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FINANCIAL LITERACY: HOW EDUCATION IN FINANCIAL AND
MATHEMATICAL CONCEPTS AMONG THE YOUTH CAN CONTRIBUTE TO
IMPROVED SAVING AND INVESTMENT DECISIONS

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ABSTRACT

Personal financial literacy has only come to the attention of researchers in the past two decades. While several studies have attempted to measure the level of financial literacy displayed by the general population, a consensus definition has been anything but clear. One trend, however, is evident and consistent: consumers and investors today are unprepared to meet the challenge of adequately managing their money to plan for future wealth. Because previous research has shown that a comprehensive understanding of financial and mathematical concepts most associated with financial literacy predicts how much wealth a person accumulates over the course of his or her lifetime, it is imperative to focus on the younger generation in analyzing how education in financial topics can translate into better prepared, more conscious consumers and investors. By concentrating on how much this younger generation understands today, the financial and mathematical topics that contribute to financial literacy, and how these financial and mathematical concepts interact, a clear link between financial literacy and informed decision making can be established. This connection enables the suggestion of solutions and education practices that may be addressed (and potentially further researched) to eradicate the financial illiteracy epidemic among the youth that the nation is facing today.

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Chapter 1

Introduction

At the most fundamental level, personal financial literacy concerns the understanding of one's saving and investment opportunities. More specifically, financial literacy entails knowing how much of a paycheck to set aside for future use, what stocks to invest in, and how to create a diversified portfolio that will generate substantial returns. However, the skills necessary to build and maintain a comprehension of the financial and mathematical concepts vital for understanding have been unclear, and in some cases, ambiguous.

To knowledgeable individuals dedicated to their careers in business, and more specifically finance, forming an investment portfolio may be a simple task. However, for those not exposed to or interested in the methods and strategies to create a saving and investment plan for the future, financial preparation for the future can be a daunting task. In fact, one-third of people in their fifties have failed to create any retirement plan for the future (Lusardi & Mitchell, 2011, p. 2). More specifically, an investigation of financial literacy in those aged 50 and above found that "fewer than one-third of this cohort [studied] on the verge of retirement had ever tried to come up with a retirement plan, and only two-thirds [of this same group] had succeeded" (Lusardi & Mitchell, 2011, p. 16).

As a society, we cannot continue this trend of being uneducated consumers and individuals. There may be no way to quantitatively pinpoint exactly how much wealth is lost due to financial illiteracy; however, the younger we are educated and understand such topics, the more likely we are to utilize this knowledge as a resource for planning and investing. This relationship has been clearly exhibited in a longitudinal study of the effects of financial literacy education in high school on subsequent financial behavior years later. Those who had been exposed to financial concepts in high school were much more likely to save a greater proportion

of their income later in life (Bernheim, Garrett, and Maki, 2001, p. 29). As the number of financial instruments available to consumers for saving and investing multiplies, it becomes increasingly important for the average individual to understand what they are investing and saving in as “ineffective money management can also result in behaviors that make consumers vulnerable to severe financial crises” (Braunstein and Welch, 2002, p. 445). At no point in time has this been more evident than in the recent financial crisis in which consumers lost a quarter of their net wealth (U.S. SEC, 2009, p. 5). Subsequently, when consumers do not have the ability to make effective financial choices, “market operations and competitive forces are compromised” (Braunstein & Welch, 2002, p. 445). Because researchers want to determine how these financial illiteracy trends manifest themselves, recent studies have focused on examining how much the younger generation today understands about how to save and invest for the future. The results have been grim.

With little financial experience and accumulated wealth, high school and college students are primary suspects in having little knowledge of how to manage their money. However, this generation is also a key target for education in financial literacy topics as they will soon begin accumulating wealth as they enter the workforce. The first study of college students in 1987 showed that participants had an inadequate understanding of “credit cards, insurance, record keeping, personal loans and overall financial management” (Danes & Hira, 1987, p. 14). More recently, detailed questionnaires have shown that college respondents generally only answer about half of financial questions correctly (Chen & Volpe, 1998, p. 112). Furthermore, when taking into consideration that these questionnaires are designed based on the most simple and fundamental concepts (for example, understanding that a savings account compounded more often than annually will earn a greater return than the stated interest rate), it is clear that an adequate understanding should reflect a higher number of correct responses. Overall, studies have found that of those aged 18 to 24 several trends exist; most importantly, that financial

knowledge of this younger generation is poor. Yet also notable has been the fact that results vary by gender, socioeconomic status, and topic area of finance (Chen & Volpe, 1998, p. 113). For example, researchers have confirmed the finding several times that savings comprehension is much better than investment knowledge when considering what people understand of the different areas of finance (Chen & Volpe, 1998, p. 116).

Perhaps the most startling aspect of the studies conducted on the youth and general population is the fact that many researchers have highlighted the gap in financial literacy that exists within our society today but have found no proven way of combating the heart of the problem. However, by simply examining financial literacy through the two basic fields of finance and mathematics, it becomes much easier to see how an understanding of the principles that underlie a solid financial understanding interact and ultimately contribute to a decision making process that affects the value of one's future wealth. As the National Council of Teachers of Mathematics noted, by focusing on a combination of mathematics and real-world (financial) concepts, "[...] reason and sense making will produce citizens who make informed and reasoned decisions, including quantitatively sophisticated choices about their personal finances" (NCTM, 2009, p. 3). That is, if understood correctly, a solid comprehension of financial literacy through the tools of financial and mathematical concepts can be used in making educated decisions about one's saving and investment opportunities.

Chapter 2

Methodology and Roadmap

To create a sufficient understanding of how financial and mathematical concepts can interact to create increased understanding of financial topics and subsequently better decisions for managing one's wealth, the focus of this paper must first be how the literature defines financial literacy. Using expert opinions will lead to a comprehensive list of areas in the realm of finance that can and have been assessed to determine how much individuals know about topics of financial interest. These subjects range from saving and interest rate knowledge to risk diversification and efficient portfolios. In addition, a review of the literature on financial literacy will provide a standard definition to be used throughout this paper.

After discussing how financial literacy is defined in the literature, a complete overview of the research to date on financial literacy will be discussed. By examining the research and levels of financial literacy across a range of ages, the importance of financial literacy in today's society can be established. Next, a discussion of financial literacy's correlation to several demographic factors such as gender, ethnicity, and education will be discussed to once again emphasize the importance of financial literacy in ultimate wealth accumulation. Lastly, an analysis of certain financial topics and problem areas for adults and those about to enter retirement can help determine what subjects should be emphasized in the education of the youth population. For example, several studies indicate that literacy in the understanding of investment opportunities and outcomes is often one of the weakest categories of comprehension across all ages because of the complexity of the task (Emmons, 2005, p. 337). In addition, the correlation between understanding of the stock market and financial literacy can help display topic areas that educators can focus on to increase financial literacy and the likelihood of more positive saving and investment outcomes.

After a general overview of the state of financial literacy in society, an analysis of how much the younger generation knows will be conducted. In particular, what the research has shown with differences in understanding between gender, socioeconomic status, and topic areas will be considered. When taking into account how the youth cohort understands financial and mathematical topics, reasoning, a “process of drawing conclusions on the basis of evidence or stated assumptions,” and sense making, “developing understanding of a situation, context, or concept by connecting it with existing knowledge,” are imperative to mention (NCTM, 2009, p. 4). By showing exactly what this cohort approximately aged between 18 and 24 years old does not comprehend, it will be evident that the use of reasoning and sense making in combining financial and mathematical concepts is a serious barrier to adequate financial literacy capabilities.

Next, to further appreciate the gap in understanding, it is necessary to specifically look at certain financial concepts before turning the attention to mathematical ones. The order in which these concepts will be addressed is due to the idea that comprehending distinct pieces of information about the realm of finance is much different than an additional awareness of the underlying mathematical assumptions behind the information. For the purpose of this paper, the focus will be on saving decisions (compound interest), investment opportunities (measuring risk), and the formation of portfolios (return strategies). This focus is important because understanding these topics and the behaviors that follow can help determine how much individuals invest in stocks and ultimately accumulate in wealth (Lusardi, 2008, p. 14). In addition, it has been shown that financial literacy is often a precursor for financial planning and therefore planning does not promote and enhance financial literacy (Lusardi, 2008, p. 14). That is, individuals are more likely to plan for their future if they already understand the concepts necessary to save money and create an efficient portfolio; they do not become financially literate by learning from planning activities. Subsequently, the financial concepts involved in creating an efficient portfolio (for example, risk diversification and maximization of utility) can lead to planning for investment opportunities and

ultimately a greater accumulation of wealth, while an understanding of the compounding of money and inflation can lead to smarter choices in savings decisions.

While presenting the financial tools that can be employed for a solid financial understanding, mathematical principles that are essential to the understanding of financial literacy will also be discussed. This includes the ability to understand simple compounding and exponential functions, the ability to analyze sets of data and determine various statistics such as standard deviation, and the ability to calculate weighted and expected averages of various sets of data. This last topic, statistically analyzing and calculating weighted and expected averages, is especially significant because it is arguably the most important mathematical ability involved in the formation of efficient portfolios to determine the ultimate return one makes on an investment. As noted by the National Council of Teachers of Mathematics, the skills required for statistically analyzing data are: “[...] necessary to become informed citizens and intelligent consumers” (NCTM, 2000, p. 47).

While the financial and mathematical concepts are presented above separately, within the paper each financial concept will be subsequently matched to its corresponding mathematical concept. This will facilitate a determination of how the two fields interact and will enable a better understanding of financial literacy as a whole. In addition, the investigation of the relationship between these two fields will suggest that financial and mathematical principles can be used holistically and practically as tools for making effective decisions when it comes to one’s finances. For example, a simple understanding of statistically calculating the variance of a set of data is much different than using this knowledge in combination with what one knows about the riskiness of an asset to make decisions about investments and their contribution of risk to a portfolio. Therefore, a hierarchy in the development of ideas and understanding is evident: first knowledge and rote information is obtained; next, this understanding is used in combination with previously acquired knowledge through a medium of behaviors and actions.

Finally, after evaluating how the financial and mathematical concepts interact, it will be much clearer to see any gaps in research or education that would allow the concepts learned about financial and mathematical topics to facilitate better decision making in regards to managing one's money in investments. Because "increased information does not automatically result in [significant] improvement," the importance of analyzing various strategies' use of financial and mathematical knowledge as tools for improving financial decision making is an area that further research would be beneficial (Braunstein & Welch, 2002, p. 9). These relations and missing links suggest that much can be done to facilitate a greater understanding of financial literacy in terms of one's saving and investment opportunities. In addition, the strategies imply that education of the youth, and specifically government involvement and interest, is a great place to start in increasing the understanding of financial literacy and its impacts on wealth accumulation over time.

Chapter 3

Financial Literacy Definition

Defining financial literacy was of little interest to researchers until about a decade ago. Most of the emphasis before this period was on analyzing the various levels in understanding financial concepts, but not actually defining how much individuals should know in a set of standards that could be used universally. In fact, even today there are various opinions and formulations on what constitutes a financially literate individual (Remund, 2010, p. 276). Consequently, investigating the various definitions and synthesizing the current research to date on financial literacy is important if a conjecture as to how financial and mathematical principles interact is to be deemed feasible. Before directing attention to the research to date on levels of financial literacy, let us first turn to the various definitions of financial literacy.

In 2000, researchers Mason and Wilson presented a holistic definition of financial literacy by examining how other fields of study defined “literacy” and then appropriately applied this meaning within the realm of finance. Meaning-making, they determined, was one of the most fundamental characteristics of a literate person. Without meaning-making, it was considered nearly impossible to achieve a desired outcome or objective. Mason and Wilson therefore decided that financial literacy could be defined as “an individual’s ability to obtain, understand and evaluate the relevant information necessary to make decisions with an awareness of the likely financial consequences” (Mason & Wilson, 2000, p. 32).

Mason and Wilson’s emphasis on the consideration of the consequences of financial decisions is a key ingredient in this definition. It implies that consumers and investors have an opportunity to evaluate the foreseeable effects of their financial decisions on their future wealth. Indeed, Mason and Wilson note that these consequences are contemplated regardless of outcome: “[...] financial literacy can only ensure individuals are informed to make decisions, it cannot

ensure that the ‘right’ decision is actually made” (Mason & Wilson, 2000, p. 32). With the common assumption that investors tend to make rational decisions when it comes to their finances, this suggests that financially literate investors will only put their money where they believe there is a positive expected return on their investment. In addition, Mason and Wilson’s definition implies that financially literate people could be expected to understand that taking on more risk in investment opportunities results in a greater likelihood of not only a higher return, but also a greater probability of loss. Furthermore, Mason & Wilson note that without any desired outcomes, financial literacy would be “unimportant” (Mason & Wilson, 2000, p. 32). More specifically, it is the desire for a positive outcome that gives financial literacy its significance in society today.

Another important revelation of Mason and Wilson’s definition of financial literacy is its implications for behaviors and actions. Because the crux of the definition rests on an analysis of various consequences of financial decisions, it is therefore appropriate to assume that financial literacy promotes financially fit behaviors and actions. As the researchers note, “It is hard to think of an example where financial literacy is relevant where a decision is not implicit” (Mason & Wilson, 2000, p. 32). Positive financial behaviors and decisions are therefore a result of financial literacy.

Also in 2000, the Fannie Mae Foundation commissioned a national field study to address financial literacy education in the U.S. The heart of the study focused on the efficiency of the various methods of teaching financial literacy; however, to ensure consistency, a definition of financial literacy is first provided. The Foundation notes that financial literacy is “the ability to read, analyze, manage, and communicate about the personal financial conditions that affect material well-being” (Vitt, 2000, p. xii). In addition, the capability to distinguish between financial choices and to “respond to everyday financial decisions, including events in the general economy” is also discussed (Vitt, 2000, p. xii).

The Fannie Mae Foundation's focus on abilities and competencies indicates that financial literacy is more of an individual confidence measure; being able to "discuss money and financial issues without (or despite) discomfort" is addressed (Vitt, 2000, p. xii). This poses in stark contrast to Mason and Wilson's belief that understanding the consequences of one's financial decisions is the foundation of financial literacy. By focusing on how the individual views their abilities, the Fannie Mae Foundation's definition leaves very little room for serious analysis of one's financial capabilities considering that individual confidence levels are subjective in nature.

A significant contribution of the Fannie Mae Foundation's definition, however, is the line of reasoning that suggests "financial literacy is a function of the financial information to which one has access" (Vitt, 2000, p. xii). So although levels of financial literacy may be difficult to assess because they are subjective, improving how much people understand about managing their personal financial conditions may merely be a matter of exposing them to financial concepts with which they are unfamiliar. Providing the resources and information for people to understand financial concepts is considered a matter of educating the public. This idea is simple in nature, as it assumes increasing inputs to education will increase the output of financially literate individuals; however, improving levels of financial literacy is certainly more complicated than the Foundation suggests. Nevertheless, this definition remains one of the first institutional attempts to advocate a solution to an epidemic of nationwide financial illiteracy.

In 2002, Hogarth defined financial literacy through the use of international opinions. She discerned that financial literacy is comprised of three different parts:

1. Individuals who are "knowledgeable, educated, and informed on issues of managing money and assets, banking, investments, credit, insurance and taxes;"
2. An "understanding [of] the basic concepts underlying the management of money and assets;"

3. Individuals “using that knowledge and understanding to plan and implement financial decisions” (Hogarth, 2002, pp. 15-16).

Like Mason and Wilson, who interpret that financial literacy involves actions and decision making, Hogarth expresses that a financially literate individual is able to successfully use the knowledge they have acquired to implement financial decisions. However, Hogarth does not imply that individuals make their decisions based on positive expected returns or consequences but rather simply that these decisions are made by more “well-informed, well-educated consumers” and that the decisions can potentially increase “economic security and well-being” (Hogarth, 2002, p. 16). The idea of economic security and well-being relates well to the Fannie Mae Foundation’s emphasis on individual confidence as a contributing factor to financial literacy. Hogarth’s definition, conversely, rests more on the assumption that financially literate individuals are focused more on the elimination of risky outcomes to ensure economic security than on the possibility of positive expected returns.

In addition, Hogarth’s view centers on financial literacy as a determinant for economic efficiency in the marketplace. She cites the shifting demographics and increasing responsibilities of employees to contribute to their long-term future in the form of defined contribution plans as pivotal to the need for greater financial literacy and the ability to decipher and understand the management of money for the long-term future (Hogarth, 2002, p. 17). Lastly, Hogarth points to the need for more research studies to determine the link between knowledge and behaviors because a discovery of this link could help develop programs and initiatives to improve consumer financial literacy.

As a reaction to the internet bubble and recession in the early 2000s, other researchers began to view financial literacy in a different light: as a reactionary device necessary for consumers and investors to effectively function in increasingly complex financial markets. Citing that “forces of technology and market innovation, driven by increased competition, have resulted

in a sophisticated industry in which consumers are offered a broad spectrum of services by a wide array of providers,” researchers Braunstein and Welch regarded financial literacy as a reactive necessity to a more dangerous and risky market (2002, p. 445). Rising levels of consumer debt were also stressed as factors that called for increased financial literacy.

Because consumers have many more options available to them through banking organizations and insurance companies, Braunstein and Welch felt that consumers “need a base level of financial knowledge” in order to effectively make decisions (2002, p. 446). In fact, understanding how to manage financial decisions was deemed so important because the researchers found that “misguided choice can result in higher costs due to monthly fees, overdrafts, or excessive transactions” in many saving and investment opportunities (2002, p. 446). Therefore, financial literacy from this perspective was not just responsible consumer behavior, but necessary for economic survival in a new marketplace.

Braunstein and Welch’s view was much different than that of peer researchers: instead of seeing financial literacy as a knowledge and meaning-making process that was underscored by an understanding of financial outcomes, the researchers deemed financial literacy compulsory as a reactionary device in an ever-changing financial society. The perspectives are similar, however, in that financial literacy is assumed to lead to behaviors and decisions about money management tendencies such as saving and investing. In a sense, all researchers seem to agree with one simple statement: “When individuals cannot manage their finances, it becomes a problem for the society” (Chen & Volpe, 1998, p. 16).

A year later, in 2003, the term “financial literacy” was more prominently brought to the spotlight in the U.S. government’s creation of the Financial Literacy and Education Commission as part of the Fair and Accurate Credit Transactions Act (FACT). Formed as a response to several research studies in the 1990s that indicated consumers were lacking in understanding of financial concepts, the sole purpose of the entity was to promote financial literacy through both

the private and public sectors (U.S. Department of the Treasury, 2012). Today, the Commission says that its vision is to help create “sustained financial well-being for U.S. individuals and families” (Financial Literacy and Education Commission, 2011, p. 6). However, a distinct definition of financial literacy was not provided until 2007 when the Government Accountability Office suggested a clear definition be provided (U.S. Government Accountability Office, 2007, p. 7). Even today, the definition is not clearly transparent in the Commission’s yearly strategic report and could not be retrieved for use in this paper.

The Commission has, however, set up standards and initiatives despite a lack of a transparent formal definition for financial literacy. One such initiative is MyMoney.gov, a website that “serves as the one-stop shop for federal financial literacy and education programs, grants, and other information” (U.S. Department of the Treasury, 2012). Still active today, the commission indicated in 2011 desire to focus on changes in policy, education, practice, research, and coordination of financial literacy efforts.

Also in 2003, a brief summary of investor literacy research was published by the National Association of Securities Dealers known today as the Financial Industry Regulatory Authority (FINRA). In determining how much an average investor understood, this private organization released a brief definition upon which it founded its research. The organization noted that financial literacy, or more specifically investor literacy, was “the understanding ordinary investors have of market principles, instruments, organizations and regulations” (NASD, 2003, p. 2). Essentially, the NASD directed attention to the basic levels of comprehension that would help investors function in the market. By specifically focusing on the knowledge portion of an investor’s understanding, the NASD implies that adequate knowledge leads to functionality in the marketplace.

Lacking in this definition, however, is any assumption as to the effect of financial knowledge on an average investor or consumer’s resulting actions and decisions. In other words,

functionality, or being able to participate in a financial market, does not imply adequate understanding. For example, an investor may easily be aware of how a trade is made in the stock market and may actually participate in stock transactions. In the NASD view, this investor could be considered a functional player in the market. However, functionality does not always suggest that the trade is a good idea or a profitable one. With research goals to help “better understand levels of investor knowledge and to identify opportunities to improve education initiatives,” the NASD’s definition clearly lacks a key part of what should be included in the definition of financial literacy: the ability to make decisions based on a comprehension and understanding of the consequences of those decisions (NASD, 2003, p. 2). Because several other researchers have pointed out the role of understanding consequences in shaping financial literacy, most notably Mason and Wilson, the NASD’s definition is clearly not satisfactory.

In 2007, researcher Lusardi implicitly defined financial literacy in the introduction of her study concentrating on how financial literacy can be used in making consumer choices by listing several behaviors that characterize a person as financially literate. She included basic financial concepts such as “interest compounding, the difference between nominal and real values, and the basics of risk diversification,” as well as more complex topics that should be understood like “the difference between bonds and stocks, the working of mutual funds, and basic asset pricing” (Lusardi, 2008, p. 2). Ultimately, Lusardi is able to show that “a lack of retirement planning, lack of participation in the stock market, and poor borrowing behavior” can be attributed to an ignorance of these basic topics (Lusardi, 2008, p. 2).

Clearly, Lusardi’s definition is more intricate: it points to specific subject matter that should be implicit rather than making a broad statement about consumers’ ability to grasp how to manage their money. In addition, her ability to show that financial knowledge affects consumer behavior is a revelation that links financial literacy to decision making. This sentiment is shared by other researchers. Martin notes: “There is a connection between knowledge and behavior,

with increases in knowledge having a positive impact on personal finance behaviors” (Martin, 2007, p. 22). Hung, Parker, and Yoong concur that financial behaviors depend on “actual knowledge, perceived knowledge, and skills” and also emphasize how financial literacy “consistently predicts measures of people’s planning behaviors” (2009, pp. 12, 19). Therefore, informed financial decisions are the root of Lusardi’s definition.

After a variety of incongruent definitions and programs for financial literacy had surfaced in the private and public sectors, in 2008, the President’s Advisory Council on Financial Literacy (PACFL) instituted a standard definition in its annual report to President Bush that it suggested other organizations adopt before planning any programs or educational activities. The Council defined financial literacy as “the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being” (PACFL, 2008, p. 35). Not only does this definition include an emphasis on decision making, but it also allows for the individuality of financial decisions. A financially well-off citizen is one who is therefore informed and knowledgeable, but also able to act on knowledge to produce effective financial decisions based on particular circumstances.

The PACFL’s definition is also in agreement with a more recent definition provided by the National Financial Educators Council (NFEC), which defines financial literacy as: “Possessing the skills and knowledge on financial matters to confidently take effective action that best fulfills an individual’s personal, family, and global community goals” (NFEC, 2012). The consistency between the two definitions exhibits the strength in the organizations’ ability to use past researchers’ work to create a more standard, comprehensive explanation of what it means to be financially literate.

Furthermore, these last two definitions are able to thoroughly encompass most of the previous research and literature and are subsequently most appropriate to use for the purpose of this paper. The definitions are broad enough to ensure that many topic areas fall under their

domain, and they also imply that financial literacy is a combination of knowledge, abilities, behaviors, and ultimately experiences that shape financial well-being over the course of an individual's life. Topics cited as part of a comprehensive financial literacy program included an understanding of the capital market system and financial institutions, cash flows, spending plans, emergency funds, credit management, financial risk management, identity theft protection, basic investment products, the relationship between risk and return, retirement planning methods, financial security and stability (PACFL, 2008, pp. 36-37).

Additionally, the definitions provided by the PACFL and the NFEC do not preclude the possibility for the changing of market conditions over time and the individual's capacity to adjust to these variations. Instead, the definitions focus on the long-term positive results that can transpire for a financially literate individual. Consequently, because these definitions combine knowledge, abilities, and behaviors, they exemplify the logical process in which financial literacy can be educated to others with the ultimate goal of positive or effective financial decisions. As a result, the view that financial literacy involves adequate knowledge, abilities, and behaviors is the most comprehensive definition of financial literacy because it draws upon all of the research to date. In moving forward, this definition will provide a consistent approach in understanding what it means to be financially literate.

Chapter 4

General Levels of Financial Literacy and their Significance

Now that a consensus definition for financial literacy has been established, current levels of financial literacy in the overall population, financial literacy's correlation to demographics, and the relationship between adequate financial literacy and important financial concepts and behaviors are appropriate to discuss. Ideally, a "financially savvy consumer compares competing offers and can plan for future financial needs such as buying a house, sending a child to college, and retirement" (Emmons, 2005, p. 336). However, the results of research studies have suggested that there are not that many financially savvy consumers. In synthesizing research findings from studies conducted before 2010, Lusardi, Mitchell, and Curto found that those individuals with low levels of financial literacy are "more likely to have problems with debt, less likely to participate in the stock market, less likely to choose mutual funds with lower fees, less likely to accumulate wealth and manage wealth effectively and less likely to plan for retirement" (2010, p. 360).

Because financial literacy, by definition, concerns managing financial decisions effectively, investigating the behaviors of consumers and investors is deemed the most suitable method for research investigation. This point is made clear by Mason and Wilson who argue that, "The reason that researchers are concerned with an individual's ability to understand and analyse financial information is that his/her actions are thought to depend on this ability" (2000, p. 14). However, for the purpose of thoroughness a presentation of studies involving the examination of behaviors and also those studies that test the levels of knowledge and their results will be presented.

Levels of Financial Literacy in the Overall Population and Relations to Decision Making

One of the earlier studies designed to measure overall levels of financial literacy was conducted by researchers Hilgert and Hogarth in 2003. In using data from the University of Michigan's monthly Surveys of Consumers (November and December 2001), four areas of "financial management activities," or those vital to overall financial literacy, were addressed: cash-flow management, credit management, saving, and interest (Hilgert & Hogarth, 2003, p. 309). In this study, 1,000 households ages 18 to 97 were asked questions about their "consumer attitudes and expectations with regard to consumer finance decisions" (Hilgert & Hogarth, 2003, p. 321). The results of the simple survey found that consumers were much better equipped to handle daily basic needs, such as making payments on time, versus becoming seriously involved in investment and saving opportunities. For example, though the study found that over 80% of respondents had savings accounts, less than 50% said that they regularly saved any part of their income (Hilgert & Hogarth, 2003, p. 316). If a financially literate person is one who understands that saving more today will equate to the possibility of more accumulated wealth tomorrow, clearly these consumers lack an understanding of simple financial literacy concepts.

In addition, the study suggested, like others, that not many people understand how to save for retirement. In fact, of those who attempted to estimate how much money they would need for retirement, 44% underestimated their future expected needs (Hilgert & Hogarth, 2003, p. 317). This indicates a consumer misunderstanding and overestimation about how money compounds. In addition, it reemphasizes the importance of the effect of consumers' beliefs on their behaviors. If consumers believe they are putting away an amount of money adequate for a happy retirement, they believe there is no need to save more. In other words, consumers who save too little for retirement are missing a clear understanding of their expected future wealth and retirement options which is a significant part of the definition of financial literacy.

A few years later, in 2006, researchers Lusardi and Mitchell used a 2004 Health and Retirement Study to analyze workers aged 50 and above to determine whether or not these respondents “possessed the financial literacy needed to make informed decisions” (2006, p. 3). In general, they concluded that an understanding of interest compounding and inflation was only exhibited by about half of those surveyed (2006, p. 3). In total, they found that only one-third of this cohort could answer three simple questions about interest compounding, inflation, and risk diversification (2006, p. 3). These three questions are presented below:

1. “Let’s say you have 200 dollars in a savings account. The account earns 10 percent interest per year. How much would you have in the account at the end of two years?”
2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?
3. Do you think that the following statement is true or false? ‘Buying a single company stock usually provides a safer return than a stock mutual fund’” (Lusardi & Mitchell, 2006, p. 4).

They deemed these results of asking these questions unsettling considering how many financial decisions an individual must make before retirement and how simple the questions were designed to be. The first question is especially significant because Lusardi and Mitchell essentially asked this question with the intent of determining numeracy by asking participants to make actual calculations based on financial concepts. Unfortunately, only 18% correctly computed the answer, while 43% of those who attempted used a simple interest formula and entirely ignored the effect of compounding interest (Lusardi & Mitchell, 2006, p. 6). Evidently, the individuals lacking an understanding of the knowledge portion of the definition of financial literacy are subsequently at a disadvantage in translating any knowledge capabilities into appropriate financial decisions.

Three years later in 2009, Lusardi and Mitchell expanded on their idea of financial literacy as an aid for people of all ages to make complex economic decisions in a study designed to measure how prepared the U.S. population was for retirement. By using participants' information from the University of Michigan's Survey Research Center sample of those 18 and older, Lusardi and Mitchell were able to determine that by separating the difficulty of financial questions into categories, similar to a 2007 study by Rooij, Lusardi and Alessie, the results were consistent with previous research. While the most basic questions were all answered correctly by fewer than 50% of the sample, the more sophisticated questions concerning stock market functioning, knowledge of mutual funds, riskiness of stocks and bonds, and diversification were only answered correctly by 16 % of the sample (Lusardi & Mitchell, 2009, p. 12). Lusardi and Mitchell note that because the concepts tested in the simple survey are vital for accumulation of wealth, these results represent widespread financial illiteracy in the U.S. (Lusardi & Mitchell, 2009, p. 1).

More particularly, the study determined that financial literacy is an important predictor for retirement planning at all ages. The researchers found that: "Financial literacy not only matters for planning but its effect is sizable" (Lusardi & Mitchell, 2009, p. 18). As part of this point, Lusardi and Mitchell briefly discussed how enhancing financial knowledge in the youth is a great place for educators to start having an impact, especially because of the increasing complexity of the marketplace that requires a greater understanding on the consumers' part (Lusardi & Mitchell, 2009, p. 21). This short analysis of the youth cohort as a subset of the entire sample replicates what other, more specific research studies have found: that young adults are not prepared to make their own financial decisions.

One of the most recent studies that examined how an understanding of financial literacy relates to decision making was Lusardi and Mitchell's May 2011 study that served as an extension in their examination of the effects of financial literacy on retirement preparedness and

well-being. In analyzing the results of their survey, the researchers were once again discouraged that only two-thirds of the respondents understood compound interest because the cohort examined was primarily individuals on the verge of retirement. These results were so startling because by the age of 65, the researchers were certain this generation had “made many important financial decisions over its lifetime” (Lusardi & Mitchell, May 2011, p. 6). In lacking an understanding of a concept as simple as compound interest, it was also found that a 70% correlation exists between those who understand interest compounding and those who understand inflation (Lusardi & Mitchell, May 2011, p. 7). The researchers note that this deficiency in comprehending simple concepts can translate into poor decision making and missed opportunities to further increase wealth.

Clearly on a general basis, studies have shown that financial illiteracy is widespread. By examining individuals of all ages, researchers have been able to determine that financial literacy is highly correlated to an understanding of the basic concepts of finance and mathematics. In addition, they have been able to determine financial literacy’s relation to prepared financial decisions primarily through the examination of retirement planning. However, researchers did not stop their investigation of financial literacy at simply estimating levels of knowledge and its impact on decision making; they also attempted to examine how various populations’ characteristics such as gender, ethnicity, education, and geographical location affected financial literacy.

Financial Literacy’s Correlation to Demographics and Relations to Decision Making

One of the first studies to observe demographics’ relation to financial literacy was Lusardi and Mitchell’s previously mentioned 2006 study of those on the verge of retirement which revealed other significant findings based on educational status and ethnicity. Those who

reported more years enrolled at educational institutions and were White in ethnicity were much more likely to answer all three questions of the survey correctly. Those with fewer years of schooling, Blacks, and Hispanics all struggled with compound interest in particular (Lusardi & Mitchell, 2006, p. 6). Though the examination of these factors was not thoroughly delved into in this particular research study, it served as a basis for further research on the relation between financially literate individuals and their demographic characteristics.

However, this study was able to determine a link between financial literacy and economic behavior. Those who answered all three questions correctly were also more likely to have thought about or have attempted to plan for retirement (Lusardi & Mitchell, 2006, p. 8). Consequently, the researchers emphasized that because financially literate individuals are more likely to plan for retirement and because other research studies have shown that planning is imperative to successful retirement savings, it can be concluded that “lack of planning is tantamount to lack of saving” (Lusardi & Mitchell, 2006, p. 8).

In 2008, Lusardi again attempted to compile the existing research in assessing financial literacy to determine how it acts as an instrument for informed consumer choice based on demographic characteristics (Lusardi, 2008). While discussing her previous work and the work of other researchers mentioned above, Lusardi found that several trends existed and were consistent in the research. One prominent finding was that the results of surveys and assessments that measured financial literacy varied sharply based on gender. Women tended to demonstrate lower levels of financial understanding than men especially in terms of their comprehension of topics concerning investments (Lusardi, 2008, p. 11).

In addition, the conviction that education and ethnicity are predictors of financial knowledge seemed to hold in various studies (Lusardi, 2008, p. 12). More years spent in the education system translated to more knowledge of financial concepts; furthermore, those without a high school degree only answered questions concerning compound interest correctly half of the

time (Lusardi, 2008, p. 12). The effect of ethnicity as a predictor of informed consumer decisions was also confirmed as African Americans and Hispanics were shown to answer fewer questions correctly than other ethnicities.

This synthesis of the research up until 2008 had important implications for consumer decision making. After using information on individuals' past levels of financial understanding, Lusardi was able to find that "it is literacy that affects planning and not the other way around" (Lusardi, 2008, p. 14). This suggests the use of education as a tool to increase financial literacy and ultimately the accumulation of wealth is more beneficial than allowing consumers to simply encounter financial situations and learn from their mistakes. This active approach has been reflected in how government officials, educators, and policymakers are attempting to eradicate the problem.

While many of the recent financial literacy studies conducted have focused on the U.S. population, Guiso and Jappelli's 2008 Italian study of the effects of financial literacy on portfolio diversification displayed that alarming rates of financial illiteracy are also observable abroad. By using a 2007 Unicredit Customers' Survey, which contained a sample of clients from the largest Italian bank, the researchers found that "measures of financial literacy are strongly correlated with the degree of portfolio diversification" (Guiso & Jappelli, 2008, p. 3). In addition, it was inferred that the "evidence is consistent with explanations of under-diversification based on investors' limited literacy" (Guiso & Jappelli, 2008, p. 3).

Because diversification essentially eliminates idiosyncratic (or firm specific) risk, it is an essential tool for mitigating risk while also maximizing returns. In other words, diversification enables the creation of an efficient portfolio: the highest amount of return for the lowest amount of risk. Guiso and Jappelli point out that those who do not understand this concept are "excessive" in their risk taking (Guiso & Jappelli, 2008, p. 6). These findings from Italy are consistent with those of U.S. studies; more specifically, the 2007 work of Rooij, Lusardi and

Alessie which will be discussed later. Financially literate individuals are more likely to participate in the stock market and are also therefore more likely to sufficiently diversify their portfolios. The extension of financial literacy's effects on investment behaviors establishes a strong push for education in the benefits of diversification, stock market participation, and more generally, financial literacy itself.

In 2009, the relationship between financial literacy, education, and financial market participation was once again examined by U.S. researchers Cole and Shastry. Using U.S. census data, the researchers were able to classify households and individuals based on whether or not they earned interest or dividend income, and how many years they spent in educational institutions. Simply phrased, an additional year in school was found to increase the likelihood of financial market participation by about 8% (Cole & Shastry, 2009, p. 2). In other words, individuals less exposed to financial concepts were less likely to participate in buying stocks, bonds, and other financial assets. Financially illiterate individuals and households could therefore expect lesser returns if they did not participate in the financial markets.

Another significant finding of the study concerned the specificity of education's effects on financial literacy and partaking in financial market behaviors. Acquired knowledge was found less important than cognitive ability; consequently, education's effects on cognitive ability "in turn affect [...] savings and investment decisions" (Cole & Shastry, 2009, p. 27). This recurring theme of financial literacy's link to subsequent behaviors and actions suggests that it is a consistency in the research that cannot be ignored. In addition, it insinuates that financial literacy can, in fact, be used as a tool in making decisions, a topic which will be discussed later.

In response to the link between financial literacy and wealth accumulation that was established by Lusardi in 2008, a new study was conducted in 2010 using information from the Microdata Center of the University of Chile to isolate the effects of financial literacy and educational achievement on the accumulation of wealth. By controlling for risk aversion,

motivation, and several other factors, the study examined levels of financial literacy through a series of questions (similar to the ones used in the Lusardi study) that measured abilities in simple computations, compound interest, inflation, and retirement knowledge. Researchers found: “[T]he impact of financial literacy [is] economically meaningful and potentially quite important” (Behrman et al., 2010, p. 25).

Not only did the study reconfirm Lusardi’s findings of financial literacy as a strong predictor of wealth, but the study also showed that the “investments in financial literacy could well have high payoffs” (Behrman et al., 2010, p. 25). More simply, demographic factors such as further schooling and sufficient financial abilities were positively correlated to higher wealth accumulation later in life through saving and investing. Researchers found this relationship valuable as individuals and nations could capitalize on this connection through increasing education. In fact, it was found that a “0.2 standard deviation increase in the PRIDIT [a weighted scoring mechanism] financial literacy score could, on average, raise net wealth by \$13,800, broken down into about \$5,200 boost in pension wealth, a \$1,600 rise in net housing wealth, and a gain of \$6,900 in other wealth” (Behrman et al., 2010, p. 22). Average pension contributions were also shown to increase in tandem with financial literacy scores. Clearly, a conclusion as to the existence of a relationship between the comprehension of financial topics, education, and subsequent financial behaviors can be established through this data.

Moreover, this study was important not only because it remained consistent with the earlier findings of researchers, but also because of its international applications. Through the use of data of the Chilean population ages 25 to 65, financial literacy was shown to be a more of a global factor in predicting the amount of money built up over the course of an individual’s life. In other words, financial literacy as a tool for forecasting future wealth accumulation was shown not to be a link specific to the U.S. population. The Italian study conducted in 2008 by Guiso and Jappelli which demonstrated citizens’ inadequate understanding of their investment opportunities

and this study conducted in Chile facilitate a more international understanding of the scope of financial illiteracy around the world. The global perspective presented strengthens the argument of financial illiteracy as a worldwide phenomenon, but does not assist in suggesting a link between the concepts vital to financial understanding and decision making specific to the U.S.

Lusardi and Mitchell's May 2011 study focused once again on the U.S. and provided evidence of variations in financial literacy across demographics. The results confirmed what was found in 2006: Whites were more likely to have higher financial literacy than Blacks and Hispanics. More specifically, it was found that Hispanics were least likely to understand compound interest and inflation, while both Blacks and Hispanics only understood risk diversification about 40% of the time (Lusardi & Mitchell, May 2011, p. 7). Other key demographic differences uncovered included the affirmation that "women are generally less financially knowledgeable than men" and that the Baby-Boomer generation observed in the study understood less about inflation because of their "limited historical exposure to inflation" (Lusardi & Mitchell, May 2011, p. 9).

In determining a relationship between levels of educational attainment and financial literacy, people who did not hold a high school degree were found to be the most illiterate with the number of correct responses rising with more years of schooling. However, the topic of risk diversification was barely understood to an acceptable degree even by those with college degrees (Lusardi & Mitchell, May 2011, p. 9). After taking all of the various demographic relationships into consideration, the conclusion that financial literacy must be observed on a topical basis arises. In other words, a comprehensive understanding of financial literacy involves the sum of its various financial and mathematical components which is similar to the consensus definition presented earlier.

After determining several factors that were connected to levels of financial literacy, Lusardi and Mitchell synthesized their findings in relation to retirement planning and wealth

outcomes. The financially literate cohort was more likely to have invested in stocks, have had a greater knowledge of risk diversification, have saved more throughout their lives, and ultimately to have had a more “satisfying retirement” (Lusardi & Mitchell, May 2011, p. 15). Because financial literacy was associated with several positive outcomes, Lusardi and Mitchell lastly suggested that “education programs targeted to particular subgroups may be better suited to address substantial differences in preferences and saving needs” (Lusardi & Mitchell, May 2011, pp. 17-18).

A month later, Lusardi and Mitchell presented an article that provided a complete overview of financial literacy at an international level. Using similar survey and study metrics, the researchers discovered that financial illiteracy across a range of ages “is widespread even when financial markets are well developed as in Germany, the Netherlands, Sweden, Italy, Japan, and New Zealand” (Lusardi & Mitchell, June 2011, p. 9). In addition, it was determined that because mathematical abilities vary from country to country, numeracy levels and consequently results for financial problems involving calculations were answered more correctly in nations where people generally have more knowledge of math concepts, as in Sweden and the Netherlands (Lusardi & Mitchell, June 2011, p. 9). Furthermore, current events in a nation were found to affect how many of its citizens understood concepts such as inflation; for example, people in Italy had a higher probability of answering questions about inflation correctly because of their personal experiences with the phenomenon. Lastly, risk diversification was not found to be positively correlated to the level of financial development of markets in a country. With the U.S. and Germany considered highly developed markets, respondents still did not display increased understanding in risk diversification principles (Lusardi & Mitchell, June 2011, p. 10).

Once again, the international analysis of financial literacy confirmed findings that financial literacy abilities vary demographically. The study upheld the gender disparity: men answered more financial questions correctly while women were more likely to respond with

incorrect answers or not at all. Educational achievement was also determined to be correlated to financial literacy. However, the study differed from others on the notion that the highest financial capabilities reported were adequate, citing that “even at the highest level of schooling, financial literacy tends to be low” (Lusardi & Mitchell, June 2011, p. 10). In addition, the study noted that ethnic differences were more pronounced in the U.S., while other countries varied more geographically (Italy) or on an urban and rural basis (Russia).

Financial Literacy’s Correlation to Topic Areas and Relations to Decision Making

Building off of the 2006 work of Lusardi and Mitchell, Rooij, Lusardi and Alessie (2007) investigated the relationship between literacy and stock market participation. While they found that literacy is a strong predictor of stock market participation, the researchers also attempted to devise a more refined and comprehensive method of measuring financial literacy. The study gathered information from a 2005 DNB Household Survey (DHS) which provided insight into wealth and saving data of respondents aged 22 to 90. Rooij, Lusardi, and Alessie divided the survey questions into two sections: basic financial literacy concepts (numeracy, interest compounding, inflation, time value of money, money illusion) and advanced financial knowledge topics (stocks, bonds, risk diversification) (2007, pp. 6-7). In terms of basic financial literacy concepts, only 40.2% of those surveyed could answer all five questions correctly (Rooij, Lusardi, & Alessie, 2007, p. 10). The results for advanced financial concepts were a stark contrast as only a mere 5% of participants could answer all of these questions correctly.

These results clearly exhibit a hierarchy in terms of which ideas are easier for the average consumer to understand. For example, the effect of interest compounding on a sum of money over the course of a few years is easier to comprehend than how choosing different assets to add to a portfolio affects the risk characteristics of the portfolio. Considering previous studies have

shown that a lack of knowledge concerning interest compounding is apparent (Lusardi & Mitchell 2006), the disparity between what consumers *should* know versus what they *actually* know about managing their money as financially literate individuals is significantly unacceptable.

Following the recent financial crisis, an in-depth analysis of subprime mortgage delinquency was undertaken in 2010 by Gerardi, Goette, and Meier. In conducting their research, levels of financial literacy and cognitive ability were taken into account. Once again, the results proved intriguing as the authors concluded that “limitations in certain aspects of financial literacy played an important role in the subprime mortgage crisis” (Gerardi, Goette, & Meier, 2010, p. 1). As an understanding of credit, debt, and loan repayments are all essential aspects of personal financial decisions and financial literacy, it was found that those with late mortgage payments and defaults were much more likely to be part of a large number of “confused” consumers who entered into adjustable rate mortgages that they were unable to handle as interest rates rose and mortgage payments escalated (Gerardi, Goette, & Meier, 2010, p. 3).

In using this data of subprime mortgage borrowers from the Federal Reserve Bank of Boston’s collection of information, Gerardi, Goette and Meier were able to determine a distinct correlation exists between financial literacy and mortgage delinquency. Of those in the bottom quartile of the researchers’ financial literacy index, 20% had experienced foreclosure as opposed to only 5% in the top quartile (Gerardi, Goette, & Meier, 2010, p. 4). Similarly, those in the bottom quartile were also more likely to be late in their mortgage payments 25% of the time (Gerardi, Goette, & Meier, 2010, p. 4). Clearly then, an understanding of financial literacy concepts such as the calculation of mortgage repayments and loans in general serves as a useful guide in household financial decisions.

Most significant in this work, however, was the finding that in a survey administered by contacting a random sample of households from the Federal Reserve Bank of Boston’s data acquired from FirstAmerican LoanPerformance, the correlation between mortgage delinquency

and financial literacy was strongest when considering numeracy capabilities, a subset topic area of financial literacy. By testing people first on simple calculations like division and exponential functions, the researchers were able to find a correlation between people who could calculate the answers correctly and those who scored highly on the financial literacy part of the survey. This relationship strengthens the idea that financial literacy includes both a comprehension of financial and mathematical concepts used in decision making. In other words, mathematical abilities in calculating simple mortgage payments may be an integral part of financial literacy that can help predict levels of financial literacy.

As interpreted in the article, the results of the survey also link “poor financial literacy to higher consumption, less saving, and out-of-control credit usage” (Gerardi, Goette, & Meier, 2010, p. 5). This relation implies that financial literacy is correlated to many aspects of financial decisions. Therefore, financial literacy is an important predictor of subsequent financial behaviors, and appropriate financial action in saving, investing, and borrowing decisions is more likely to be taken by a financially literate individual.

Implications

In summation, over the past decade a multitude of research studies have attempted to measure financial literacy across all ages and determine how it relates to specific behaviors and actions. Overall, the results have been consistent. Financial illiteracy tends to be widespread and correlated to a host of undesirable outcomes: higher debt, lower likelihood of participation in the stock market, lack of diversification of portfolio investments if involved in the stock market, lack of planning for retirement, and ultimately lower wealth accumulation. Although more education has generally been linked to higher financial literacy levels, exactly the best way to educate the population is unknown. However, because education is most accessible to the youth, several

researchers view the easiest way to positively manifest financial literacy as focusing on the youth. This belief is why a range of studies have focused more heavily on the youth subset of the entire population and determining how much they understand before designing and implementing any programs. The U.S. Congress upholds this notion: “Consumer protection and relevant financial education must go hand-in-hand and must include an emphasis on our Nation’s young people” (U.S. Congress, 2009, p. 22). Echoing this sentiment, a subset of researchers have taken a more specific look at just how much the younger generation understands when it comes to managing and making financial decisions.

Chapter 5

Financial Literacy Levels among the Youth Population

Today, the youth population ages 18 to 24 faces a greater number of challenges than previous generations when it comes to managing finances; escalating student loan debt, increasingly complex financial markets, and limited exposure to and experience in saving, borrowing, investing, and insurance all lead to ill-prepared and ill-advised decisions (Chen & Volpe, 1998, p. 8). In fact, while undergraduate student loan debt has increased over 58% (after accounting for inflation) since 1999, the U.S. Senate Committee on Banking Housing, and Urban Affairs has found that “the fastest- growing group of bankruptcy filers was those aged 25 and younger” (Lusardi, Mitchell, & Curto, 2010, p. 359).

Clearly, a misunderstanding of how to manage this money may be a contributing factor to the financial difficulties of this cohort. At a time when young adult men and women are entering the workforce and should begin building up savings and investment portfolios, they are often too bogged down in debt from previous financial decisions and may ultimately delay retirement savings. As William Emmons, a Senior Economist at the Federal Reserve bank of St. Louis, notes, “Apparently it is difficult for many to appreciate how important early and consistent saving is for financial security in retirement” (2005, pp. 339-340). Because financial literacy is a predictor for planning for retirement and because planning for retirement has been found to be a predictor of wealth, evaluating the levels of financial literacy in the youth cohort is a valuable way to determine what should be done to aid this generation in making practical, wise saving and investment decisions (Lusardi, 2008).

As evidenced by the existing research on overall levels of financial literacy, financial literacy is so important because the decisions made based on financial knowledge “have a direct

impact on people's quality of life" (Volpe, Chen & Pavilcko, 2010, p. 1). Therefore, an earlier understanding can lead to a greater accumulation of wealth over the course of an individual's life.

Similar to the previous investigation of financial literacy levels of the overall population, general financial literacy levels among the youth will first be addressed. This will be followed by financial literacy among the youth's correlation to demographics and to topic areas. Within each section, relations to decision making will be made once again. Lastly, implications for future education and financial literacy research will be discussed.

Levels of Youth Financial Literacy and Relations to Decision Making

Citing the necessity for consumers to make financial decisions at an earlier age as an important reason to study financial literacy among a younger demographic, Lusardi, Mitchell, and Curto assessed how much a younger cohort of consumers understood using a ten year longitudinal study that started in 1997. The survey they presented at the end of the study therefore assessed individuals aged 23 to 28 years old, but can still be considered valid for the purpose of this paper because of the longitudinal nature of the study. The results of this study were consistent with, if not surprising more indicative, that "Financial literacy is an important component of sound financial decision making [...]" and that the youth cohort lacks adequate knowledge on financial topics to make informed decisions (Lusardi, Mitchell, & Curto, 2010, p. 360).

Because the 2006 Lusardi and Mitchell study that used three simple questions (presented earlier) to assess levels of financial literacy had been shown to be an accurate predictor of levels of financial literacy, the researchers used this test again on the younger cohort while also incorporating new variables such as educational attainment and exposure to financial knowledge. Not surprisingly, only 27% could answer all three questions correctly. This is a slightly worse

number for the youth demographic when compared to the 33% who could answer all of the questions correctly in Lusardi and Mitchell's previous study of the overall population. Therefore, while individuals tend to improve on their financial literacy to some extent over the course of their lifetimes, it also appears that "financial illiteracy seems to persist for long period and sometimes throughout the lifetime" (Lusardi, Mitchell, & Curto, 2010, p. 374).

Also troubling to the researchers was the fact that each question had a number of responses under the category "Do Not Know." The largest number of responses like this arose in the final question about risk diversification where 37.4% indicated they could not determine a correct answer (Lusardi, Mitchell, & Curto, 2010, p. 365). When taking into account that these three questions were designed to be a simplistic account of an individual's financial literacy, this number is concerning. Clearly then, financial literacy specifically within the young adult demographic is scarce.

Lusardi, Mitchell, and Curto's research also included implications for decision making. In finding that this age group is notably unknowledgeable when it comes to simple financial circumstances, the researchers were able to conclude that these young adults are more at risk to make ill-informed financial decisions and that the result could be costly especially because this group faces impending first-time decisions about mortgages, college funds, and retirement savings. The researchers noted that as the general trend is for individuals to become more involved in their financial decisions and subsequently their well-being, "it is becoming more and more important to equip workers with basic tools to make financial decisions" (Lusardi, Mitchell, & Curto, 2010, p. 375).

Youth Financial Literacy's Correlation to Demographics and Relations to Decision Making

While examining the degree of financial literacy of the population as a whole has been conducted for several decades, the first specific study on the youth's levels of financial literacy and its correlation to demographic trends did not occur until Danes and Hira's 1987 study of college students. Although primitive in nature, the study served as a foundation for further research of the youth generation by showing that financial decisions made by the youth can be affected by demographics.

Some of the most important results of this research study were the correlations between gender, marital status, and age as determinants of financial literacy. While gender has consistently been cited in the overall research of financial literacy levels, it is also an important predictor of youth financial literacy on a topical basis. Men tend to understand more about investments and personal loans, while women were cited in the study to have greater overall financial management skills (Danes & Hira, 1987, p. 15). Therefore, men tended to participate more in the stock market, while women were more likely to manage daily budgeting. Marital status was viewed as a precursor to the need for greater financial understanding because it generally involves managing more than one income; therefore, the study found that married individuals in the cohort had greater financial awareness, and generally made better financial decisions. With the recent trend of marrying later, this development may be outdated; however, no other recent study has looked at the effect of marriage on financial literacy capabilities in the younger generation. Lastly, the study indicates the natural tendency to acquire financial knowledge with age and experience (an idea that can be contested with the statistics presented earlier in this paper).

Much later in 2006, the Eastern Family Economics and Resource Management Association held a conference which addressed where college students tend to acquire their

financial knowledge and what could be done to improve their understanding. Not surprisingly, the multi-state study first found that financial literacy was highly correlated to academic performance (GPA). In addition, the survey found that college students tend to cite their parents as significant contributors to their financial understanding (Cude et al, 2006, p. 106). Not only does this finding implicate that more can be done to educate parents first and foremost about financial topics and that this will affect how much college students understand, but it also subtly emphasizes the role of demographics in current levels of youth financial literacy. For example, this study implies that the age of parents, their ethnicity, and even their gender can eventually impact the financial literacy of their children. No studies have been done, however, to further this conclusion. Lastly, students were much more receptive to managing their finances online versus balancing a checkbook by hand, indicating that the manner in which financial topics are presented to college students may be an important function of how literate they become and the consequent decisions that they make. This further supports the idea that education is a demographic factor correlated to financial literacy among the youth.

Youth Financial Literacy's Correlation to Topic Areas and Relations to Decision Making

One of the only studies to expand upon research of financial literacy among the youth and its correlation to topic areas was a 1996 study conducted by Volpe, Chen and Pavilcko. The researchers used a questionnaire designed by *Money* magazine that addressed risk, diversification, tax planning, interest rate changes, stocks, bonds, mutual funds, and global investing knowledge. In administering the survey to a medium sized metropolitan university, an IQ score on the survey of 70 and higher was deemed adequate understanding. The mean score of participants, however, was only a 44 (Volpe, Chen, & Pavilcko, 1996, p. 88).

One of the most understood topics addressed by the survey was diversification (58%) while tax planning (17%), the impact of interest rate changes (~28%), and stock market valuation (29% for females; 42% for males) were all topics that were the least understood. Taking into account that 58% is a fairly low rate of understanding, these results confirm that financial illiteracy remains a considerable problem. This study differed in its results from the Lusardi, Mitchell, and Curto study previously mentioned. Diversification in this study was the most understood topic, whereas the question in Lusardi, Mitchell, and Curto's survey about risk diversification was the question answered least correctly.

The study found that the largest gap in knowledge between women and men occurred in topics concerning stock valuation, mutual fund performance, business math, and global investing, where men tended to display better understanding than women. Most importantly, however, the researchers noted that the inadequate knowledge displayed by college students could negatively affect making important decisions such as a down payment for a home and retirement. Therefore, it was concluded that the "importance of personal investment decisions cannot be overemphasized" (Volpe, Chen, & Pavilcko, 1996, p. 86).

Implications

Overall, research concerning the youth demographic not only supports the notion that the general population is financially illiterate but also expands the idea that the youth cohort actually understands less than the general population due to limited exposure and experience with financial topics and issues. Just as the general population's comprehension of financial literacy was correlated to gender and topic areas, the youth demographic also displayed these trends. In addition, however, a correlation was made between academic performance and financial literacy and parental educational attainment and financial literacy. This suggests that education may be a

key component to improving financial literacy and subsequently decision making. It also reinforces the idea that educating about the basics of certain topic areas of finance such as various asset classes and risk diversification may be a legitimate way to improve financial literacy among the youth and ultimately of the general population.

Chapter 6

Financial and Mathematical Concepts Vital to Financial Literacy

After discussing what financial literacy entails, current levels of financial literacy throughout the general population, and specific research concerning the financial illiteracy of the youth, a shift must be made to discuss what financial and corresponding mathematical concepts a solid financial understanding includes. By investigating what individuals must know about specific concepts, suggestions as to techniques to teach financial literacy can be made. In addition, the link between financial and mathematical concepts will be clearer.

Compound Interest and Exponential Functions

First, one of the most fundamental concepts of finance is the idea that saving more now will result in a greater accumulation of wealth later. This idea is most simply described in the finance realm as the effect of compounding interest on a sum of money. In a study on perceptions of compound interest, Binswanger and Carman define compound interest as the idea that “money accumulates exponentially, and the effect is more pronounced over a longer time horizon” (2010, p. 2). In other words, as interest accumulates in a savings account with a decent interest rate, or one whose interest rate is greater than the level of inflation in the economy, that interest becomes a part of the principal savings amount. Any further interest payments made to the account owner are made on the basis of the outstanding principal of interest and current savings amount combined. The result is an accumulation of money over the long term greater than the gain that would be experienced if compound interest were not realized.

While this topic may seem simple to comprehend, its importance cannot be emphasized enough. The idea of compound interest inevitably brings about a dilemma in regards to

consumption versus saving and investment choices over the course of an individual's life. Saving now and having more money later as opposed to spending now and having less money later are two very different ends of a spectrum that can have a direct impact on quality of life. Also significant is Binswanger and Carman's finding that "50 percent [of the sample] neither calculate the benefits of long-term savings themselves, nor get any help with this from advisors or financial websites" (2010, p.27). Since the definition of financial literacy presented earlier proposes that a financially literate individual is one whose knowledge, abilities, behaviors, and in the end experiences positively shape financial well-being over the course of an individual's life, clearly an understanding of compound interest and its effect on accumulated wealth is a topical determinant of financial literacy. Planning to save more now versus later is therefore an important result of understanding the effect of compound interest on a sum of money, and essentially becoming a financially literacy individual as well.

Compound interest cannot be fully understood, however, without an additional understanding of a distinct mathematical topic: exponential functions. In fact, the definition of compound interest just presented by Binswanger and Carman actually uses the idea of accumulating a sum exponentially. Mathematics educators have built upon several explanations of how individuals understand exponential functions. Comprehension was originally viewed from the standpoint of first understanding rates of change (additive versus multiplicative), but later, understanding a term called "splitting" served as an indication of knowledge in the topic of exponential functions (Confrey & Smith, 1995, p. 72).

Those who viewed understanding of exponential functions from a rate of change standpoint argued that viewing a pattern of how function values change or vary over the function domain delineates an exponential function from a simple function (Confrey & Smith, 140). More specifically, an individual learns and locates additive and multiplicative patterns in functions. To do so, an individual must have an understanding of function domain and range. Domain is a

description of “the set of values for which a function (map, transformation, etc.) is defined,” while range refers to the output of a function (Weisstein, 2012). Therefore, when looking at the results or output of a function, an individual can compare new output or range values to a previous result through addition or subtraction. This approach is considered the additive approach to understanding functions. Alternatively, the multiplicative approach implies an individual can create a ratio of the new output values to the previous output value of the function. The increasing nature of a positive exponential function is subsequently indicated by an escalating additive increase in the function range or a constant multiplicative rate of change based on a previous output value. Indeed, Confrey and Smith note that: “the drama of the increasing magnitude of the rate of change is an essential component to being mathematically literate about the exponential” (1994, p. 158). A simple graph can therefore show how over time, the output values of the function grow rapidly as the input values increase.

From this vantage point, compound interest is a classic example of how earning interest on interest results in a much larger output of money over time. In addition, it suggests that understanding compound interest may be a combination of both the additive and multiplicative approaches. That is, the end sum created may be viewed as the old value of the function (P or principal value) multiplied by a constant (one plus the interest rate divided by the number of compound periods, or one plus r divided by n) that is raised to the power of the number of interest compounding periods (n) multiplied by the time (t). This formula for compound interest can be seen in Figure 1.

A = new principal value

P = old principal value

r = interest rate (annual or APR)

n = number of compounding periods in time t

t = time

$$A = P \left(1 + \frac{r}{n} \right)^{nt}$$

Figure 1: Compound Interest Formula.

The variables and mathematical processes involved in the calculation of interest that compounds.

Alternatively, compound interest may be seen as merely adding a new amount of interest to the previous principal value. Therefore, as the previous principal value grows, the interest component will become a larger contribution to the new principal value, further escalating the value of the output or savings this case. More simply, “An interest rate of 5% per year means that the new money will be 5% of the old money and then must be added on to get the total amount in the account” (Confrey & Smith, 1994, p. 141). The recursive mathematical formula for this conception of compound interest is depicted in Figure 2. This formula most importantly implies that the principal amount the interest is multiplied by is not lost with the addition of new interest. In fact, assuming a positive interest rate and a positive number of compounding periods, the output will undoubtedly increase. Therefore, the parts of this equation enable a more sufficient understanding of what the compounding of interest entails.

P_0 = initial principal or savings value

v = number of iteration

r = interest rate (annual or APR)

n = number of compounding periods

$$P_v = P_{v-1} + P_{v-1} \left(\frac{r}{n} \right)$$

Figure 2: Recursive Compound Interest Formula.

The variables and mathematical processes involved in calculating compound interest recursively.

To further this idea, Confrey and Smith later viewed understanding of exponential functions as a “natural extension” of exploration of the differences between the operations of addition and multiplication. Rather than solely comprehending exponential functions through repeated addition, Confrey and Smith coined the term “splitting” and noted a splitting structure as “a multiplicative structure where multiplication and division as seen as inverse operations” (1995, p. 72). Consequently, a function that is repeatedly multiplied by the same number over a certain number of iterations or time periods would grow exponentially in a manner similar to a recursive formula where a starting value is given and each succeeding value of the function is determined based on the previous output (Understanding Basic Recursion, 2012). Again, the researchers turned to compound interest as a valuable example of a splitting structure: “A compound interest rate of 5% per year over a period of 10 years is seen as ‘holding the rate constant’” (1995, p. 78). While the result of an exponential function is a rapid augmentation of an end result, it is important to understand it is the constant rate (such as a locked-in interest rate) simply applied repeatedly over a period of time that results in the escalating value.

Clearly then, the financial principle of compound interest and mathematical issue of exponential functions go hand in hand for a financially literate individual. The ability to combine knowledge that saving more money now will result in more money later with an understanding of the actual calculation of a new amount of expected future money can lead to more effective planning when making savings decisions. There lies the importance of compound interest: a financially literate individual would use the financial and mathematical components of this concept as tools in making smarter savings decisions.

Riskiness of Asset Classes, Standard Deviation, and Variance

Another important financial topic that has direct ties to financial literacy is the ability to determine various asset classes' risk characteristics in relation to each other. The capacity to understand riskiness of asset classes is especially important in investing decisions for not only determining the optimal individual risky portfolio, but for actually understanding the relative nature of investment options that are available. Adequate knowledge of this topic could subsequently lead to a simple comprehension that a younger individual would be more willing to take on risk in the form of stocks, while an older individual might want a more certain stream of cash flow through safer investments. Directly related to characterizing various asset classes are the concepts of standard deviation and variance: two tools used to assess the riskiness of asset classes.

An asset class can be defined as “a set of assets that bear some fundamental economic similarities to each other, and that have characteristics that make them distinct from other assets that are not part of that class” (Greer, 1997, p. 96). This generally includes cash, bonds, and stocks (domestic and international); although there are other asset classes that exist that will not be discussed. A definition and ranking of categories within each type of asset class (if necessary)

from least risky to most risky will be discussed below; however, at the most basic level, it should be understood that cash is less risky than bonds, which are less risky than stocks.

Cash

To start off in ranking the various asset classes, it is important to note that cash is the most liquid and least risky asset available to individuals (assuming inflation rates are not extremely high). Liquidity, or marketability, refers to the “ability of an economic agent to exchange his or her existing wealth for goods and services or for other assets” (Nikolaou, 2009, p. 10). In a sense, cash is the most immediate form of payment that may be accepted in exchange for other goods, services, or assets. The risk inherent in holding cash, however, is that in a high interest rate environment a dollar today may be worth much more than a dollar tomorrow. This is indicative of another financial concept: the time value of money. However, by holding cash in a high interest rate environment today, an individual forgoes the opportunity to earn a higher rate of return in the future by either saving the money or investing it in any of the asset classes that will be discussed below.

Bonds

Bonds are more complex in nature than cash, yet they are often seen as one of the safest ways to earn a return over a period of time. *The Wall Street Journal* defines a bond as a loan in which money is given to “a company, a city, the government – and they promise to pay you back in full, with regular interest payments” (2012). As mentioned above, bonds can be separated into several categories: treasury, municipal, corporate. Treasury bonds are considered safer than municipal and corporate bonds because it can generally be expected that the government will not

default on its debts and will pay the investor back. Municipal bonds, however, are sometimes more attractive than treasury bonds because of their tax exempt status and also because interest rates on treasury bonds have been very low recently. Corporate bonds, on the other hand, are issued by companies to aid in the financing of various projects. They are considered riskier because of the lesser likelihood of a corporation making good on its coupon (interest) and principal repayment.

It is important to note that bonds issued by the Treasury may also be separated by time to maturity. Generally, a bond with a maturity between zero and one year is called a treasury bill. The short maturity of this bond makes it more liquid and therefore less risky. A bond with a maturity between one year and ten years is considered a treasury note, while any maturity greater than ten years is considered a treasury bond. Treasury bonds are commonly considered more risky than treasury bills because if held to maturity, they are a long-term investment with greater uncertainty of expected returns. But it is important to remember, however, that any type of bond issued by the treasury is considered less risky when compared to other bonds in the market.

Another important characteristic of bonds is their interest rate sensitivity. If holding a bond to maturity, or the full amount of time the municipality or corporation has to pay back their debt, interest rate has no effect on the yield of the loan. However, if not expecting to keep the bond for the entirety of its defined term, the interest rate has direct effect on the yield of the bond. A rise in interest rates lowers the return on the bond, because the holder of the bond is missing out by receiving a lesser coupon payment than what is available for current bonds in the open market. The opposite is true if interest rates fall. Here, the holder of the bond has an advantage because they are receiving higher coupon payments than what others are receiving at current market rates. Either way, bonds of both types are generally preferred for more risk averse investors, often older individuals closer to retirement, who are looking for a constant and safe stream of payments or return on their investment.

Stocks

While stocks are considered riskier than bonds, they often have higher returns to reflect their unpredictable nature. Stocks can be defined as “ownership shares in a company” whose return on investment “depends on the success or failure of that company” (FINRA, 2012). If held over a period of time, stocks are expected to provide a return to the shareholder through capital gains. If profitable, companies may also choose to reward shareholders through a distribution of dividends. Shareholders are able to accept cash payment from their stocks or ask for more shares within the company.

There are two types of stock that should be noted here: common and preferred stock. While common stockholders have distinct voting rights, they are not guaranteed dividend payments on a regular basis. On the other hand, preferred stockholders generally have no voting rights, but are considered less risky than common stock because if a dividend is to be issued or the company fails, preferred shareholders are paid first. In a sense, “preferred stock works like bonds” in that preferred stockholders can expect to receive a payment of dividend that is comparable to the interest payment received on a bond (Stallman, 2012). Therefore, in terms of riskiness, preferred stock is less risky than common stock.

Stocks can be even further separated into categories of risk by looking at the size of the underlying company. For example, a small company with very little equity and fewer shares outstanding (a small market capitalization) is considered riskier than larger company with a larger amount of outstanding equity and shares outstanding (a large market capitalization). This reflects that the company may be new to the trading market or have not reached economies of scale; therefore, its return on investment may be more uncertain than the larger company stocks which tend to have more predictable returns (FINRA, 2012). In return for being riskier, however, small capitalization stocks often have more upward potential. This is due to the ability of small

company stocks to grow in value much more quickly than larger company stocks because of the original size of the company in question.

Another feature of stocks that should be considered is the classification of the stock as domestic or international. Because investors tend to know more about the companies that work and do business in the United States, these stocks are considered safer to domestic investors. The business environment tends to be more predictable for these companies, and therefore investors are more certain of the return they will receive on their investment. International companies, on the other hand, may be subject to different rules and regulations in the ways in which they conduct business which could have a direct impact on the stock price.

Lastly, the industry in which the company is in should be considered when evaluating the riskiness of the stock. For example, a stock that is part of the utility industry can expect fairly small and stable growth because of the low-risk nature of the utility industry. Stocks in the tech industry, however, are less predictable because the companies own fewer real assets than they do intellectual property. Tech stocks' riskiness translates into higher potential returns for investors as they are compensated for taking on more risk in their portfolios.

The riskiness of each of these asset classes, however, cannot be understood without an understanding of standard deviation: a common mathematical measure of risk in finance that is directly related to variance. This is because the risk of an asset is determined by its variability, or how much one can expect the asset value to change over time. In effect, "Internalizing the many aspects and possible definitions of this concept [variability] should be one of the most important goals of statistical education" (Lann & Falk, 2003, p. 17). To calculate a standard deviation, it must first be assumed that the individual has knowledge of how to calculate a simple mean. After taking this into consideration, it is easiest to explain variance as the average of squared deviations from the mean of a data set. Standard deviation is simply the square root of the variance. It is also important to note the difference between population and sample standard deviation. For

financial purposes, usually only a sample (of returns) is being assessed. In fact, it is nearly impossible to include all measurements of returns, which a population standard deviation would assess; therefore, in calculating the standard deviation, the squared deviations from the mean are divided by n minus one instead of n . The technical formula for standard deviation can be seen in Figure 3. It is important to understand the mathematical significance of the variables contained within Figure 3. For example, the closer an observation is to the mean, or the closer x_i is to \bar{x} , the nearer to zero the numerator term and smaller the resulting standard deviation will be. This calculation furthermore implies a smaller amount of risk when the observations are closer to the mean value expected.

Sample Standard Deviation	
$S =$	$\sqrt{\sum_{i=1}^n \frac{(x_i - \bar{x})^2}{n - 1}}$

Figure 3: Sample Standard Deviation.
The mathematical formula (Measure of Dispersion, 2012).

Standard deviation is often a more practical measure of spread in finance than variance because it is in units that can be easily understood (percent versus percent squared). For example, under the common assumption that stock returns follow a normal curve, a stock with an expected return of 10% and a standard deviation of 5%, the stock's return could be expected to be between 5% and 15% 68 % of the time which is the equivalent on a normal curve of one standard deviation above and below the mean. If variance were to be used, assessing the spread of possible returns and their subsequent likelihood would be much more difficult.

While sample standard deviation is useful for determining individual assets' riskiness of returns, a different formula must be used to determine the standard deviation of a portfolio of

assets. While time will not be taken to explain the derivation of this formula, it is important to realize that the standard deviation of a portfolio, and therefore the riskiness of the portfolio's returns, is measured by a separately derived formula. Essentially, the weight invested in each asset and the covariance between assets matters more to the riskiness of a portfolio's returns; subsequently, the formula must take these variables into consideration. Figure 4 contains the formula for the standard deviation of a portfolio with two different assets. Calculation of a portfolio with more than two or three assets would be nearly impossible to calculate by hand because of the increasing nature of the covariance terms. For example, a portfolio with two assets has only one covariance term ($2w_1w_2cov_{1,2}$), a portfolio with three assets has three covariance terms, a portfolio with four assets has six covariance term, a portfolio with five assets has ten covariance terms, and so on and so forth.

$$\sigma_{portfolio} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1w_2Cov_{1,2}}$$

Figure 4: Standard Deviation of a Portfolio of Two Assets.

The mathematical formula involving the weights, variances, and covariance between two assets (Portfolio Management – Portfolio Calculations, 2012).

While “ w_1 ” and “ w_2 ” represent the weight of investment in each respective asset, “ $Cov_{1,2}$ ” is the covariance between the two. In looking at the actual formula itself in Figure 4, it is clear to see that if the covariances of returns between assets are not positively related, the portfolio standard deviation will fall. That is, if as the returns of one asset go up the returns of the other asset fall, the covariance term between these two assets is negative and the calculation of standard deviation of the portfolio will have a negative covariance term that decreases the resulting standard deviation. It can therefore be seen that the covariance terms have the most impact because they have the potential to increase or decrease the portfolio standard deviation and determine the riskiness of the portfolio more so than the actual weights and standard

deviations of the assets when considered individually. It should also be noted that because this formula can be used to calculate the standard deviation between two assets, the formula can also be used to calculate the portfolio standard deviation of a proportion of an investment in a group of risky assets (if a single standard deviation of the group is known) and a proportion in risk free treasury bills.

Standard deviation and variance can be calculated quickly with practice; however, a fundamental comprehension suffices for the purposes of financial literacy. Exactly how people understand standard deviation, though, is important for educating purposes. In a study conducted by researchers Lann and Falk, one of the most common incorrect methods cited by individuals to evaluate the variability of a data set was its range instead of its standard deviation or variability (2003, p. 14). Using only the range of a data set gives large weight to the lowest and highest values of the data set. Perhaps then, an understanding of standard deviation can be developed through a process described in the work of Mathews and Clark where:

[C]ognitive development in an individual relative to a given concept can be explained, or modeled, as follows. First, the individual must perform actions implementing a concept. Next, these actions are interiorized into processes. The resulting processes are, in turn, encapsulated into objects. Finally, the individual coordinates these individual mental constructs into a schema for a concept (Mathews & Clark, 2007, p. 4).

Calculating a standard deviation, internalizing what it means, and applying it to financial situations may therefore be a valuable way for standard deviation and variance knowledge to be manifested in individuals.

Internalizing standard deviation and variance may be most easily accomplished through visual graphical analysis. As researchers delMas and Liu note: "It is through the coordination of distribution (as represented by the coordination of value and frequency) and deviation (as distance from the mean) that a dynamic conception of the standard deviation is derived" (2005, p. 56). In finding that the students in their study tended to use pattern recognition when comparing distributions, it can be furthermore concluded that the most effective understanding of standard

deviation as the spread around a mean stems from both a mathematical, financial, and graphical approach (2005, p. 80). For example, by graphing the expected values for an asset class, the larger spread of a stock versus the spread of a bond may be easier to visually perceive and wholly understand versus solely completing a mathematical calculation. This relationship is demonstrated in Figure 5.

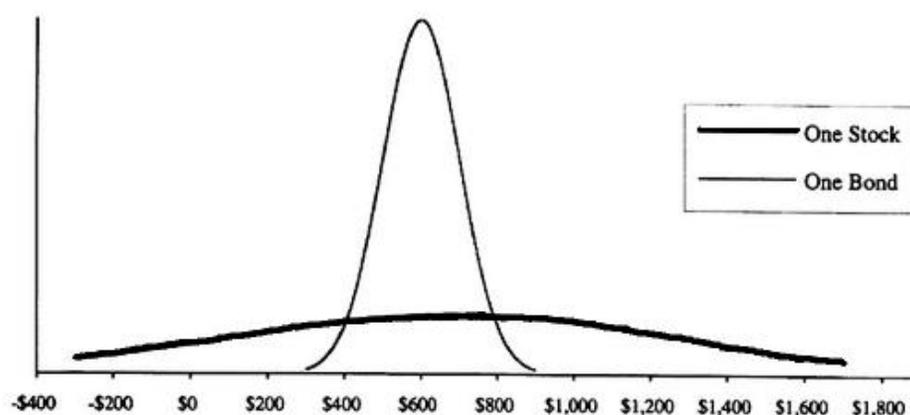


Figure 5: Stock versus Bond Dispersion.

The spread and possible range of values for stocks compared to bonds (Asch & Hershey, 1995, p.847).

Most important then is an understanding that a larger standard deviation means a greater possibility for change in the data set (more risk) while a lower standard deviation implies less variability (less risk). More specifically, stocks tend to have a greater probability of rising in value or falling in value; therefore, a stock's distribution would appear less steep than a bond's plot. That is, compared to bonds, stocks have more upside and downside potential. Bonds are considered safer. This connection is reflected in the lower standard deviation of bond returns compared to stock returns that is shown in the graph above.

Minimization of risk and therefore standard deviation is the natural tendency of investors. Yet, because more risk equates to more return, standard deviation can be seen as a useful tool in comparing various stocks to each other. Another example, as will be discussed later, is the importance of standard deviation and variance of a portfolio of assets including stocks and bonds

to the formation of an efficient portfolio. Put simply, standard deviation can be used to calculate the variation of returns of a single stock, the variation of the value of a single stock, or as a method to evaluate the variation of the returns or value of a portfolio of assets. Essentially, standard deviation and variance serve as useful tools in assessing the potential movement of stock prices or portfolio value.

However, standard deviation and variance have applications beyond the ability to perceive the riskiness of various stocks. In particular to one asset class, stocks are often measured in riskiness by their correlation to the market through a calculation of Beta (β), or the covariance of a stock to the market divided by the variance of the stock. The mathematical formula is depicted in Figure 6.

$$\beta_{Asset} = \frac{Cov(Asset, Market)}{Var(Market)}$$

Figure 6: Asset Beta

The mathematical formula for the calculation of an individual asset's beta.

Use of beta enables stocks to be compared to the market, which naturally has a beta of 1.0. Standard deviation and variance are therefore very important concepts in the technicalities of investing as they are direct inputs into this calculation that helps compare stocks' riskiness to the market. A negative beta implies that the returns of a stock move inversely to returns of the market and is due to a negative covariance of the stock to the market. Beta is therefore an important tool in the comparison of stocks to each other because it standardizes the riskiness of different stocks by comparing them to the market. Consequently, a basic grasp of standard deviation and variance can lead to improved financial literacy and potentially improved investment decisions in the future.

In summation, a basic understanding of the risks associated with various asset classes and a mathematical understanding of standard deviation and variance can create a greater certainty as

to returns or values that can be expected over the long run. This is further manifested in portfolio diversification, a financial topic which will be discussed next.

Portfolio Diversification, Investment Strategies, Expected and Weighted Averages

The final topic of specific financial knowledge that should be understood is the idea of portfolio diversification and subsequent return strategies for investors. While investing can be a daunting task for individuals, avoiding putting money that is to be invested for the future into a single asset class or place is a simple way investors and financially literate individuals can avoid making costly money mistakes. This is why the topic of portfolio diversification is so important for financially literate individuals. To highlight this importance, investment strategies cited by researchers will be discussed. In addition, the relation and significance between mathematical concepts such weighted averages and expected values and financial understanding of portfolio diversification will become evident.

Without getting into excessive technical details, the most fundamental concept of portfolio diversification is the ability to generate a higher return portfolio by combining both risky and non-risky assets. In other words, creating a portfolio of various stocks and treasury bonds ultimately allows investors to achieve a more efficient portfolio than investing solely in one individual asset. Investors experience higher returns and the minimization of risk through portfolio diversification. The reason this is possible is because of the varying correlations stocks have to each other and the subsequent standard deviation of the portfolio that results. After creating the most efficient risky portfolio possible (only risky securities such as stocks and corporate bonds), an individual can choose based on their risk aversion what portion of their portfolio they want to invest in a risk free asset (treasury bonds). The result is a portfolio of investments that have a maximized return potential and a minimization of risk.

Determining the asset allocation of one's portfolio may subsequently influence or be influenced by the type of investment strategies an investor is expecting to practice. Perold and Sharpe suggest four different methods that investors use: a buy-and-hold strategy, a constant mix, a constant-proportion portfolio insurance strategy, and option-based portfolio insurance strategy (1988, pp. 16-17). A brief summary of each of these follows:

Buy-and-hold strategy

A buy-and-hold strategy is one of the simplest strategies to execute. It entails determining an initial mix of stocks and bonds and maintaining this percentage without ever selling or reinvesting in different stocks. Perold and Sharpe cite the unlimited upside potential as a benefit to this type of investment strategy (1988, p. 18). This type of strategy is correlated to the performance of the stock market; therefore, the "greater the initial percentage invested in stocks, the better the performance of a buy-and-hold strategy when stocks outperform bills and the worse the performance of a buy-and-hold strategy when stocks underperform bills" (Perold & Sharpe, 1988, 18). Essentially, the buy-and-hold strategy is a laid back approach to investing.

Constant-Mix Strategy

While a buy-and-hold strategy is more passive in nature, the constant-mix strategy involves rebalancing of one's portfolio after the underlying price of assets change. This is done in order to maintain an initial proportion of stocks to bonds that is selected. The strategy generally involves "the purchase of stocks as they fall in value" to keep the proportion of stocks to bonds at a desired rate and "the sale of stocks as they rise in value" (Perold & Sharpe, 1988, pp.19-20). For a simple investor, this strategy may be harder to accomplish as it involves

constant maintenance of a proportion of risky to non-risky assets. In general, this strategy is more effective when the stock market is oscillating versus relatively flat.

Constant-Proportion Portfolio Insurance Strategy

Investors who are averse to risk to a certain extent and would like to limit their losses may be most interested in this strategy. By setting a minimum or “floor” to portfolio value, an investor can sell off stocks if the portfolio value becomes close to this limit and buy safer treasury bonds (Perold & Sharpe, 1988, p. 22). This type of strategy therefore provides safety when the markets are down, but potential when markets are increasing.

Option-Based Portfolio Insurance Strategy

This last investment strategy also attempts to limit the downside risk of investing in the stock market, but it additionally accounts for how long an investor expects to invest (their investment horizon). Therefore, the mix of stocks and bonds changes over time and the strategy can be considered more active in nature. In a way then, this strategy could be seen as more complex for an individual investor.

The technicalities of each of these strategies are not important to remember to become financially literate. Rather, understanding the ideas behind each of these strategies (such as creating an investment portfolio that is easy to manage or limiting downside potential of an investment) can aid in making smarter investment decisions even if it is with the help of a professional.

The benefits of portfolio diversification are not easily realized without at least a limited grasp of weighted and expected averages. Often considered an input to calculating standard

deviation (as discussed earlier), weighted and expected averages from a financial standpoint can help indicate the expected or potential return on a portfolio of varying assets. To understand an average, Leavy and Middleton note that a data set must be understood as “more than a series of numbers– an understanding of the data set as a unit must exist” (2011, p. 236). Therefore, conceptualizing a weighted average or expected value as a measure of center and as the most likely outcome signifies mathematical understanding of portfolio diversification that can be translated to financial returns.

Weighted averages and expected values are often viewed as synonymous (Leavy & Middleton, 2011, p. 236). That is, the mean of a distribution is the most common measure of center that is defined as the “weighted average of the possible values of a variable and is also the referred to as the expected value of the variable” (Leavy & Middleton, 2011, p. 236). Expected value, though it represents the same notion as a weighted average, is a function of varying probabilities of a data set. While a simple average is calculated by summing observations and dividing by the number of observations, the expected value is based on the probability or likelihood of an observation that occurred. A weighted average, on the other hand, is not conceptualized by probabilities, but rather by the emphasis placed on each observation. By definition, the two concepts are similar; yet the manner in which each is understood varies by their purpose. The statistical formulas for expected value and weighted average are presented in Figures 7 and 8.

$$\mu = E(X) = \sum [xP(x)]$$

where

μ = mean

$E(X)$ = expected value

x = an outcome

$P(x)$ = probability of that outcome

$$\text{Weighted Avg}_x = w_1x_1 + w_2x_2 \dots w_nx_n$$

w = relative weight(%)

x = value

Figure 7: Expected Value

Mathematical formula for the calculation of expected value (Expected Value or Mean, 2012).

Figure 8: Weighted Average

Mathematical formula for the calculation of a weighted average (Weighted Average, 2012).

In the formula in Figure 7, the expected value is calculated by multiplying each potential outcome by its probability of occurring and subsequently summing the results. The outcome therefore reflects the most likely value. The second formula calculates a weighted average by multiplying each observation by a percentage or proportion (not a probability or likelihood of occurring). Adding these terms together results in a weighted average based on historical observations. The important difference between these two formulas lies in what exactly each is calculating. While the first formula for expected value calculates a hypothetical future outcome, the second formula calculates an actual average based on the emphasis placed on each observation. This difference may be clearer from a financial standpoint than from a mathematical one. While expected value could be used in approximating a potential future stock return, weighted average could provide, based on the proportion of an investment in stocks and bonds, an estimate on the return on a portfolio based on historical (past) returns on stocks and bonds.

The clarity with which expected and weighted averages are understood may perhaps be further illustrated with an investment example. In financial terms, an expected value first and foremost assists in the calculation of a specific asset's return. After splitting money to be invested in various asset classes (40% in stocks and 60% in bonds, for example), a weighted average can therefore be calculated as the weight of money invested in each asset class times the expected value of each asset. The result: an expected return on the portfolio mixture of assets.

Undoubtedly, and consistent with research, the most difficult part of understanding expected and weighted averages is not the computational aspect, but what the subsequent result represents. To simplify the concept of a mean in mathematics, Strauss and Bichler created a list of key qualities whose understanding leads to a complete embodiment of the representation of a mean (1988, p. 66). A few relevant qualities listed were first, that the expected or mean value is located between extreme values as a sort of measure of center. Secondly, that the sum of

deviations from the mean is equal to zero. Third, that an average is influenced by numbers other than the average. For example, if the data set experiences a change, the weighted or expected average may move to reflect the new data. For the purpose of the example above, if a stock suddenly becomes riskier, its expected average may increase to reflect an increase in expected return to compensate for additional risk. This change would further increase the weighted average return of the portfolio. Care must be taken, however, to assess the increased risk of the portfolio as it entails a more complex approach not relevant for this discussion. The fourth and last relevant characteristic mentioned is that the average value serves as a representation of all of the values of the data set.

This comprehensive description of expected and weighted averages in mathematics thus facilitates an understanding of the benefits of portfolio diversification. By dividing investments into stocks, bonds and other assets, an investor has the opportunity to control the weighted return on his or her portfolio based on the expected returns of individual assets and to consequently determine a risk level he or she is comfortable with for that certain level of return. This ability to make educated investment decisions functions as a valuable advantage to knowledgeable investors and financially literate individuals.

Extensions to More Complex Topics: Modern Portfolio Theory

The integration of finance and mathematics is no more evident than in the sophisticated financial theory labeled Modern Portfolio Theory (MPT). While the technicalities of the theory are not important for the purpose of improving the financial literacy of individuals, the basic concepts embedded within the theory indicate that financial literacy may facilitate a higher and more complex financial awareness and well-being.

The crux of MPT is a combination of two topics discussed earlier: standard deviation and expected returns on a portfolio. MPT contends that “the best way to minimize risk and maximize return [...] is to diversify a portfolio” (Modern Portfolio Theory, 2006, p. 36). The benefits of diversification, as mentioned earlier, include a reduction of risk. When considered on a portfolio basis, this translates to a lower portfolio standard deviation. The combination of assets with different correlations to the market forms an “efficient frontier” in which returns are maximized for each given level of risk. Lastly, when combining a risky portfolio of assets with a certain proportion invested in the risk-free asset (treasury bills), an optimal portfolio for an individual investor can be reached. The most important part of this argument, for the purposes of financial literacy, is that an understanding of standard deviation (understanding the riskiness of different assets) and expected returns (portfolio diversification) are the pillars on which the theory is founded.

Figure 9 is a depiction of the efficient portfolio frontier, an important aspect of MPT, based on the combination of a portfolio of risky assets and a risk free asset. The efficient portfolio frontier is defined as “the set of feasible portfolios that have the largest expected return for a given standard deviation” (Merton, 1972, p. 1856). While risk is portrayed by standard deviation on the x -axis, expected returns are displayed on the y -axis. An investor would like to maximize return and minimize risk as much as possible; therefore, portfolios visually closer horizontally to the y -axis and vertically higher are preferred. An explanation of the x and y -axes and the relationship between the integration of financial and mathematical concepts can be described further with the aid of Figure 9.

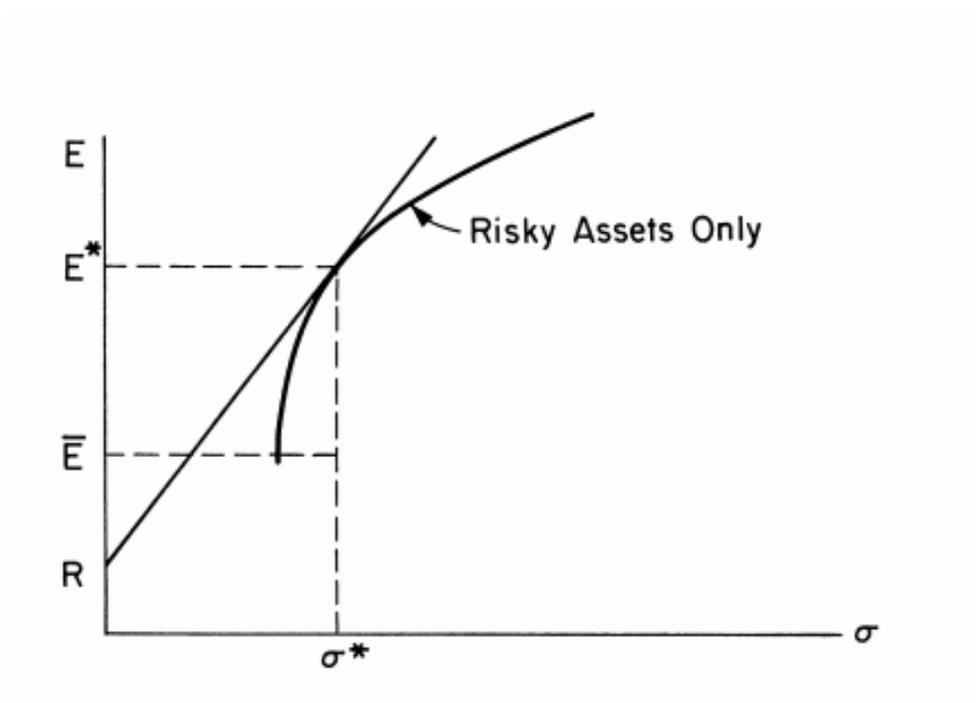


Figure 9: Efficient Portfolio Frontier.

This graph depicts how a portfolio of risky assets can be combined with a risk free asset to create an optimal portfolio (Merton, 1972, p. 1867).

Minimizing risk entails an analysis of various asset classes' standard deviations (and correlation coefficients). As mentioned previously, standard deviation is graphed on the x -axis as a measure of risk in MPT. Although the formula for calculating portfolio risk is different from calculating the standard deviation of a single asset, the concept is fundamentally the same. As more and more assets are added to a portfolio, standard deviation shrinks because of the decreasing correlation of assets to each other. In Figure 9 this is represented by the curve of risky assets only. Therefore, a simple understanding of standard deviation and asset risk can lead to the potential for future comprehension of more advanced financial topics.

Maximizing returns most directly relates to the ability to calculate and grasp expected returns. Represented on the y -axis, returns that are higher are preferred. Clearly, the ability to both mathematically calculate and interpret an expected return and to financially understand what

it represents assist in a comprehension of MPT and the formation of efficient portfolios, which is a higher level financial concept.

Specific to Figure 9, the curve represents the most efficient combination of risky assets into an optimal market portfolio. The straight line represents a potential investment in risk free assets or treasuries. This line is straight because it depends on the proportion invested in the risk free asset versus the risky portfolio of assets. The curved line represents a combination of risky assets and is curved based on the emphasis placed in riskier or safer assets. The point of intersection at (σ^*, E^*) represents the maximization of utility based on investor preferences for risk. In other words, based on an investors' risk aversion, appropriate weights to be invested in risk free assets and the optimal risky market portfolio can be determined. Consequently, standard deviation and expected returns enable knowledge extensions to more complex financial topics.

Summary

The three broad financial topics listed above— compound interest, riskiness of asset classes, and diversification and investment strategies— are certainly not an exclusive list of all of the financial topics that must be understood to be financially literate. They are, however, some of the most important simple concepts that can aid in a facilitation of financial literacy. Nowhere is this more apparent than in the combination of these topics to further higher financial understanding of MPT and the formation of efficient portfolios. Because financial literacy comprises conception and being able to make both wise saving and investing decisions, a basic understanding of these three concepts and the potential to understand a fourth more complex topic can serve as facilitators on the path to financial success.

Chapter 7

Conclusions: Implications for Decision Making and Financial Literacy Improvements

In understanding the definition of financial literacy, the levels of financial literacy observed today from both a broad and youth perspective, and the ability of financial and mathematical concepts to facilitate adequate financial knowledge, the creation of potential suggestions for improving financial decision making and financial literacy overall are possible. Substantial financial literacy has been already unmistakably attributed to more positive outcomes for individuals including more accumulated wealth and a potentially higher standard of living. Therefore, an increase in financial and mathematical knowledge and understanding is needed. It can be seen with clarity that if a significant improvement is to be made in the levels of financial literacy among the youth, the most obvious and influential place to start is education. Because it has been noted that adequate rote understanding of a subject is not sufficient, any education methods to increase financial literacy must also emphasize strategies and real world experience in financial literacy.

Several questions arise with the suggestion that including financial literacy more clearly into education is the solution. First, who should be responsible for improving education? If the new education is to be part of the public education system, at what grade levels should it be addressed? How exactly would this new material be presented and integrated? And when would this change most appropriately be made? A simple attempt to address all of these questions ensues below; however, creating sustainable change is a matter that should be addressed by future research. Exactly how to integrate financial literacy into the curriculum and the forefront of educators' agendas remains a difficult and complicated task that must be proactively pursued in order to enact a feasible change.

Who should initiate change?

There are innumerable stakeholders in a society with more financially savvy individuals including families, financial institutions, local communities, and governments. Nevertheless, not all stakeholders should be obligated to start a movement to enact improvements in the education practices of financial literacy. Resources, capital, knowledge, and experience are all inherently important to improving education. While several of the stakeholders presented above display these characteristics, not all are suited for appropriately educating others about financial and mathematical principles necessary for financial literacy due to conflicts of interest (financial institutions) or simply the undue burden the responsibility could cause (families). Out of the five options presented above, it can therefore be argued that the most influential entity capable of making a positive change in financial education is the government. With the help of policy reforms and partnerships with researchers that specialize in financial education, improved financial literacy throughout the nation may be possible.

Before turning to the government as a solution, an explanation as to why families, financial institutions, and local communities are not suitable to initiate change in financial literacy education practices must be discussed. First and foremost, placing the responsibility of financial education on families may seem to be the most direct way to impact understanding of financial and mathematical principles necessary for comprehensive financial literacy. Individual families, however, may not have access to accurate information concerning financial principles and may be ignorant of the fact that they lack financial knowledge to improve the wealth attainment of the family. In addition, families may be distracted by more pressing concerns such as managing daily finances versus engaging in smarter long-term saving and investing decisions. Families therefore lack the time and important resources required for adequate financial literacy to be expected to initiate national change in this type of education.

Financial institutions, on the other hand, may have the resources and knowledge necessary for financial literacy; yet, these establishments have serious conflicts of interest in educating individuals about financial concepts because they are often responsible for managing the money of consumers. In this way, financial institutions may selectively present information they want consumers to know while strategically leaving out other concepts that would help consumers understand terms and conditions that favor the corporation over the consumer. In no way has this been more evident than the recent financial crisis where risky loans and mortgages were issued to unknowing consumers who did not have the financial means to sustain the repayments required of the floating rate system. In this case, adequate financial knowledge is not a sufficient precondition for the improvement of financial education of consumers and the youth.

Local communities may have the best intentions in attempting to institute financial education changes through the form of increased awareness and smarter financial decision making skills of individuals in the community, yet the collective power of communities is not strong enough to generate sustainable national change. Moreover, the effectiveness of community instituted change would vary by the wealth and resources available in each community. Wealthier communities would be at an advantage compared to rural and poorer regions heightening the disparities in financial literacy based on geographic and demographic characteristics.

Furthermore, the government has the most breadth and depth to enact change throughout the education system. Although most funding for education comes from non-federal sources such as State, local and private sources, the federal government uses its 10.8% contribution to target where “its funds can do the most good” as a way to “[fill] gaps in State and local support for education when critical national needs arise” (“Federal Role,” 2012). From this point of view and based on the evidence of a financial illiteracy epidemic presented earlier, it can be argued that financial literacy education is a critical national need that the federal government should address.

In providing funding for schools to implement financial literacy instruction, society would be one step closer to improving the sufficiency of financially educated communities.

However, providing monetary support is simply not enough to enact sustainable change. The government needs to provide state policymakers with credible resources for developing and administering financial literacy education. To an extent, the government has already taken steps towards providing resources to policymakers in its formation of the Financial Literacy and Education Commission through the Fair and Accurate Credit Transactions Act of 2003. Part of the Commission's role is to create and promote a national strategy for financial education ("Financial Literacy and Education," 2012). In addition, the commission has produced a national financial education web site at MyMoney.gov that describes and provides resources for financial literacy education. Most importantly, and what could be most improved upon, is the marketing and prevalence of financial literacy research and education. In improving this aspect, the government could provide more tangible resources to state governments and policymakers, and thus serve its role as a facilitator of national financial literacy education.

If the government is to be involved in the creation of financial literacy education, it cannot ignore the role of teachers as a driving force behind education. In a 2009 study conducted by Way and Holden, less than 20% of teachers said they felt confident teaching personal financial literacy (Way & Holden, 2009). Nearly half of those surveyed, however, believed that financial literacy courses or the passing of a literacy test for high school graduation should be required. This gap in perceived competency and the belief that financial subject matter should be taught in schools signifies an important opportunity for financial literacy education. Providing resources to train and prepare teachers for financial literacy education could be a crucial facet of government involvement and one that could involve both financial and mathematical principles of financial literacy.

An exact approach the government should take in instituting greater financial literacy education may need refining through practice and research. However, based on several studies conducted concerning financial literacy, one current approach for the government to take may be mandates. In viewing the levels of financial literacy, researchers Bernheim, Garrett, and Maki (1997) examined levels of financial literacy as a function of the quality of high school mandates concerning financial literacy curriculum instead of as skill that is naturally acquired through experience (and thus observable across the entire population). By studying in 1995 the direct long term effects of mandatory financial literacy education of the youth between 1957 and 1985, it was determined that “mandates have significantly raised both exposure to financial curricula and subsequent asset accumulation once exposed students reached adulthood” (Bernheim, Garrett, & Maki, 1997, p. 1). In fact, education’s ability to support development of strong decision making skills among the youth, a key component of effective financial literacy, was also highlighted in the study. A mandate that specifically required instruction in consumer education and personal finance resulted in higher savings rates among individuals once they reached adulthood and a net worth that was one year’s worth of earnings greater for an individual exposed to that mandate (Bernheim, Garrett, & Maki, 1997). Clearly then, those students not exposed to financial concepts were at a disadvantage in their financial literacy when compared to their peers.

Another, more recent indication that progress through financial literacy education is possible was the 2011 Survey of the States conducted by the Council for Economic Education. While it noted that opposition to mandates exist, collaborate efforts to involve all stakeholders in Arkansas enabled the implementation of a required course for graduation in economics and finance (“Survey of the States,” 2011). The study indicated the adoption of state standards may set in motion more accepting attitudes towards the implementation of a financial literacy mandate. In addition, the study included research conducted by Gutter, Copur, and Garrison in 2010 that indicated “Students from states where a financial education course was required had the

highest reported financial knowledge and were more likely to display positive financial behaviors and dispositions” (“Survey of the States,” 2011, p. 4). This result is extremely important to containing and eradicating the financial illiteracy epidemic. Through education, financial literacy and all of its positive associated outcomes may be possible.

The study also observed specific statistics concerning financial education in the United States. While 46 states included personal finance in their grades K–12 state standards in 2009, only 13 states required a high school course to be taken that involved financial concepts, and only 5 states tested learning of personal finance concepts (“Survey of the States,” 2011, p. 7). Further research of the education models of Georgia, Idaho, Kansas, Louisiana, and Tennessee, states who require testing in financial literacy concepts, may therefore be beneficial to determine how effectively governments can enact standards or mandates of financial literacy.

Clearly, the study exhibits substantial room for improvement in personal financial literacy education. Based on the research presented earlier concerning financial and mathematical topics, one potential way to improve financial literacy education may be to integrate the learning into the math curriculum. Ultimately, the sentiment that “personal finance likely is not taught unless it is somehow prescribed in the standards” translates to a responsibility of the government to become involved in instituting change potentially through prescribed mathematical standards (Gutter, Copur, & Garrison, 2010, p. 7). Therefore, policy changes at the government level, with federal influence, may subsequently prove most appropriate in supporting sustainable financial literacy education change.

What grade levels should be affected?

Generally, the earlier financial concepts are integrated into mathematics education or as their own separate programs, the better. However, the degree of complexity with which the

financial and mathematical principles are presented should obviously be appropriate to the age and grade level of the students being taught. Because the crux of the argument presented rests on the assumption that financial illiteracy among the youth or college aged students is rampant and is a negative predictor of future wealth, specific financial education should start before an individual enters post-secondary school; most ideally, the concepts should be emphasized with the most importance in high school after a foundation of the mathematical principles necessary for financial literacy has been established.

Firstly, high school students have undoubtedly been exposed to using money in some way or another, and they should be able to better understand the increasing importance money will play as they look to attend postsecondary school or start a career. Students may not have dealt with large sums of money yet, but they have likely experienced using money to make purchases or to save for a coveted good. The students likely understand money's inherent worth as an exchange of value for goods and services. Therefore, students' limited familiarity in using money could be combined with principles that could be taught in high school to start improving financial literacy at a prime age.

Another reason to start the integration of financial and mathematical topics concerning financial literacy in high school is to inform students and give them practice managing money before there are higher stakes involved such as budgeting for mortgage payments or saving for a retirement fund. In simulating and understanding how to save and invest, students may acquire the skills to effectively deal with money before they actually have to. In this instance, the knowledge students acquire can prevent them from making costly mistakes when they start their college and professional careers and begin accumulating money. Therefore, the earlier understanding that could accompany the education of students in high school could prove beneficial to the decision making capabilities of these individuals as young adults and subsequently for the rest of their lives.

Lastly, because the mathematical principles discussed previously necessary for adequate financial comprehension are already embedded into national mathematical standards before grade 9, integration of financial concepts in a high school setting is a logical place to present financial topics and promote decision making skills. Simple algebraic topics, for example, are mainly introduced in middle school (grades 6 through 8), though they could be presented earlier. In fact, the National Council of Teachers of Mathematics (NCTM) notes that: “even young children can be encouraged to use algebraic reasoning as they study numbers and operations and as they investigate patterns and relations among sets of numbers” (NCTM, 2012, p. 3). Since an introduction to the algebraic concept of functions occurs before high school (grade 8), presenting the correlating financial topic of compound interest when discussing exponential functions in high school could improve students’ understanding of savings decisions.

Similarly, data analysis and probability are also first taught before high school. In fact, one grade 8 standard vital to any subsequent understanding of the financial concept of an efficient portfolio is the ability to “Investigate patterns of association in bivariate data” (Common Core, 2010, p. 56). The inclusion in the *Common Core State Standards for Mathematics* of topics that are important precursors to fundamental financial understanding further augments and supports the notion that presenting financial and mathematical topics side-by-side starting in high school may be the most appropriate course of action. For example, investing could be appropriately introduced to students and integrated into a lesson about standard deviation and the riskiness of assets. Furthermore, high school is the most appropriate time to integrate financial topics into the education system because the knowledge necessary for financial literacy builds upon mathematical topics, even if just an introduction, that are already included in the standards at lower grade levels.

How should the material be presented and distributed?

The exact format of financial education tools needs time and effort to develop. However, a more personal experience for students in the education of financial concepts will generally be the most effective in the instruction of financial literacy. This conclusion has been realized in several research studies concerning the effectiveness of attempted financial literacy education. That is, “[F]inancial education programs are most effective when they are tailored to the needs of the recipient and include face-to-face time, either with a counselor or in a classroom setting” (Martin, 2007, p. 22). By dedicating classroom time in high school to financial education, students can become exposed to simple financial principles earlier than they would be otherwise. In addition, students will have practice and experience in financial topics, which as mentioned earlier, is a positive predictor of the level of financial literacy of individuals and subsequently a predictor of future wealth.

These more personal interactions should also involve a greater emphasis on realistic examples that should be embedded into a specific classroom course when educating about financial concepts. In fact, “financial education efforts [in the classroom] are more likely to improve knowledge if the mandate requires the teaching of personal finance concepts within a specific course” (Martin, 2007, p. 15). This conclusion serves as an indication that financial education may be most influential if it is embedded into the mathematics curriculum. While compound interest may be most appropriately tied to algebraic standards for exponential functions, standard deviation and expected returns may be most suitable for standards within data analysis and probability. In addition, using realistic examples such as interest on a savings account or investigating the riskiness of current stocks could serve as beneficial learning tools for students.

Clearly, there is room for further investigation as to the best educational method for teaching financial literacy. However, from the research presented previously, it should be apparent the specific topics that should be addressed by classroom instruction include compound interest, riskiness of asset classes, and portfolio diversification at the very least. More broadly, saving and investing topics may prove the most beneficial to students to promote more responsible decision making about their finances in the future. In summation and based on the research to date, financial education should be presented in a course-oriented mathematics format with an emphasis on saving and investment topics and decision making. However, further research and evaluation of current financial literacy mandates and programs within the classroom could prove useful in making significant strides forward in eradicating financial illiteracy among the youth.

When should an attempted change be made?

Given the research presented that financial illiteracy among the youth is rampant, there is no better time to attempt to implement change than now. Clearly, the effort to improve financial literacy will be a process, but the clarity with which a need for change can be seen has never been more apparent. It may seem obvious, but waiting to start a push for change only delays the benefits that can be reaped from more educated consumers and individuals as they become involved in saving and investing activities. Therefore, the movement for change needs to be initiated as soon as possible. Companies, employees, policymakers, and communities alike have an interest in more financially educated society. These stakeholders' interests will be presented below and hopefully provide *raison d'être* for immediate action on the part of financial literacy education of the youth.

Companies have a direct interest in a more financially savvy youth generation: better informed consumers and a more knowledgeable workforce to hire. Especially for financial firms, consumers who are better able to manage their money are attractive because the companies can spend less of their time and money explaining terms and conditions of purchases and investments. Lauber, a researcher and proponent of financial literacy education argues, “If we are going to make the effort to develop a pool of informed consumers, then we must apply the same strategic planning models we use for the teaching of math, science, social studies, and other core subject areas to the teaching of financial literacy” (2010, p. 41). By including financial education as a part of mathematics education, financial literacy can be assured to part of a strategic and well developed curriculum and serve the interests of companies. An informed youth demographic is also desirable to companies for hiring purposes. Every company, regardless of industry, must have internal functions to manage the monetary aspects of conducting business operations. In addition, companies serve as valuable contributors to retirement funds for their employees. Hiring employees with previous knowledge of investing and saving decisions can therefore help stem the costs of training and programs that the companies will need to provide for employees. By enacting change sooner rather than later, companies may reap the financial and time benefits of better informed customers and workforce.

Employees also experience positive benefits from greater financial knowledge. With increasingly complex financial and consumer markets, employees have a lot of options for how to spend, save, and invest their money. Indeed, as noted by the NCTM, “[t]he underpinnings of everyday life are increasingly mathematical and technological” (NCTM, 2000, p. 4). This phenomenon results in purchasing and insurance decisions requiring a more sophisticated understanding of mathematical, and similarly, financial topics. By introducing a more thorough teaching of financial concepts in high school, those entering the workforce and becoming

employees can become more equipped to manage important financial decisions that arise during adulthood.

Policymakers, on the other hand, have a duty to their constituencies that justifies a push for increasing financial literacy education as soon as possible. Because accumulated wealth is positively correlated to financially literate individuals and because a better standard of living is a goal of policymakers that can be achieved through the accumulation of wealth, promoting legislation to create a set of national standards for financial literacy is in the interests of local, state, and national leaders. In the end, supporting financial education changes is beneficial not only to policymakers but also to the communities and societies they represent as well.

Communities are often shaped by the people that live in them, and by promoting increased financial literacy, communities can extend the positive benefits associated with financial literacy to the people that are a part of it. As was true of a 2008 survey of students that were exposed to high school mandates concerning financial literacy, with individuals becoming more likely to save, less likely to make late payments or default on credit cards, and more likely to understand the financial risks of investing, communities can embrace the positive aspects the increased financial literacy instruction provides to societies (Gutter, Copur, & Garrison, 2010, p. 2). Therefore, support of an increase in the teaching of financial concepts in high school provides favorable outcomes for communities.

The push for augmenting the education of financial principles in high schools through mandates is beneficial for a variety of stakeholders. It is this mutual interest in aiding the youth demographic to understand financial topics that will impact accumulated wealth and financial literacy that is a key determinant in the urgency to drive a change in financial education among the youth. Altering the current system of instruction may be a tedious, uphill battle, but it is necessary for stemming the financial illiteracy epidemic that faces our nation today.

Conclusion

Ultimately, financial literacy is one of the smartest investments a society can make: it is low risk with potential for a very high return. Not only is financial literacy a subject that affects every individual, but it is also a factor that shapes the ability to accumulate wealth in the future. The attempt to provide a clearer definition of financial literacy provides a foundation to view how financial and mathematical concepts work together to augment knowledge and comprehension of financial issues. In viewing the research among the overall population, it is clear that inadequate understanding of saving and investment topics has been widespread for quite some time. More specifically, it is shown that the current youth generation has insufficient and potentially detrimental comprehension of the most basic financial tools necessary to make informed decisions about saving and investing.

However, by separating financial literacy into respective financial and mathematical components it is obvious that these two fields have important connections that facilitate the development of basic knowledge and behavior concerning financial decision making later in life. Through the integration of compound interest and exponential functions, riskiness of asset classes and standard deviation and variance, and portfolio diversification and expected and weighted averages, potential educational changes can be suggested. Essentially, “it is likely beneficial to provide financial education *before* individuals engage in financial contracts and *before* they start making financial decisions (Lusardi, Mitchell, & Curto, 2010, p. 276). Viewing financial literacy as a function of financial and mathematical topics that can be taught, practiced, and experienced enables a more complete model in how individuals understand and make financial decisions.

Lastly, financial education and reform to include financial education in high school standards and classrooms is an important step that must be taken if an improvement is to be made across the nation. With the government’s support, the creation of a financial curriculum that is

embedded into mathematics courses and promotes realistic and applicable examples of the financial topics mentioned above has the potential to initiate a vast change in the competency of the youth demographic as financially savvy individuals, consumers, employees, and community members. The stakes have never been higher, and the future wealth of the youth depends upon enacting significant change.

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ACADEMIC VITA

Amy C. Twerdok

Honors and Awards

The Evan Pugh Scholar Award

Undergraduate Scholastic Award at Pennsylvania State University

University Park, PA

April 2012

- Earned for rank in top 0.5% of class (84 credits)

John, Miriam, and Robert Reed Scholarship

Undergraduate Scholastic Award in the Smeal College of Business

University Park, PA

July 2011, 2012

- Awarded for outstanding academic performance in the College of Business

Schreyer Honors College Academic Excellence Scholarship

Academic Scholarship for Enrollment in the Schreyer Honors College

University Park, PA

Fall 2009-Present

- Awarded while maintaining semester grade-point average above 3.4

Professional Experience

PNC Financial Services Group, Inc

Public Finance Intern

Pittsburgh, PA

June-Aug 2012

- Supported a relationship manager with non-profit, government, and university clients of varying sizes
- Participated in sales calls for current and prospective Public Finance clients
- Researched client backgrounds and current debt profiles before meetings with customers
- Reviewed legal documents and term sheets for business agreements with clients

Corporate Banking Middle Markets Intern

May-Aug 2011

- Assisted relationship managers with clients whose revenues ranged from \$30MM to \$500MM
- Analyzed client performance by completing economic profitability and relationship value calculations
- Used profitability models to help establish pricing for client deals
- Compiled and researched 125 clients and prospects to create detailed resource book for client calls

Morgan Academic Support Center for Student-Athletes

Academic Assistant/Tutor

University Park, PA

Aug 2010-Jan 2011

- Provided support and assistance on a flexible weekly basis in math and computer science courses
- Encouraged time management skills and study methods for students