

# Market Volatility and Retirement Capability

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**Abstract:** As it is easy to perceive movements of the Dow Jones Industrial Average (DJIA) to be greater in magnitude and frequency, and with more people anticipating adequate retirement income from a defined contribution (DC) or 401(k) plan, it is economically important that we consider the potential for the stock market to impact all of us. DC pension plans began in the 1980s as a supplement to other sources of retirement income, but have become the predominant vehicle used to provide for a suitable standard of living in retirement for the majority of the US workforce. The increased volatility as described in the indices considered may be positive if the continued direction is up, but could mean disaster if the direction changes course. As retirement funding for a majority of the workforce is attached to the stock market via DC or 401(k) plans, it is in everyone's interest for the numbers to keep progressing positively. However, with the more recent 2008 experience and stubborn rates of unemployment, we must all consider the future of economic growth as a source of stability.

Key words: retirement plans; pension plans; 401(k) plans; volatility; retirement funding

**JEL codes:** G1, E2, E6

## 1. Introduction

It is easy to perceive volatility in the markets, both stocks and commodities, to be more pronounced in recent times than "what it used to be". However, as employees and investors, we owe it to our own financial prudence to be sure.

#### 1.1 Volatility

Andersen et al. (2000) used daily return observations with the Dow Jones Industrial Average (DJIA) in their study and found equity volatilities and correlations to move together, thereby potentially reducing the effectiveness of diversification in reducing portfolio risk. Positive returns were found to have a smaller impact on future volatility than negative returns of the same magnitude (Andersen et al., 2000). Stiglitz (2000) maintains that increased capital market liberalization leads to increased economic volatility and even an increased propensity for recession. Liberalization of capital markets opens up markets for cash to flow into and out of a country. He feels that a political and economic climate that attracts foreign investment is of greater importance to economic success and argues that capital market liberalization may actually lead to increased instability as financial crises are likely to be worse when they do occur (Stiglitz, 2000).

Bouchaud et al. (2008) studied price drops and their correlation with past prices, finding that there is a correlation between past price changes and future volatilities. The volatility-return correlation was short-ranged

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for both stocks and stock indices, indicating that the correlated activity occurred quickly (10 days for stock indices and 50 days for individual stocks). The amplitude of the correlation was also larger for indices than individual stocks, indicating a greater "leverage effect" for indices. This may indicate the potential for increased volatility of indices as compared to individual stocks (Bouchaud et al., 2008). Antinolfi et al. (2013) discovered a negative relationship between volatility in GDP during the 1980s and the development of mortgage-backed securities (MBS). They found this relationship to turn positive in the early 2000s. Mortgage-backed securities became more important as this part of the economy grew from a small percentage to over half of US GDP in 20 years. Household mortgage debt reached levels close to the size of GDP. MBSs were associated with reduced risk through the 1980s, but changed sign and became associated with increased risk in the 2000s. Aggregate volatility increased with the use of MBSs at this point (Antinolfi et al., 2013). According to Gustman et al. (2009b), the market rose approximately 21 percent per year compounded from 1995-1999. Then, from the beginning of 2000 to the end of September 2002, it fell by 13 percent per year, realizing a cumulative loss of 34% from August 2002...a little over one third of market wealth was removed in the span of two years (Gustman et al., 2009b). Campbell et al (2001) found an increase in firm-level volatility relative to market volatility from 1962 to 1997 that was not explained by the increase in the number of publicly held companies. They found that uncertainty on the part of individual firms had also increased in the period considered, 1926-1997. Industry-level volatility helped forecast economic volatility, and economic downturns. The number of stocks one would need to hold to achieve diversification had increased (Campbell et al., 2001).

### 1.2 Defined Benefit (DB) and Defined Contribution (DC) Plans

Defined benefit (DB) pension plans are organized and supported by the employer, with the employee promised a payout at retirement but having no control over the investments thereof in the process of accumulation (Mitchell et al., 1998; Gustman et al., 2009b; Friedberg et al., 2002; Kaplan, 2004; Munnell et al., 2006). Defined contribution (DC) pension plans require the employee to contribute and allocate the resources in their plans. The employer usually contributes a portion in these plans, dependent on tenure and position of the employee with the company (Mitchell et al., 1998; Gustman et al., 2009b; Friedberg et al., 2002; Kaplan, 2004). In Mitchell et al. (1998), DC pensions appealed to smaller and medium sized employers and therefore experienced increasing investment during the late 1970s and through the 1980s, as compared to DB pensions. Moving forward into 1990s, the prevalence of DC plans increased more as they were the only opportunity in many smaller firms. One of the reasons listed for growth in DC pensions was its increased flexibility. Employees are usually able to take a portion of their DC plan with them should they leave the organization, as well as borrow against it in times of hardship (medical or college expenses, for example). DC plans also have more flexibility at retirement, allowing participants more discretion in how their money would be distributed to them (lump sum vs. annuity). DB plans were more rigidly defined in that respect. Employees tended to value the increased flexibility in allocating funds during the buildup and distribution of value, while employers tended to value the increased ability to target their matching contributions in such a way as to reward behaviors they consider valuable to the organization (Mitchell et al., 1998).

With DC plans, the organization is able to contribute more to those employees that contribute more to the business in their matching plan; and if an employee contributes less, then the organization also contributes less (Mitchell et al., 1998). This matching feature therefore realizes the more productive employees being rewarded more and the less productive employees being rewarded less. The DC pension system is also thought to experience lower administrative costs as compared to DB pension systems, although investment management fees

were excluded in that analysis. The erosion of tax advantages for the small businesses with DB plans during the 1980s is also thought to have pushed smaller business into the DC pension systems. Another factor contributing to the popularity of the DC plans was the perception of less risk regarding the impacts of bankruptcy, as employees/investors would be more diversified in their investment. A DB plan could more likely find itself underfunded with respect to the value of assets unable to meet the promised obligations. The DC system also rewards the longer-term, longer-focused employees more than those with a more short-term fixation. They considered those with increased financial training to be more likely to maximize their longer term rewards, and those will less training to be more at risk in the market. This ability, or inability, to save is then expected to have economy wide impacts. As we understand the increasing popularity of DCs during this time, it is also important that we understand the associated risks. A DC places more responsibility on the plan participant, who may or may not be completely knowledgeable with regard to issues of finance, markets, and economics or the mechanics of investing and tax management. When employees are poorly informed about their investment choices, the tendency for unwise or irrational investment choices is increased (Mitchell et al., 1998).

As more DC plans were offered and more employees began to participate with the rising stock market prices in the 1990s, Hanna et al. (2003) expressed concern regarding the availability of adequate retirement funding after the portfolio reducing declines began in the stock market in mid-1999. Retirement adequacy was defined as the employee having funds available in the amounts necessary to finance retirement consumption to the same level experienced before retirement. They used a replacement rate to estimate the level needed by a retiree to maintain his or her level of consumption. The replacement rate was defined as the level of pre-retirement income divided by the level of retirement consumption. For calculations, this became projected income from the DC plan plus that from Social Security compared to annual pretax earnings just before retirement. They projected the value of these investments using a mean, or average, rate of return and a pessimistic rate of return in their analysis, as well as a retirement age of 65 and no expectation of post-retirement employment, or earnings. DC balances were less than 25% of the total investment assets held for participants aged 50-61. Stocks were less than half of all investments for the median level of the ratio, but were almost two-thirds of the DC balances. This indicates that stock price declines would have a significant impact on DC balances for workers aged 50-61, but less of an impact on total value of investment assets (Hanna et al., 2003). Hanna et al. (2003) reported 72% of households who retired at 65 with one DC account and average returns would achieve adequate retirement funding, but only 42% would achieve adequate retirement with no DC accounts and average returns. Pessimistic projections reduced adequacy rates to 46%. When looking at the retirement ratio, half of all households had a ratio of 100% — high enough to maintain their accustomed standard of living in retirement. Seven percent of those with a DC fell below 70% of funds needed for an adequate retirement, which is compared to 37% with no DC with average returns. Using pessimistic projections of investment returns, this number is increased to 31% for those with a DC. Hanna et al. (2003) concluded 7 in 10 would achieve retirement adequacy with DC plans, and 4 in 10 without. Households were more likely to achieve retirement adequacy than individual workers. Households with DC plans were more likely to have adequate retirement funds (70% compared to 40%), but 25-30% with DC plans were still expected to have insufficient finances available for retirement (Hanna et al., 2003).

Gustman et al. (2009a) considered the effects of the stock market decline from 2008-2009 on the wealth of those approaching retirement age. Even with the increased tendency to invest in defined contribution (DC) plans and their nearness to retirement, the average person was not expected to experience life-changing financial losses in this economic event. Retirements were expected to increase, not be reduced, considering this economic event.

DB plans accounted for two-thirds of early boomers' pension wealth, with most of DC wealth in the form of stocks (60%). Individuals thought to fare the worst were those laid off in their mid-50s during this time frame, or who lost their home. Retirement coverage gaps between genders closed from 1992-2004. DC plans were more prevalent in younger cohorts, with previous generations possessing greater pension coverage. Tenure with DC plans was less than 10 years on average, while tenure with defined benefit (DB) plans was on average greater than 16 years. The 401k plan is the predominant DC plan, but was not available until 1982. Social Security wealth experienced greater rates of growth over the 12 year period considered (1992-2004) than the 25.9 percent return generated by the retirement portfolio. Increased Social Security benefits were based on the increase in the level of earnings, increase in the number of two-paycheck families, and rising real wages. The percentage of earnings subject to payroll taxes increased over this period, which is used in determining benefits, so while there is no immediate benefit of the additional taxes — the employee will receive increased benefits once retired because of the higher ceiling on taxable earnings. With increased benefits from Social Security, the early boomer group was expected to suffer less as the result of declining markets (Gustman et al., 2009a).

In Gustman et al. (2009b), the authors consider the prospects of those nearing retirement and with little time to adjust to the wealth loss created by stock market declines from 2007 through 2008 and 2009. With increased use of defined contribution (DC) plans, such as the 401k or 403b, this group is thought to be especially vulnerable as they reduce wealth expenditures during retirement. Prior to DC plans, defined benefit (DB) plans provided yearly income for life to the retiree upon retirement. They were funded by the employer, and dispersed using a formula defining the benefit based on earnings, age, and service. Gustman et al. (2009b) determined that a fifty-percent stock market decline would decrease the DC plan holders' wealth by approximately 6.6%, and while this is significant, it was not likely to be life-changing for the participant. This was stated with the expectation that assets held by retirees would retain sufficient value to protect them from negative stock market actions. The increased incidence of dual income households were expected to reduce vulnerability as well. Women contributed approximately 25% in 1992, but were up to a third in 2004. Falling home prices are not thought to be as damaging to this group, as most in this demographic will have already paid off their homes and are not expected to cash out the equity in those homes for many years to come, thereby allowing time for housing prices to recover. The effects of the recession are thought to be more significant to this population than the decline in stock market prices. Gustman et al. (2009b) also expected the largest financial losses to be incurred by those in the upper division of the wealth distribution. This is expected to contribute to economic challenges, as these are the individuals who will be expected to take the higher taxes to fund redistribution to those in the lower tax brackets. It will be difficult to target effective policy actions without damaging retirement incomes and standards of living, as there is less wealth to distribute. Gustman et al. (2009b) lists Social Security as the largest asset, at 35% of wealth, with pensions being the second largest source of wealth at 20%. DC plans for the early boomer population account for 35% of their total pension wealth, and only 7% of their total wealth. Exposure to stock market fluctuations is very little for those in the bottom two-thirds of the wealth distribution and reliance on Social Security is increased for this group (Gustman et al., 2009b).

Pension plans were designed to provide a fixed income upon retirement, which took place after 20-30 years of employment with the entity providing the pension (Friedberg et al., 2002). If the individual left early, he or she left with nothing. The 401(k) plan allows the employee to take his or her retirement with them should they separate from the employer after a vesting period (1-2 years, for example). The money to be paid out of a DB plan is set in advance, dependent on salary and tenure. The final value of a DC plan is uncertain and depends on the

rate of return achieved accumulated contributions and the respective performance of allocations. Contributions to both types of plans are tax-deductible, so returns accumulate tax-free. Withdrawals from both types of plans are taxable. DB plans reduce worker mobility for many years after a worker starts a job, but encourages retirement when pension accruals turn negative, thereby reducing the incentive of the employer to fire older workers. DC accruals can remain positive and steady at this point of a worker's employment. Overall pension coverage declined from 67% of full-time employees in 1983 to 58% in 1998, with a decline in DB pension plans and increase in DC plans (Friedberg et al., 2002).

Considering uncertainty with both market return rates and interest rates, the adoption of DC pensions may increase the volatility of retirement rates. As expressed by Freidberg et al. (2002), the reduction of employees with DB plans was accompanied by an increase in employees. DB plans, but it is also interesting to see the downward slope of the line depicting full-time employees. DB plans are less attractive when the value of long term employment declines. Employers offering DB plans tend to require and invest in greater training of workers, and look to retain those workers and their skills for a longer period of time. Changes in technology as well as legislative restrictions may also explain part of the tendency of employers to offer DC plans in the place of DB plans in more recent history. DB benefits are paid out as an annuity, while DC assets are transferred out as a lump sum, which leaves the firm bearing the risk of employee longevity with a DB plan and the employee bearing the risk with a DC plan. As a retiree with a DC plan is more likely to outlive his or her finances, the increased incidence of these plans increases the reliance on Supplemental Security Income, Medicaid, and food stamps. Medicaid also encourages the retiree to spend down his or her assets qualify, as the recipient of Medicaid has strict low income requirements. DC plans increase worker choice in their investment strategy, which will be expressed in financial markets. Diffusion of information among both firms and individuals increases rates of return and volatility in financial markets (Friedberg et al., 2002).

Kaplan (2004) describes defined benefit (DB) plans as the more traditional, standard pension plans with the retiree receiving a prescribed payout from the date of retirement until death, with the surviving spouse continuing to receive a portion until their death. A worker will not outlive his or her retirement with a DB plan. Another benefit of a DB plan is that the employer assumes the associated investment risk. A defined contribution (DC) plan defines the amount that both the employee and the employer pay into the employee's account. The DC plan usually offers a mix of a money market account, a bond fund, and two or more stock portfolios. A growth stock would focus on companies with higher than average expected rates of growth, and a value stock would focus on companies whose assets are worth more than their stock price suggests. With a DC plan, the employee is responsible for the performance of his or her plan, and thereby, the income available to them upon retirement. Investment risk with a DC lies with the employee during both the accumulation and the payout phase. The number of workers in DC plans has increased while the number with DB plans has declined, 1979 to 1998. This change is attributed to several factors, including reduced compliance costs as a result of less burdensome regulations and technology enterprises. The effect is that employees are bearing more of their retirement income or pension risk (Kaplan, 2004).

As described in Kaplan (2004), 401(k)s offer the employee an opportunity to save money from their paycheck "pre-tax", so that the savings are reallocated from their paycheck before the tax is calculated. The tax is therefore deferred until the employee takes the funds from their retirement account, and allows the employee to save more money. An employee is likely to be in a lower tax bracket during retirement than while actively

working. A 401(k) is not considered a true pension plan because they involve only the employee's money. A DB or DC pension plan involves employer contributions. Another difference is that with a DB or DC plan, all employees are usually covered. A 401(k) requires voluntary participation on the part of the employee. Participation rates tend to differ more with 401(k) plans, with younger employees at lower salaries participating less than those of more advanced age and resources (Munnell et al., 2006). To increase saving, many employers have instituted "matching" funds for employees enrolled in 401(k) plans. This increases funds to those who are enrolled, thereby forcing those who do not enroll to forfeit the added money, which has increased participation rates for some. Employees with 403(b) and 457 plans tend to have some pension available, and not be entirely dependent on portfolio performance for their retirement. Companies that force employee 401(k)s to invest in company stock pushes the stock price up and helps finance mergers as shares of stock are traded, but it leaves employees vulnerable to that company's financial performance (Enron). Kaplan (2004) raises the question about the suitability of non-financially trained, interested, or motivated employees in effectively manipulating 401(k) plans in the best interest of their own retirement. Social Security was described as more important for low-earning households, while pension plans such as the 401(k) and earnings on assets are more important for higher income earners (Munnell et al., 2006). The authors expect Social Security to provide less overall though as retirement ages needed for full benefits increase, Medicare Part B premiums increase, and increased percentage of Social Security benefits are included under the personal income tax. As discussed here, personal saving has been reduced as employees rely on these pension plans to save for retirement — which increases the importance of these plans to maintaining standards of living in retirement for many workers (Munnell et al., 2006).

With a DB plan, the employer puts money back for the employee which the employee could collect at retirement. These plans were usually under the direction of a professional investment manager, so the employee's decision making was limited to the date of retirement. Defined contribution (DC) plans, in the form of 401(k) plans, spread during the 1980s and were viewed as supplements to other existing retirement plans (DB pension and profit-sharing plans).<sup>16</sup> In more recent times, more workers are reliant only on 401(k) plans for retirement savings, and for better or worse, have more say in where their money is invested as well as when and how much is removed to fund other significant life events. Participation in a 401(k) is voluntary so many workers may not choose to contribute at all. Younger workers are less likely to contribute than their older colleagues, which significantly reduces their preparation for retirement. Under-prepared investors tend to not diversify their holdings, hold more company stock than is prudent, and fail to rebalance their portfolio as they age. There is also an increased tendency to cash out their retirement account when they change jobs.

Pence (2001) found 401(k) plans to have little effect on savings by households. She found little evidence that households fund their 401(k)s by reducing household assets, and no evidence that 401(k) balances are a result of employer redirection of funds from defined benefit plans (Pence, 2001). 401(k)s were intended to supplement benefit plans, but eventually replaced them. With a 401(k), employees become more responsible for the success of their financial portfolio returns, and thereby — their own retirement. Pence (2001) concluded that 401(k) plans did not increase the wealth of eligible households even though their balances grew during the time period studied. In the aftermath of the Enron, WorldCom, and Global Crossing collapse, Choi et al. (2005) found that programs put in place to educate employees about the dangers of too little diversity in their retirement portfolios did little to actually convince employees to diversify their holdings. This has become a greater issue with increased use of defined contribution (DC) retirement plans, as defined benefit (DB) plans were legislatively limited on the amount of employer stock held. They found that merely allowing diversification to happen did not realize actual

diversification among employees' holdings (Choi et al., 2005). Ippolito (2002) considered firm goals to attract "savers", as they were deemed better workers than non-savers, through the use of deferred wage contracts, or pensions. Higher wages are predicted in firms using defined benefit (DB) plans. In his descriptions, "stayers" tended to save more and were thereby attracted to employers that offered deferred wage plans. He found that any compensation package that offered pensions tended to attract higher quality workers. The rate of quitting and disciplinary action was lower for "savers" than "non-savers" at every level of tenure in his research (Ippolito, 2002).

The literature outlines several concerns for the historic movement from DB pensions to DC plans as single source or retirement outcome. In this paper, we consider several indicators of volatility and the resultant concerns presented for one's adequate funding of retirement at a comparable standard of living. There are economic concerns at all levels (individual, firm, and nation) that are postponed for later work.

#### 2. Materials and Methods

Historical daily values were obtained for the S&P 500 (SPX) index, the S&P 100 Volatility (VXO) index, and the Dow Jones Volatility index (VXD) (CBOE, 2014a, b, and c). Values were available from January 2, 1986, to May 30, 2014, for both the SPX and VXO. Values available for VXD began with October 7, 1997, omitted the single day of October 27, 1997, and continued daily thereafter through August 29, 2014. The following descriptive statistics were reported (as rounded to the nearest whole number): maximum, minimum, and standard deviation. The maximum is the highest value, the minimum is the lowest value, and the standard deviation indicates variation from the mean, or average value. Historical charts were also created to illustrate the movement of the SPX, VXO, and VXD during the period covered in the data available.

According to the CBOE *Execute Success*, January 2014 issue, the CBOE Volatility Index (VIX) is the "world's most widely followed barometer of investor sentiment and market volatility" (CBOE, 2014d). The VIX is a measure of near-term market expectations as expressed in the S&P 500 stock index option prices (CBOE, 2014e). VIX is the denotation of the new method of calculation used on data since 2003. For this paper, data using the older method of calculation and denoted VXO was used as it was available for data spanning 1986 to present. Therefore, the CBOE Volatility Index is referred to using the VXO abbreviation in this paper (CBOE, 2014f). The SPX index has been used as a benchmark since 1983 (CBOE, 2014c). The Standard & Poor's 500 index is a capitalization weighted index of 500 stocks representing a broad range of industries, with the stocks weighted according to the total market value of their outstanding shares (CBOE, 2014g). The CBOE DJIA Volatility Index (VXD) is calculated on real-time option prices of the Dow Jones Industrial Average. It is considered able to reflect the future expectations of volatility held by investors (CBOE, 2014a). These indices were used to exhibit volatility in the market for this study.

#### 3. Results

The range presented for the SPX, VXO, and VXD indices appeared large, with that of the SPX index being the largest and the VXD index the smallest. Standard deviation was especially sizable for the SPX index.

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	SPX	VXO	VXD	
Maximum	1924	150	75	
Minimum	203	9	9	
Standard				
Deviation	451	9	8	

Table 1 Descriptive Statistics for the SPX, VXO, and VXD Indices (CBOE, 2014a, b, and c).

Historical charts depict volatility increasing over time for the extended period that data was available. As retirement accounts are directly tied to the market with DC and 401(k) retirement plans, this will impact employees as they approach and achieve retirement. As the baby boomer generation retires, this may well impact the US economy. That impact could be positive if accounts increase in value, but could also be negative should those accounts experience a reduction in value. Retirements will occur, but the spending capabilities of those retirees are directly tied to market performance with current retirement planning methodology.

Figure 1, depicting the SPX index from 1986 to 2014, portrays a continual increase in volatility expectation for the S&P 500 index. The S&P 500 index includes 500 leading companies, reflects 80% of the market capitalization, and is considered the best indicator of US large cap equities (S&P, 2014a). It is interesting in this chart that the peaks are higher and the dips lower as we progress forward through time. Higher highs and lower lows are a concern with volatility. Increased volatility also presents greater risk, which will be reflected in greater margin requirements in respective futures contracts (Kleinman, 2013).

It is reasonable, however, that the increase in participation and number of defined contribution (DC) pension plans may have contributed to this long-run rise in value when considering the literature and the upward movement through the 1980s and 1990s. There should be concern, however, with the downward trending two-year periods spanning the summers of 2000-2002 and summer 2007-late winter 2009. These downward trends likely eroded much of the value gained in portfolios from the mid-1990s, and with the closeness of the peaks and valleys, would rest more heavily on the minds of investors... even though the chart looks like those investors may have commenced buying in amounts significant enough to push the market back up. Those that were financially able to stay in for the long-run may be ok, but it is just as likely when considering the literature that inexperienced, unprepared investors may have suffered dramatic losses with ill-timed placement and lifting of positions. As macroeconomic policy is based on impacting aggregate spending, the erosion of a portion of the population's retirement income would have significant and widespread economic impacts in the national and global economy (Krugman et al., 2013).

The S&P 100 Volatility Index (VXO) reflects near-term volatility expectations in the S&P 100 index options (CBOE, 2014b, e, and f). This chart is interesting in that it expresses increased volatility near the occurrence of economic turmoil (mid-1980s, 2001-2002, 2008), although we do see increased volatility with other periods that were not as significant in economic history (1990, 1997-1998, 2010-2011). Caution is encouraged when using volatility only to predict or forecast formal recessions, but with increased use of DC pension plans, it may reflect investor concern during or prior to periods of economic concern. Recessions are heavily defined by increased unemployment numbers, but individuals may act conservatively with their investing as they see spending habits change with respect to their customers or employers. These individual actions may create some aggregate expression of concern seen in their reliance upon their DC pension plan and its use as a source of funds for major life events (family illness, wedding, impending changes with their employment).

The VXO does not reflect the same patterns of increased volatility that the SPX does, with respect to timing





Figure 1 The S&P 500 (SPX) Index Using Daily Values and Charted Over Time from January 2, 1986 to May 30, 2014 (CBOE, 2014c)



Figure 2 The S&P 100 Volatility Index (VXO) Using Daily Values and Charted Over Time from January 2, 1986, to May 30, 2014 (CBOE, 2014b)

The Dow Jones Volatility Index (VXD) is based on option prices for the Dow Jones Industrial Average (DJIA) (CBOE, 2014a). The DJIA is an average of 30 companies selected to represent the performance of the stock market and by extension, the US economy (S&P, 2014b). Two-thirds of the 30 companies are in manufacturing of industrial and consumer goods, with the rest more widely dispersed into sectors such as financial services, information technology, and entertainment (S&P, 2014b). VXD is considered able to reflect investors' view of the near-term (next 30 days) volatility in the stock market (CBOE, 2014a). Volatility increased as communicated in the VXD at approximately the same time periods as seen with VXO, although the information available for this index did not include the events of the 1980s. The 2008 adventure was appropriately recognized in both charts, leading us to agree with the literature in that volatility does increase with economic downturns.

As we see in Figure 4, the DJIA index portrays a long-run increase from 1902-2014. Periods of economic volatility (the first 20 years, the Great Depression, the 70s and 80s, '01-'02, and '08) and well as periods of economic stability (late 40s-the 60s) are visible. Increasing industrialization of the nation could also be a part of the long-run increases in the DJIA index, which is expected as a nation develops. Increased efficiencies of labor inputs, most notably labor as a result of increased education, may also contribute to increased value of the companies reflected here. However, macroeconomic policies (monetary and fiscal) as were applied as we recovered from the Great Depression may also have some impact (Krugman et al., 2013). Are these companies worth this much more, or is the dollar by which we measure their value worth this much less? Whichever the case, is the path sustainable for future retirees?



Figure 3 The Dow Jones Volatility Index (VXD) Using Daily Values and Charted Over Time from October 7, 1997, to August 29, 2014 (CBOE, 2014a)

Increases in volatility, and thereby risk, with economic downturns is well documented. What should we expect with more employees relying on DC pension plans for their retirement? Will retirement still be possible? What is the alternative if it is not? Can we work forever? If so, what happens to overall US productivity? Will the market only move up? If so, what is the cost? These are all questions that will be investigated in upcoming research activities as tomorrow's history unfolds. There are macroeconomic policy questions, individual and family questions, and global economy questions, just to get started.

Increased life spans over the last century have been beneficial if we must work longer to attain retirement. The inclusion of women in the work force after WWII has been beneficial to retirement plans, as married couples are documented in the literature to expect more favorable retirement outcomes (Hanna et al., 2003; Gustman et al., 2009a; Gustman et al., 2009b). Increased part-time employment and reduced full-time endeavors may seriously diminish the pension plan potential for retirees of the next generation. Therefore, Social Security may be of increasing importance for the upcoming retirees, but the ability for the nation to fund it may also be of increasing concern.



#### 4. Conclusions

Retirement plans have increasingly moved from defined benefit (DB) to defined contribution (DC) plans in

the last thirty years. Effects of this may be seen in the increased values and volatility of the indices representing economic activity (VXD, VXO, and SPX). Retirements at continued standards of living may be possible if the continued nature of a rising stock market is sustained; however, disastrous outcomes may become a reality if the stock market fails to continue the climb with increased reliance on DC pension plans. Macroeconomic policy and national attention to job growth will be important as we move forward, as well as individual and aggregate relationships concerning saving and consumption.

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