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The Impact of Demographic Changes on Financial Markets

An empirical study of the historical relationship between age structure and real returns in the United States

Carl Frederick Bjerke

Supervisor: Michael Kisser

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NORWEGIAN SCHOOL OF ECONOMICS

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Abstract

This paper studies the impact of demographic changes on financial markets, by testing the historical relationship between US age structure and the real return of the S&P 500 index. By critically discussing relevant research on the subject, we begin by providing an overview on where we stand today. Based on the theoretical framework of the Bakshi and Chen (1994) paper we then present two hypotheses, the life-cycle investment hypothesis and the life-cycle risk aversion hypothesis, as a motivation for the following empirical tests. The life-cycle investment hypothesis states that investors initially allocate most of their wealth in housing and other durables, before they gradually begin to invest in financial assets as they grow older. The life-cycle risk aversion hypothesis states that an investor's risk aversion increases with age, increasing the risk premium demanded for holding risky assets. By replicating parts of this paper, we test both hypotheses against annual data from the time period 1950 until 2012. We also perform additional tests, using 5-, 10- and 20-year overlapping time periods to study the different components determining long-term real returns. In addition to age, the empirical tests include changes in consumption, dividend yields and term premiums, to improve the robustness of results.

The empirical results of this paper support the conclusion made by Bakshi and Chen (1994), that demographic changes have had a significant impact on capital market prices. We find annual changes in average age to be significantly and positively correlated with real returns in the following year, giving support to the life-cycle risk aversion hypothesis. We also find annual, 5-, 10- and 20- year changes in average age to be significantly and positively correlated with real returns during the same period, giving support to the life-cycle investment hypothesis. The historical correlation appears to increase with the length of each observation period, suggesting that demographic variables are best at explaining long-term movements in stock market prices. The additional variables related to consumption, dividend yields and term premiums are also significant in explaining real stock market returns.

1. Introduction

The financial press has devoted much attention to the potential effects of the large cohorts born shorty after World War II on the real economy and financial markets. This large generation, known as the baby boomers, has also lead to speculations regarding what will happen once this generation starts to retire. The objective of this paper is to critically discuss the relationship between demographic change, efficient markets theory and the predictability of financial markets.

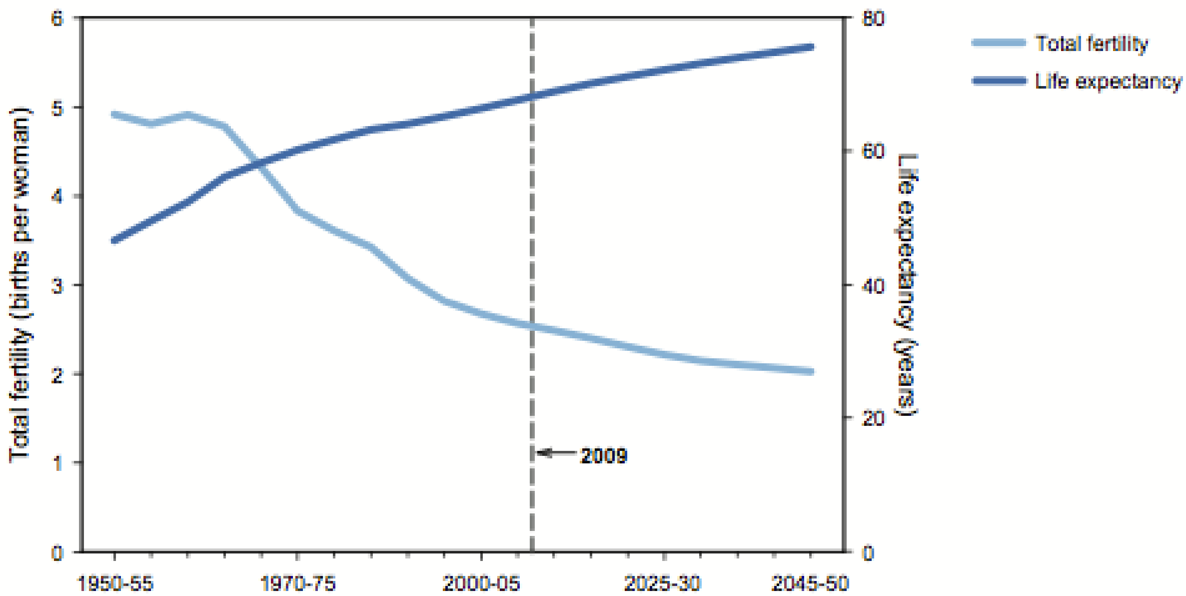
The question of whether stock market returns are predictable is an essential one within finance. After all, an investor able to predict stock market behavior could make a great deal of money by trading based on this “knowledge”. However, predicting future stock movements continues to be a challenging exercise in practice, despite countless attempts and vast amounts of research. As investors continuously calculate opportunities and threats, obtaining an information edge compared to the rest of the market seems extremely difficult. The interesting aspect regarding demographic forecasts is that they are quite accurate for several years ahead since today’s 40-year-olds are next year’s 41-year-olds and so on (Arnott and Chaves, 2012). In the empirical section we will therefore study the historical relationship between changes in age structure and the market development, to see if demographic changes hold any explanatory power when it comes to financial market returns.

1.1 Are demographics really changing?

The world population is currently aging at a pace never seen before, leading to rapid changes in the balance between different age groups (UN, 2009). The UN predicts that by 2045 the total number of people above the age of 60 will exceed the number of children (people below the age of 15), for the first time in history. The result of this process is building pressure on policy makers to implement the reforms necessary to secure the sustainability of society in the future.

Declining fertility rates combined with increasing life expectancy (see figure 1) is shifting the age distribution of populations in developed countries towards older age groups; a development that is only expected to accelerate as baby boomers get older (Anderson and Hussey, 2000). The increasing life expectancy at birth is the result of a steady decline in infant mortality combined with increasing life expectancy at older age, also known as longevity (IMF, 2012). In developing countries the population aging process is happening at an even higher pace, as medical advances have been bigger while fertility rates have dropped faster (Shrestha, 2000). Although developing countries will have less time to adapt to the changing age structure, the developed countries may actually be the ones facing the biggest challenges, as their demographic development seems to be less advantageous (Arnott and Casscells, 2003).

Figure 1) Total fertility and life expectancy at birth: world, 1950-2050

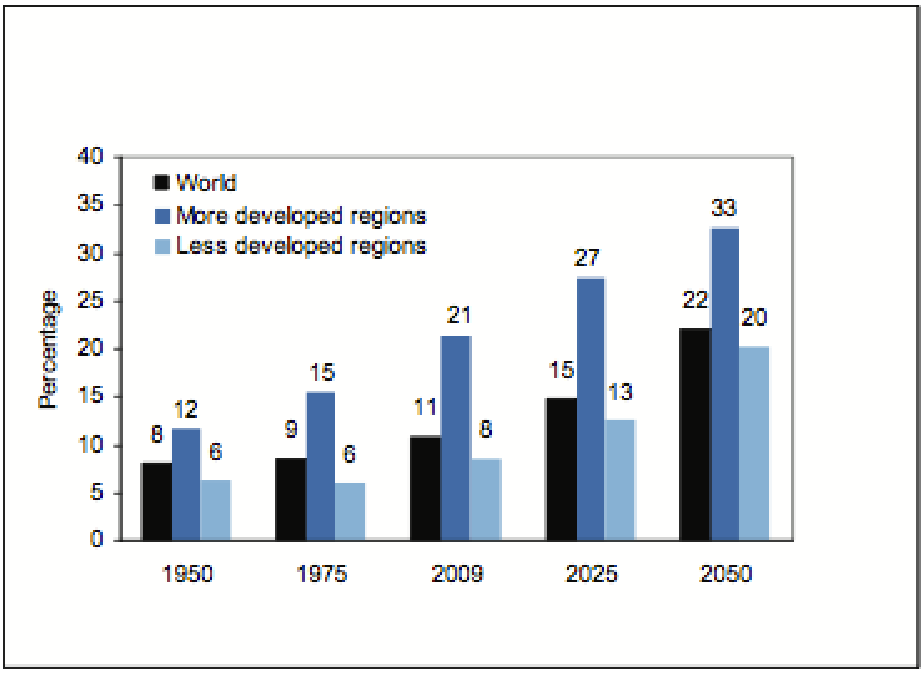


Source: World Population Aging Report, UN, 2009

Figure 1 illustrates the considerable changes we are experiencing as the development with declining fertility rates and rising life expectancy continues. The world median age, which is the age that divides the population into two equal parts, is expected to rise from 28 years in 2009 to 38 years in 2050 (UN, 2009). As a result, we expect the proportion of old people to grow as more and more people get to live long and healthy lives (see figure 2).

The direct effects of these older populations will be an increase in government expenditures and a decrease in labor supply, as seniors will consume a growing portion of each nation’s aggregated disposable income (Masson and Tryon, 1990). The economic and social consequences will affect all age groups as the dependency burden of the working population continues to increase in developed nations (Shrestha, 2000). Parts of this increased burden may however be offset by a simultaneous increase in the support capability of the working population. As their will be a limited supply of labor compared to capital, real wages are expected to rise as the country's capital intensity increases (Auerbach et. al., 1989). While population aging is expected to reduce growth in industrialized countries as the proportion of seniors rises, growth in developing nations is expected to increase as working-age populations grow larger (Batini, Callen and McKibbin, 2006).

Figure 2) Proportion of people aged above 60: world and different development regions, 1950-2050



Source: World Aging Report, UN, 2009

Figure 2 shows the historical and projected future proportion of old people (people aged 60 or above). As we can see, the UN expects the global share of old people to double between 2009 and 2050, going from 11% to 22% of the world population. In less developed regions the percentage change is expected to be even bigger with a 150% increase in the proportion of elders. It is important however to notice that their demographic transition comes from much lower levels of average age, meaning that the effect of population aging may be somewhat different than in more developed regions. As we will explain later the smaller expected change in developed regions actually causes more reason for concern.

1.2 Does it matter?

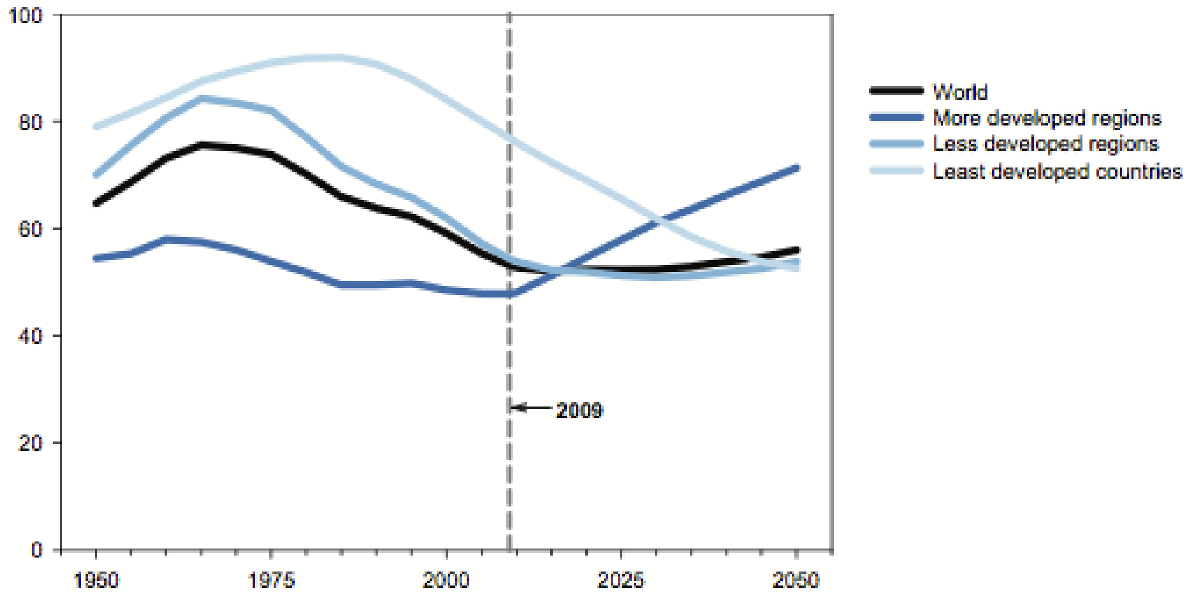
A number of studies link population age structure to important parts of the economy such as GDP growth, financial asset returns and Social Security systems (see, for example, Arnott and Chaves, 2012). However, despite vast amounts of research on the subjects, there does not seem to exist any form of consensus among scientists, as some still claim that the relationship between demographics and financial markets at best is statistically insignificant (Poterba, 2001).

The primary savers of an economy are households, and since their savings rate changes with age, the nation's savings rate should be linked to the age distribution of the population (Börsch-Supan, 1995). The saving pattern of private investors is believed to be hump-shaped, with households saving until they retire and then liquidating their financial assets afterwards (Modigliani and Ando, 1957). Studies based on this assumption find that population aging will lead to a decrease in aggregated saving in countries where the old part of the population gets larger (see Heller, 1989 or Auerbach and Kotlikoff, 1987). As a result the fastest aging countries could experience a considerable decline in aggregate savings as retirees run down their financial assets (Batini, Callen and McKibbin, 2006). Other studies have, however, come to different conclusions, finding that people continue to save even after they have retired (see, for example, Poterba, 1994).

Young adults are the driving force of GDP growth as their entry into the labor market increases the size of the working population (Arnott and Chaves, 2012). As a result GDP growth in most countries is expected to decline as populations grow older and the proportion of young adults becomes smaller. Arnott and Chaves also find that middle-aged adults have the biggest impact on capital market returns as their income catches up with their consumption, and they begin to purchase financial assets. For developing countries with younger populations, population aging may increase the proportion of middle-aged adults, increasing demand for financial assets. In most advanced economies, on the other hand, aging will mainly increase the proportion of seniors, and the effect on stocks and bonds will therefore depend on risk preferences among old investors.

Macroeconomic textbooks (see, for example, Blanchard and Johnson, 2013) define total dependency ratio as the total number of people depending on others for support divided by the size of the working population. The ratio is commonly used as an indicator to describe the demographic development in a population over time. The intuition is that children and seniors do not work, thus making them dependent on the working aged population between the age of 15 and 64. This assumption is of course not completely accurate, as the number of workers may deviate from that of the working-age population for a number of reasons, such as for instance unemployment or early retirement.

Figure 3) Total dependency ratio: world and different development regions, 1950-2050

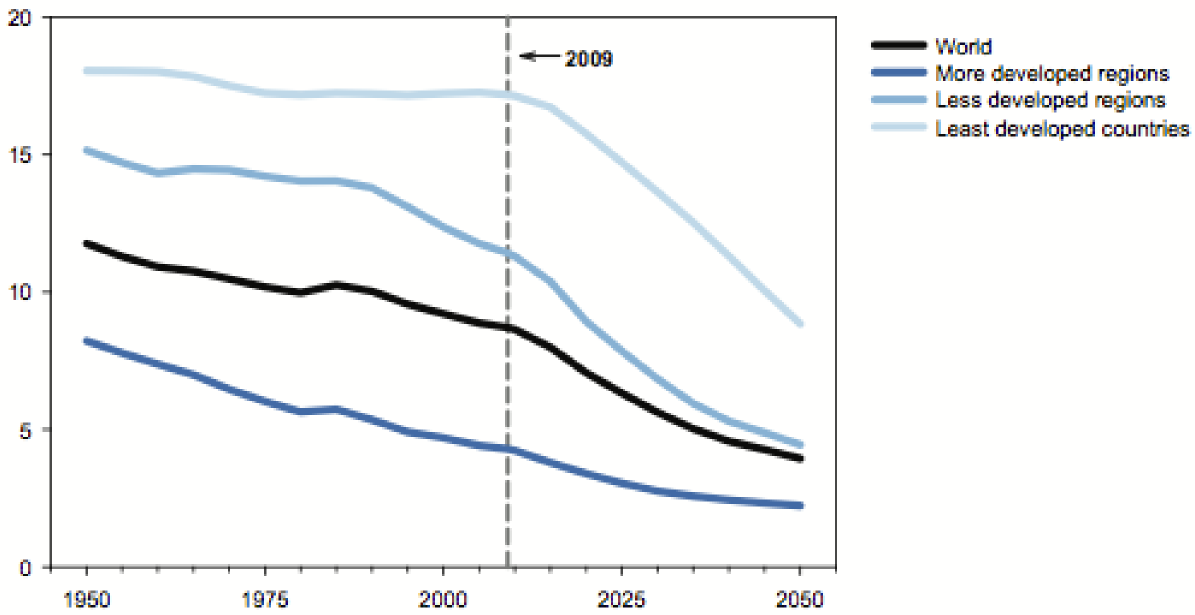


The total dependency ratio is calculated by dividing the number of people below the age of 15 or above the age of 64 with the number of people between 15 and 64, expressed per hundred people. Source: World Aging Report, UN, 2009

By studying figure 3 we can see that the global total dependency ratio has decreased steadily from the late 1960s until now as a result of changes in fertility rates and life expectancy, as described before. We can also see that there are considerable differences between the different development regions both in the past and the expected future development. While total dependency in more developed regions has already started to rise, the least developed countries are likely to experience a continuing decline. These differences give us reason to believe that also the demographic effect on society will differ between the development regions. The effect of changes in total dependency may seem counter intuitive in the way that any decrease reduces the burden on the working population, which is positive for the economy, and vice versa. As the figure shows, developed countries are projected to experience the fastest increase in total dependency, meaning that it is likely that they will also face the biggest challenges.

Another common measure of demographic development is the potential support ratio, defined as the number of workers per retiree. Providing us with a rough estimate of the retirement burden of the working population, this ratio is more intuitive than the total dependency ratio in the sense that an increase is considered to be good for the economy. A high potential support ratio implies that there are many workers to split the cost of financing the retirement of each senior, while a low ratio implies that the proportion of people receiving pension benefits is high compared to the number of people paying taxes.

Figure 4) Potential support ratio: world and different development regions, 1950-2050



The potential support ratio is calculated by dividing the number of people aged between 15 and 64 by the number of people above the age of 64.
Source: World Aging Report, UN, 2009

By looking at figure 4 we can observe several interesting trends. First, we see that the lowest potential support ratios are found in developed countries, implying that the share of seniors in these countries are considerably higher than in other regions. Secondly, we see that while the least developed countries have the highest potential support ratio they are also expected to experience the fastest decline over the next couple of decades. Even more interestingly, comparing figure 3 and figure 4 reveals that the declining total dependency in these regions is the result of a declining proportion of children, since the potential support ratio shows that the proportion of seniors will increase in these countries as well.

Following Romer (1990), Cutler et al. (1990) suggests that the incentives to innovate are strongest when the supply of labor is scares. Studying 29 developed economies, they find that the annual labor productivity growth increased as the labor force growth decreased between 1960 and 1985. As a result the projected demographic change over the next couple of decades may provide us with opportunities as well as challenges

1.3 How will this affect financial markets?

During times when large cohorts are born people tend to spend relatively more of their income on consumption and save less, than in periods when the number of child births is lower (Brooks, 2002). Basic economic theory states that in a free market, prices are set on the basis of supply and demand (Smith, 1776). Any shortfall in supply will lead to competition among buyers, making them eventually bid up the price. Similarly, if supply exceeds demand suppliers will be forced to reduce their asking price in order to attract new buyers into the market. This implies that the ratio between sellers and buyers of an asset should affect market prices as any transaction requires both a seller and a buyer.

The effect on financial assets is less clear-cut. Some theories predict declining asset prices as baby boomers reach retirement, arguing that there will be a shortage of buyers compared to the large cohort wishing to cash in their financial assets (see, for example, Siegel, 1998). Others argue that if markets truly are forward-looking, than any expected decline in asset prices should lead investors to sell their assets today eliminating any expected future movement in prices (Poterba, 2004). In addition workers may anticipate the generosity of government pension schemes to be significantly reduced in the future, and as a consequence increase their savings rate in an attempt to reduce the negative income effect (Auerbach et al., 1989).

This paper will provide a summary of the ongoing debate among academics and practitioners regarding whether demographic changes will affect asset prices or not. The topic is important as changes in asset prices may not just affect the returns of investors, but the economy as a whole (Siegel, 1998). As such, we will divide the literature into two groups; advocates of efficient markets and advocates of life-cycle consumption patterns. The theory on efficient markets argues that all available information will be reflected in asset prices at any given time (Fama, 1970) meaning that any expected future change in demographics should have no effect on prices. The macro literature on the other hand argues that prices are set on the basis of supply and demand, and that the demand for financial assets changes with age (Modigliani and Brumberg, 1954). Both views will be described in more detail in the theory section, with emphasis on how they relate to demographic change.

2. Theory

The effects of changing demographics has been a subject of great interest for many years, leading to a vast amounts of research completed on different parts of the topic. This section is meant to provide a brief presentation of the theoretical framework that will be discussed in the empirical section later on. Given the limited length of this paper, we focus on the parts of each theory that are particularly relevant to this topic.

2.1 The Efficient Market Hypothesis

The efficient market hypothesis (EMH) states that in an efficient market security prices should fully reflect all available information at any time (Fama, 1965b). As a result, changes in prices should be impossible to predict as prices fluctuate randomly (Samuelson, 1965). The unpredictability of price changes is the aggregated result of an army of investors actively seeking to profit from their information, and by doing so eliminating any profit opportunities that may have motivated them to trade initially (Lo, 2007). The EMH assumes that agents maximize their utility and that they have rational expectations. The last assumption implies that, while some investors may be wrong about the effect of new information, the market as a whole is always right. According to the EMH, this makes it impossible for investors to make abnormal profits over time, also known as to “beat” the market, especially when we include transaction costs.

Fama (1970) divides market efficiency into three forms, weak-, semi-strong- and strong-form efficiency, each of which include different assumptions on how the market works.

- Weak form efficiency states that market prices should reflect all historical data. This means that excess returns should not be possible over time by using strategies based on historical prices or trading volumes. EMH claims that asset prices follow a random walk, meaning that asset price trends or patterns do not exist. If weak-form efficiency holds all sorts of technical analysis and algorithm trading should be useless in trying to systematically profit from the market’s inefficiencies.
- Semi-strong-form efficiency states that all new public available information is reflected in asset prices immediately. This form of market efficiency implies that fundamental analysis, which is the most common kind of equity research, holds no

value at all. As a result investors should be better off by investing in a broad index as opposed to actively trying to outperform the market by picking single stocks.

- The last form of efficiency is the strong form where asset prices should reflect all information, both public and private, meaning that no one should be able to earn any abnormal returns. If strong-form efficiency holds than not even insiders should be able to predict future stock price movements better than the market, making all regulations regarding shareholder information and inside trading redundant.

In his book, A Random Walk down Wall Street, Malkiel (1973) argues in favor of the EMH by examining popular investing techniques, such as technical and fundamental analysis. Malkiel finds significant flaws in both techniques, leading him to conclude that most investors will be worse off by following these methods rather than following a passive investment strategy. Malkiel also criticizes actively managed mutual funds for their varying results over time. He argues that returns from these funds tend to return to the average performance, before costs and fees, hereby reverting toward the mean. Some of his later studies (see, for example, Malkiel, 2003; 2005) also show that professional investment managers do not outperform their index benchmarks, providing evidence that the EMH still holds well. He concludes that whatever pricing irregularities found in the past are unlikely to persist, and do therefore not provide investors with a way of obtaining extraordinary returns.

As a response to Burton Malkiel’s book, Lo and MacKinley (1999) present an alternative view on the subject in their book, A Non-Random Walk down Wall Street. They conclude that financial markets are in fact predictable to some extent, but rather than being a symptom of irrationality they see predictability as a necessity in order for the capitalistic system to function properly. They argue that outperforming the market over time is difficult, as it requires continuous hard work and constant innovation. The initial framework of the EMH has later been extended to allow for risk-averse investors in different versions where price changes are weighted by aggregate marginal utilities (see, for example, LeRoy, 1973 or Rubinstein, 1976). In markets where all investors have rational expectations, prices do fully reflect all available information and marginal-utility-weighted prices fluctuate randomly (Lucas, 1978).

2.2 Random Walk Hypothesis

An important part of the theoretical reasoning behind the EMH is that of the random walk hypothesis (RWH), arguing that stock price movements are in fact random. A number of tests, comparing the frequency of sequences and reversals, such as Cootner (1962; 1964), Fama (1963; 1965a) Fama and Blume (1966), and Osborne (1959), all provide empirical support for the RWH using historical stock price data. However, later studies, such as Lo and MacKinley (1988), reject the RWH for weekly US stock return indexes from 1962 to 1985. They find a positive serial correlation in weekly returns, causing variance to grow faster than linearity as the holding period increases. Another phenomenon contradicting the RWH is that average daily stock return variances are considerably lower over weekends and holidays, suggesting that trading itself creates volatility (French and Roll, 1986). For longer holding periods Fama and French (1988) and Poterba and Summers (1988) find negative serial correlation in US stock return indexes using data from 1926 to 1986. However, their results are not statistically significant meaning that they are insufficient in order to reject the RWH. A third potential departure from the RWH is that of long-term memory, implying that observations done in the past are correlated with observations in the future, even over large time spans. There is, however, little evidence of long-term memory in stock market prices, and departures from the RWH can be fully explained by conventional models for short-term independence (Lo, 1991).

Variance bounds tests

In an uncertain world, the market price equals the expected present value of all future dividends, discounted at the appropriate risk-adjusted cost of capital, and conditional on all available information (Grossman and Shiller, 1981). This is the starting point for several studies comparing the variance of stock market to the variance of present values of future dividends, measured *ex post* (see, for example, LeRoy and Porter, 1981 or Shiller, 1981). Using annual US stock market data from various sample periods, both papers find that the variance bound is violated dramatically. Based on his results Shiller concludes that stock market prices are too volatile, meaning that the EMH should be rejected. Several researchers have later come up with different conclusions, challenging Shiller by arguing that the variance bound violation may just as well be the result of the sample size (see, for example, Flavin, 1983; Kleidon, 1986 or Marsh and Merton, 1986). These issues are also discussed in later papers such as Gilles and LeRoy (1991) and Merton (1987). Another way of interpreting violations of the variance bound is as a sign of risk aversion among investors meaning that it does not violate the EMH (Lucas, 1978).

Overreaction and underreaction

Muth (1961) finds that in general expectations are found to underestimate the extent of changes that actually take place in the future. The market does not always respond proportionately to new information, causing prices to deviate temporarily from their "fair" market value. For example, stocks that have enjoyed recent gains tend to attract new investors who will bid up prices, beyond what is rational. Eventually, rational investors take advantage of the situation and sell the stock, bringing prices back to their fair level. This creates what is known as price reversals, meaning that what goes up in one period is likely to come back down in the next. The phenomenon is empirically documented by DeBondt and Thaler (1985), who show that winners and losers over the last 36- month period tend to reverse their performance in the following 36-month period. Contrarian investment strategies attempt profit from these overreactions in the stock market by purchasing "losers" and selling "winners", in order to obtain abnormal returns. Lehmann (1990) finds that a portfolio containing long positions in losers financed by short position in winners on average yield positive monthly returns, by studying US stock data from 1962 to 1985. Supporters of the EMH however, argue that studies supporting the profitability of contrarian investment strategies do not adjust returns for the changing risk. By doing so, Chan (1988) shows that the expected returns of any contrarian strategy are consistent with the EMH.

Anomalies

An anomaly is a regular pattern in the return of an asset, which is reliable, widely known among investors, and unexplainable (Lo, 2007). An example of an anomaly is the "size-effect", implying that small companies offer higher risk-adjusted expected returns than other companies (Banz, 1981). The similar pattern of small-cap stocks outperforming the returns of blue-chip stocks around new-year is found in numerous papers such as Keim (1983), Roll (1983), and Rozeff and Kinney (1976). This so-called "January effect" is difficult to reconcile with the EMH because it is widely referred to in the financial press and still seems to occur almost every year. Other documented anomalies are the profitability of medium-term momentum strategies (Jegadeesh and Titman, 2001), and the relationship between price/earnings ratios and expected returns (Geanakoplos, Magill, and Quinzii, 2004). By studying the post-war time period, Geanakoplos, Magill, and Quinzii finds that high P/E ratio on average are followed by low rates of return, while low P/E ratios are followed by high rates of returns. The fact that most of these relatively easy trading strategies can be exploited by investors seems to be a clear violation of the EMH (Lehmann, 1990). Supporters of the EMH, on the other hand, argue that these anomalies are difficult to exploit due to transaction costs. Perceived patterns in historical data may also be the result of nothing but pure coincidence (Brown et al. 1992).

Behavioral critiques

Behavioral scientists argue that human decision-making under uncertainty may deviate considerably from what is assumed in the EMH. A number of so-called behavioral biases may lead to irrational behavior among investors, as their relative risk aversion changes depending on the situation (Kahneman and Tversky, 1979).

Market efficiency and demographic change

The most common argument made by supporter of the EMH is that any slow-moving and predictable change in demographics is already incorporated in today’s prices; meaning that the effect of demographic changes on financial markets should be insignificant (Arnott and Chaves, 2012). Several papers however explain how, even in the case where investors act completely rationally, demographics can affect the returns of financial assets (see, for example Abel, 2003). The intuition is that since only living generations trade in financial markets at any given time, differences in the supply and demand for financial assets cannot be arbitraged away (IMF, 2004). Another paper supporting the case of demographics is Geanakoplos, Magill, and Quinzii (2004), finding that the turning points of stock prices and P/E ratios synchronize well with the demographic cycle, measured by the M/Y ratio (middle-aged to young adults). DellaVigna and Pollett (2003) comes up with a moderate result suggesting that demographic changes expected to happen more than six years into the future do not have any significant effect on asset prices, while changes expected to happen closer in time do. Defending the EMH are papers such as Poterba (2001), studying the historical relationship between demographic structure and real returns on Treasury bills, long-term government bonds, and corporate stock, using data from the United States, Canada, and the United Kingdom. His empirical results suggest that it is difficult to find a robust relationship between asset returns on stocks, bonds, or bills, and the age structure of the US population over the last seventy years.

2.3 The Life-Cycle Hypothesis

The life-cycle hypothesis (LCH) is an economic theory explaining the consumption decisions faced by consumers over time (Modigliani and Brumberg, 1954). The theory is built on the notion that consumers seek to smooth their consumption over time in order to maximize their overall lifetime utility. By borrowing in some periods and saving in others, individuals are able to adjust consumption to their needs at different stages in life, independently of their income at each stage. As a result a person's savings rate is expected to change over time, following what we call a life-cycle pattern.

The LCH rate is believed to be hump-shaped for the typical investor, with income only exceeding consumption in the middle-aged period (Modigliani and Ando, 1963). Young people, for instance, borrow from their future income while taking an education hoping that it will pay off later. Middle-aged people, on the other hand, tend to save money for retirement (future consumption) while they are still working. However, later empirical studies have found that average wealth decreases much slower than predicted by Modigliani and Brumberg, leading to considerable intergenerational transfers through bequests (see, for example, Kotlikoff, 1988 or Dynan, Skinner and Zeldes, 2002).

In addition to being able to predict the consumption patterns of individuals, the LCH explains how a nation's wealth is passed around between different generations. Young people, on average, start off with little wealth and then gradually accumulate assets during their working years. As individuals approach retirement age their wealth peaks right before they begin to sell off assets in order to finance consumption. The buyers of these assets are young adults saving for their own future retirement, and so the process continues with ownership being handed from one generation to another.

With a growing population there will be more young people than old, meaning that there will be more people saving than dissaving. Income growth will have the same effect, as young people save on a larger scale than the old are dissaving. The LCH is therefore useful when predicting aggregated net savings, since it provides us with a framework to estimate the ratio between net borrowers and -lenders. Unfortunately the LCH does not explain how the typical investor's portfolio composition changes over time, which is important to determine the demand for each asset class separately.

2.4 Where do we stand today?

Even though research performed by academics and practitioners has provided us with useful insight on the effects of demographic changes, available projections on asset prices still involve a great deal of uncertainty. Some theoretical models predict a sharp decline in financial asset prices as the baby boom generation retires and start liquidating their investments to finance consumption (see Abel, 2000 or Brooks, 1999). Their argument is that a shortage of young investors to buy their assets will reduce the price baby boomers receive for their stocks and bonds. Others argue that the market is efficient, meaning that prices today already reflect all available knowledge about future demographic trends. If this is the case, then the economic effects of large cohorts entering retirement should not be enough to move asset prices in either direction. In fact, Poterba (2001) finds that there exists very little or no relationship between population age structure and asset returns, making predicted changes in asset prices highly unpredictable.

Based on currently available knowledge, an asset meltdown as described by Abel (2000) and Brooks (1999) seems unlikely. Since the financial asset sell-off during retirement happens at a much slower rate than the asset accumulation during working years (Poterba, 2001), asset demand may not decline at all even as baby boomers retire. Nevertheless there are several reasons why a decline in the prices of risky assets should not be ruled out. First, almost all models studying the potential impact of an aging population predict falling asset prices as the result. These models are all based on the intuition from the Life-Cycle Hypothesis, assuming a hump-shapes savings pattern for the average investor. By accumulating assets during their working years, and then gradually selling them off during retirement the investors seeks to maximize his overall lifetime utility.

Research, however, shows that many people do not sell all their financial assets when they are old as expected, which can be explained by a number of reasons (see, for example, Ang and Maddaloni, 2003). In countries where public social security systems are generous, the answer might be that people do not sell their financial assets simply because they do not need the money. Other important factors could be the desire to leave something behind for family members or longevity; the uncertainty surrounding how long people will live (see, for example, IMF, 2012). Even though medical breakthroughs are good news for old people, it also created uncertainty regarding whether they eventually will run out of savings or not. Without the possibility of getting a job and generating paychecks later on, seniors tend to play it safe when adjust their consumption to their remaining wealth. It is interesting, however, to notice that in countries where retirement relies more on individual savings, people tend to behave more similar to what the life-cycle hypothesis would suggest.

3. Data

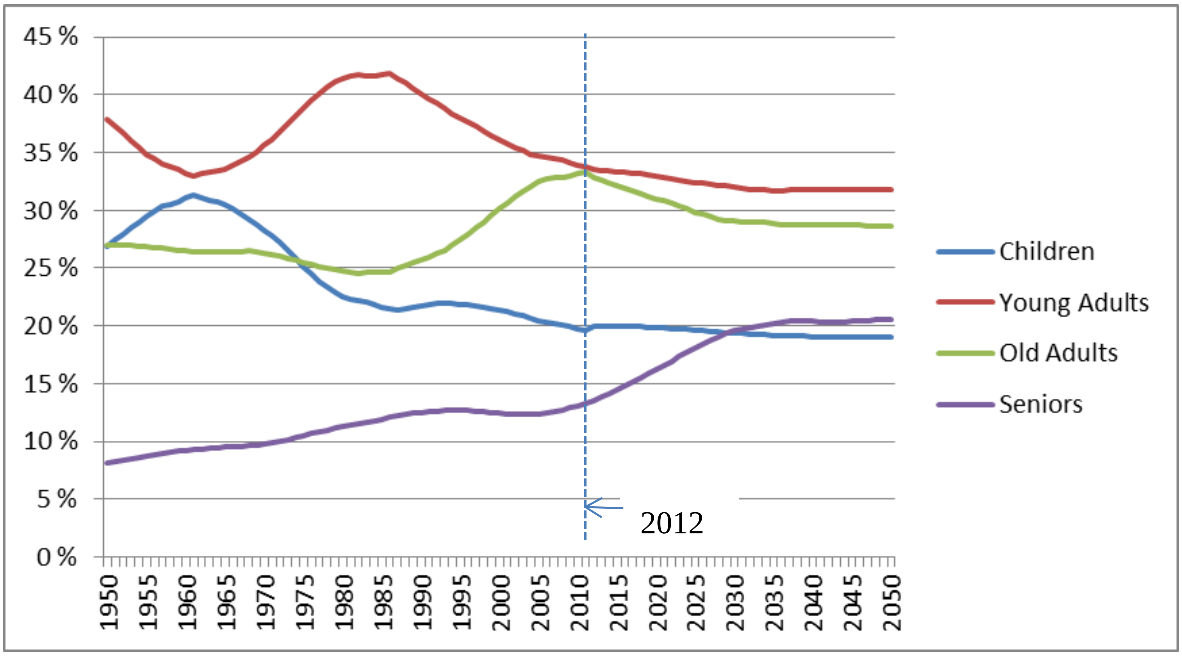
In this paper we study time series data from the 63 year period 1950 to 2012 presented in chronological order. Since demographic changes are slow moving compared to the returns of financial assets (Yoo, 1994), using low frequency data when studying the relationship between the two should provide results with a higher significance than using high-frequency data. The dataset is therefor based on annual observations, removing the challenge of any seasonal variations in the variables that may exist. We do not use a longer data set due to the extraordinary effect of World War I and II on demographic and economic figures.

3.1 Demographic development in the US

In this paper we chose to focus on the United States, when trying to explain how demographics may affect financial assets. We chose to study the US financial market for a number of reasons. With the largest and most developed stock market in the world, the US offers good liquidity and a high degree of market participation. In addition the stock market is well diversified, preventing single factors from distorting empirical results. This could for instance have been the case had we studied a commodity based economy such as Norway where returns over the last couple of decades has been largely influenced by the oil age. As a result anything that has gone up in this same time period could be misinterpreted as an explanatory factor of the high economic growth. Finally US data are highly reliable and easy accessible, making them well suited for this paper where we are interested in relationships and not the numbers themselves.

Since 1940 US longevity has increased much faster than the retirement age for full Social Security and Medicare benefits, raising the question of how society is going to be able to finance its future retirement obligations (Arnott and Casscells, 2003). As the population ages, the falling potential support ratios will increase the retirement burden of the working population. The expected wave of seniors has created building pressure to privatize social security systems raising the question of who, in terms of which generation, should cover the transition costs (Brooks, 2002). Brooks finds that baby boomers are expected to be better off than smaller cohorts around them, and there is therefore no reason why they should be exempted from contributing to Social Security reforms through benefit cuts. Despite lower expected returns on their retirement savings, they will be better off than both their parents and children in terms of lifetime consumption. However, Arnott and Casscells (2003) finds that the biggest challenge is not the failure to prefund future retirement obligations, but the changed support ratio as a result of demographic change. Since goods and services needed in the future will have to be provided by someone willing to provide these goods and services, the economic effect is likely to be poor asset returns, rising inflation and reduced Social Security benefits, which combined will drive people to work a bit longer. Increased immigration is projected to reduce the shortage of labor caused by retiring baby boomers (Little and Tries, 2001), but this will not be enough to offset the expected demographic change.

Figure 5) US age distribution, 1950-2050



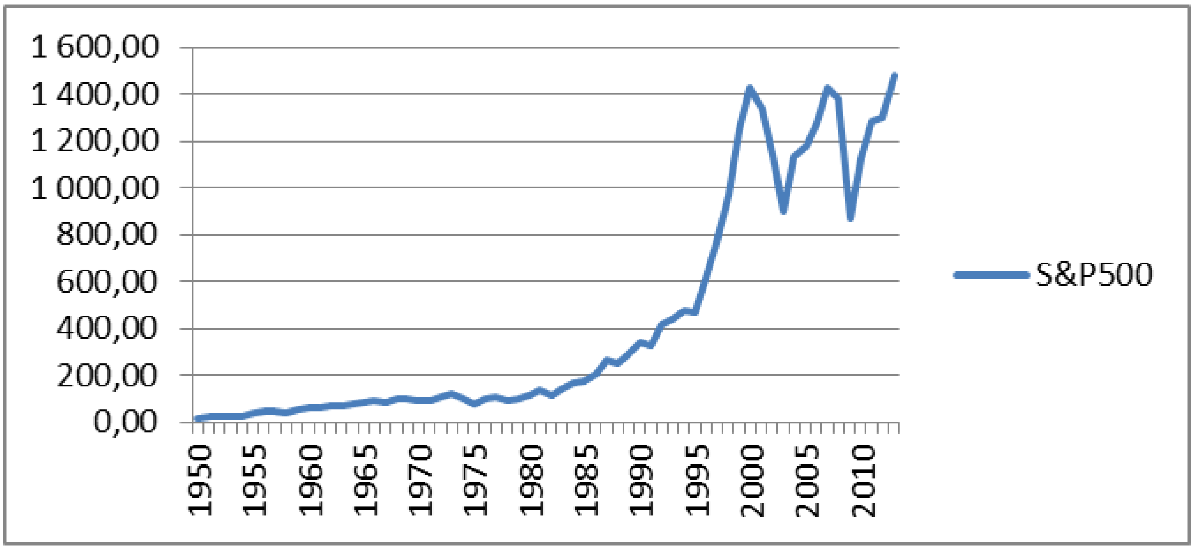
Children are defined as people aged 0-14, young adults 15-39, old adults 40-64, and seniors above the age of 65. Source: US Bureau of Census, 2012

If we study figure 5, we can observe the clear impact that the baby boom generation has had on the US age structure. The increasing proportions of children from 1950 until the early 60s, young adults from the early 60s until the late 80s, old adults from the late 80s until around 2010, and finally the projected increased proportion of seniors from 2010 to 2035, are all the result of the baby boomers.

3.2 Stock Market Development

As a proxy for the development of the US stock market we chose to look at the historical development of the S&P 500 index, measured annually. Observations are obtained from Shiller Data (2014) with prices measured in January each year. Prices are adjusted for any dividends or splits and we assume that all dividends are reinvested into the index.

Figure 6) S&P 500 index



Note: Historical prices are adjusted for dividends and splits. Source: Shiller Data, 2014

As figure 6 shows, the S&P 500 index has increased from 16.88 to 1480.40 over the 63-year period, making the January 2013 total value of the stocks included in the index 8.67 times higher than what it was in January 1950. However, when studying financial data we are primarily interested in the return investors would have made from purchasing an asset, and not in the prices themselves. We therefore calculate the historical returns of the S&P 500 index (K_t), defined as the change in prices from one year (Y_t) to the next (Y_{t+1}).

Whenever we talk about stock market returns, we normally focus on prices, and whether they have gone up or down over the last period. It is important, however, to remember that from an investor's point of view it is the total return that is interesting and not just the capital gains. In the dataset we have therefore included any dividends received during the year (D_t). This provides us with the following formula for the annual total return of the S&P 500 index.

$$Total\ Return\ \% = K_t = \frac{(Y_{t+1} - Y_t + D_t)}{Y_t} \times 100$$

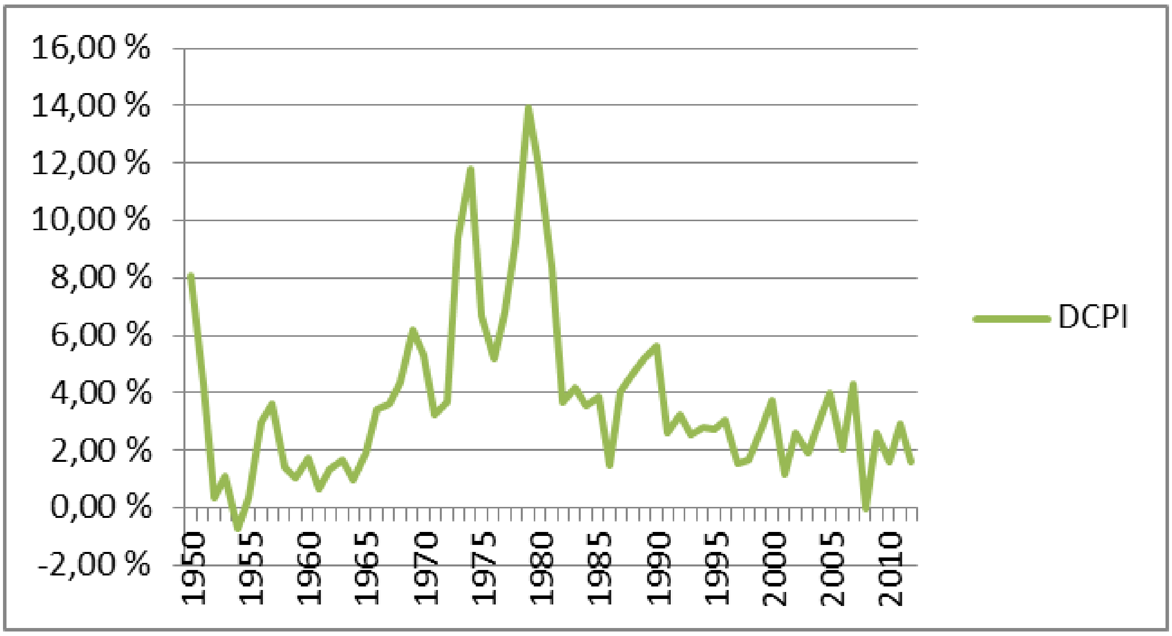
Another important concept when studying the returns of financial assets is that of the excess return. Defined as the difference between the return of the financial asset and the return of a safe asset, defined as risk-free (e.g. some government bonds), excess return gives us the risk premium of the investment. The intuition is that investors will only be willing to assume risk if their expected return exceeds that of the safe asset. It is therefore the excess return, and not the simple return, that determines the attractiveness of a certain investment.

In this paper we focus on real returns as an alternative way of measuring the risk premium received by investors. Over time the general price level in the economy tends to increase as a result of inflation, meaning that the value of a dollar today is less than what it was back in 1950. Since investors are mainly interested in changes in the real value of money, we adjust our total returns for this effect, obtaining what we define as real returns. These can be seen as the "true" return of an investment because they measure the change in purchasing power. Real returns are calculated by adjusting the nominal total return (K_t) for inflation (π_t).

$$Real\ Return\ \% = R_t = \frac{(1 + K_t)}{(1 + \pi_t)} - 1$$

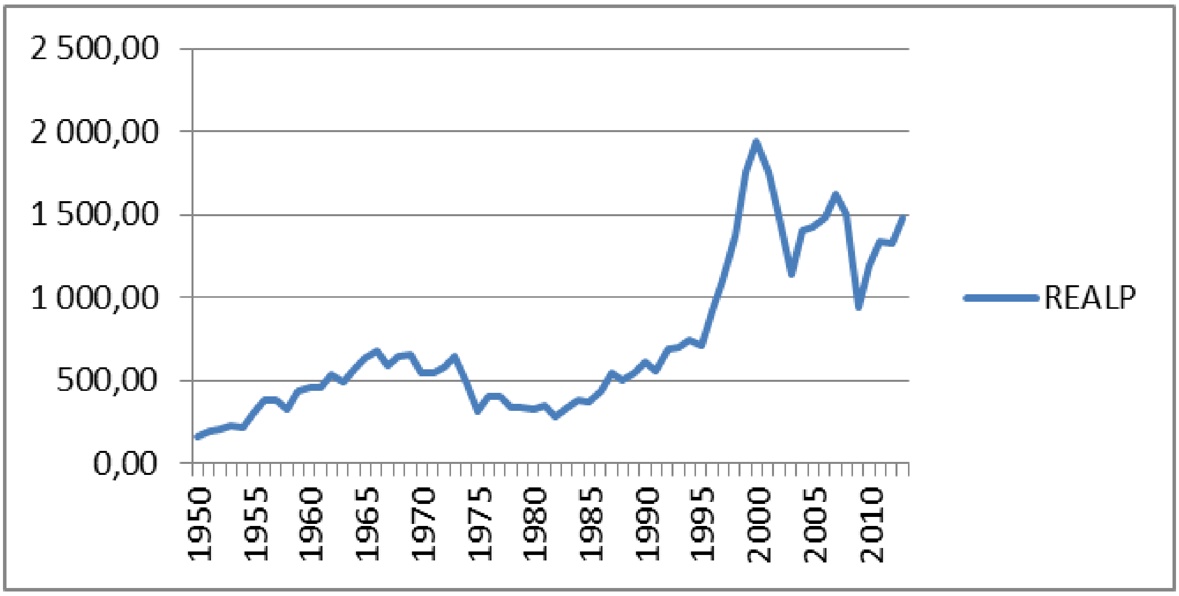
A common way of measuring inflation is by studying the changes in the Consumer Price Index (CPI). The CPI measures the general price level of the economy and data are obtained from Shiller Data (2014). The main focus here is also on CPI changes, and not on the real prices themselves.

Figure 7) Annual change CPI



Looking at figure 7, we see that US inflation rates have been between 0 and 4% during most of the time period. A clear deviation from this though is the high inflation rates of the 1970s and early 80s, where we can see that prices increased as much as 14% in a single year.

Figure 8) S&P 500 real prices



Note: Real prices are given in 2013 dollars

As we can see from figure 8, the return of the S&P 500 index over the 63-year period has been clearly positive, even when adjusted for inflation. Measured in 2013-dollars prices have increased from 165.41 in January 1950 to 1480.40 in January 2013. As a result 1 dollar invested in 1950 would be worth almost 9 dollars by the end of 2012. Studying the graph we can divide this time period into three different parts, the boom from 1950 until the late 60s, the bust from the late 60s until the early 80s, and the following boom from the early 80s until 2013. We also see that volatility seems to be higher in the years after 1995 compared to the rest of the time period. If we compare figure 8 to the previous two figures (6 and 7), we also see that the decrease in real prices from the late 1960s until the early 80s came mainly as a result of high inflation, and not as a result of a drop in nominal prices.

3.3 Economic Development

In addition to studying the relationship between changes in age distribution and real returns, we will include some economic variables to see how well they explain the real return variations. The economic factors included in the empirical section are consumption, dividend yield and term premium. All data for these three variables are obtained from Shiller Data (2014).

Consumption in this paper is real per capita spending on consumer goods, such as nondurables and services, each year. In an economy consumers can basically choose between consuming and saving/investing any available income. This implies that a dollar spent on consumption means a dollar less to invest in durable goods, like housing or stocks.

Dividend yield is the sum of all dividends received from holding the S&P 500 index over a year divided by the price of the index in January. Dividend paid in one year is normally issued the year before meaning that there is a one-period lag between earnings and dividends when we use annual observations.

Term premium is the liquidity premium received by investors for holding bonds with long time to maturity compared to holding short-term bonds, like T-bills. The term premium can be either positive or negative depending on the shape of the yield curve. Over time, however, long-term investments need to yield a higher return than short-term investments in order to incentivize investors to choose such bonds or other securities.

4. Methodology

In the empirical section we start by replicating parts of the Bakshi and Chen (1994), using the updated dataset. It is important, however, to notice that while Bakshi and Chen use excess returns as their dependent variable, this paper we uses real returns instead. Since investors are mainly interested in purchasing power changes, inflation determines the attractiveness of the return of an investment. We study the statistical impact on real returns of changes in demographics, consumption, dividend yields and term premiums. The variables used in the first two regressions are exactly the same as the ones used by Bakshi and Chen (see table 1 for definitions). In addition we also introduce a number of modified versions of the same variables (defined in table 2), measuring development over longer time periods. In the remaining parts of the empirical section they are used to study how time-period length affects the statistical significance of the explanatory variables.

4.1 Definition of Variables

Our definitions of annual variables follow Bakshi and Chen (1994), with all calculations done as similarly as possible. The only variable calculated in a different way is AGE_t. While Bakshi and Chen use 5-year age groups when calculating the average age of adults our data set allows us to use single-year age groups instead. This improves accuracy as it reduces the possible delays in the observed effect of particularly small or large cohorts. In addition our final age group is 85 and above, instead of the Bakshi and Chen which ends at 75 and above. We have extended our dataset to include detailed demographic information for 10 more years as a consequence of the increased life expectancy. This way our updated variable should be able to include any change in investment behavior among seniors as well.

Table 1) Annual Variables

C_t =	Real per capita consumption of nondurables and services in year (t – 1). This equals the nominal per capita consumption deflated by the January producer price index of year t.
$DCONN_t$ =	Percentage change in real consumption of nondurables and services from year (t – 1) to year t.

$RETURN_t$ =	Real rate of return on the S&P 500 with dividends included. The real S&P 500 index is the January value of the nominal S&P 500 index deflated by the January producer price index. The dividends are the most recent year's dividends on the S&P 500 stocks.
$DIVYLD_t$ =	Dividend yield on the S&P 500. The dividend yield on the S&P 500 equals the sum of dividends on all S&P 500 stocks over year (*t* – 1) divided by the January S&P 500 index of year *t*.
$TBILL_t$ =	Real rate of return investing for 6 months, first in January at the January 4-6-month prime commercial paper rate and then continuing for another 6 months at the July 4-6-month prime commercial paper rate. The Federal Reserve Board discontinued its 6-month commercial rate series August 1997. After that, the 6-month Certificate of Deposit rate, secondary market, is used.
$TERM_t$ =	Term premium. The difference between the yield of a portfolio holding Aaa-rated bonds and the nominal interest rate. We use the 10-year US government bond as a proxy of the Aaa-rated portfolio of bonds.
AGE_t =	The year t average age of the adult population. It is constructed as $$\mathrm{AGE}_t = \sum_{i=1}^{66} A_i \times \frac{N_{i,t}}{N_t},$$ Where N_t is the year t total population of ages 20 and above, $N_{i,t}$ is the year t population of persons in the *i*th age group, and A_i is the age of the *i*th age group. A total of 76 age groups are used, each of them containing a single cohort except the final group containing people aged 85 and above. The population estimates for each year are based on the July 1 samples, provided by the US Census Bureau (2012).
$DAGE_t$ =	Percentage change in average age from year (*t* – 1) to year *t*.

Note: In order to maintain consistency, all variables except $DAGE_t$ are based on data from Shiller Data (2014).

Based on the variables defined in table 1, we also define a set of more long-term variables measuring the same factors, but at a lower frequency. These variables are based on *n*-year overlapping time periods, where observations annualized to make them comparable.

Table 2) Other Variables

RETURNn_t =	The average real rate of return on the S&P 500 index over the last *n*-year period.
DAGEn_t =	The average percentage change in average age over the last *n*-year period.
DCONNn_t =	The annualized percentage change in real consumption of nondurables and services over the last *n*-year period.
DIVYLDn_t =	The annualized dividend yield of the S&P 500 index over the last *n*-year period.
TERMn_t =	The annualized difference between the yield of a portfolio with Aaa-rated bonds and the nominal interest rate over the last *n*-year period.

Note: Our long-term variables measure 3 time periods of different length, where n equals 5, 10 or 20 years.

4.2 The Life-Cycle Investment Hypothesis

In this paper we hypothesize that young adults, typically in their 20's or 30's, allocate most of their savings into housing and other durables, similar to the Bakshi and Chen (1994). One of the first studies to connect demographics and asset prices, Mankiw and Weil (1989), study the effect of demographic changes on the US housing market. Their results show a strong relationship between the entry of the baby boom generation into the housing market and the increasing real prices during the 1970's. They report that there seems to be a jump in demand for housing somewhere between the age of 20 and 30, supporting our hypothesis. Bossons (1973) comes to a similar conclusion by showing that the age group 35-44 years holds the highest percentage of their wealth invested in housing and other durables.

As people grow older and the number of remaining paychecks (human capital) declines, we hypothesize that the need to save for retirement will lead to increasing demand for financial assets, such as stocks and bonds. Bakshi and Chen (1994) shows that demographic fluctuations have had a significant impact on capital markets in the post-1945 period in the United States by studying historical data for the S&P 500 index. As an indicator of demographic change they use average age among people aged 20 or above. This is meant to be a proxy for the age of the representative investor, with the intuition being that children and teenagers play an insignificant role in economic decision making. Bakshi and Chen conclude that as the age of the average investor rises, so does the demand for financial assets.

We hypothesize that the demand for financial assets reaches its peak right before a person retires and begins to liquidate financial assets in order to finance consumption. Poterba (2001) uses data from repeated cross sections of the Survey of Consumer Finances to generate projected asset demands from households throughout the life cycle. His results show that wealth rises sharply with age when households are in their thirties and forties and begin to decline as households enter into retirement, though at a much lower rate. Goyal (2004) also finds support for the life-cycle investment hypothesis by showing that capital outflows (dividends plus repurchases less net issues) from the stock market are positively correlated with changes in the fraction of people aged 65 or above and negatively correlated with changes in the fraction of people aged 45 to 64.

The demand for housing, on the other hand, is expected to stabilize and slightly decrease with age. Several studies support this hypothesis by showing that the aggregated demand for housing declines with age (see, for example, Lampman, 1962 or Bakshi and Chen, 1994). Bossons (1973) also show that demand for housing drops by around 1% annually after the age of 45 by studying the 1962 Survey of Consumer Finance.

4.3 The Life-Cycle Risk Aversion Hypothesis

We hypothesize that an investor’s relative risk aversion increases with age, implying that market risk premiums should be correlated with demographic changes. This hypothesis is based on the documented biological relationship between aging and risk aversion (Harlow and Brown, 1990). Empirical studies find that portfolios of assets held by households tend to vary with age (see, for example, Ameriks and Zeldes, 2001) implying that changes in demographics should affect the expected returns and the return variability for stocks (Allen and Gale, 1994). We therefore hypothesize that an aging population will result in investors shifting their portfolios from risky assets, such as stocks, over to safe assets like bonds or cash, causing risk premiums to increase with the age of investors.

Increasing risk aversion can also be explained from a portfolio theory point of view if we consider the value of remaining paychecks (human capital) to be a safe asset. As their human capital decreases over time, investors should purchase safe assets in order to rebalance the risk of their portfolios (Erb, Harvey and Viskanta, 1997). Bakshi and Chen (1994) find that increases in the average age of investors lead to higher risk aversion, causing higher equilibrium risk premiums, as older investors prefer to hold a larger share of safe assets in their investment portfolios. The result of increased risk aversion is a decline in prices of stocks and an increase in prices of bonds. Based on their results Bakshi and Chen conclude that fluctuations in market risk premiums, at least partly, can be explained by changes in the population's age structure.

By studying a single 1984 cross-section of the US population Riley and Chow (1992) finds that relative risk aversion increases with age for those aged 65 or above and decreases with age for those that are younger than 65. Their results suggest that a country's relative risk aversion increases with an aging population, implying that investors will demand higher risk premiums to be willing to participate in the equity market. The results found for the U.S population are similar to the results from empirical studies looking at other countries as well. Erb, Harvey and Viskanta (1997) compare equity returns and changes in average age for a sample of 18 developed nations, finding a statistically significant relationship for the time period 1970 to 1995. Looking at global data instead, they find no such relationship which can be interpreted either as evidence against the global life-cycle aversion hypothesis or as evidence against perfect integration of world capital markets (see also, Bekaert and Harvey, 1995). Countries experiencing the highest rate of population aging are normally the least developed and most risky ones, making it reasonable that equity premiums are higher in these countries (Ferson and Harvey, 1999).

The empirical relationship between demographic change and risk premiums is, however, far from clear, as other papers such as Ang and Maddaloni (2003) come up with contradicting results. By studying data from 1900 to 2001 for the G5 countries (France, Germany, Japan, US and UK), they find that increases in the retired part of the population as a fraction of the total adult population actually causes risk premiums to decrease. The strongest effect is found in countries where Social Security benefits are high or financial markets are less developed. Their results are consistent with Davis and Li (2003), who study different levels of demographic variables and cohort ratios. Both conclusions deviate considerably from the general assumption that an increasing number of retirees should lead to increased liquidation of financial assets, causing prices to drop and risk premiums to increase.

Structural differences between the financial system in the US and other developed economies may provide an explanation of these conflicting results, since for instance the absence of young participants in the financial market has shown to have a substantial effect on the level of returns (Constantinides, Donaldson and Mehra, 2002). Countries with less developed financial markets tend to have a lower degree of stock market participation than more developed markets such as the Japan, the US and the UK (Guiso, Haliasos and Jappelli, 2000).

4.4 Interpreting Regression Results

In our empirical section we calculate the adjusted R^2, measuring the percentage of variance in the dependent variable explained by variance in the explanatory variables. The R^2 can never be negative and it can never exceed 1, since 1 implies a perfect fit (Koop, 2006).

Hypothesis testing

If $\beta = 0$ then our explanatory variables hold no explanatory value, making the regression useless. It is therefore important that we test the null hypothesis that $\beta = 0$, whenever we interpret regression results. If the *p*-value is below 0.05, then *t* is “large” and we can conclude on a 5% level of significance that $\beta \neq 0$. If the *p*-value is above 0.05, then *t* is “small”, meaning that we cannot conclude that $\beta \neq 0$. Another way of testing the significance of β is by studying the 95% confidence interval for the explanatory variable. If it does not include 0 we can be 95% certain that the true value of β is different from 0, meaning that we can conclude that the coefficient is statistically significant.

Omitted variable bias

In general if we omit explanatory variables that should have been included in the regression and any of these variables are correlated with those we have included, then the coefficients of the included variables will be wrong. To prevent this from happening we should always attempt to include all explanatory variables that could have an effect on the dependent variable. In practice this is often not possible since it could require a huge number of variables, some of which may be very difficult to measure. In addition, including any irrelevant variables decreases the accuracy of the estimation of all the coefficients, resulting in wider confidence intervals and higher *p*-values. A common way of solving this problem is therefore to include as many explanatory variables as possible at first, then discard those variables that are not statistically significant before re-running the regression with the new set of variables (Koop, 2006).

Multicollinearity

Multicollinearity is a statistical problem that arises if some or all of the explanatory variables are highly correlated with one another. As a result, the regression model will have difficulties telling which of the independent variables is affecting the dependent variable. The problem reveals itself through low t-statistics and high P-values, leading us to the conclusion that coefficients are insignificant and should be dropped from the regression. The only way to remove the problem of multicollinearity is by excluding some of the highly correlated variables from the regression.

Autocorrelation

When a variable is correlated with a lag of itself this is called autocorrelation. When we for instance study stocks the current price will normally be highly correlated with prices in the past, making such data unfitting for regression analysis. Instead of including non-stationary time series variables like prices into our regression model we should transform our data into stationary variables like returns, which will solve the problem of autocorrelation. To prevent the problem of autocorrelation in our analysis, we study annual changes (returns) instead of prices.

5. Empirical Results

5.1 Predictability of Annual Real Returns

In this section we perform OLS regression, following the exact framework of Bakshi and Chen (1994), with explanatory variables for each year *t* explaining real return in year (*t* + 1). We start by including all four explanatory variables, $DAGE_t$, $DCONN_t$, $DIVYLD_t$ and $TERM_t$ (see table 1 for definitions), in our multivariate regression in row 1. In rows 2 and 3 insignificant variables are then excluded one by one, until only variables holding significant predictive power remain. We then finally perform univariate forecasting tests in rows 4 to 7, in order to test the individual predictive power of each variable.

Table 3) Regression results

No.	b_0	b_1	b_2	b_3	b_4	R^2	NOBS
1	- .10 (.07) [.12]	24.42 (10.81) [.03]	1.29 (1.28) [.32]	3.18 (1.59) [.05]	- 1.07 (1.60) [.51]	.08	59
2	- .10 (.07) [.13]	21.21 (9.64) [.03]	.96 (1.17) [.42]	3.31 (1.57) [.04]		.09	59
3	- .07 (.06) [.20]	19.98 (9.15) [.03]		3.20 (1.50) [.04]		.10	62
4	.04 (.02) [.15]	18.60 (9.39) [.05]				.05	62
5	.05 (.03) [.12]		.44 (1.21) [.72]			- .02	59
6	- .03 (0.05) [.54]			2.96 (1.54) [.06]		0.04	62
7	.06 (.02) [.01]				.33 (1.33) [.81]	- 0.02	62

Note: Estimation of the equation is based on OLS regressions,

$$RETURN_{t+1} = b_0 + b_1 \cdot DAGE_t + b_2 \cdot DCONN_t + b_3 \cdot DIVYLD_t + b_4 \cdot TERM_t + \sum_{t+1},$$

where the variables are defined as in table 1. Standard errors for each coefficient are in parentheses, and p-values are in brackets. The reported R^2 is the adjusted R^2 statistic and NOBS is the number of observations.

By studying the results in table 3 (row 1), we see that the variables $DAGE_t$ and $DIVYLD_t$ are significantly and positively correlated with $RETURN_{t+1}$, with coefficient estimates more than 2 standard errors away from zero and *p*-values below 0.05. This implies that a rise in average age or dividend yields increases future real returns. With coefficient estimates close to zero and *p*-values above 0.05, $DCONN_t$ and $TERM_t$ are not significantly correlated with $RETURN_{t+1}$. Changes in consumption and term premiums hold little predictive power when estimating future real returns, and are therefore dropped from the equation. We end up with an adjusted R^2 of 0.10, meaning that our equation (row 3) is able to explain 10% of the variations in future annual real returns. Since this implies that the remaining 90% of variations are determined by other factors, the predictive power of our regression is very limited. The univariate forecasting tests (rows 4 to 7) show that none of the variables seem to hold any significant predictive power by themselves, with *p*-values above or equal to 0.05 and explained variances (R^2) close to 0.

Before we extend the time period between each observation, we remove the one-period lag in the dependent variable by replacing $RETURN_{t+1}$ with $RETURN_t$. We do this in order to obtain annual results that are comparable to the long-term regressions we perform later on, without any lag in the dependent variables. Removing the lag implies that changes in the dependent and independent variables now happen simultaneously. Making this adjustment helps us maintain as many observations as possible later on when we switch from annual to 5-, 10- and 20-year time periods.

Table 4) Regression results

No.	b_0	b_1	b_2	b_3	b_4	R^2	NOBS
1	- .24	26.50	5.36	4.21	.93	.51	59
	(.05)	(7.91)	(.93)	(1.16)	(1.17)		
	[.00]	[.00]	[.00]	[.00]	[.43]		
2	- .24	29.28	5.65	4.10		.51	59
	(.05)	(7.07)	(.86)	(1.15)			
	[.00]	[.00]	[.00]	[.00]			

3	.04	18.80				.05	63
	(.02)	(9.37)					
	[.12]	[.05]					
4	- .04		4.94			.28	59
	(.03)		(1.01)				
	[.14]		[.00]				
5	- .05			3.62		.07	63
	(0.05)			(1.50)			
	[.33]			[.02]			
6	.05				3.43	.10	63
	(.02)				(1.24)		
	[.01]				[.01]		

Note: Estimation of the equation is based on OLS regressions,

$$RETURN_t = b_0 + b_1 \cdot DAGE_t + b_2 \cdot DCONN_t + b_3 \cdot DIVYLD_t + b_4 \cdot TERM_t + \sum_t,$$

where the variables are defined as in table 1. Standard errors for each coefficient are in parentheses, and p-values are in brackets. The reported R^2 is the adjusted R^2 statistic and NOBS is the number of observations.

From table 4 (row 1), we see that, in addition to $DAGE_t$ and $DIVYLD_t$, $DCONN_t$ is now also significantly and positively correlated with $RETURN_t$. With coefficient estimates significantly different from zero and *p*-values equal to zero for all three variables, our regression results indicate a much better fit than in table 3. The last explanatory variable, $TERM_t$ is still insignificant with an estimated coefficient close to zero and *p*-value above 0.05. By omitting $TERM_t$, we come up with an equation (row 2) explaining 51% of variations in annual real returns. The univariate regression tests (rows 3 to 6) show significant individual explanatory power for each variable, with *p*-values below or equal to 0.05. The variable $DCONN_t$ now seems to hold the strongest explanatory power, being able to explain 28% of real return variations on its own. It is also interesting to see that $TERM_t$ appears to be statistically significant by its own (row 6), even though it is insignificant in the multivariate regression (row 1). This could be a sign of multicollinearity, meaning that $TERM_t$ is highly correlated with one or more of the other explanatory variable, making it difficult for the regression model to tell the different variables apart.

5.2 Predictability of Long-Term Real Returns

In this section we continue to perform OLS regression, using our 5-, 10- and 20-year variables (see table 2 for definitions).

Table 5) Regression results 5-year overlapping time periods

No.	b_0	b_1	b_2	b_3	b_4	R^2	NOBS
1	- .17	30.10	4.24	3.04	- .08	.71	55
	(.03)	(3.53)	(.68)	(.53)	(.82)		
	[.00]	[.00]	[.00]	[.00]	[.92]		
2	- .17	29.89	4.23	3.05		.71	55
	(.03)	(2.79)	(.67)	(0.50)			
	[.00]	[.00]	[.00]	[.00]			
3	.03	20.17				.29	59
	(.01)	(4.02)					
	[.00]	[.00]					
4	- .03		1.53			.01	55
	(.03)		(1.17)				
	[.26]		[.20]				
5	- .00			2.07		.08	59
	(.03)			(.83)			
	[.88]			[.02]			
6	.05				1.96	.04	59
	(.01)				(1.05)		
	[.00]				[.07]		

Note: Estimation of the equation is based on OLS regressions,

$$RETURN5_t = b_0 + b_1 \cdot DAGE5_t + b_2 \cdot DCONN5_t + b_3 \cdot DIVYLD5_t + b_4 \cdot TERM5_t + \sum_{t},$$

where the variables are defined as in table 2. Standard errors for each coefficient are in parentheses, and p-values are in brackets. The reported R^2 is the adjusted R^2 statistic and NOBS is the number of observations.

Similar to our results using annual data, table 5 (row 1) shows that $DAGE5_t$, $DCONN5_t$ and $DIVYLD5_t$ are all positively and significantly correlated with $RETURN5_t$, with coefficient estimates more than 2 standard errors away from zero and *p*-values below 0.05. This implies that increased average age, consumption or dividend yields over a 5-year period are likely to increase real returns in the same time period. $TERM5_t$ is still statistically insignificant with a coefficient estimate close to zero and a *p*-value above 0.05. By dropping $TERM5_t$ and re-running the regression (row 2), our equation explains 71% of variations in 5-year real returns. When testing each explanatory variable separately (rows 3 to 6), we notice that while $DCONN_t$ held the strongest explanatory power when we studied annual data, $DAGE5_t$ is now the most powerful explanatory variable, explaining 29% of variations in $RETURN5_t$ on its own. Also worth commenting is, that while $DCONN5_t$ appears to be highly significant in the multivariate regressions (rows 1 and 2), it is insignificant by itself (row 4).

Table 6) Regression results 10-year overlapping time periods

No.	b_0	b_1	b_2	b_3	b_4	R^2	NOBS
1	- .23 (.02) [.00]	24.06 (2.27) [.00]	5.55 (.61) [.00]	3.96 (.34) [.00]	3.45 (.64) [.00]	.90	50
2	.04 (.01) [.00]	19.36 (3.18) [.00]				.41	54
3	.09 (.04) [.02]		- 1.21 (1.58) [.45]			- .01	50
4	.03 (.03) [.26]			1.00 (.78) [.21]		.01	54
5	.05 (.01) [.00]				3.55 (.95) [.00]	.20	54

Note: Estimation of the equation is based on OLS regressions,

$$RETURN10_t = b_0 + b_1 \cdot DAGE10_t + b_2 \cdot DCONN10_t + b_3 \cdot DIVYLD10_t + b_4 \cdot TERM10_t + \sum_t,$$

where the variables are defined as in table 2. Standard errors for each coefficient are in parentheses, and p-values are in brackets. The reported R^2 is the adjusted R^2 statistic and NOBS is the number of observations.

Our results in table 6 (row 1), using 10-year data, show that all 4 explanatory variables are positively and significantly correlated with $RETURN10_t$. With coefficient estimates significantly different from zero and *p*-values below 0.05, they are able to explain 90% of variations in 10-year real returns. Our univariate regression tests (rows 2 to 5) show that $DAGE10_t$ and $TERM10_t$ are statistically significant by themselves, while $DCONN10_t$ and $DIVYLD10_t$ are statistically insignificant with coefficient estimates close to zero and *p*-

values above 0.05. Once again average age seems to be the most powerful explanatory variable, explaining 41% of variations on its own. It is also interesting to see that our univariate tests show a negative correlation between changes in consumption and real returns (row 3). Although the relationship is statistically insignificant, it implies that increased consumption over a 10-year period will reduce real returns during the same time period.

Table 7) Regression results 20-year overlapping time periods

No.	b_0	b_1	b_2	b_3	b_4	R^2	NOBS
1	- .18	25.98	3.83	3.71	2.57	.92	40
	(.03)	(2.37)	(.80)	(.40)	(.59)		
	[.00]	[.00]	[.00]	[.00]	[.00]		
2	.04	17.56				.57	44
	(.00)	(2.33)					
	[.00]	[.00]					
3	.16		- 4.11			.07	40
	(.05)		(2.11)				
	[.00]		[.06]				
4	.09			- 1.02		.02	44
	(.02)			(.71)			
	[.00]			[.16]			
5	.05				3.41	.41	44
	(.00)				(.61)		
	[.00]				[.00]		

Note: Estimation of the equation is based on OLS regressions,

$$\text{RETURN20}_t = b_0 + b_1 \cdot \text{DAGE20}_t + b_2 \cdot \text{DCONN20}_t + b_3 \cdot \text{DIVYLD20}_t + b_4 \cdot \text{TERM20}_t + \textstyle\sum_t,$$

where the variables are defined as in table 2. Standard errors for each coefficient are in parentheses, and p-values are in brackets. The reported R^2 is the adjusted R^2 statistic and NOBS is the number of observations.

Our results in table 7, using 20-year data, confirm many of the trends we have already seen when moving from annual to 5- and 10-year data in table 5 and 6. Our multivariate regression (row 1) is able to explain 92% of variations in RETURN20_t, with coefficient estimates significantly different from zero and *p*-values below 0.05 for all explanatory variables. All 4 variables are also still positively correlated with 20-year real returns. Similar to our 10-year data, our univariate regression tests show that DAGE20_t and DTERM20_t are statistically significant by themselves, while DCONN20_t and DIVYLD20_t are not. It is interesting to see that as stand-alone variables both consumption and dividend yield are negatively correlated with real returns.

In summary, the results in table 5 to 7 all find that the explanatory variable DAGEn_t is positively and significantly correlated with RETURNn_t for all 3 observation frequencies. In other words changes in average age are able to explain a significant part of real returns during the same periods. The explanatory power is significant both in the multivariate regressions and in the stand-alone tests, and seems to increase with the length of each observation period. When it comes to the economic variables, DCONNn_t and DIVYLDn_t seem to hold little explanatory power as stand-alone variables, while TERMn_t is able to explain a considerable part of variations in 10- and 20-year real returns in its own. All 4 explanatory variables appear highly significant in the multivariate regressions, implying that our regression equation captures important drivers behind fluctuations in real returns.

6. Comments

Even though our regression equation includes three economic variables in addition to our demographic variable, the statistical impact of demographic changes that we find on real returns, may in reality be the effect of changes in on or more omitted macroeconomic variables. Chen, Roll and Ross (1986) suggests that returns are determined by macroeconomic variables such as industrial production, changes in the risk premium, twists in the yield curve, and to some extent unanticipated inflation and changes in inflation during periods with high volatility. Omitting these variables from our regression will therefore result in the omitted variable bias if one or more of these variables are correlated with our demographic variable (Koop, 2006). One way of reducing the risk of the omitted variable bias being present would be to include more variables in our regression analysis. Given the limited length of this paper, however, we here chose to focus on the 4 explanatory variables defined by Bakshi and Chen (1994). Even though our multivariate regression, including these variables, is able to explain a significant part of historical fluctuations, uncertainty regarding how real returns are determined still exists. For annual returns almost 50% of variations remain unexplained, meaning that further work is needed in order to fully understand the dynamics of financial markets.

7. Conclusion

Similar to the results obtained by Bakshi and Chen (1994), this paper finds annual changes in average age to be significantly and positively correlated with real returns in the following year. These results support the life-cycle risk aversion hypothesis, stating that an older population will demand higher compensation for holding risky assets in their investment portfolios. Increasing average age will therefore lead to increasing future real prices, as investors become less willing to assume risk.

This paper also finds strong support for the life-cycle investment hypothesis, stating that demand for financial assets increases with age. Our results, using both annual and 5-, 10- and 20-year data, show that changes in average age have been significantly and positively correlated with real returns during the same periods. This implies that during time periods with increasing average age, real prices tend to increase simultaneously. It also implies that increasing real prices may partly be explained by increased demand for financial assets. The correlation between average age and real returns appears to increase with time, suggesting that demographic variables are best suited to explain long-term movements in stock market prices.

Unsurprisingly, our results also show that our economic variables related to consumption, dividend yields and term premiums are significant in explaining real stock market returns. While consumption and real returns are positively correlated when studying annual and 5-year data, the correlation is negative when studying 10- or 20-year time periods instead. The negative correlation can be explained by the fact that a dollar spent on consumption is a dollar less to invest in financial assets. Dividend yields also switch from a positive annual, 5- and 10-year correlation to a negative 20-year correlation with real returns. This can be explained by the fact that high dividend yields leave less money for reinvestment by the companies, resulting in lower long-term growth. Finally, term premiums are positively correlated with real returns for all tested time periods. Since term premiums are a measure of economic expectations, it seems reasonable to believe that financial markets perform well in periods when the economic outlook is strong.

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Appendix

A. Annual Data

Year	RETURN$_{t+1}$	RETURN$_t$	DAGE$_t$	DCONN$_t$	DIVYLD$_t$	TERM$_t$
1950	14,57 %	21,76 %	0,32 %	-0,12 %	6,54 %	1,00 %
1951	12,77 %	14,57 %	0,41 %	1,40 %	6,70 %	0,45 %
1952	1,63 %	12,77 %	0,45 %	2,99 %	5,67 %	0,29 %
1953	38,50 %	1,63 %	0,50 %	0,26 %	5,25 %	0,25 %
1954	24,80 %	38,50 %	0,52 %	5,27 %	5,54 %	0,68 %
1955	3,68 %	24,80 %	0,45 %	1,08 %	4,23 %	0,80 %
1956	-9,27 %	3,68 %	0,42 %	0,64 %	3,65 %	-0,31 %
1957	31,91 %	-9,27 %	0,42 %	-0,87 %	3,76 %	-0,40 %
1958	6,32 %	31,91 %	0,34 %	3,74 %	4,26 %	0,55 %
1959	4,39 %	6,32 %	0,35 %	0,69 %	3,10 %	0,28 %
1960	16,76 %	4,39 %	0,31 %	0,41 %	3,10 %	0,44 %
1961	-4,08 %	16,76 %	0,22 %	3,30 %	3,21 %	0,93 %
1962	17,44 %	-4,08 %	0,13 %	2,60 %	2,88 %	0,69 %
1963	13,81 %	17,44 %	-0,06 %	4,44 %	3,22 %	0,33 %
1964	9,00 %	13,81 %	0,06 %	4,88 %	2,94 %	0,08 %
1965	-10,05 %	9,00 %	0,08 %	4,38 %	2,86 %	-0,27 %
1966	11,26 %	-10,05 %	0,09 %	1,85 %	2,87 %	-0,83 %
1967	5,77 %	11,26 %	-0,37 %	4,59 %	3,34 %	-0,97 %
1968	-14,77 %	5,77 %	-0,20 %	2,66 %	3,03 %	-0,64 %
1969	1,61 %	-14,77 %	-0,17 %	1,13 %	2,96 %	-2,03 %
1970	9,69 %	1,61 %	-0,12 %	2,49 %	3,44 %	-1,33 %
1971	12,70 %	9,69 %	-0,16 %	4,87 %	3,30 %	0,58 %
1972	-26,39 %	12,70 %	-0,17 %	3,83 %	2,93 %	1,32 %
1973	-34,42 %	-26,39 %	-0,18 %	-1,68 %	2,63 %	-1,48 %
1974	26,11 %	-34,42 %	-0,18 %	1,30 %	3,46 %	-4,12 %
1975	5,67 %	26,11 %	-0,17 %	4,40 %	4,84 %	0,26 %
1976	-15,57 %	5,67 %	-0,15 %	3,15 %	3,73 %	2,02 %
1977	6,05 %	-15,57 %	-0,16 %	3,24 %	3,83 %	1,91 %
1978	2,56 %	6,05 %	-0,14 %	1,30 %	5,05 %	0,18 %
1979	11,53 %	2,56 %	-0,10 %	-1,43 %	4,96 %	-1,80 %
1980	-15,11 %	11,53 %	-0,01 %	0,42 %	4,97 %	-0,57 %
1981	21,72 %	-15,11 %	-0,13 %	0,44 %	4,53 %	-5,19 %
1982	14,33 %	21,72 %	-0,04 %	4,65 %	5,50 %	-0,01 %
1983	3,91 %	14,33 %	0,00 %	4,30 %	4,65 %	1,08 %
1984	19,23 %	3,91 %	0,03 %	4,18 %	4,17 %	0,56 %
1985	25,58 %	19,23 %	0,11 %	3,07 %	4,29 %	2,99 %
1986	-5,96 %	25,58 %	0,17 %	2,38 %	3,72 %	1,86 %

1987	11,85 %	-5,96 %	0,23 %	3,06 %	3,08 %	0,83 %
1988	15,62 %	11,85 %	0,24 %	1,83 %	3,46 %	1,03 %
1989	-6,20 %	15,62 %	0,24 %	0,89 %	3,35 %	-0,20 %
1990	24,87 %	-6,20 %	0,20 %	-1,16 %	3,20 %	-0,22 %
1991	4,10 %	24,87 %	0,20 %	1,89 %	3,65 %	1,16 %
1992	8,45 %	4,10 %	0,26 %	1,99 %	2,89 %	3,07 %
1993	-1,62 %	8,45 %	0,33 %	2,46 %	2,80 %	3,11 %
1994	27,34 %	-1,62 %	0,35 %	1,48 %	2,62 %	1,39 %
1995	21,01 %	27,34 %	0,33 %	2,27 %	2,79 %	1,32 %
1996	22,93 %	21,01 %	0,34 %	2,43 %	2,22 %	-0,03 %
1997	25,58 %	22,93 %	0,28 %	3,95 %	1,93 %	0,80 %
1998	11,70 %	25,58 %	0,27 %	4,18 %	1,60 %	-0,14 %
1999	-8,97 %	11,70 %	0,24 %	3,85 %	1,29 %	-0,59 %
2000	-15,58 %	-8,97 %	0,19 %	1,65 %	1,16 %	0,05 %
2001	-24,91 %	-15,58 %	0,20 %	1,66 %	1,21 %	0,53 %
2002	23,06 %	-24,91 %	0,23 %	1,85 %	1,37 %	3,14 %
2003	2,93 %	23,06 %	0,28 %	2,50 %	1,78 %	2,83 %
2004	5,73 %	2,93 %	0,26 %	2,39 %	1,52 %	2,63 %
2005	10,45 %	5,73 %	0,26 %	1,91 %	1,63 %	0,81 %
2006	-5,49 %	10,45 %	0,27 %	1,64 %	1,72 %	-0,90 %
2007	-43,31 %	-5,49 %	0,30 %	-1,17 %	1,73 %	-0,58 %
2008	25,47 %	-43,31 %	0,30 %	-1,90 %	1,99 %	0,32 %
2009	13,38 %	25,47 %	0,30 %		3,23 %	1,49 %
2010	0,52 %	13,38 %	0,25 %		1,97 %	3,22 %
2011	13,46 %	0,52 %	0,25 %		1,76 %	2,98 %
2012		13,46 %	0,11 %		2,01 %	1,95 %

B. 5-Year Data

Year	$RETURN5_t$	$DAGE5_t$	$DCONN5_t$	$DIVYLD5_t$	$TERM5_t$
1954	17,85 %	0,44 %	1,96 %	5,94 %	0,53 %
1955	18,46 %	0,47 %	2,20 %	5,48 %	0,49 %
1956	16,28 %	0,47 %	2,05 %	4,87 %	0,34 %
1957	11,87 %	0,46 %	1,28 %	4,49 %	0,20 %
1958	17,93 %	0,43 %	1,97 %	4,29 %	0,26 %
1959	11,49 %	0,40 %	1,05 %	3,80 %	0,18 %
1960	7,41 %	0,37 %	0,92 %	3,57 %	0,11 %
1961	10,02 %	0,33 %	1,45 %	3,49 %	0,36 %
1962	11,06 %	0,27 %	2,14 %	3,31 %	0,58 %
1963	8,16 %	0,19 %	2,29 %	3,10 %	0,53 %
1964	9,66 %	0,13 %	3,12 %	3,07 %	0,49 %
1965	10,58 %	0,09 %	3,92 %	3,02 %	0,35 %
1966	5,22 %	0,06 %	3,63 %	2,96 %	0,00 %
1967	8,29 %	-0,04 %	4,02 %	3,05 %	-0,33 %
1968	5,96 %	-0,07 %	3,67 %	3,01 %	-0,53 %
1969	0,24 %	-0,11 %	2,92 %	3,01 %	-0,95 %
1970	-1,24 %	-0,15 %	2,54 %	3,13 %	-1,16 %
1971	2,71 %	-0,20 %	3,15 %	3,22 %	-0,88 %
1972	3,00 %	-0,16 %	3,00 %	3,13 %	-0,42 %
1973	-3,43 %	-0,16 %	2,13 %	3,05 %	-0,59 %
1974	-7,36 %	-0,16 %	2,16 %	3,15 %	-1,01 %
1975	-2,46 %	-0,17 %	2,54 %	3,43 %	-0,69 %
1976	-3,27 %	-0,17 %	2,20 %	3,52 %	-0,40 %
1977	-8,92 %	-0,17 %	2,08 %	3,70 %	-0,28 %
1978	-2,43 %	-0,16 %	2,68 %	4,18 %	0,05 %
1979	4,97 %	-0,14 %	2,13 %	4,48 %	0,51 %
1980	2,05 %	-0,11 %	1,33 %	4,51 %	0,35 %
1981	-2,11 %	-0,11 %	0,79 %	4,67 %	-1,09 %
1982	5,35 %	-0,09 %	1,07 %	5,00 %	-1,48 %
1983	7,00 %	-0,06 %	1,67 %	4,92 %	-1,30 %
1984	7,28 %	-0,03 %	2,80 %	4,76 %	-0,83 %
1985	8,82 %	-0,01 %	3,33 %	4,63 %	-0,11 %
1986	16,95 %	0,05 %	3,71 %	4,47 %	1,30 %
1987	11,42 %	0,11 %	3,40 %	3,99 %	1,46 %
1988	10,92 %	0,16 %	2,90 %	3,75 %	1,45 %
1989	13,26 %	0,20 %	2,25 %	3,58 %	1,30 %
1990	8,18 %	0,22 %	1,40 %	3,36 %	0,66 %
1991	8,04 %	0,22 %	1,30 %	3,35 %	0,52 %
1992	10,05 %	0,23 %	1,09 %	3,31 %	0,97 %
1993	9,37 %	0,25 %	1,22 %	3,18 %	1,39 %

1994	5,92 %	0,27 %	1,33 %	3,03 %	1,70 %
1995	12,63 %	0,30 %	2,02 %	2,95 %	2,01 %
1996	11,85 %	0,32 %	2,13 %	2,67 %	1,77 %
1997	15,62 %	0,33 %	2,52 %	2,47 %	1,32 %
1998	19,05 %	0,31 %	2,86 %	2,23 %	0,67 %
1999	21,71 %	0,29 %	3,33 %	1,96 %	0,27 %
2000	14,45 %	0,26 %	3,21 %	1,64 %	0,02 %
2001	7,13 %	0,24 %	3,06 %	1,44 %	0,13 %
2002	-2,44 %	0,23 %	2,64 %	1,33 %	0,60 %
2003	-2,94 %	0,23 %	2,30 %	1,36 %	1,19 %
2004	-4,69 %	0,23 %	2,01 %	1,41 %	1,83 %
2005	-1,75 %	0,24 %	2,06 %	1,50 %	1,99 %
2006	3,45 %	0,26 %	2,06 %	1,61 %	1,70 %
2007	7,34 %	0,27 %	1,45 %	1,68 %	0,96 %
2008	-5,94 %	0,28 %	0,57 %	1,72 %	0,45 %
2009	-1,43 %	0,29 %		2,06 %	0,23 %
2010	0,10 %	0,28 %		2,13 %	0,71 %
2011	-1,89 %	0,28 %		2,14 %	1,49 %
2012	1,90 %	0,24 %		2,19 %	1,99 %

C. 10-Year Data

Year	$RETURN10_t$	$DAGE10_t$	$DCONN10_t$	$DIVYLD10_t$	$TERM10_t$
1959	14,67 %	0,42 %	1,51 %	4,87 %	0,36 %
1960	12,93 %	0,42 %	1,56 %	4,53 %	0,30 %
1961	13,15 %	0,40 %	1,75 %	4,18 %	0,35 %
1962	11,46 %	0,37 %	1,71 %	3,90 %	0,39 %
1963	13,05 %	0,31 %	2,13 %	3,70 %	0,40 %
1964	10,58 %	0,26 %	2,09 %	3,44 %	0,34 %
1965	9,00 %	0,23 %	2,42 %	3,30 %	0,23 %
1966	7,62 %	0,19 %	2,54 %	3,22 %	0,18 %
1967	9,68 %	0,12 %	3,08 %	3,18 %	0,12 %
1968	7,06 %	0,06 %	2,98 %	3,06 %	0,00 %
1969	4,95 %	0,01 %	3,02 %	3,04 %	-0,23 %
1970	4,67 %	-0,03 %	3,23 %	3,08 %	-0,41 %
1971	3,97 %	-0,07 %	3,39 %	3,09 %	-0,44 %
1972	5,65 %	-0,10 %	3,51 %	3,09 %	-0,38 %
1973	1,26 %	-0,11 %	2,90 %	3,03 %	-0,56 %
1974	-3,56 %	-0,14 %	2,54 %	3,08 %	-0,98 %
1975	-1,85 %	-0,16 %	2,54 %	3,28 %	-0,93 %
1976	-0,28 %	-0,19 %	2,67 %	3,37 %	-0,64 %
1977	-2,96 %	-0,16 %	2,54 %	3,41 %	-0,35 %
1978	-2,93 %	-0,16 %	2,40 %	3,62 %	-0,27 %
1979	-1,20 %	-0,15 %	2,15 %	3,82 %	-0,25 %
1980	-0,21 %	-0,14 %	1,94 %	3,97 %	-0,17 %
1981	-2,69 %	-0,14 %	1,50 %	4,09 %	-0,75 %
1982	-1,79 %	-0,13 %	1,58 %	4,35 %	-0,88 %
1983	2,29 %	-0,11 %	2,18 %	4,55 %	-0,62 %
1984	6,12 %	-0,09 %	2,46 %	4,62 %	-0,16 %
1985	5,43 %	-0,06 %	2,33 %	4,57 %	0,12 %
1986	7,42 %	-0,03 %	2,25 %	4,57 %	0,10 %
1987	8,38 %	0,01 %	2,24 %	4,49 %	-0,01 %
1988	8,96 %	0,05 %	2,29 %	4,33 %	0,08 %
1989	10,27 %	0,08 %	2,52 %	4,17 %	0,24 %
1990	8,50 %	0,10 %	2,36 %	4,00 %	0,27 %
1991	12,50 %	0,14 %	2,51 %	3,91 %	0,91 %
1992	10,73 %	0,17 %	2,24 %	3,65 %	1,22 %
1993	10,15 %	0,20 %	2,06 %	3,46 %	1,42 %
1994	9,59 %	0,23 %	1,79 %	3,31 %	1,50 %
1995	10,40 %	0,26 %	1,71 %	3,16 %	1,34 %
1996	9,95 %	0,27 %	1,72 %	3,01 %	1,15 %
1997	12,83 %	0,28 %	1,80 %	2,89 %	1,14 %
1998	14,21 %	0,28 %	2,04 %	2,71 %	1,03 %

1999	13,82 %	0,28 %	2,33 %	2,50 %	0,99 %
2000	13,54 %	0,28 %	2,61 %	2,30 %	1,01 %
2001	9,49 %	0,28 %	2,59 %	2,05 %	0,95 %
2002	6,59 %	0,28 %	2,58 %	1,90 %	0,96 %
2003	8,05 %	0,27 %	2,58 %	1,80 %	0,93 %
2004	8,51 %	0,26 %	2,67 %	1,69 %	1,05 %
2005	6,35 %	0,25 %	2,64 %	1,57 %	1,00 %
2006	5,29 %	0,25 %	2,56 %	1,52 %	0,91 %
2007	2,45 %	0,25 %	2,05 %	1,50 %	0,78 %
2008	-4,44 %	0,25 %	1,44 %	1,54 %	0,82 %
2009	-3,06 %	0,26 %		1,74 %	1,03 %
2010	-0,83 %	0,26 %		1,82 %	1,35 %
2011	0,78 %	0,27 %		1,87 %	1,59 %
2012	4,62 %	0,26 %		1,94 %	1,47 %

D. 20-Year Data

Year	RETURN20$_t$	DAGE20$_t$	DCONN20$_t$	DIVYLD20$_t$	TERM20$_t$
1969	9,81 %	0,21 %	2,27 %	3,96 %	0,06 %
1970	8,80 %	0,19 %	2,40 %	3,80 %	-0,05 %
1971	8,56 %	0,16 %	2,57 %	3,63 %	-0,05 %
1972	8,55 %	0,13 %	2,61 %	3,49 %	0,01 %
1973	7,15 %	0,10 %	2,51 %	3,36 %	-0,08 %
1974	3,51 %	0,06 %	2,32 %	3,26 %	-0,32 %
1975	3,57 %	0,03 %	2,48 %	3,29 %	-0,35 %
1976	3,67 %	0,00 %	2,61 %	3,29 %	-0,23 %
1977	3,36 %	-0,02 %	2,81 %	3,30 %	-0,12 %
1978	2,06 %	-0,05 %	2,69 %	3,34 %	-0,13 %
1979	1,88 %	-0,07 %	2,58 %	3,43 %	-0,24 %
1980	2,23 %	-0,09 %	2,58 %	3,52 %	-0,29 %
1981	0,64 %	-0,10 %	2,44 %	3,59 %	-0,59 %
1982	1,93 %	-0,11 %	2,54 %	3,72 %	-0,63 %
1983	1,77 %	-0,11 %	2,54 %	3,79 %	-0,59 %
1984	1,28 %	-0,11 %	2,50 %	3,85 %	-0,57 %
1985	1,79 %	-0,11 %	2,44 %	3,92 %	-0,40 %
1986	3,57 %	-0,11 %	2,46 %	3,97 %	-0,27 %
1987	2,71 %	-0,08 %	2,39 %	3,95 %	-0,18 %
1988	3,02 %	-0,05 %	2,35 %	3,98 %	-0,10 %
1989	4,54 %	-0,03 %	2,33 %	3,99 %	0,00 %
1990	4,15 %	-0,02 %	2,15 %	3,98 %	0,05 %
1991	4,90 %	0,00 %	2,00 %	4,00 %	0,08 %
1992	4,47 %	0,02 %	1,91 %	4,00 %	0,17 %
1993	6,22 %	0,05 %	2,12 %	4,01 %	0,40 %
1994	7,86 %	0,07 %	2,13 %	3,97 %	0,67 %
1995	7,92 %	0,10 %	2,02 %	3,86 %	0,73 %
1996	8,68 %	0,12 %	1,98 %	3,79 %	0,62 %
1997	10,61 %	0,14 %	2,02 %	3,69 %	0,57 %
1998	11,59 %	0,17 %	2,16 %	3,52 %	0,55 %
1999	12,04 %	0,18 %	2,43 %	3,34 %	0,61 %
2000	11,02 %	0,19 %	2,49 %	3,15 %	0,64 %
2001	10,99 %	0,21 %	2,55 %	2,98 %	0,93 %
2002	8,66 %	0,22 %	2,41 %	2,77 %	1,09 %
2003	9,10 %	0,24 %	2,32 %	2,63 %	1,17 %
2004	9,05 %	0,25 %	2,23 %	2,50 %	1,28 %
2005	8,38 %	0,26 %	2,17 %	2,36 %	1,17 %
2006	7,62 %	0,26 %	2,14 %	2,26 %	1,03 %
2007	7,64 %	0,26 %	1,93 %	2,20 %	0,96 %
2008	4,89 %	0,27 %	1,74 %	2,12 %	0,92 %

2009	5,38 %	0,27 %		2,12 %	1,01 %
2010	6,36 %	0,27 %		2,06 %	1,18 %
2011	5,14 %	0,27 %		1,96 %	1,27 %
2012	5,61 %	0,27 %		1,92 %	1,22 %