the time of disbursement, half of which goes into the personal savings account while the other half goes into the special savings account. Additionally, even non-borrowers are eligible to deposit with Grameen, a significant deviation from the previous system. The three-tiered savings system addresses what Armendáriz and Morduch (2005) delineate into low- and high-frequency saving needs. The personal savings accounts facilitate liquidity for consumption smoothing in the short-term, while the special savings and pension accounts keep long-range financial independence as a priority. The ease and convenience of the personal savings account also satisfies Rutherford's (2000) observation from a practitioner's standpoint that the poor are looking for savings devices that allow frequent small deposits and infrequent large withdrawals. Collins et al (2009) dedicate a portion of their financial diaries explicitly to Grameen II clients, finding that the passbook savings offered by the new system is incredibly popular and eases cash flow problems for clients much better than classic Grameen. Whereas bank workers were initially "worried that unlimited

withdrawals would push balances too low for comfort," Collins et al find that clients typically save a small portion each week and withdraw two to three times a quarter. Overall, they find that the guarantee that savings can be drawn down at will actually encouraged higher savings because such accumulated funds were not locked away indefinitely. They summarize client enthusiasm for the Grameen II savings scheme:

> *What these households were getting was more than simply a chance to withdraw savings: they got a wholly new and valuable money-management device of a sort none of them had experienced before. Because the institutions sent a worker to the village, it was easy to save a little each week into a resource that could be tapped at will for any purpose. This finding reinforces […] that poor households welcome safe, local, convenient open-access savings and use them intensively. It also shows the perils of inferring that poor households don't want to save based only on the fact that they may not currently save much. Grameen II demonstrates that introducing better products can dramatically change an equation: with the introduction of the easy-to-use passbook savings account, saving activity rose dramatically.*

This is hardly a revolutionary idea, but it is nonetheless one that development practitioners have proven sluggish to embrace: products and services shaped to fit the demands and needs of the target population will see the most impact.

In addition to redesigning accounts to facilitate consumption smoothing on various timescales, Grameen II capitalizes on another strategy: frequent opportunities to save. While Grameen II abandons joint liability contracts in which all members

of a group are held mutually responsible for group repayment, weekly meetings to settle accounts remain a centerpiece of the Grameen system. Given the renewed emphasis on savings deposits, Grameen has essentially deputized its credit officers as weekly deposit collectors, but without the fee required by informal deposit collectors as described in Rutherford (2000). In a field study in the Philippines, Ashraf et al (2006a) find a 28 percent increase in savings deposits for those offered regular opportunities to save in the form of visits by deposit collectors on either a monthly or weekly basis. Furthermore, interviewed clients of the service emphasize both the convenience of collectors that travel to the village to accept deposits, as well as the role of the regular reminder in encouraging savings.

Regular reminders to save need not come in the form of deposit collectors; for MFIs whose clientele are geographically dispersed or lack of social cohesion makes group meetings counter productive, deposit collection services might be prohibitively expensive and not cost-effective. Karlan et al (2010) find that a variety of reminders can promote increased savings deposits. In another field study in the Philippines, Karlan et al randomly assigned MFI clients that opened a savings account to receive a monthly reminder of savings goal either by text message or in a mail letter. Furthermore, these reminders were randomized as to whether the client was reminded of the particular expenditure for which the account was open (i.e. a tangible savings goal) or whether the message was a general reminder to save. The authors find an overall increase in savings of 6 percent among those receiving the reminders compared to controls receiving no such messages. Furthermore, clients that received messages with "loss-oriented" phrasing (i.e. those messages that mentioned the specific savings goal) saved 16 percent more than controls. Once again we see that adopting the strategies

the poor use to facilitate their own savings, such as making the goal more salient and engineering frequent reminders, produces real results in client savings, and a significant potential impact on welfare.

In a similar way, practitioners are beginning to experiment with savings products that allow clients to commit themselves to saving either for a particular amount or for an explicit goal. These commitment savings devices thus mimic single-item ROSCAs or the services of wandering deposit collectors that only return client savings once a predetermined amount has accumulated, as described in Rutherford (2000). Such willingness to limit choice set by participating in these commitment savings arrangements provides convincing proof of an awareness of present-biased preferences among the poor (Karlan and Morduch 2009), and so there is a potential demand for more formalized commitment devices among MFI clients. Ashraf et al (2006b) find just such a demand: 28 percent of over 700 MFI clients offered a self-assigned commitment savings product (the client could either set a date or amount) enrolled. Furthermore, client interviews suggest that present-biased individuals were 12.5 percent more likely overall (15.8 percent among females, 4.5 percent among males) to enroll in a commitment device. Results after twelve months found an 82 percent increase in savings among the treatment group compared to those not offered a commitment device. Those clients who were self-aware enough to recognize their difficulties in saving were able to "tie their hands" and commit to reaching particular savings goals, just as deposit collectors and ROSCAs function as informal commitment devices. However, a more formal commitment device offers considerable benefits to the client that informal devices do not. First of all, it is difficult for an MFI to run off with client money, whereas depositing with an unregulated money collector carries the

risk of theft or deceit. Secondly, savings products through an MFI can offer clients a positive interest rate along with convenience and commitment of a deposit collector, whereas the collector charges for his or her service.

Products that match client behavior and demands continue to be developed and analyzed for efficacy. Harvard economist Sendhil Mullainathan has begun experimenting with an "impulse savings" product to compete with impulse discretionary purchases in commercial contexts. Noting the discrepancy between the cognitively "active" decision to consume versus the "passive" decision to save by foregoing consumption, Mullainathan has collaborated with savings banks in India to sell "savings cards" in shops (Mullainathan 2010). Karlan (2010) also favors co-opting merchants as agents to encourage savings via mobile phone deposit services much in the style of the Kenyan M-PESA service, which uses secure text messages and certified depositors to facilitate transfers among mobile users. Through creative means such as these, development practitioners can drive down transaction costs and promote convenient savings products as an alternative to the easy but highly expensive credit available on the informal market.

III. Simultaneous saving and borrowing

As has so often been the result of innovations in the development arena, the intent behind savings products for the poor and clients' actual implementation have diverged in unexpected ways. Case in point: the detailed financial diaries of Collins et al (2009) bear witness to the widespread occurrence of simultaneous borrowing and saving by poor MFI clients. There is a similar "credit card puzzle" in the financial markets of wealthy countries, which refers to widespread substantial credit card debt among indi-

viduals who simultaneously hold liquid assets capable of clearing such loan obligations completely (Telyukova 2009). Collins et al specifically document this phenomenon among their Grameen II diaries, noting a peculiar preference for taking out informal loans instead of drawing down passbook savings, especially to smooth immediate consumption. This revelation jars many development practitioners since a lion's share of the theoretical arguments for pro-poor savings policies is freeing clients from reliance upon expensive informal credit in dire straits.

Morduch (2009) suggests that the answer lies in the very awareness of present-bias that leads the "sophisticated" MFI client to save in the first place. When asked about the seemingly "expensive, perhaps even irrational choice" to take on informal debt at high interest while holding sufficient funds in a liquid savings account, one client replied, "At this interest rate I know I'll pay back the loan money very quickly. If I withdrew my savings it would take me a long time to rebuild the balance." Another client similarly chimed in that "the pressure of interest charges encouraged him to repay quicker, which he liked." Morduch proposes that the role of a moneylender as a second party with a "keen interest in the success of the transaction," a sort of accountability partner motivated by interest on the loan, ensures that the client follows through by way of frequent, manageable repayments and social pressure. The high cost of borrowing encourages thrift and penalizes shirking, as delinquent loans have to be rolled over at increased cost to the borrower. Only the most self-disciplined of clients could credibly constrain themselves to accumulate the same amount in a savings account; in the absence of commitment devices, savings schemes lack analogous structure or enforcement mechanisms as the moneylender wields, since all actions are unilateral and funds are liquid.

Morduch maintains that it is in the interest of the poor to replace borrowing from informal sources with dis-savings from personal accounts in order to avoid unnecessary debt and its attendant costs. To this end, he promotes the adoption of "Rebuilder contracts" as an optional commitment savings product that mimics moneylender tactics to encourage re-building of funds within the client's savings accounts. He summarizes:

When a substantial sum is drawn from a savings account, the depositor would have the option to enter a Rebuilder contract with a clear schedule and set of incentives that facilitate re-building the amount that was withdrawn. It might be tempting to add bonuses to such a mechanism, but that could give incentives to game the bonus by simply withdrawing funds and then replacing them from the withdrawn deposit. Instead, a system of penalties may be enough, imposing costs but on much less onerous terms than the alternative of borrowing from the local moneylender.

While the idea has yet to be tested, it has the advantage of reflecting research into the habits and demands of actual clientele, which gives it a leg-up on many development practices implemented without regard to either.

Morduch is not alone in proposing an answer to simultaneous savings and borrowing. Baland et al (2007) surveyed credit cooperatives in rural Cameroon and found a full 20 percent of loans to be fully collateralized by liquid savings held within the same cooperative. Like Collins et al (2009), Baland et al investigate the apparently irrational decision to make loan payments instead of drawing down savings. Interviews with credit cooperative members revealed a strategic motivation: clients indicated that taking small debt is an effective means of fending off the demands of needy family members and acquaintances. As one cooperative member puts it:

There is one thing in Africa: we have a family. The family is elastic. There is the little brother of your father, of your mother... Everyone with a problem, you are condemned to help. Saving is difficult because there are always problems. You have to squeeze your heart before putting money on your saving account.

Baland et al thus present this "excess" borrowing as a signal to the community of financial difficulties, as a shield against a cultural norm toward redistribution of wealth along kinship and neighborhood lines; they summarize that "credit is a credible excuse to oppose demands." And it certainly seems to be a successful strategy: those members that borrowed below liquid savings accumulated saved more than twice the amount of members who took out more substantial loans. While it is doubtful that all of these members had engaged in such strategic borrowing, interview results revealed that 17 of 22 respondents had resorted to this sort of "borrowing-to-save" deceit. While hardly generalizable across cultures, this finding warrants investigation in those societies for which redistribution and reciprocal generosity are the norm among the impoverished.

IV. Conclusion: savings and the microfinance sector

When it comes to the products and services they offer, MFIs and their proponents must be vigilant at keeping the needs, demands and real-world behavior of the client in mind. After all, MFIs are a means to the end of increasing financial independence for the global poor, and not an entrenched end in themselves. At the same time, MFIs should take actions to ensure their sustainability so as to offer effective services so long as there remain clients in need of their particular services. The development of innovative savings products along client needs as outlined in this paper promotes the twin goals of effective service and sustainability. Surveys have demonstrated the demand for safe, convenient means of savings excess income both for immediate and long-range consumption smoothing. Furthermore, the mobilization of member deposits allows MFIs to cut reliance on charity, as well as limiting influence of (often uninformed) donors on institutional policy. The story of Grameen II is particularly demonstrative. In the eight years since Grameen II was enacted, Grameen membership has increased from 2.5 million (a membership which took almost thirty years to reach) to nearly 8 million as of the end of 2009 (Grameen Historical Data Series). Furthermore, from an organization that at one time struggled to find fresh capital for lending, Grameen has transformed itself into a significant deposit mobilization vehicle, impressively accumulating deposits that represent 148 percent of outstanding loans (Grameen Monthly Report February 2010). Grameen has responded to its stakeholders' needs as well as sound advice of practitioners and economists from across the globe. While other organizations might struggle to find a middle ground between sustainability and quality of service, Grameen has wisely tapped the vast aggregate savings potential of its many impoverished clients, and so has the capital to on-lend to those members in need of credit. If nothing else, Grameen convincingly demonstrates that no organization seeking to improve the financial situation of the poor can afford to ignore the paramount importance of savings, nor the effectiveness of responding to client demands with innovation and foresight.

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Culture, Parental Attitudes, and Savings Behavior

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National savings rates vary drastically between countries, and economic differences are known to be an important driver of these differences. Yet evidence indicates that there may also be a cultural root behind savings behavior. This paper will investigate how culture in the form of parental attitudes towards children affects saving behavior. Our goal is to identify whether culture appears to play a role in saving behavior and, if such a role seems to be supported, to propose and test one route through which culture might have that effect.

We will use the definition of culture from Guiso, Sapienza, and Zingales as "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation" (Guiso et al, 2006). There is evidence to support persistence of culture, including from Guiso et al who find that "the level of trust an American has toward others depends in part upon where ancestors originated" (Guiso et al, 2006). In the course of the paper we will rely on the assumption that culture is highly persistent and will also focus on the beliefs and values held by peoples as defined by country or world region of origin.

We will begin our investigation with a brief literature review. Then we will investigate the relationship between culture and levels of country savings rates. Finally, we will look at the relationship between culture and savings behavior for families within the United States. At this stage of the paper we test one mechanism through which the cultural variables of parental attitudes might affect savings behavior.

I. Literature review

The standard economic explanation for differences in savings rates relies on the Life-Cycle Hypothesis. In Modigliani and Cao (2004), the extraordinarily high savings rate in China is examined and explained using the Life-Cycle Hypothesis. They also suggest that the One-Child Policy might play a role since the traditional role of children supporting their parents in old age was undermined by the reduction in offspring per parent. Modigliani and Cao use the evidence to reject a cultural explanation as "fundamentally baseless," referring particularly periods of low levels of Chinese savings such as from 1958 to 1975.

Cultural explanations of variations in savings rates have also been proposed. Guiso et al. (2006), whose paper has already been mentioned above, developed a framework for empirically investigating cultural effects on economic outcomes. They discussed the particular difficulty in empirical work on culture of establishing causality due to the problem of reverse causality. They suggest as a solution the use of instrumentation of cultural attitudes by fixed cultural traits such as religion or ethnicity. We are influenced by this strategy in this paper and attempt to establish causality through identification with the fixed cultural trait of country of origin. In addition, Guiso et al apply their instrumentation strategy to cross-country data to investigate the effect of parental attitude towards thrift in their children using the same World Values Survey data we use in our paper. However, they restrict their work to cross-country data and also instrument with religion, which

we believe is an invalid instrument due to lack of exogeneity. We seek to expand on their research with this paper.

The literature in culture and economics more generally is relevant background for dealing with particular challenges to empirically identifying cultural explanations for economic outcomes. Algan and Cahuc (2009) investigate the role of civic virtue in the design of labor market institutions such as unemployment benefits. They demonstrate cross-country correlation between these two areas and proceed to establish causality using instrumentation. In regressing labor market institutions on civic attitudes cross-country, they instrument origin-country civic attitudes with the civic attitudes of Americans from the origin country. Using this strategy, they address the reverse causality concern in a manner similar to instrumentation by religion as pursued by Guiso et al (2006); but by using American civic attitudes, their instrumentation does not suffer from the exogeneity of religion as an instrument.

Our use in this paper of savings data both in national savings rates as well as savings by individual families is reinforced by Becker (1988) which emphasizes the connection between family behavior and macroeconomics. On topics ranging from economic growth to business cycles, Becker highlights the underlying role of family behavior to various macroeconomic outcomes. By explaining that "families have large effects on the economy, and evolution of the economy greatly changes the structure and decisions of families," Becker motivates our investigation of U.S. family savings rates as a topic that can have implications for savings rates at a national level with macroeconomic consequences.

Finally, several previous studies have attempted to investigate cultural effects on immigrant savings behavior, with in-

consistent findings. Carroll et al (1994) used data on immigrants to Canada and found no significant cultural effect on savings behavior. Noting that their data was unsatisfactory because it only identified immigrants' origin in five broad world regions, they revisit the issue in Carroll et al (1999) using U.S. immigrant data. In this latter paper they find significant differences in savings behavior between immigrants of different countries, but these savings patterns do not appear to reflect culture because immigrants from high-saving countries do not have aberrantly higher savings rates in the U.S. according to their study. More recently, however, Knowles and Postlewaite (2005), using U.S. family data from a source we also use in this paper, do find significant the intergenerational persistence of cultural variables with regards to savings preferences. They also demonstrate that these persistent preferences translate into intergenerational persistence of savings as well as other behaviors. They infer causality from their finding that cultural attitudes predict behaviors in the household, including saving, decades later. Their paper thus provides evidence of the influence of culture on savings behavior, a view we in this paper will attempt to confirm using an alternate strategy.

II. Cross-country evidence

II-A. Data

We use the 1995 wave of the World Values Survey (WVS) for data on cultural attitudes. The WVS surveyed over 80,000 individuals from 99 different countries or world regions about their cultural values. There are two questions from the WVS that are relevant to our investigation. The first reads as in Question 1.

We use this variable to understand how cultures may differ in the extent of

Question 1

Which of the following statements best describes your views about parents' responsibilities to their children?

1. Parents' duty is to do their best for their children even at the expense of their own well-being
2. Parents have a life of their own and should not be asked to sacrifice their own well-being for the sake of their children
3. Neither
9. Don't know

Question 2

Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five.
(Responses are coded 1 if mentioned as 'Important' and 2 if 'Not important')

- Good manners
- Independence
- Hard work
- Feeling of responsibility
- Imagination
- Tolerance and respect for other people
- Thrift, saving money and things
- Determination, perseverance
- Religious faith
- Unselfishness
- Obedience

the perceived duty of the parent for the well-being of the children. To make the variable more intuitive, we took the negative of the variable from the WVS so that higher values of "Parental Duty" correspond to a greater agreement with the statement that parents have a duty to do what is best for their children. We shall call this variable "Parental Duty" in this paper for the sake of brevity. The data was cleaned, eliminating responses of "Neither" or "Don't know" or unreadable responses. This left 74,528 observations, with a mean of -1.247 and a standard deviation of 0.431. We averaged Parental Duty for individuals from each country, producing country-level estimates of this variable for 54 countries.

The second variable of interest is in

Question 2 above.

We are interested in the item "Thrift, saving money and things" coded as either 1 (Important) or 2 (Not important). We use this variable to measure how much cultures value teaching thrift to children. To make this variable more intuitive we took the negative of the variable so that higher values correspond to belief in the greater importance of Thrift. We will refer to this variable as "Thrift". It is worth emphasizing that this variable measures how much importance cultures place on thrift *in children*, as the specific formulation of this variable will prove useful. The data did not require additional cleaning and 84,887 observations were available with a mean of -1.634 and a standard deviation of 0.482. We averaged Thrift for

Figure 1: Parental Duty and National Saving

Figure 2: Thrift and National Saving
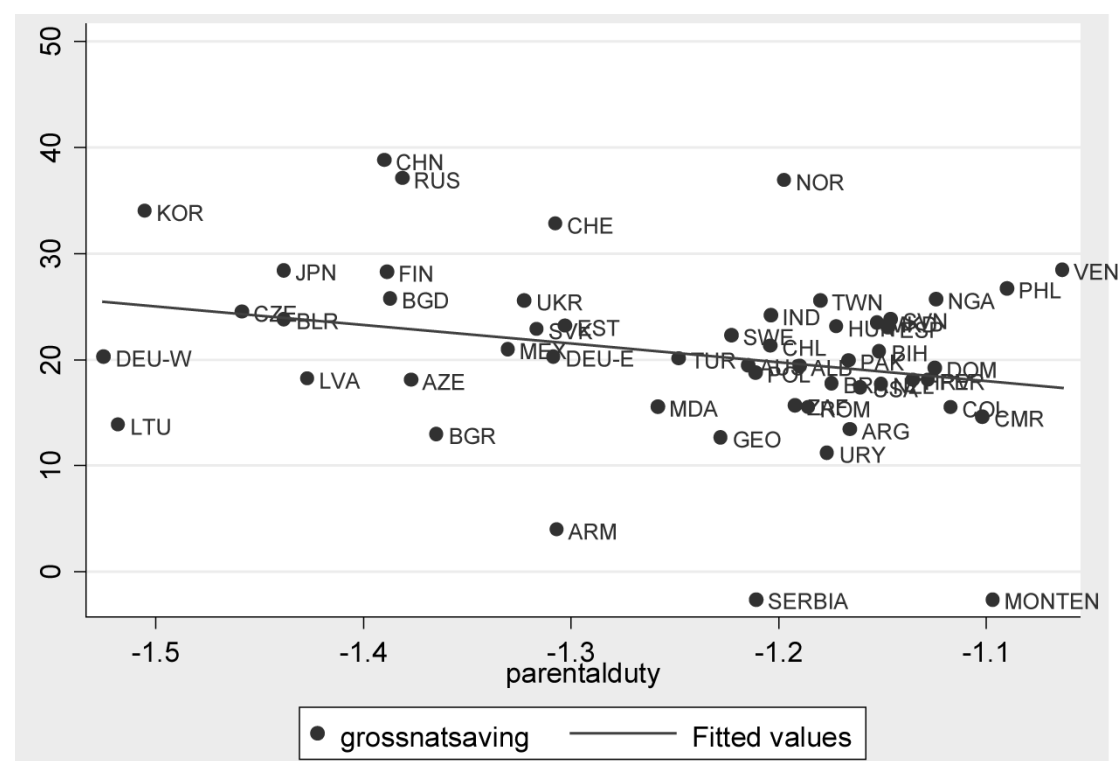
individuals within each country, producing estimates of Thrift for 55 countries.

The country-level economic variable of interest is gross national saving along with relevant cross-country controls. We use data from the World Bank on 2000 Gross National Saving (henceforth, 'National Saving') as a % of GNI reported in the World Bank report "Where is the Wealth of Nations?" in 2006. For controls we include per capita GDP (constant 2000 dollars), the growth rate of per capita GDP (annual %), and the dependency ratio (a measurement of the size of the labor force to the number of dependents). These data were obtained from the World Bank World Development Indicators. Due to variation between years the World Development Indicators data was averaged for the years 1995, 2000, and 2005.

II-B. Empirical results

We begin by analyzing the correlation at the country level between National Saving and each of the two cultural variables of interest, Parental Duty and Thrift. Figure 1 is a plot of the correlation between National Saving and Parental Duty. The negative correlation is statistically significant at the 0.1 level, as shown in Table 1, and suggests that countries with *higher*

Table 1: Parental Duty and National Saving
(Ordinary Least Squares)

Regression #	(1a)	(1b)
Dependent variable	National Saving	National Saving
High Parental Duty	-17.63879*	-17.65078*
	(9.203436)	(10.42741)
GDP per capita	-	0.0002453**
		(0.0001151)
Growth of GDP per capita	-	0.0405511
		(.5405304)
Dependency ratio	-	7.839572
		(10.76712)
Constant	-1.407623	-7.856236
	(11.52661)	(17.27867)

Observations	54	53
R^2	0.0713	0.1645
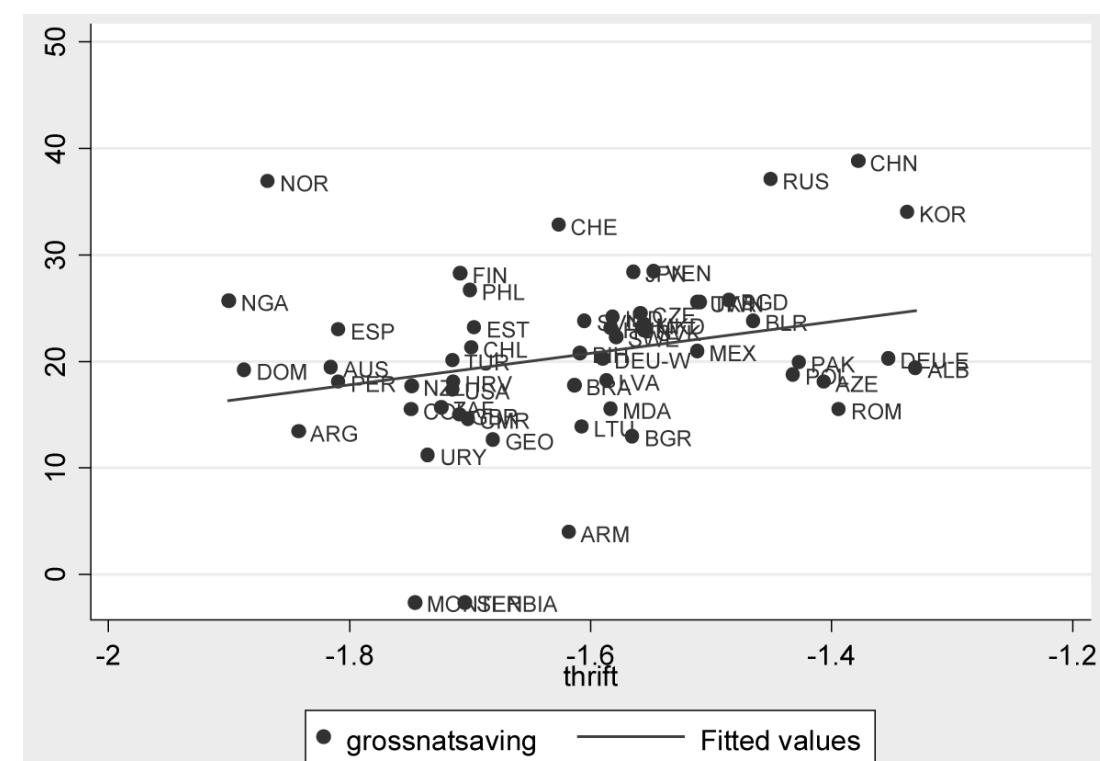
Parental Duty tend to have *lower* National Saving. The relationship remains significant, and with a larger coefficient, after controlling for GDP per capita, GDP per capita growth, and the dependency ratio as per Table 1. As a reminder, the dependency ratio is the ratio of labor force to dependents, which controls for family size and structure across countries.

Table 2: Thrift and National Saving
(Ordinary Least Squares)

Regression #	(2a)	(2b)
Dependent variable	National Saving	National Saving
Thrift is important	14.83765*	20.09768**
	(8.332753)	(8.298099)
GDP per capita	-	0.000303**
		(0.0001277)
Growth of GDP per capita	-	0.0493857
		(0.5110564)
Dependency ratio	-	9.087058
		(11.53557)
Constant	44.51669***	45.39811
	(13.2992)	(14.19552)

Observations	55	54
R^2	0.0709	0.1979

For Thrift, a negative correlation was found, suggesting that cultures with a *greater* emphasis on Thrift tend to have *higher* National Saving. This was significant at the 0.1 level without controls and at the 0.05 level with controls. As with Parental Duty, the coefficient becomes larger with the inclusion of controls. Results are shown in Figure 2 and Table 2.

These results at the country level motivate our further investigation of the Parental Duty and Thrift variables. The predictive value of these cultural variables for National Saving is comparable to that of the economic variable of GDP per capita. In the Parental Duty regression, a 1 standard deviation greater GDP per capita predicts 2.54 percentage points higher saving, while a 1 standard deviation greater Parental Duty predicts 2.18 percentage points of lower saving. In the Thrift regression, the numbers are 3.18 percentage points and 2.91 percentage

points respectively. These results suggest that the culture variables of Parental Duty and Thrift have a meaningful predictive value for National Saving.

These results, however, merely demonstrate correlation. In particular, as common with many correlations between cultural attitudes and economic outcomes, interpretation of the correlation is difficult due to reverse causality. Our interest is in the extent the economic variable of National Saving is determined by cultural attitudes of Parental Duty and Thrift. This is consistent with the correlations observed; however, reverse causality is a concern because the correlation could be a result not of the cultural variables causing differences in National Saving but alternatively that differences in National Saving are driving the differences in cultural attitudes. For example, people who save more might, as a result of their greater saving, be more likely to respond that they care more about thrift when asked; in this case, their higher savings rate would be driving their valuation of thrift instead of the other way around. The possibility of causation in either direction renders ambiguous the interpretation of the correlations observed.

III. U.S. Domestic Evidence

III-A. Background

The results of the cross-country study above suggests that the cultural variables Parental duty and Thrift are correlated with National Savings rates even with the inclusion of controls, suggesting that these variables may be determinants of savings behavior. However, due to reverse causality, the relationship between savings and the cultural variables could not be further delineated. We therefore now turn to U.S. data to attempt to clarify the relationship by eliminating the reverse causality con-

cerns.

This section of the paper will attempt to predict saving behavior amongst Americans using the cultural variables Parental Duty and Thrift of the world regions from which the ancestors of the American families originated. This strategy is adopted from Algan and Cahuc (2009) who studied civic attitudes and labor market institutions like unemployment benefits and employment protection both cross-country and in U.S. born individuals.

By studying the impact of origin-country Parental Duty and Thrift on the savings behavior of Americans, we eliminate reverse causality concerns because the savings behavior of Americans would not cause any attitude differences in the origin country; this eliminates the "reverse" direction of possible causality. Thus, to the extent that other concerns are controlled, the direction of causality, if significance is found, should be identified to run from culture to the economic outcome, savings behavior.

The validity of this identification relies on two ideas. First, it assumes our previously referenced definition of culture as something persistent between generations. Thus, U.S.-born Americans would nevertheless reflect some of the cultural characteristics of their ancestors' origin countries. This ensures that the cultural attitudes of the origin country are relevant to the cultural attitudes of the Americans.

Second, it relies on the exogeneity of the cultural variables Parental Duty and Thrift in the regression specifications. Specifically, it assumes anything that can affect savings behavior that families from foreign countries might bring with them to the U.S. and pass on to future generations besides the cultural attitudes are controlled for in the regression. If this assumption is not satisfied, the cultural variables Parental Duty and Thrift would be

Question 3

> *Do you (or anyone in your family living here) have any money in checking or savings accounts, money market funds, certificates of deposit, government savings bonds, or treasury bills, NOT including assets held in employer-based pensions or IRA's? If you added up all such accounts (for all of your family living here), about how much would they amount to right now?*
>
> *Answers were given in dollar amounts.*

endogenous, capturing effects on savings behavior that varies between societies besides their cultural attitudes. For example, income would need to be controlled (and is controlled in our regressions) if the savings rate depends on income and income levels vary between Americans from different origin countries.

III-B. Data

We use the Panel Study of Income Dynamics[1] (PSID) 2005 series for data on the savings behavior of individuals. The PSID has surveyed and followed the same set of families in the United States since 1968, providing detailed information on the characteristics of these families across generations. For the purposes of this paper, only data from the year 2005 was used.

It is crucial that the families have been in the U.S. since at least 1968, assuring that the savings behaviors of these Americans are not a direct result of savings practices they had developed from before their emigration to the U.S. There are 8002 families in the 2005 PSID. However, in 1997 and 1999 additional immigrant families were added who were not

part of the original 1968 batch of families. We discarded this immigrant data to focus only on the data from families in the U.S. since at least 1968, leaving 7435 families. Of these families we further eliminated data from families whose head of household was not currently working because we are only able to control for current income; among families with retired or out-of-work heads of households, it is difficult to control for their lifetime incomes which is likely to be a major driver of savings. This leaves 5489 families to be used from the dataset.

Families were asked to indicate their "ancestry or family origin." Respondents were allowed to choose from one of 14 world regions (henceforth known as 'PSID regions'): American (meaning U.S.), Native American, British, Western European, Eastern European, Scandinavian, Middle Eastern, East Asian, South Asian, Pacific Islander, Canadian, Hispanic, African, and Oceania. We averaged the country-level data on Parental Duty and Thrift at the level of the PSID regions. Each individual was then attributed the value of the cultural variables for the region of their family's origin.

The primary variable of interest is the response to Question 3, which was asked of the heads of household.

This variable is used as an estimate of the amount of savings held by the family, measuring the relatively liquid and discretionary type of saving (as opposed

Figure 3

S705 (saving amt) ● Fitted values ——

Figure 4

S705 (saving amt) ● Fitted values ——
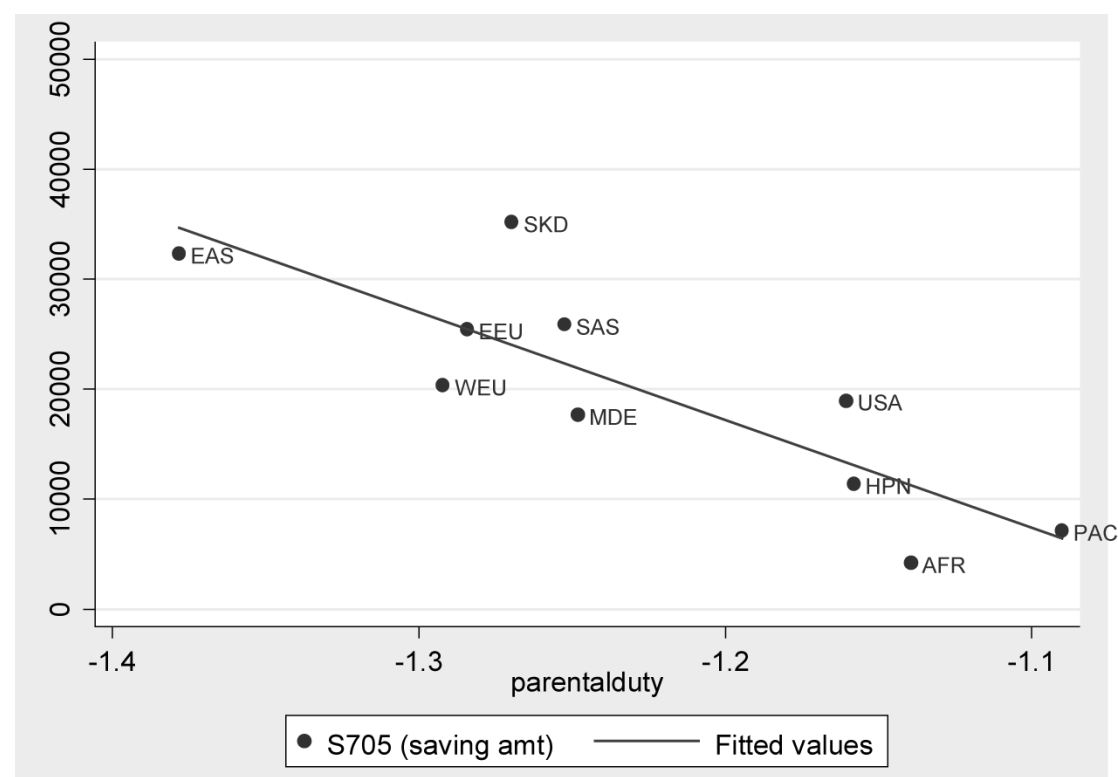
to employer-based pensions or the value of real estate, for example). For the non-immigrant portion of the dataset, the mean was $14,574 with a standard deviation of $53,677. Due to the large standard deviation, suggesting a long right tail, we log-transformed this variable for use. This resulted in a log-transformed mean of 8.11801 with a standard deviation of 2.059342. As a log-transformation, negative results were invalidated, reducing the sample size to a final 4,347.

For controls we used data on the head of the household for age and income. In addition, we used a dummy variable for whether there are children in the household, and one dummy variable each for whether the family owns a business, real estate besides the main home, or miscellaneous assets (like cash value in a life insurance policy). The data for income was log-transformed. Finally we include a dummy for whether the family was of

Western origin: American, British, Canadian, or Western European.

III-C. Empirical results

In figures 3 and 4, we show that the Parental Duty and Thrift of a family's PSID region of origin strongly predicts their level of saving as Americans in the U.S. The negative correlation for Parental Duty suggests that, at this regional level, those who believe parents have a duty to their children save less, while the positive correlation for Thrift suggests that those who value thrift in their children save more. The correlation for both Parental Duty and Thrift are statistically significant at 0.01 and 0.05 respectively.

We next run regressions of the relationship with the inclusion of controls for the age of the head of household, log of income, and dummies for whether the family owns a business, real estate besides
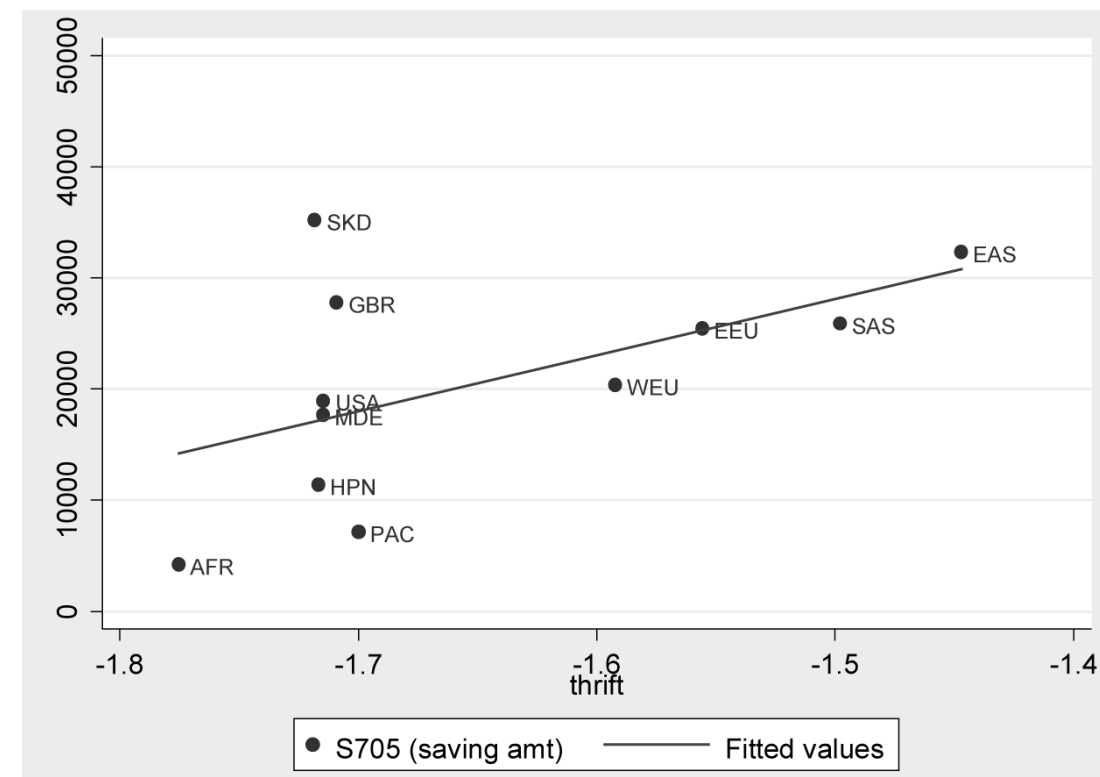
the main home, miscellaneous assets, and families of Western country origins. As regressions 3a and 3b indicate, both Parental Duty and Thrift are statistically significant. This significance warrants some discussion. It suggests that controlling for the variables we have included, the culture of a person still has explanatory power for the economic behavior of savings. Unlike the cross-country evidence in the earlier portion of this paper, reverse causality is no longer a concern because economic behavior cannot cause differences in the country of origin of a family. That is, the savings behavior of an American family does not affect the family's country of origin and in turn does not affect the cultural value of Parental Duty or Thrift in that country of origin. Significant correlation of this specification, as we observe here, thus suggests that characteristics of the family's country of origin brought over to the new economic environment of the United States and passed on to subse-

quent generations actually affect the family's saving behavior.

There are two potential avenues of concern about using regressions 3a and 3b to establish that attitudes towards Parental Duty and Thrift can drive differences in savings behavior. First, while using origin country culture to predict American family savings behavior resolves reverse causality concerns, there could still be omitted variables bias. In particular, there could be omitted economic variables that correlate between American families and their country of origin. It thus may be these economic variables rather than origin-country culture that are responsible for the correlation seen. We have included reasonable controls for characteristics of the American families, but certainly our list is not exhaustive. Second, cultural variables may themselves be omitted variables. In regressions 3a and 3b, only one cultural
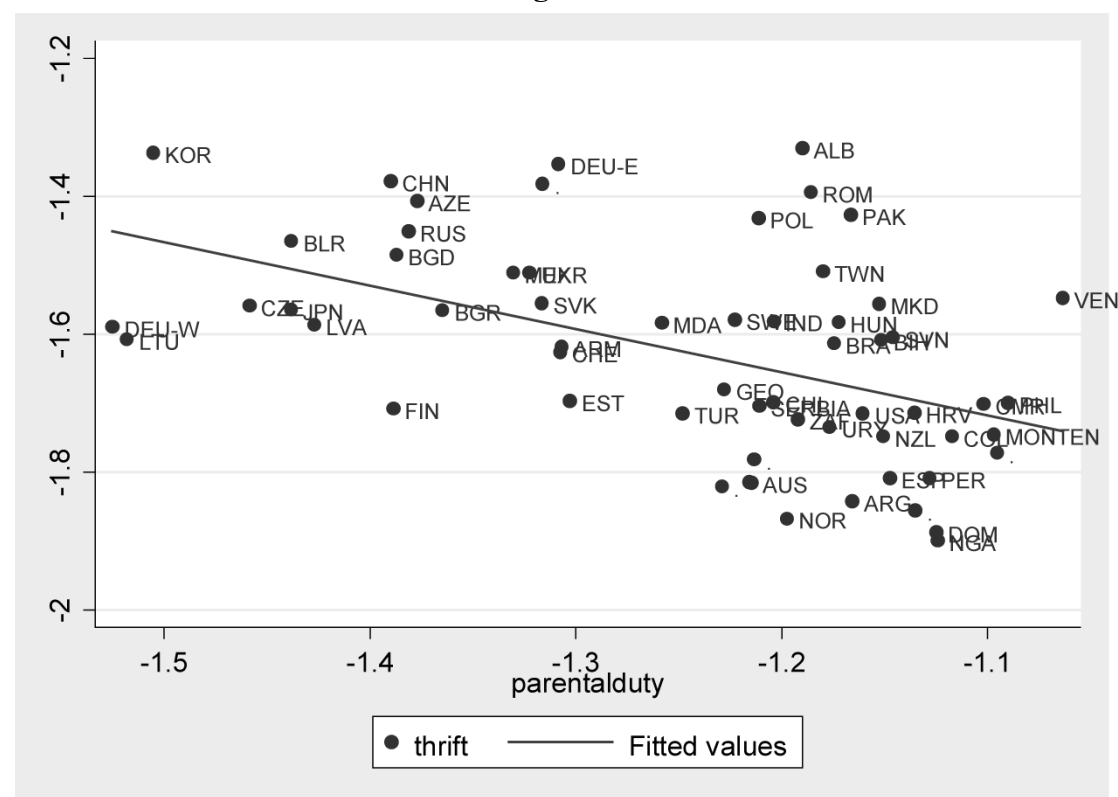
Figure 5

Table 4: Children Mechanism: By Parental Age Ranges
(Ordinary Least Squares)

Regression #	(4a)	(4b)	(4c)	(4d)
Parental Age Range	Under 50	50 and up	Under 50	50 and up
Dependent variable	U.S. family saving	U.S. family saving	U.S. family saving	U.S. family saving
High Parental Duty	-4.3455*** (1.262299)	-6.170768*** (1.937688)	-	-
(High Parental Duty) * (Children)	-2.476923* (1.372443)	0.4736284 (3.206831)	-	-
Thrift is important	-	-	1.850363** (0.7929084)	2.501066** (1.068755)
(Thrift is important) * (Children)	-	-	2.303393** (1.021197)	0.4222257 (2.50589)
Age of head of household	0.0258323*** (0.007556)	0.0367031** (0.0144108)	0.0249467*** (0.0065905)	0.0373432*** (0.0111696)
Log family income	0.7604087*** (0.1342944)	0.5151598*** (0.0996665)	0.8433716*** (0.120315)	0.5748543*** (0.0784138)
Own business or farm?	0.4551335*** (0.1668492)	0.6005985*** (0.2334508)	0.5041254*** (0.1488847)	0.5138364*** (0.1908735)
Own real estate besides main home?	0.5836871*** (0.1618148)	0.7844903*** (0.1899968)	0.5757911*** (0.1380956)	0.6490297*** (0.1579028)
Own miscellaneous savings?	0.2319772* (0.1254459)	0.3193561 (0.2062768)	0.3146747*** (0.1035961)	0.3097502* (0.1606364)
Children	-3.256697* (1.708413)	0.2504472 (3.988529)	3.576275** (1.701131)	0.4394086 (4.203623)
Western origin	-0.3851696*** (0.1330596)	-0.0616564 (0.2166158)	-0.1038799 (0.0916143)	0.3121825* (0.1596226)
Constant	-6.083764*** (1.83556)	-6.779006*** (2.52604)	1.418463 (1.809221)	4.300347* (2.283196)
Observations	1268	456	1695	669
R^2	0.2546	0.2071	0.2543	0.1804

We therefore present a final piece of evidence that we believe helps address the two concerns outlined above. Recall the wording of the questions from the World Values Survey that we have been using. Each of Parental Duty and Thrift are cultural questions that concern parental attitudes with regards to children. One mechanism, therefore, through which these cultural attitudes should affect household saving behavior would thus be in the raising of children. We would expect that the effect of these cultural attitudes concerning children, to the extent that they affect savings rate directly, would have a different effect in families that have children than families that do not; in addition, we would expect a further difference for parents with their children still living at home (and, importantly, still living on the family's income) than for parents whose children have left home. With children at home, for example, a stronger sense of parental duty might suggest that more money is spent on the children, leaving less for savings; but once the children have left home, parental duty might have the opposite effect, causing parents to save more than those of low parental duty in an effort to have wealth to bequeath to their children.

We exploit this implication of parental attitudes to test whether they appear to affect savings behavior through the pathway of their treatment of their children. We run the regressions with the inclusion of an additional interaction term for *Children*ParentalDuty* in the regression for Parental Duty and *Children*Thrift* in the regression for Thrift. In addition, we split the data between parents under the age of 50 and those over 50, with the former intending to capture parents with children at home and the latter capturing those whose children have left home.

The results are shown in Table 4. Regressions 4a and 4b show that for families without children the effect of Parental Duty is not statistically different for those under 50 than for those over 50. However, the interaction term for Parental Duty is statistically significant in 4a. This means

Table 2: Parental Duty, Thrift and U.S Family Saving
(Ordinary Least Squares)

Regression #	(3a)	(3b)
Dependent variable	U.S. family saving	U.S. family saving
High Parental Duty	-5.791543*** (0.8581688)	-
Thrift is important	-	2.962968*** (0.4827858)
Age of head of household	0.0242668*** (0.0035028)	0.0273655*** (0.002945)
Log family income	0.6790774*** (0.0803913)	0.7390193*** (0.0688648)
Own business or farm?	0.5046241*** (0.1358723)	0.5122481*** (0.1168682)
Own real estate besides main home?	0.6481347*** (0.1247112)	0.5853135*** (0.1038036)
Own miscellaneous savings?	0.2521071** (0.1096228)	0.312511*** (0.0889051)
Children	-0.1848431** (0.0858223)	-0.2541359*** (0.0726796)
Western origin	-0.2940831*** (0.1146213)	0.0194946 (0.0802428)
Constant	-7.076083*** (1.163382)	4.170923*** (1.156512)
Observations	1724	2364
R^2	0.2511	0.2509

variable is included in each regression. Even if the previous concern of omitted economic variables is unsubstantiated, we might only be able to conclude that some cultural variable is affecting savings behavior but be unable to conclude which one (or both) if the two are correlated. As Figure 5 shows, Parental Duty and Thrift are indeed highly correlated, significant at 0.01. Thus, in regression 3a the coefficient on Parental Duty might be picking up the effect of Thrift or vice versa in regression 3b. Alternatively, both Parental Duty and Thrift might be picking up the effect of some third cultural variable. If we assume that we have included sufficient controls for economic variables we might use the significance in Table 3 to conclude that culture seems to affect savings behavior, but it is difficult to specify which cultural attitude is responsible based on those regressions.

that for those with children, higher levels of parental duty lead to lower savings under the age of 50 while this effect is no longer significant above the age of 50. These results suggest that Parental Duty appears to act through the mechanism of children in the household since higher levels of Parental Duty is significantly associated with less spending in the age range when children are likely to be still living at home. We believe this may be evidence that Parental Duty is an important determinant of savings behavior for parents with children in the household. The insignificance of the interaction term in 4b suggests that the hypothesis that higher Parental Duty parents would save more later in life to have more wealth to bequeath to their children is unsubstantiated.

However, these various conclusions are tentative because of the large difference in sample size for those under 50 than over 50, a result of the dataset we used. With 1268 observations for the under 50 group and only 456 observations in the over 50 group, the insignificance of the interaction term in the over 50 group may be the result of the smaller sample size. Further research is needed to validate whether the interaction between Children and Parental Duty really is different for those with children still living in the household versus those whose children have left the home.

Regressions 4c and 4d show the results for Thrift. For couples without children, the effect of Thrift on savings behavior is not significantly different for those under 50 than for those over 50. As with the case of Parental Duty, however, the interaction term is significant for those under 50 but not those over 50. This suggests that for those with children, a stronger regard for Thrift in children leads to more saving when the children are living at home but does not have this effect once the children have left home. The intuitive explanation

of this finding is less clear than in the case of Parental Duty. It indicates that, for those with children, valuing Thrift in children has a larger impact on their savings behavior when their children are still living at home than when they have left home. Again, these regression conclusions are tentative due to the difference in sample size for the under 50 and over 50 datasets.

More broadly, the significance of the interaction terms in any of the regressions in Table 4 between parental attitudes and children is interesting despite only tentative findings for regression 4b and 4d. The interaction significance suggests that parents who have children will have their savings behavior more impacted by the cultural attitudes about the parent-child relationship than those from the same cultures who do not have children. For example, high values of Parental Duty not only causes lower savings compared to cultures with low values of Parental Duty, but in addition, having high Parental Duty while actually being a parent lowers savings most of all. We believe this finding is consistent with our interpretation that cultural parental attitudes affect savings through the parent-child relationship, and we believe this finding would be difficult to reconcile with alternate explanations; in particular concern about omitted variables bias would only be consistent with the significance of the interaction terms if the omitted variable has a greater impact on savings behavior in the presence of children, a peculiar and non-intuitive characteristic for most variables but one which is fully expected for the parental attitudes we believe our regressions identify.

Finally, recall that we are using cultural variables of a family's origin country to predict the savings behavior of the family in the United States decades after they emigrated (since they have been in the U.S. since 1968 and their savings data

was collected in 2005); this approach eliminates reverse causality. Regardless of the tentative nature of the interaction results in Table 4, the results from Tables 3 and 4 provide evidence for the effect of the cultural variables Parental Duty and Thrift on savings behavior that is robust to reverse causality. This suggests that culture is an important determinant of savings behavior.

IV. Conclusion

This paper began with the observation that Parental Duty and Thrift correlate strongly with country savings rates. We then used Parental Duty and Thrift of the country of origin of U.S. families to predict their savings behavior in the U.S.; this strategy addressed reverse causality concerns. Finally, we tested the implication that parental attitudes towards children—like Parental Duty and Thrift—should affect economic outcomes in part through their effects on the behavior of parents.

We found that among immigrants to the U.S. who have been in the country since 1968, the cultural attitudes from their origin countries still significantly affect their savings behavior in the U.S. Households from cultures with lower Parental Duty and higher Thrift tend to save more even decades after their families emigrated to the U.S. These results do not suggest that culture is infinitely persistent, but they do suggest that within the span of approximately 40 years culture is still persistent enough to impact savings behavior. These findings are not susceptible to reverse causality since the savings behavior of U.S. families would not cause any change in the country of origin of the family nor the cultural attitude of that country of origin. Therefore, the broader finding is that culture affects savings behavior and may be an important expla-

nation for the cross-country variation in savings rates observed at the beginning of this paper.

Our further exploration of the mechanisms through which Parental Duty and Thrift might impact savings behavior provides interesting but tentative results. We found that for those under 50, the interaction between Parental Duty and Children and the interaction between Thrift and Children were both significant, but neither was significant for those over 50. This suggests that Parental Duty and Thrift are potentially important cultural determinants of savings behavior for parents with children still living in the household, an observation that is consistent with the idea that parental attitudes affect savings behavior but would be puzzling for many alternate explanations that would not suggest a difference in savings behavior for those with children in the home and those without. The signs of the coefficients suggest that higher Parental Duty leads to more spending and lower savings when children are at home, and higher Thrift leads to the effect of more savings. These results are tentative, however, due to the large difference in sample sizes for the under 50 and over 50 portions of the dataset we used.

We conclude, therefore, that cultural differences are part of the explanation for differences in savings behavior between families and between countries. In particular, the values placed by a culture on Parental Duty and Thrift in children appear to be potentially important cultural determinants of savings behavior. Future research should further investigate spending on children living in the household as a mechanism for cultural effects on savings behavior.

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Coase, Incentives, and the Final Frontier

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The commercial space industry has not been able to fulfill the promise of the Space Age. It remains heavily dependent on national space agencies and defense ministries for business. This is at least partly the result of the persistence of an inefficient Cold War-era legal environment. The international legal framework which governs the use and exploration of outer space favors equity over efficiency. It does not provide for private property and therefore dulls the incentive for private entities to develop extraterrestrial resources in an efficient and responsible manner.

The economic theory of property is based on the Coase Theorem. It holds that in situations where transaction costs are high enough to preclude private bargaining, the legal protection of private property can serve to lower transaction costs and encourage mutually beneficial exchange (Cooter and Ulen, 2008). Transaction costs refer to the communication costs incurred during the process of exchange. Assuming it is in the best interest of both parties for the exchange to occur, it would constitute a loss of economic welfare for high transaction costs to prevent it. In such an instance, the assignment of property rights reduces transaction costs by making the determination of ownership easier. Thus, property law serves to make the act of private exchange less costly and more efficient. It follows that more efficient bargaining enables individuals to exchange until each possesses the good or combination of goods which they value most (Cooter and Ulen, 2008). This is an allocatively efficient outcome.

Economic theory also describes substantive differences between private goods which are rival and excludable, and public goods which are nonrival and nonexcludable. Given that private goods, like mp3 players, are rival and their excludability is easily enforced, it is most efficient for them to be privately owned. Conversely, public goods, like national security, are nonrival and involve high excludability costs, so it is most efficient for them to be collectively owned. When these policy prescriptions are not followed, inefficiency results. For example, public ownership of a private good will lead to overuse of the resource in question. Congestion and exhaustion of the resource may result (Cooter and Ulen, 2008).

Outer space is big. So big, that at first glance, scarcity seems to be a non-issue. Should space be considered a public good to be owned collectively or a private good to be owned privately? I think it depends. Certainly, given our limited ability to venture very far from Earth orbit and especially from the solar system, the space we have is, to an extent, limited. There are at least two areas of human involvement in space which, I believe, qualify as private goods and ought to be exchanged in a marketplace where their exchange can lead to an allocatively efficient outcome.

The first is geosynchronous orbit. Geosynchronous orbit is a narrow orbital plane which exists about 22,000 miles from all points on Earth's equator. This orbit is more valuable than others because satellites here orbit at the same velocity as the Earth rotates. This means that they are above the same position on the Earth at all times (Diederiks-Verschoor and Kopal, 2008). This feature is invaluable for ground-based receivers (like satellite TV dishes) which don't have to aim at different points in the sky for continuous signal

Source: The European Space Agency

The outer ring of satellites is geosynchronous orbit. Size of sattelites and debris exaggerated as compared to the Earth.

reception. Since only a limited number of satellites can occupy this valuable orbit, this resource is rival and ought to be considered a private good.

The Moon and near-Earth asteroids should also be subject to private property rights. There is only one Moon and there are only a handful of asteroids which may be suitable for mining. The issue here boils down to uncertainty. No private capital would be willing to fund an enterprise whose fate rests on a resource for which it cannot prove ownership (Wihlborg and Wijkman, 1981). A system of private property would serve as an incentive for private ventures to develop outer space.

Any assessment of space law requires a discussion of the two most important international treaties governing human activities in space: The Outer Space Treaty and the Moon Treaty. Prior to Apollo and amidst great uncertainty over the international status of the Moon, there was fear on both sides of the Iron Curtain that whoever got to the Moon first would claim sovereignty over it and possibly even use it as a launch site for nuclear weapons. The result of this mutual fear was the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies," commonly known as the Outer Space Treaty of 1967. Its provisions reflected the desire of the Cold War adversaries, which were unsure of each other's and their own capabilities, to prevent the other side from dominating outer space (Reynolds, 2004). The Outer Space Treaty remains the most comprehensive and significant structure in space law in large part because it has the most signatories.

Given the desire of the superpowers to prevent each other from annexing the Moon, Article II of the treaty prohibits the "national appropriation by claim of sovereignty, by means of use or occupation, or by any other means" of outer space, the Moon, and other celestial bodies (Reynolds and Merges, 1997: 63). In other words, this treaty establishes outer space as a *res communis*, or public common. This does not seem to bode well for the establishment of private property rights. White, for example, has noted that a basis for private property exists only in so far as it is recognized by a sovereign legal regime. Even though private property rights are not explicitly forbidden, in other words, the explicit ban on sovereignty may imply a ban on private property as well (White, 1998). Conversely, others have argued that, indeed, the treaty is accommodative of private property rights based on the provisions of Article I. Article I states that "Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind." Markoff has claimed that the right of "use" referred to in Article I implies a kind of narrow property right. Under this interpretation, for example, a private body would have a legal right to the land under a lunar base as long as the base is in use (Markoff, 1970).

Christol sets aside the issue of direct ownership of space property. He notes that the treaty does not explicitly prohibit the exploitation of lunar or celestial resources. This interpretation is in keeping with other *res communis* tracts like maritime law which permit corporations to engage in deep-sea mining, but does not allow them to own the seabed on which they mine (Christol, 1984). Gangale shares this view. He observes that "Earth is replete with examples of private, for profit activities on public land, such as livestock grazing and timber harvesting" (Gangale, 2009: 43). Although it seems like there is sufficient scope of interpretation to mount an argument for at least narrow property rights in the context of the Outer Space Treaty, it is clear that the treaty is mainly concerned with issues of equity.

In the tradition of the Outer Space Treaty, "The Agreement on Activities of States on the Moon and Other Celestial Bodies," also known as the "Moon Treaty," is geared towards promoting an equitable distribution of space resources. The Moon Treaty was pushed along primarily by developing countries who were concerned that the rich-world domination of space would come at their own expense. The provisions of the treaty reflect this influence. This treaty carries far less weight than the Outer Space Treaty because it has not been ratified by a single space-faring power.

The section of the treaty most relevant to the issue of property rights is Article XI. Like the Outer Space Treaty, it prevents the extension of national sovereignty to outer space, but it also explicitly prevents ownership of lunar tracts by "any natural person" (Reynolds and Merges, 1997: 105). It has been noted, however, that the treaty does endorse exploitation of lunar resources and protects the national and private property rights over equipment placed on the Moon. It is unclear, however, as to whether the ownership of equipment like a base confers ownership over lunar territory (Walsh, 1981). Although the treaty allows for exploitation of natural resources as per Article XI, it only does so under the condition that this exploitation be overseen by "an international regime…to govern the exploitation of the moon…" (Reynolds and Merges, 1997: 105). Some like Goedhuis have worried that this as yet non-existent regime might have the power to expropriate resources extracted by private actors

on the Moon in order to further its goal of achieving an equitable sharing of lunar resources (Goedhuis, 1981).

Recall that the Coase Theorem implies that property law should be structured to reduce the transaction costs of bargaining so as to improve efficiency (Cooter and Ulen, 2008). Even if some narrow conception of property rights can be teased out of the language of these treaties, the wide range of interpretations seems to defeat the purpose of property law. By being so vague with regard to property rights in space, I go would go so far as to say that these treaties *add* transaction costs. To put it another way, I cannot imagine a wealthy person who would provide the venture capital for, say, a lunar mining company without being absolutely sure that said company could procure widely recognized rights to property on the Moon.

If all of this talk of Moon bases seems a bit farfetched, the principle of *res communis* as enshrined in the Outer Space Treaty of 1967 has also been extended to the operation of artificial satellites in geosynchronous orbit. These satellites are critical to the ability of millions of satellite television subscribers to get reception and many modern militaries' ability to communicate and coordinate.

The International Telecommunication Union (ITU) is the UN body charged with assigning orbital slots and radio communications frequencies to these satellites (Diederiks-Verschoor and Kopal, 2008). Assignment of frequencies is necessary to prevent satellites owned by different parties from interfering with each other's transmissions. Orbital assignments are ostensibly necessary to prevent congestion and even collisions from occurring in this valuable orbit. The problem is that the ITU's allocation mechanism is deeply inefficient. In the ITU's quest to fulfill the Outer Space Treaty's promise of "free… use by all States…on a basis of equal-

ity…" of outer space it sacrifices the opportunity to allocate rights to geosynchronous orbital space efficiently (Reynolds and Merges, 1997: 63). The ITU mandates that geosynchronous orbital slots be *free* (Scheraga, 1987).

In situations when a private good is owned collectively, there will be an incentive for rational actors to consume too much of it (Cooter and Ulen, 2008). The classic example of this is cattle grazing on public land. Since the owners of the cattle do not own the land, they have no incentive to prevent their cattle from overgrazing. The result is mass defoliation. Similarly, under the ITU orbital regime, the fact that slots in geosynchronous orbit are simultaneously scarce and free results in their overuse (Wihlborg and Wijkman, 1981). The multiplicity of corporations, countries and international organizations which operate satellites in this orbit ensure that the search costs of private bargaining are high. The result is that private bargaining is not attempted and too many satellites are placed in orbit. In fact, given that the ITU mandates are not binding, there exists a rather serious congestion problem in this particular orbit. Thus, the ITU fails in one of its intended objectives: promoting the efficiency of telecommunications equipment in geosynchronous orbit (Diederiks-Verschoor and Kopal, 2008).

What should be done? How can we optimize the use of scarce orbital planes and provide incentives for the future development of celestial bodies? One option would be to amend the Outer Space Treaty to allow for the auction of extraterrestrial property rights. In order to build a market for extraterrestrial property, the property would first come under the jurisdiction of an international regime such as a modified ITU.

This system would be analogous to the Federal Communication Commis-

sion's (FCC) initial jurisdiction over the electromagnetic communications spectrum in the United States. Like the FCC, this international regime could then auction property rights (whether they apply to the Moon or slots in Earth orbit) to the highest bidder (Wihlborg and Wijkman, 1981). This would result in an outcome where property rights are assigned to those parties which value them most. As the Coase Theorem implies, these property rights would then be exchanged in a marketplace such that they come into the possession of those who value them most (Cooter and Ulen, 2008). This efficient allocation of clear and transferrable property rights would eliminate problems of congestion in orbit by assigning a value to the scarce geosynchronous orbit space. Fewer satellites would therefore be launched. It would also lower transaction costs so as to provide a much clearer incentive for companies which wish to develop and exploit resources on other celestial bodies to secure funding to do so.

It is important to point out here that the lack of a clear international framework for dealing with extraterrestrial property rights is only one obstacle amongst many to the commercial development of the Moon and other hard to reach places. In the near term, any reform like the kind I have outlined will influence only resource allocation in geosynchronous orbit. However, as I have stated, for ventures as large, expensive, and inherently uncertain as the first commercial forays to the Moon are likely to be, it is imperative that the legal environment be as accommodative as possible.

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Do High Birth Rates Depress Economic Growth: Evidence from China's One Child Policy

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This paper examines whether high birth rates lead to lower economic growth. Using the neoclassical growth model as framework to evaluate the effects of China's One-Child Policy, I evaluate panel data on China's province-level regions over a thirty year time horizon. The findings indicate that the birth rate has a statistically significant and substantial negative effect on economic growth. These results support the exogenous growth theories and indicate that China's population reduction policies may have indeed contributed to its tremendous economic growth over the past several decades.

I. Introduction

The relationship between population change and economic growth has been one of contentious debate amongst economists for hundreds of years. Over the past several centuries, the Earth has given rise to an unprecedented degree of economic inequality as residents of some nations enjoy a per capita nominal income of over US$50,000 per year, while nearly three billion people still live on less than two US dollars per day (Seeme Mallick and Naghmana Ghani, 2005). Many economists focus on the significant variation in demographic change across nations as one of the driving forces behind economic growth and this widespread disparity. China, for example, has proven to be such an influential source of research into the economic consequences of population growth since the country's institutions of a strict One-Child Policy in 1980 provides a natural experiment for economists to examine the economic implications of declining birth rates.

I. A. Growing Populations and Economic Growth: Recent Phenomena

It took roughly 500,000 years for the Earth's population to finally reach one billion people in 1804 and then 123 more years until another billion were added. It only took 13 years, however, for the Earth's population to grow from four to five billion (The United Nations, 1999). Prior to 1900, the world's population growth rate lingered around 0.50 percent per year, less than one third the current rate. Similarly, it was not until the 19th century that the world began to experience any significant increases in its GDP growth rate. Beginning in the middle of the 20th century, however, the world's population began to increase at nearly two percent annually and coincided with an economic explosion that witnessed the world's GDP grow at nearly five percent per year from 1950-1973 (Hendrik Van Den Berg, 2001).

I. B. Theories Concerning the Economic Impact of Population Growth

In light of the startling changes which have been observed over the past several centuries in both economic and population growth, many economists have cultivated distinct theories to explain the effects of population change on the economy. Changes in population growth will have very divergent effects on one's predicted economic outcomes depending upon the growth theory and assumptions which one supports.

In 1798, Thomas Malthus revolutionized economic growth theory with the publication of his theoretical framework in *An Essay on the Principle of Population*. Malthus holds that natural resources are limited and that the food supply grows algebraically while the population expands exponentially. He argued that an expanding population would eventually outstrip the Earth's limited resources and also reduce living standards (Mallick and Ghani, 2005). His ideas are predicated on the "congestion" effect of growing populations whereby each additional person lowers the marginal product of labor, thereby reducing the economy's average output per capita (Van Den Berg, 2001).

In 1956, Robert Solow proposed his now-famous economic growth model which, like Malthus's, assumed technological progress to be exogenous (See Section III for further detail). Exogenous growth models do not allow for the interaction between population growth and technological progress to drive economic growth (Robert Solow, 1956). They instead predict that rising populations reduce economic output per capita and therefore advocate a reduction in population growth as a means of increasing output.

In contrast, Ester Boserup presented a radical idea in 1965 which introduced a new perspective to the potential effects of population growth on economic development. Boserupians, as her followers have come to be called, do not disagree with Malthus' idea that expanding populations strain the Earth's scarce supply of resources. They argue, however, that this pressure intensifies production processes and thereby induces an increase in technological efficiency. According to this theory, as the Earth's supply of resources dwindles, people find a way to use each input more economically and productively. This drastically alters the Malthusian model of economic growth by allowing technological progress to be endogenous to the models of economic development (Mallick and Ghani, 2005).

Provided that per capita output is equal to total output divided by the population, one might logically expect rising populations to decrease per capita output. However, if population growth spurs changes which induce total output to grow at a faster rate than the population, a rising population would actually increase economic growth. This allowing of technological progress to be endogenous has been shown to yield a neutral and even positive effect of population growth on economic progress.

I.C. Current Debate

Despite the wealth of theoretical debate concerning the impact of population growth on economic development, there exists a relatively small amount of empirical evidence testing this relationship. As a result, the economics profession has yet to reach a clear consensus. This paper seeks to econometrically test the effect of changing birth rates on economic development by employing panel data of China's provincial level regions over a thirty year horizon. The rest of the paper is organized as follows. Section II examines the past theoretical and empirical literature concerning the interaction of population growth and economic development. Section III provides the contextual setting for the empirical tests of this paper by assessing the economic and demographic conditions of China over the past thirty years. Section IV discusses the panel data utilized herein. The methodology and empirical model used to test the effects of birth rates on economic growth are discussed in Section V. Section VI econometrically tests the growth model presented in Section V and reports the empirical results of the analysis. The implications and consequences of the empirical findings are discussed in Section VII. Section VIII concludes.

II. Empirical Evidence of the Link between Population Growth and Economic Growth

Economists have studied the nature of economic growth for centuries, beginning primarily with Adam Smith in 1776 and then continuing with Thomas Malthus, David Ricardo, and other classical economists (Barro, Robert J. and Sala-i-Martin, Xavier, 2004). Although these 18th and 19th century economists laid the foundation for subsequent economic theory, it was not until 1956 that Robert Solow published his Nobel Prize winning model of economic growth which has since become the most frequently utilized growth model.

Solow's growth model serves as the underlying model for the empirical tests of this paper and differs from previous economic theories in several fundamental ways. Solow employs a standard, neoclassical production function whereby output, Y, is a function of capital, K, and labor, L:

$$Y = F(K, L) \tag{1}$$

Solow assumes that this production function is subject to constant returns to scale and that each input exhibits diminishing returns. He takes the savings rate, population growth rate, and rate of technological progress as exogenous and shows that economies will invariably converge to steady-state levels of income based upon these exogenous factors (Mankiw et al., 1992). Solow's model predicts that a higher rate of savings will lead to a higher steady-state income and a larger population growth rate will lead to a lower steady-state income. The directions of Solow's predictions have been borne out in real life; however, the magnitudes predicted by his model are well off of those given by historical data (Mankiw et al., 1992).

Although Solow's model persists today as the foremost function of economic growth, much literature has been devoted to studying and amending his model so as to make it more amenable to real-world data. Mankiw, Roemer, and Weil (1992) augment Solow's model to include accumulated human capital. They employ a proxy for human capital accumulation as an explanatory variable in their growth regressions. After augmenting the Solow growth model to include the accumulation of human capital, Mankiw et al. (1992) show that the Solow model does accurately predict the economic performance of many countries by finding a statistically significant negative relationship between the birth rate and economic growth. Moreover, augmenting for human capital has been shown to actually increase the negative effects of population growth since rising populations lead to human capital being spread out more thinly over the population, thereby reducing total factor productivity.

Most of the empirical literature does not attempt to evaluate a causal effect of population changes, but instead employs correlations to find a negative relationship between population change and economic growth (Hongbin Li and Junsen Zhang, 2007). Kelly and Schmidt (1994) find that population growth exerts a statistically significant negative effect on GDP growth. Li and Zhang (2007) employ instrumental variable regressions over panel data of China's provinces and find a statistically significant negative effect of population on economic growth. Their findings argue in support of Malthusian diminishing marginal products and show that a decline of the birth rate by 1/1000 increases economic growth by 0.9 percentage points per year.

Figure 1: Investment per Capita and Real GDP Per Capita in China

Source: Penn World Tables

Figure 1: Investment per Capita and Real GDP Per Capita in China
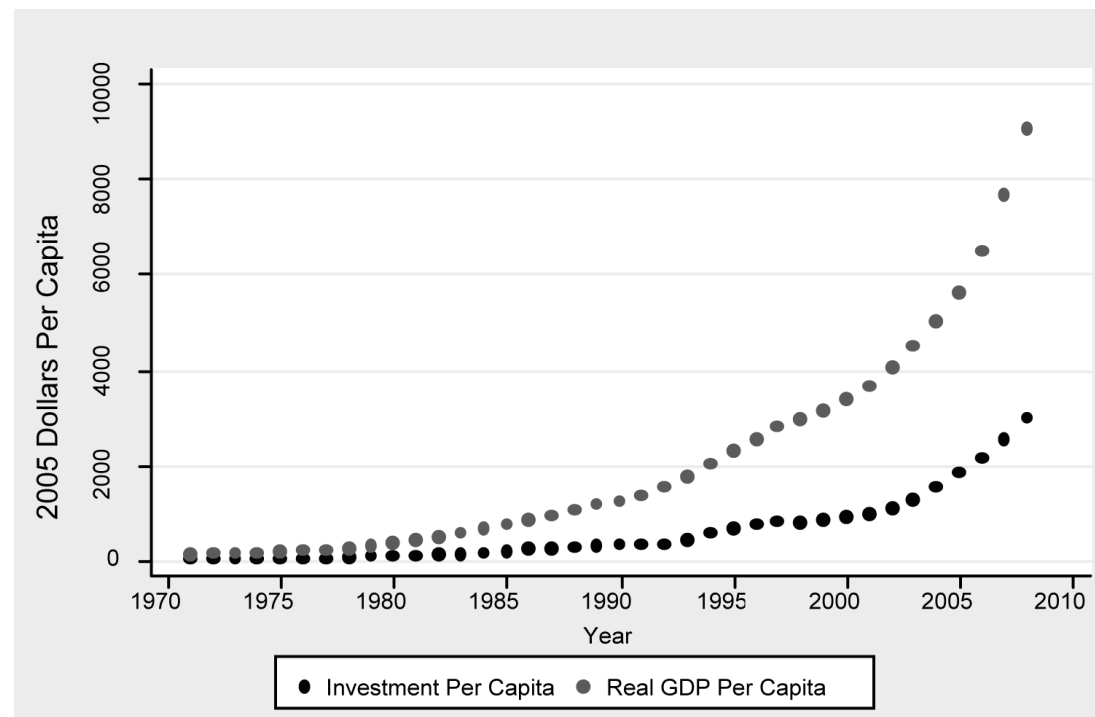
Source: Penn World Tables

III. China: Historical Context and Population Policies

III. A. Country Background

The People's Republic of China is the most populous country in the world with more than 1.3 billion residents. It is ruled by the Community Party of China and is the third largest economy based on nominal GDP and second largest economy when accounting for purchasing power parity. Its nominal GDP is just under five trillion U.S. dollars and its real per capita GDP is $3,180 in 2005 U.S. dollars. China's economy has revolutionized itself in the past three decades. Market-oriented reforms and institutional changes have transformed China from an autarkic country to an international power which is now the largest exporter and recipient of foreign direct investment in the world (Penn World Tables, 2009). This rapid increase in China's economic growth is depicted in Figure 1.

Despite its unparalleled economic growth, the majority of Chinese citizens remain mired in poverty. One of the most economically unequal nations in the world, China is currently ranked ninety-two in terms of the Human Development Index and 122 in per capita Gross National Income (World Bank, 2008). One of the foremost reasons for the subpar living standards of most Chinese citizens is China's tremendous income inequality and inability to enact growth on the aggregate. In a 2003 speech at Harvard University, Chinese Premier Wen Jiabao stated, "Since China has 1.3 billion people, any small individual shortage, multiplied by 1.3 billion, becomes a big, big problem. And any considerable amount of financial and material resources, divided by 1.3 billion, becomes a very low per capita level."

III.B. One Child Policy

What makes China a particularly valuable case study of population growth on economic performance is its institution of a stringent policy aimed at reducing the population. In 1980, China was the most populous country in the world and contained over twenty-five percent of the world's population despite comprising less than seven percent of the Earth's land (Therese Hesketh, 2005). As a result, China instituted a population reduction policy in 1980 with the goals of improving living standards and supporting economic growth. Officially known as the One-Child Policy, China's family planning regulations restrict all Chinese families to a maximum of one child (Gu Baochang et al., 2007). Over time this restriction has been relaxed for a large portion of the Chinese population and many families are now allowed a second child after a designated period of time (Hesketh, 2005). Other child allowances are provided at the discretion of local leaders although they remain rare in China's urban centers.

This policy has been highly effective in reducing China's population growth rate. As depicted in Figure 2, the population growth rate began to decline steadily in the mid-1980s. This supports the fact that families were induced to have fewer children and that it took roughly five years for this policy, which was introduced in 1980, to have an effect. China's population growth rate is now approximately 0.55 percent, less than half the rate of growth in 1980 when this policy was first introduced. Additionally, fertility rates vary greatly amongst provinces and range from 1.06 in the urban province

Figure 3: China's Provinces

Source: TwoLibrarians.com

of Shanghai to 2.37 in the rural XinJiang (Baochang et al., 2007). The One-Child Policy, however, has generated some troubling results including a marked increase in the ratio of male births to female births and a rise in the number of unregistered female births. Moreover, many claim that China will soon experience a "4:2:1" phenomenon whereby a large proportion of couples will have to care for four parents and one child (Hesketh, 2005).

IV. Data

IV. A. Data Sources and Summary

This paper employs annual economic and demographic data on China's province-level regions from 1970 to 1999. All of China's twenty-two provinces, which are displayed in Figure 3, are accounted for with the exception of Hainan. As China's newest province, Hainan only formally became a province in 1988 and individual statistics for this region do not exist over much of the time period analyzed herein. In addition to these twenty-one provinces, I also employ data from China's five autonomous regions as well as its four major municipalities. I have not included the Special Administrative Regions of Hong Kong and Macau because they were not subject to the One-Child Policy. In total, there are thirty province-level regions included in this data set. These regions are listed in Table 1 of the Appendix. The data were gathered from the China Data Center at the University of Michigan as well as various issues of the China Statistical Yearbooks.

Summary statistics of all variables are

Table 1: Summary Statistics of Demographic and Economic Variables in China from 1960-2008

Yearly Values (1960-2008)					
Variables	N	Mean	Standard Deviation	Min.	Max.
Annual growth of nominal per capita GDP (%)	1470	0.104	0.111	-0.522	0.539
Birth Rate (1/1000)	1470	21.058	9.905	5.200	53.260
Nominal per capita GDP (Yuan)	1470	3627.707	6899.845	85.400	66367.000
Secondary School Enrollment Rate (%)	1470	79.614	22.142	28.100	99.980
Construction share of GDP	1470	0.059	0.028	0.011	0.257

Five Year Averages (1970-1999)					
Variables	N	Mean	Standard Deviation	Min.	Max.
Annual growth of nominal per capita GDP	180	0.144	0.064	0.0203	0.383
Birth Rate (1/1000)	180	16.900	5.137	5.200	32.574
Nominal per capita GDP (Yuan)	180	1802.041	2738.386	125.400	22082.400
Secondary School Enrollment Rate (%)	180	84.467	13.316	28.100	99.980
Construction share of GDP	180	0.064	0.023	0.011	0.158

included in Table 1 for both their yearly values over the period 1960-2008 as well as the five-year intervals from 1970-1999 (see Section V for further explanation). The annual growth of nominal per capita GDP (g) represents the percent change of GDP. Nominal GDP is employed because the values for real GDP, the GDP deflator, or the annual inflation rates were not available across all provinces over the time period examined. It was therefore determined that using real GDP would cause such a marked reduction in the sample size that the benefits of using real GDP in place of nominal GDP would be outweighed by the loss of statistical robustness. Moreover, the regression techniques explained in Section VI allow me to control for price variation over time. The birth rate (BR) measures the number of births per 1000 people per year. The

secondary school enrollment rate (Enroll) measures the percentage of primary school graduates who go on to attend secondary school. China's education system includes both junior and senior secondary schools and the secondary school enrollment rate accounts for the sum of enrollment in both junior and senior secondary schools. The construction share of GDP (Cons) represents the percentage of a province's GDP which is devoted to construction.

IV. B. Problems with the Data

One substantial problem with conducting an accurate analysis of China's economic growth is the unreliability of its data. Many researchers question the accuracy of Chinese statistics and assert that it is commonplace for the government to

deliberately underestimate inflation and overstate output (Selin Ozyurt, 2007). China's statistics are primarily derived from the reports of local officials who are often pressured to exaggerate production in order to meet central policy targets. Additionally, China has undergone fundamental changes with respect to data collection and reporting over the past several decades. China's National Bureau of Statistics revised its reporting procedures in 1984 and 1994 in order to better align Chinese data with international reporting standards. In utilizing data from only China, however, I am able to avoid the inconstancies of cross-country data and statistical methods. Moreover, China's provincial-level regions are large enough to provide meaningful results and comparisons given that each province-level entity has a larger population than most countries in the world.

V. Methodology

My empirical analysis aims to illustrate the effects on economic growth of the rapid decline in China's birth rate induced by the One Child Policy. The underlying model used in this paper is the Solow growth model with exogenous population growth rate, rate of technological progress and savings rate (see Section II). Following the empirical literature on economic growth and development, I augment the Solow growth model to include the accumulation of human capital (Mankiw et al., 1992). Kendrick (1976) estimates that in the United States, more than half of the capital stock is comprised of human capital. Most recent literature therefore augments the Solow model to account for this possible bias. Moreover, the regression equations used herein are based upon open economy growth models since each province in China has the ability to interact with each other. Based largely upon the work of Hongbin Li

and Junsen Zhang (2007), the regression equation for economic growth utilized throughout this paper is:

$$g_t = \beta_1 \ln(InitialGDP_t) + \beta_2 BR_t + \beta_3$$

$$Enroll_t + \beta_4 Cons_t + \varepsilon_t \qquad (2)$$

where g_t is the growth rate of nominal per capita GDP from period $(t-1)$ to t, $\ln(InitialGDP_t)$ is the natural log of the nominal per capita GDP at the start of the period t, BR_t is the birth rate in time t, $Enroll_t$ is the secondary school enrollment rate in time t, $Const_t$ is the share of provincial GDP devoted to construction in time $_t$ and ε_t is the error term. Following the empirical work of Levine and Renelt (1992) as well as Temple (1999), the secondary school enrollment rate serves as a proxy for the accumulation of human capital while the share of GDP devoted to construction serves to control for the accumulation of physical capital. The initial level of GDP at the start of the period is included as per the Barro growth model to test for convergence towards a steady state level of income specific to each province-level region (Benedict Clements et al., 2003).

To control for short-term fluctuations in the economy, five year averages were used for the panel data regressions. Each time period t corresponds to the average value over that five year interval. The six intervals of time used were 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, and 1995-1999. For example, over the interval 1970-1974, the value used for the initial level of per capita GDP is its 1970 GDP whereas the values of the annual economic growth rate, birth rate, secondary school enrollment rate, and construction's share of GDP all represent five year averages. Summary statistics of these five-year averages are included in Table 1. The model represented in equation (2) and the strategies outlined above provide the framework and methodology

Table 2: Analysis of the Effect of the Birth Rate on GDP Growth

Dependent Variable: Growth Rate of nominal, per capita GDP

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Birth Rate	-0.035**	-0.053**	-0.065***	-0.038*	-0.035***	-0.035**
	(0.015)	(0.021)	(0.022	(0.021)	(0.009)	(0.017)
Five Year lagged LogGDP	0.080*			0.119*	-0.726***	-0.726***
	(0.045)			(0.665)	(0.131)	(0.133)
Ten Year lagged LogGDP		0.058				
		(0.088)				
Fifteen Year lagged LogGDP			-0.049			
			(0.124)			
Secondary School Enrollment Rate	-0.015***	-0.016***	-0.014**	-0.018***	-0.0003	-0.0003
	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)
Construction Share of GDP	-0.103	0.146	1.958	-0.546	3.019**	3.019*
	(1.992)	(2.752)	(1.924)	(2.680)	(1.469)	(1.676)
State Fixed Effects	No	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	Yes	Yes
F-statistic that State Fixed Effects are zero		5.76	5.08	7.59	2.50	123.94
		(p<0.001)	(p<0.001)	(p<0.001)	(p<0.001)	(p<0.001)
F-statistic that Time Fixed Effects are zero					81.99	137.88
					(p<0.001)	(p<0.001)
Heteroskedasticity and Autocorrelation Consistent Standard Errors						Yes
R²	0.161	0.175	0.174	0.160	0.515	0.811
Provinces	30	30	30	30	30	30
Observations	180	180	180	180	180	180

*Notes: Heteroskedasticity-robust standard errors appear in parentheses below estimated coefficients. p-values appear in parentheses beneath heteroskedasticity-robust F-statistics. *, **, and *** represent significant levels of 10, 5, and 1% respectively. Data are from China Data Online and China Statistical Yearbooks*

to test the hypothesis that birth rates are negatively related to economic growth.

VI. Results

This section tests whether the birth rate has a negative effect on economic growth as predicted by the augmented growth model presented in equation (2). Table 2 presents differing regressions of the annual growth rate of GDP on the birth rate as well as other explanatory variables. The results clearly indicate that the birth rate has a negative effect on economic growth. In fact, the point estimates of the birth rate in all six specifications are negative and statistically significant at a minimum significance level of ten percent. In regression (1), ordinary least squares (OLS) was used to regress the annual economic growth rate on the birth rate, initial value of logGDP, construction share of GDP, and secondary school enrollment rate. Regressions (2) through (6) employ fixed effects regressions. The primary advantage of a fixed effects regression is that it can provide consistent estimates even when there exist province-specific effects that are correlated with the explanatory variables (Clements et al., 2003). The fixed effects regressions are shown to be preferable to simple OLS regressions insofar as the F-tests on regressions (2) – (6) reject the null hypothesis of a common intercept across provinces and time. As stated in Section V, the initial value of province GDP is utilized as an independent variable to test for convergence towards a steady level of growth. Moreover, three potential lag lengths of initial GDP were tested with regressions (2), (3), and (4) employing lagged lengths of logGDP of five, ten, and fifteen years respectively. For example, the usage of a five year lag of logGDP indicates that the average, annual economic growth for each five year interval is regressed on the initial value of logGDP at the start of that

five year period. In the case of ten and fifteen year lags, the economic growth rates are regressed upon the initial level of log GDP ten and fifteen years earlier respectively. Regression (4) was determined to be the most preferable of (2), (3), and (4) insofar as it was the only one that yielded a statistically significant point estimate on the lag of initial GDP and also yielded the highest F-statistic. Moreover, the usage of a five-year GDP lag is consistent with the bulk of empirical literature which uses this lag to account for the value of GDP at the start of the period (Li and Zhang, 2007).

In addition to province fixed effects, regressions (5) and (6) add time fixed effects to control for variables that vary over time, but not across states. The main benefit of this analysis is that it allows us to account for inflation's impact on nominal GDP. If we assume that inflation affects all of the provinces in China to a similar extent, then the effects of inflation on nominal GDP will have been controlled for by using time fixed effects. Controlling for inflation allows us to isolate the real changes in GDP which is a valuable ability insofar as the factors employed in our neo-classical growth model directly impact real GDP and thus the explanatory power of our model might be eroded by inflation if we simply use nominal GDP without time fixed effects. The time fixed effects employed of regressions (5) and (6) are shown to be significant as their F-statistics reject at the one percent significance level the null hypothesis that the provinces maintain a common intercept across time. Regression (6) employs the same variables and parameters as regression (5), however, it uses Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors to control for possible autocorrelation of the error terms. The standard error on the point estimate of the birth rate nearly doubles with the inclusion of HAC standard errors, thereby indicating the likely autocorrelation of the

error terms. Explaining over 81 percent of the variation in the data, regression (6) uses both entity and time fixed effects as well as HAC standard errors and is the most robust and preferable regression:

$$g_t = \beta_1 \ln(\textit{five year lag InitialGDP}_t) +$$

$$\beta_2 BR_t + \beta_3 Enroll_t + \beta_4 Cons_t + \varepsilon_t \quad (2.b)$$

This specification yields a negative point estimate (-0.035) of the birth rate ,which is statistically significant at the five percent level. Moreover, there is a significant negative effect of the five year lagged value of logGDP(-0.726) on economic growth as well as a significant positive relationship between construction's share of GDP(3.019) and economic growth. These entity and time fixed effects regressions support the augmented Solow model's prediction that birth rates have a negative effect on economic growth.

VII. Discussion

VII. A. Does the Birth Rate Affect Economic Growth?

The empirical analysis conducted herein supports the augmented Solow growth model's prediction that the economic growth rate is negatively affected by the birth rate. Using equation (2), the point estimate of the birth rate remains statistically significant and negative across all six regressions of Table 2 and the results are invariant to regression specification. Regression (6), the most preferred regression (See Section VI), yields a point estimate on the birth rate of -0.035. More than simply being statistically significant, this relationship is economically significant as well. This coefficient indicates that every reduction of (1/1000) in the birth rate would increase the growth rate of per capita GDP in the corresponding five-year period by 3.5 percentage points.

This equates to an increase in the annual growth rate of 0.7 percentage points, or about seven percent of the annual growth rate of 10.4 percent which China's province-level regions averaged over the sample period. Following the methods of Li and Zhang (2007), the results manifest an implied increase in the steady-state per capita GDP of 4.8 percent.[1] There is also a significant negative coefficient on the five year lagged value of logGDP(-0.726), thereby indicating that a higher level of GDP at the beginning of the period would lead to lower average economic growth over the ensuing five years. This supports the Solow model's predictions that all countries converge towards a steady state level of output and that the rate of growth of output decreases as a nation approaches its steady state. Moreover, the implication of these findings is that reduction in birth rates contributed to economic growth in a significant, real-world manner.

VII. B. Shortcomings

Although my empirical analyses are econometrically robust, there exist many potential sources of error and endogeneity. The fundamental endogeneity problem is the same dilemma which fuels the debate concerning the nature of economic growth discussed in Section I: endogenous vs. exogenous growth theory. Although the model specification presented in equation (2) assumes the population growth rate to be exogenous, it may indeed be endogenous to economic development. Reverse causality is certainly plausible insofar as higher levels of income might affect the population growth rate. For example, a

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1 The implied semielasticity of the steady state per capita GDP is the change in the growth rate of GDP induced by a decline in the birth rate divided by the effect of the five-year lagged logGDP on the growth rate of GDP: -0.35/0.726 = -0.048. Therefore a one unit decrease in the birth rate increases stead-state GDP by 4.8 percent.

more educated population is likely to emphasize investment in the human capital of children instead of simply the number of children. Demographic or institutional characteristics of China's province-level regions might also be endogenous to the growth model (Li and Zhang, 2007). Additionally, Galor and Weil (1996) show that as income increases and the wages of women rise, fertility declines. In addition to reverse causality, there exists the potential for omitted variable bias. Possible omitted variables include the share of the population in the labor force and the youth dependency ratio.[2] Both of these variables are correlated with the birth rate and are likely to effect economic growth, thereby qualifying as omitted variables. One way to account for these possible sources of endogeneity would be to utilize instrumental variables; however, such an analysis is beyond the scope of this paper.

VIII. C. Robustness Tests

This section tests the robustness of my primary estimates of how birth rates impact economic growth. These tests are conducted by adjusting the independent variables to reflect macro-level intuition of why my abovementioned results might be biased. The primary growth equation employed herein regresses the average annual economic growth rate over a five year period on, inter alia, the five year average birth rate over that same time period. It could be argued, however, that the actual effects of a changing birth rate would require many years before they manifest themselves insofar as the economic ramifications of changing demographics are far from instant. As a result, Table 3 displays the robustness tests

whereby five and ten year lags of the GDP growth rate were utilized. These measure the extent to which a change in the five year average of the birth rate in time t affects the economic growth rate of the five year periods beginning five and ten years after the interval during which the birth rate changes are examined. Regression (1) in table 3 is again our primary specification of equation (2) while regression (2) and (3) introduce the five and ten year lags of the LogGDP growth rate respectively. As is manifest in Table 3, the most significant and robust of the three specifications is regression (1). Although regression (2) does generate rather larger F-statistics, the F-statistics are still smaller than those of regression (1) and the point estimate on birth rate(-0.029) is no longer significant at even the 10% level. Moreover, regression (3) generates a negligible F-statistic for testing the hypothesis that the time fixed effects of zero. The lack of statistical significance likely results from the greatly diminished sample size of the panel data when employing five and ten year lags. Given that the values of the variables utilized herein represent five year averages, a ten year lag of the economic growth rate eliminates two data points for each province and thus the regressions under specification (3) only possess four remaining data points per province. As a result, our robustness tests confirm the greater statistical significance of my initial regression which supports the hypothesis that economic growth decreases with the birth rate.

VIII. Conclusion

There is significant a priori evidence to presume that population growth affects economic development. Many of the world's fastest growing economies over the past several decades, including the four "Asian Tigers," have witnessed their economics expand at tremendous rates while also enjoying relatively low population growth rates (World Bank, 2008).

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[2] The Youth Dependency Ratio represents the ratio of the number of dependents (aged 0-14 and over the age of 65) to the total population (aged 15-64). It used to measure the extent to which the employed population must provide for the nonworking.

Table 3: Robustness Tests

Variable	(1) LogGDP Growth Rate	(2) Five Year Lag of Log GDP Growth Rate	(3) Ten Year Lag of LogGDP Growth Rate
Birth Rate	-0.035** (0.017)	-0.029 (0.021)	-0.016** (0.021)
Five Year lagged LogGDP	-0.726*** (0.133)	-0.489** (0.183)	-0.006 (0.011)
Secondary School Enrollment Rate	-0.0003 (0.003)	-0.003 (0.004)	-0.016*** (0.005)
Construction Share of GDP	3.019* (1.676)	-0.349 (2.258)	-3.522 (3.190)
State Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
F-statistic that State Fixed Effects are zero	123.94 ($p<0.001$)	42.46 ($p<0.001$)	52.27 ($p<0.001$)
F-statistic that Time Fixed Effects are zero	137.88 ($p<0.001$)	42.82 ($p<0.001$)	0.96 (0.424)
Heteroskedasticity and Autocorrelation Consistent Standard Errors	Yes	Yes	Yes
R^2	0.811	0.799	0.836
Provinces	30	30	30
Observations	180	150	120

*Notes: Heteroskedasticity-robust standard errors appear in parentheses below estimated coefficients. p-values appear in parentheses beneath heteroskedasticity-robust F-statistics. *, **, and *** represent significant levels of 10, 5, and 1% respectively. Data are from China Data Online and China Statistical Yearbooks*

As a result, the debate over whether or not technological progress is exogenous and population growth can thereby stifle economic progress has gained widespread attention as of late. This paper empirically examines the effect of population growth on economic performance by assessing the impact of changing demographics within the province-level regions of China over a thirty year horizon. In doing so, I find that the birth rate has a statistically significant and substantial negative effect on economic growth which is robust even after controlling for several potential ex-

planatory variables and their respective influences over time. Thus, the empirics of this paper support the Malthusian notion that population growth does have a negative effect on economic growth.

I certainly acknowledge that this relationship is not enough to warrant any normative claims supporting population reduction. As is discussed in Section III, population altering policies are inextricably linked to a wide range of social welfare concerns and thus cannot be divorced from their spillover effects on human life. Moreover, this paper only tests the consequences of a reduction in the birth rate and therefore can make no judgment as to the relative efficacy of China's birth control policy. The results contained herein also do not address the potential existence of alternative policies which might be able to reduce population growth in a more equitable and socially optimal manner. From a purely positive perspective, however, these results suggest that China's One-Child policy and the resultant reduction of population growth may have indeed bolstered China's unprecedented growth and prosperity over the last thirty years.

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Appendix 1: Province-Level Regions Included in Data Set

Provinces:
    Anhui
    Fujian
    Gansu
    Guangdong
    Guizhou
    Hebei
    Heilongjiang
    Henan
    Hubei
    Hunan
    Jiangsu
    Jiangxi
    Jilin
    Liaoning
    Qinghai
    Shaanxi
    Shandong
    Shanxi
    Sichuan
    Yunnan
    Zhejiang

Municipalities:
    Beijing
    Chongqing
    Shanghai
    Tianjin

Special Administrative Regions:
    Guangxi
    Inner Mongolia
    Ningxia
    Tibet
    Xinjiang

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