Projected Retirement Adequacy of Workers Age 50 to 61: The Role of 401(k) Plans in the Context of Total Wealth

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Introduction

During the rising stock market of the 1990's, a growing number of employers sponsored defined contribution (DC) retirement programs for their employees. Also, employee participation in 401(k) plans increased. The 401(k) plans grew in importance as a key part of America's retirement planning. The more recent stock market declines since the middle of 1999 has reduced the values of many employees' 401(k) retirement portfolios and simultaneously raised the question, "Will American workers nearing retirement age have a financially adequate retirement?"

Retirement adequacy is having sufficient retirement resources to finance retirement consumption. According to the life cycle theory, individuals should try to wisely arrange their whole resources over the life cycle to maintain a certain level of consumption stream so that they will enjoy the same level of consumption before and after retirement (Modigliani & Brumberg, 1954). Therefore, if retired individuals have acquired enough wealth to maintain their pre-retirement consumption, they are said to have achieved retirement adequacy.

A method to estimate the level of one's retirement need is to compare pre-retirement income and retirement consumption level. The ratio of pre-retirement income divided by retirement consumption is called the "replacement rate." Duncan, Mitchell, and Morgan (1984) used replacement rates in the range of 70% to 90% in their calculation of hypothetical cases of people preparing for retirement. Li, Montalto, and Geistfeld (1996) used data from the National Longitudinal Survey of Older Men to compare households' needed resources and actual resources at the point of retirement. Their results showed that men born between 1907 and 1921 were not adequately prepared for retirement.

Empirical measures of retirement wealth often include the value of all possible retirement resources including both financial assets and nonfinancial assets. In one study, Burns and Widdows (1988) included the value of home equity as one type of retirement resource. In other research, Bernheim (1996) excluded home equity from retirement resource. If individuals do not plan to sell their home to

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finance retirement needs, the home equity should not be included as available retirement resources.

Purpose of the Study

The purpose of this study is to determine how defined contribution plans fit into a context of total wealth. In effect, the task is to create a wealth profile obtained from a highly reliable national dataset of pre-retirees who are nearing retirement age. This report shows that the crucial role defined contribution plans play in helping workers achieve a financially adequate retirement.

Data Source and Procedures

The Survey of Consumer Finances (SCF) is a triennial survey of consumers sponsored by the Board of Governors of the United States Federal Reserve System with the cooperation of the U.S. Department of Treasury. The SCF data are collected by the National Opinion Research Center at the University of Chicago and made available through the Federal Reserve Board.

The SCF is designed to provide detailed information on the balance sheets of the U.S. households, including their use of financial services, expected defined benefit pensions, labor force participation, and demographic characteristics. The SCF is the most comprehensive national survey dataset available with detailed information on household financial and other assets. Such robust information exists because the primary focus of the SCF is upon financial information. Not other large dataset is as useful as the SCF.

The 1998 SCF is representative of 102.6 million households. The SCF dataset includes numerous variables in the following categories: demographics, financial characteristics, other financial and nonfinancial assets, types and amounts of debts, and opinions/attitudes. A list of those variables appears in Appendix A, *Variables in the Survey of Consumer Finances*. Many top quality research articles that have used the SCF have been published in the *Federal Reserve Bulletin*, a prestigious journal. In one professional journal, *Financial Counseling and Planning*, over forty refereed articles using the SCF datasets have been published in recent years. Additional information about the SCF is in Appendix B, *About the* Survey of *Consumer Finances*. Appendix C, *Use of the Survey of Consumer Finances*, compares and contrasts the strengths and weaknesses of using the SCF for this study rather than two other well-respected databases.

Methodological Approach to Retirement Adequacy

In this report, analyses are presented based on the resources projected to be available for households. This is the best way to consider retirement adequacy because all resources, including the assets of married workers' spouses, are included. However, for comparison with studies that only included defined contribution plans and Social Security benefits of individual workers, we also

report analyses based only on individual workers' defined contribution plans and projected Social Security pensions. Details on methodology are in Appendix D, *Empirical Methodology*.

For households, we define retirement adequacy as having enough financial resources to cover retirement needs. Retirement needs are based on households' pre-retirement consumption level. In other words, at retirement, households should be able to spend at the pre-retirement level. This is the standard approach used by a number of academic studies of retirement adequacy (e.g., Yuh, Hanna and Montalto, 1998). For our analyses based on individual workers, we define the replacement rate as the ratio of projected income from a DC plan plus a Social Security pension to annual pretax earnings just before retirement.

Using the actual allocation of investment assets, including individual retirement accounts, (IRAs), 401(k) plans and other defined contribution plans, we projected the values of these investments at retirement, both based on the historical average, or mean, rate of return of each investment type, and also based on a pessimistic projection. (See Appendix E, *Lognormal Projection of Investment Assets*, for technical definitions of mean and pessimistic projections.) Even though many experts suggest reducing the proportion of investments in stocks as retirement approaches, many workers do not bother to change their allocations, so our pessimistic projections show the consequences of keeping a high proportion of investments in stocks in the years leading to retirement.

This report includes descriptive analyses for households of percentage of defined contribution (DC) participation, retirement adequacy analysis by ownership of a DC plan, and by current age, and the distribution of resources to needs ratio by ownership of a DC plan. This report also includes the distribution of the replacement rate for individual workers by ownership of a DC plan.

All of the analyses in this report were done both for retirement at the respondent's expected retirement age and at age 65. In the 1998 SCF, respondents were asked how old they would be when they expected to retire. We deleted respondents who did not provide such information because the number of years until retirement is key information needed in the analysis of retirement adequacy. Therefore, in this study, all sample households had an expected retirement age. The reason for also presenting the analyses based on retirement at 65 is that other analyses based on datasets without expected retirement age typically have assumed that workers will retire at age 65. Also, other surveys usually do not ask about the respondent's expected retirement age. Furthermore, the assumption was that there would not be any earnings after retirement, though in many households someone will in fact be employed part-time after retirement from full-time employment.

<u>The Dataset</u>

The 1998 SCF data set had a total sample of 4,305 households. The respondents' ages ranged from 17 to 95. Assuming all respondents will retire at their expected retirement age, there were a total of 693 households that met our sample selection criteria. (For details, see Appendix F, *Sample Selection Criteria.*) Our sample included households with respondent being between 50 and 61 years of age. For the purpose of this analysis, we also had other sample selection criteria. Therefore, we had a total sample of 693 households here, and, as noted earlier, the entire SCF sample represents 102.6 million households, so the sample of households with workers age 50-61 represent roughly 16.5 million households. Even though it is possible to obtain information about households with a worker of a particular age, e.g., 55, the sample size becomes too small to provide reliable estimates, so we provide analyses of all households with a worker age 50 to 61, and also by three-year groupings of age. See also Appendix G, *Definitions of Selected Variables*.

This study assumes that all workers in our sample were eligible for Social Security and that all workers will retire at their expected retirement age. There were a total of 923 workers that met the above sample selection criteria for workers who will retire at their expected retirement age.

Profile of Investment Assets for Retirement
for Households and Individual Workers

Households accumulate investments for various goals, although for households with workers age 50 or older, retirement is the primary goal. Even though some households borrow against Defined Contribution (DC) accounts or even liquidate them and pay tax penalties, we will ignore that possibility in the following analyses.

Table 1
Distribution of Total Asset and DC Asset Levels of Households with a Defined Contribution Plan, By Current Age of Respondents

	Current Age of Respondent				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Total Assets	100%	100%	100%	100%	100%
Less than $100,000	12.31%	8.80%	15.51%	18.77%	5.59%
$100,000 to $249,999	37.11%	42.94%	27.57%	44.36%	29.81%
$250,000 to $499,999	26.87%	21.41%	32.10%	18.80%	41.63%
$500,000 to $999,999	10.15%	10.25%	14.74%	6.39%	7.70%
$1,000,000 or more	13.56%	16.61%	10.08%	11.68%	15.27%
Median Level of Total Assets	$254,170	$249,700	$361,400	$199,060	$368,730
Mean Level of Total Assets	$747,737	$727,482	$566,012	$773,920	$1,053,672
Total Investment Assets	100%	100%	100%	100%	100%
Less than $100,000	48.68%	54.32%	43.20%	60.19%	29.09%
$100,000 to $249,999	21.32%	15.62%	21.71%	20.76%	33.95%
$250,000 to $499,999	14.63%	11.96%	20.93%	6.44%	21.69%
$500,000 to $999,999	6.27%	8.39%	6.19%	5.93%	2.21%
$1,000,000 or more	9.10%	9.71%	7.97%	6.68%	13.06%
Median Level of Investment Assets	$100,450	$96,500	$120,500	$72,100	$190,300
Mean Level of Investment Assets	$528,174	$494,825	$377,702	$571,412	$787,295
DC Balance	100%	100%	100%	100%	100%
Less than $10,000	33.68%	36.88%	25.56%	36.69%	35.77%
$10,000 to $24,999	20.33%	18.07%	25.77%	19.62%	17.33%
$25,000 to $50,000	15.97%	12.72%	19.74%	16.02%	16.83%
$50,000 to $100,000	13.21%	14.98%	10.87%	17.31%	7.39%
More than or equal to $100,000	16.81%	17.35%	18.05%	10.37%	22.69%
Median Level of DC Assets	$20,000	$20,000	$21,000	$20,000	$22,000
Mean Level of DC Assets	$79,085	$69,616	$65,490	$69,399	$135,793

Households with a DC Account

For all households with at least one DC account and with the respondent age 50-61, Table 1 shows that the median level of total assets (including the residence) was over $250,000, with the median level for those age 59-61 being almost $370,000. The median level of investment assets was less than half the value of total assets. The median level of DC balances was less than a fifth of the value of investment assets for all households with DC balances. The mean levels of balances were much higher than the median levels.

Table 2 shows the ratio of DC balances to total assets and to investment assets for households with a DC account and a respondent age 50-61. Overall, DC balances represent less than a quarter of investment assets.

Table 3 shows for households with a DC plan the ratio of stock assets in all types of accounts to total assets and the ratio of stock assets to investment assets, as well as the ratio of stocks in DC plans to total DC assets. Overall, the median level of the ratio of stock assets to all assets (including residences) is just over one-sixth. Stocks represent less than half of all investment assets at the median level of the ratio. However, stocks represent almost two-thirds of DC balances. Clearly, decreases in stock indexes have a big impact on the value of DC balances for workers age 50 to 61, but a much lower impact on the total value of investment assets.

Table 2
Distribution of Ratio of DC Balance to Total Assets and to Total Investment, Asset Levels of Households with a Defined Contribution Plan, By Current Age of Respondents

			Current Age of Respondents		
	All	**50-52**	**53-55**	**56-58**	**59-61**
Ratio of DC Balance to Total Assets	100%	100%	100%	100%	100%
Less than 5%	38.33%	37.70%	32.48%	38.24%	49.42%
5% to 9.9%	15.85%	22.47%	14.45%	13.39%	7.17%
10% to 14.9%	9.67%	10.06%	8.56%	12.67%	6.42%
15% to 19.9%	8.02%	7.13%	14.68%	3.70%	5.13%
20% or more	28.13%	22.64%	29.83%	32.01%	31.86%
Median Level of Ratio of DC Balance to Total Assets	7.89%	6.8%	11.6%	8.9%	5.0%
Mean Level of Ratio of DC Balance to Total Assets	272%	255%	295%	278%	263%
Ratio of DC Balance to Total Investment Assets	100%	100%	100%	100%	100%
Less than 5%	21.13%	20.26%	14.03%	21.27%	34.52%
5% to 9.9%	12.57%	11.62%	17.87%	8.53%	11.66%
10% to 14.9%	8.41%	4.95%	7.66%	14.31%	8.89%
15% to 19.9%	3.99%	2.87%	4.56%	3.34%	6.40%
20% or more	53.90%	60.30%	55.88%	52.55%	38.55%
Median Level of Ratio of DC Balance to Total Investment Assets	23.9%	30.0%	28.1%	25.6%	12.7%
Mean Level of Ratio of DC Balance to Total Investment Assets	500%	371%	370%	357%	303%

Note: negative and zero assets are set to be equal to $1.

Table 3
Distribution of Ratio of Stock Assets to Total Assets, to Total Investment Assets, and to Total DC Assets of Households with a Defined Contribution Plan, By Current Age of Respondents

	Current Age of Respondents				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Ratio of All Stocks to Total Assets	100%	100%	100%	100%	100%
Less than 10%	42.88%	44.63%	32.76%	55.35%	38.05%
10% to 49.9%	44.98%	44.88%	51.88%	42.04%	37.99%
50% to 89.9%	11.76%	10.48%	15.36%	2.16%	22.17%
90% to 94.9%	0.39%	0.00%	0.00%	0.44%	1.79%
95% or more	0.00%	0.00%	0.00%	0.00%	0.00%
Median Level of Ratio of All Stocks to Total Assets	16.5%	14.8%	21.3%	8.6%	21.3%
Mean Level of Ratio of All Stocks to Total Assets	170%	166%	183%	148%	188%
Ratio of All Stocks to Total Investment Assets	100%	100%	100%	100%	100%
Less than 10%	31.22%	27.84%	26.81%	40.45%	32.87%
10% to 49.9%	20.91%	17.66%	21.94%	22.00%	24.76%
50% to 89.9%	25.69%	29.08%	30.21%	13.66%	27.84%
90% to 94.9%	4.40%	8.88%	2.33%	1.59%	2.01%
95% or more	17.77%	16.55%	18.70%	22.30%	12.52%
Median Level of Ratio of All Stocks to Total Investment Assets	46.2%	55.9%	51.4%	26.5%	37.5%
Mean Level of Ratio of All Stocks to Total Investment Assets	257%	269%	264%	243%	237%
Ratio of DC Stocks to DC Assets	100%	100%	100%	100%	100%
Less than 10%	29.41%	23.35%	30.35%	40.16%	25.94%
10% to 49.9%	0.61%	0.00%	2.31%	0.02%	0.00%
50% to 89.9%	2.45%	2.90%	2.61%	0.00%	4.66%
90% to 94.9%	1.81%	0.82%	3.41%	0.00%	3.88%
95% or more	65.72%	72.94%	61.31%	59.82%	65.52%
Median Level of Ratio of DC Stocks to DC Assets	100%	100%	100%	100%	100%
Mean Level of Ratio of DC Stocks to DC Assets	374%	400%	363%	339%	383%

Note: negative and zero assets are set to be equal to $1.

Households with No DC Accounts

For households with no DC accounts and with the respondent age 50-61, Table 4 shows that the median level of total assets (including the residence) was about $184,000, with the median level for those age 59-61 being about $207,000. The median level of investment assets was less than a third of the value of total assets.

All Households

For all households, both those with no DC accounts and those with a DC account, with the respondents age 50-61, Table 5 shows that the median level of total assets (including the residence) was just over $210,000, with the median level for those age 59-61 being over $241,000. The median level of investment assets for all households, $67,000, was less than a third of the value of total assets.

Individual Workers With DC Accounts

Table 6 shows the distribution of the value of DC assets for individual workers. The median level was only $20,000, though almost one-seventh of the workers had $1,000,000 or more.

Table 7 shows the distribution of the ratio of stocks to total DC assets for individual workers. Almost 70% of workers have stocks representing at least 95% of their balances, and the ratio is highest for those age 59-61.

Table 4
Distribution of Total Asset and Total Investment Asset Levels of Households with No Defined Contribution Plan, By Current Age of Respondents

	Current Age of Respondent				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Total Assets	100%	100%	100%	100%	100%
Less than $100,000	27.81%	30.01%	26.33%	28.98%	24.33%
$100,000 to $249,999	32.10%	31.63%	29.84%	34.63%	32.34%
$250,000 to $499,999	20.87%	20.64%	18.67%	18.75%	26.97%
$500,000 to $999,999	10.59%	10.80%	15.57%	8.29%	6.99%
$1,000,000 or more	8.63%	6.92%	9.58%	9.35%	9.37%
Median Level of Total Assets	$183,899	$162,300	$214,450	$182,599	$207,271
Mean Level of Total Assets	$525,321	$465,483	$574,867	$507,160	$589,503
Total Investment Assets	100%	100%	100%	100%	100%
Less than $100,000	63.04%	65.82%	55.48%	69.22%	59.49%
$100,000 to $249,999	17.22%	16.23%	18.06%	13.89%	22.40%
$250,000 to $499,999	8.94%	8.58%	13.63%	6.03%	7.52%
$500,000 to $999,999	5.43%	5.86%	5.40%	5.82%	4.18%
$1,000,000 or more	5.38%	3.51%	7.43%	5.04%	6.41%
Median Level of Investment Assets	$50,000	$52,500	$66,700	$41,500	$72,000
Mean Level of Investment Assets	$341,009	$286,512	$391,537	$321,209	$397,005

Table 5
Distribution of Total Asset, Total Investment Asset and DC Asset Levels of All Households, By Current Age of Respondents

	Current Age of Respondent				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Total Assets	100%	100%	100%	100%	100%
Less than $100,000	23.51%	23.74%	23.11%	26.39%	19.68%
$100,000 to $249,999	33.49%	34.97%	29.17%	37.10%	31.72%
$250,000 to $499,999	22.53%	20.87%	22.67%	18.76%	30.61%
$500,000 to $999,999	10.47%	10.64%	15.33%	7.81%	7.17%
$1,000,000 or more	10.00%	9.79%	9.73%	9.94%	10.83%
Median Level of Total Assets	$210,250	$202,300	$238,150	$183,599	$241,400
Mean Level of Total Assets	$586,973	$542,945	$572,234	$574,850	$704,628
Total Investment Assets	100%	100%	100%	100%	100%
Less than $100,000	59.06%	62.42%	51.83%	66.93%	51.95%
$100,000 to $249,999	18.36%	16.05%	19.15%	15.63%	25.27%
$250,000 to $499,999	10.52%	9.58%	15.80%	6.13%	11.04%
$500,000 to $999,999	5.66%	6.61%	5.64%	5.85%	3.69%
$1,000,000 or more	6.41%	5.35%	7.59%	5.46%	8.06%
Median Level of Investment Assets	$67,000	$61,100	$92,800	$44,500	$95,000
Mean Level of Investment Assets	$392,890	$348,102	$387,422	$384,697	$493,806
DC Balance	100%	100%	100%	100%	100%
Less than $100,000	81.62%	81.34%	77.86%	83.93%	84.07%
$100,000 to $249,999	5.64%	5.34%	7.67%	4.98%	4.30%
$250,000 to $499,999	4.43%	3.76%	5.87%	4.06%	4.18%
$500,000 to $999,999	3.66%	4.43%	3.23%	4.39%	1.83%
$1,000,000 or more	4.66%	5.13%	5.37%	2.63%	5.63%
Median Level of DC Assets	$0	$0	$0	$0	$0
Mean Level of DC Assets	$21,922	$20,582	$19,476	$17,610	$33,680

Table 6
Distribution of DC Assets of Individual Workers By Current Age of Workers, For Those Age 50-61.

	Current Age of Respondent				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Total DC Assets	100%	100%	100%	100%	100%
Less than $100,000	35.91%	38.09%	27.29%	44.90%	29.22%
$100,000 to $249,999	19.61%	17.51%	23.59%	20.44%	16.49%
$250,000 to $499,999	16.65%	15.34%	20.93%	12.50%	20.02%
$500,000 to $999,999	13.24%	13.86%	14.09%	13.31%	9.90%
$1,000,000 or more	14.59%	15.20%	14.09%	8.85%	24.38%
Median Level of DC Assets	$20,000	$20,000	$20,000	$11,000	$32,000
Mean Level of DC Assets	$69,375	$60,226	$60,012	$53,744	$139,128

Table 7
Distribution of Ratio of Stock Assets to Total DC Assets By Current Age of Workers

	Current Age of Respondent				
	All	**50-52**	**53-55**	**56-58**	**59-61**
Ratio of DC Stocks to DC Assets of Workers	100%	100%	100%	100%	100%
Less than 10%	27.39%	22.32%	27.88%	39.06%	18.63%
10% to 49.9%	0.03%	0.00%	0.10%	0.01%	0.00%
50% to 89.9%	2.69%	2.47%	4.56%	0.00%	4.83%
90% to 94.9%	0.00%	0.00%	0.00%	0.00%	0.00%
More than or equal to 95%	69.89%	75.21%	67.46%	60.93%	76.54%
Median Level of Ratio of DC Stocks to DC Assets	100%	100%	100%	100%	100%
Mean Level of Ratio of DC Stocks to DC Assets	71.95%	77.27%	70.69%	60.93%	80.21%

Retirement Adequacy

Household Analysis

As shown in Table 8, based on average investment returns between the year of the survey and each household's retirement, 51% of the households in the sample would be adequately prepared for retirement at the point of retirement based on their planned retirement ages. (All percentages are reported as rounded numbers.) In effect, their retirement resources will be more than or equal to that of their retirement needs. Fifty-three percent will achieve adequacy if they all retired at age 65.

For households with at least one defined contribution account, 72% would be adequately prepared based on average investment returns and retirement at their planned retirement ages. Seventy-five percent achieved adequacy if they all retired at age 65. For households with no DC accounts, only 42% would be adequately prepared based on average investment returns and retirement at their planned retirement ages. Only 44% will achieve adequacy if they all retired at 65.

Pessimistic inflation-adjusted rate of returns also were calculated based on lognormal projection, for the 10th percentile. (See Appendix E, *Lognormal Projection of Investment Assets*.) Based on pessimistic investment returns between the year of the survey and each household's retirement, 46% of the households in the sample would be adequately prepared for retirement at the point of retirement based on their planned retirement ages (see Table 8). In effect, their retirement resources will be more than or equal to that of their retirement needs, with 47% achieving adequacy if they all retired at 65.

For households with at least one DC account, 68% would be adequately prepared based on average investment returns and retirement at their planned retirement ages, with 69% achieving adequacy if they all retired at 65 (see Table 8). For households with no DC accounts, 38% would be adequately prepared based on average investment returns and retirement at their planned retirement ages, and 38% achieving adequacy if they all retired at 65.

Table 8
Projected Percent of Households Aged 50-61 Who Would Be Able to Maintain Pre-Retirement Level of Living After Retirement, Households with a Defined Contribution (DC) Plan, Households without a Defined Contribution Plan, and All Households

	With a DC Plan	Without a DC Plan	All Households
Mean Projection of Investments			
Based on planned retirement age	71.85%	42.36%	51.54%
Based on retirement at 65	74.52%	44.11%	52.54%
Pessimistic Projection of Investments (10th percentile)			
Based on planned retirement age	67.53%	38.24%	46.36%
Based on retirement at 65	69.28%	38.43%	46.98%

Also analyzed were the ratio of retirement resource divided by retirement needs (see Table 9). For all of the sample households, based on mean projections of investment returns, 30% had resources less than 70% of the amount needed to maintain their current level of living (defined as the current consumption level), 5% had a ratio between 70% and 80%, 8% had a ratio between 80% and 90%, and 7% had a ratio between 90% and 99.9%. Half of the total households (51%) had a ratio greater than or equal to 100%, which indicates that their retirement resource will be high enough to cover their maintain their living standards.

For households with at least one DC plan, far fewer households had projected resources much lower than needs, compared to households with no DC plans (see Table 9). Only 9% of households with DC plans had a projected ratio of resources to needs less than 70%, compared to 37% of households with no DC plans having such a low projected ratio.

Table 9
Distribution of Projected Replacement Ratios of Resources at Retirement to Needs, Households Aged 50-61, for Households with a Defined Contribution (DC) Plan, Households Without a Defined Contribution Plan, and All Households, Based on Planned Retirement Age

	With a DC Plan	Without a DC Plan	All Households
Based on Mean Projection of Investments			
Less than 70%	9.3%	37.3%	29.6%
70% to 79.9%	4.2%	5.8%	5.3%
80% to 89.9%	7.0%	8.1%	7.8%
90% to 99.9%	7.7%	6.4%	6.8%
100% and over	71.9%	42.4%	50.5%
Pessimistic Projection of Investments (10th Percentile)			
Less than 70%	10.9%	38.8%	31.0%
70% to 79.9%	5.4%	6.2%	5.9%
80% to 89.9%	8.3%	9.6%	9.3%
90% to 99.9%	7.9%	7.2%	7.4%
100% and over	67.5%	38.2%	46.4%

Based on pessimistic projections of investment returns, the percentage of households with resources less than 70% of the amount needed increases slightly for households, 31% for all households in the sample compared to 30% for the mean projection (Table 9). Even for households with at least one DC plan, the pessimistic projection shows 11% having resources less than 70% of needs, and this compares to 9% for the mean projection.

Table 10
Projected % of Households with a Defined Contribution Plan Who Would Be Able to Maintain Pre-Retirement Level of Living After Retirement, By Current Age of Respondents

	Current Age of Respondent			
	50-52	**53-55**	**56-58**	**59-61**
Based on Mean Projection of Investments				
Based on planned retirement age	68.40%	68.78%	79.74%	73.32%
Based on retirement at 65	71.21%	75.00%	78.83%	74.91%
Based on Pessimistic Projection of Investments (10th Percentile)				
Based on planned retirement age	59.57%	66.47%	79.05%	70.39%
Based on retirement at 65	63.47%	69.35%	77.44%	70.38%

Table 10 shows the projected percentages of households with defined contribution plans who would be able to maintain their pre-retirement level of living by current age of the respondent. Based on mean projection of investment returns and planned retirement ages, 68% of those age 50-52, 69% of those age 53 to 55, 80% of those age 56 to 58, and 73% of those age 59 to 61 are adequately prepared for retirement. Based on pessimistic projection of investment returns and planned retirement ages, 60% of those age 50-52, 66% of those age 53 to 55, 79% of those age 56 to 58, and 70% of those age 59 to 61 are adequately prepared for retirement.

For households with no DC plans, based on mean projection of investment returns and planned retirement ages (see Table 11), 43% of those age 50-52, 39% of those age 53 to 55, 39% of those age 56 to 58, and 51% of those age 59 to 61 are adequately prepared for retirement. Based on pessimistic projection of investment returns and planned retirement ages, 36% of those age 50-52, 35% of those age 53 to 55, 38% of those age 56 to 58, and 46% of those age 59 to 61 are adequately prepared for retirement.

Table 11
Projected % of Households with No Defined Contribution Plans Who Would Be Able to Maintain Pre-Retirement Level of Living After Retirement, By Current Age of Respondents

	Current Age of Respondent			
	50-52	**53-55**	**56-58**	**59-61**
Based on Mean Projection of Investments				
Based on planned retirement age	42.81%	38.89%	39.11%	50.50%
Based on retirement at 65	44.86%	39.56%	41.21%	52.60%
Based on Pessimistic Projection of Investments (10th Percentile)				
Based on planned retirement age	35.86%	35.36%	38.02%	46.30%
Based on retirement at 65	37.06%	34.76%	38.13%	45.90%

<u>Households with Some Stocks Versus No Stocks</u>

For households that have at least one DC plan, we compared their retirement adequacy by whether they possessed any stocks, including stocks in all investments (Table 12). For households with at least one DC plan and assuming all households would retire at their expected retirement age, 64% held some stocks and were adequately prepared for retirement. Only 8% were adequately prepared for retirement and held no stocks. Of these households, 9% held no stocks and would not be able to have an adequate retirement. Assuming all households would retire at age 65, 67% who held some stocks would be able to maintain their pre-retirement level of living, but only 7% who held no stocks were adequately prepared for retirement. Of these households, 10% held no stocks and they are not adequately prepared for retirement.

Table 12
Projected Percent of Households Aged 50-61 and With a DC Plan,
Households With Stocks and Without Stocks—Mean Projection

	With Stocks	Without Stocks
Based on Planned Retirement Age		
% Adequate	64.35%	8.43%
% Not adequate	17.84%	9.38%
Based on Retirement at 65		
% Adequate	67.26%	7.45%
% Not adequate	14.93%	10.36%

For households with at least one DC plan and assuming all households would retire at their expected retirement age, 60% who held some stocks would have an adequate retirement even with a pessimistic projection of investment returns between 1998 and each household's retirement (see Table 13). Only 8% who held no stocks were adequately prepared for retirement. Of these households, 10% who held no stocks would not be able to have an adequate retirement. Assuming all households would retire at age 65, 62% who held some stocks were prepared for retirement, but only 7% who held no stocks are adequately prepared for retirement. Of these households, 11% held no stocks and were not adequately prepared for retirement.

Table 13
Projected Percent of Households Aged 50-61, Households With Stocks and Without Stocks—Pessimistic Projection, With at least One DC Plan

	With Stocks	Without Stocks
Based on Planned Retirement Age		
% Adequate	59.73%	7.79%
% Not adequate	22.46%	10.02%
Based on Retirement at 65		
% Adequate	62.47%	6.81%
% Not adequate	19.72%	11.00%

Workers

Overall, based on a mean projection of the returns on DC assets, only 10% of workers' will have a projected retirement income generated by DC plans and Social Security equal to at least 100% of pretax earnings just before retirement (see Table 14). About 13% of workers with DC plans had a projected ratio less than 30%. When using pessimistic projections of investment returns, only 3% of those with DC plans will be able to replace 100% of pretax earnings and 26% will be able to replace less than 30% of pretax earnings. These numbers are much lower for those without DC plans, as 43% had projected replacement rates of less than 30% based on pessimistic projections.

Table 14
Distribution of Projected Replacement Ratios of Retirement Income from DC Accounts and Social Security to Pre-retirement Earnings, Workers Aged 50-61, for Workers with a Defined Contribution (DC) Plan, Workers Without a Defined Contribution Plan, and All Households—Based on Workers' Real Expected Retirement Age

	With a DC Plan	Without a DC Plan	All Households
Based on Mean Projection of Investments			
Less than 30%	12.5%	43.4%	36.2%
30% to 39.9%	25.0%	19.6%	20.9%
40% to 49.9%	21.6%	15.5%	16.9%
50% to 59.9%	9.5%	8.7%	8.9%
60% to 69.9%	10.0%	6.5%	7.3%
70% to 79.9%	6.7%	3.5%	4.2%
80% to 89.9%	2.6%	1.3%	1.6%
90% to 99.9%	1.9%	1.0%	1.2%
100% and over	10.3%	0.6%	2.9%
Pessimistic Projection of Investments (10th Percentile)			
Less than 30%	26.2%	43.4%	39.4%
30% to 39.9%	35.2%	19.6%	23.3%
40% to 49.9%	18.0%	15.5%	16.1%
50% to 59.9%	8.6%	8.7%	8.7%
60% to 69.9%	5.6%	6.5%	6.3%
70% to 79.9%	1.9%	3.5%	3.1%
80% to 89.9%	1.1%	1.3%	1.3%
90% to 99.9%	0.7%	1.0%	0.9%
100% and over	2.7%	0.6%	1.1%

Conclusions and Recommendations

A number of conclusions and recommendations follow that are based upon the findings of this study.

1. Impact of a DC Plan on Household Retirement Adequacy

Households with a DC plan are much more likely to achieve retirement adequacy than those without a DC plan, both based on either average or pessimistic projections of returns on investments. Seven in ten households with a DC plan will be able to maintain the same pre-retirement level of consumption in retirement. Even with a pessimistic projection of investment returns, more than two-thirds of the households with at least one DC plan will be able to maintain a pre-retirement level of living after retirement. In contrast, about four in ten households without a DC plan could achieve an adequate retirement based on pessimistic or mean projections of returns on investments.

2. Impact of a DC Plan on Replacement Ratios

Those workers with a DC plan are much more likely than those without a DC plan to have a higher ratio of pre-retirement income divided by retirement consumption. Stated another way, having a DC plan substantially reduces the chance that workers will have a low replacement rate. Based on mean projections of returns on investments, four in ten workers without a DC plan will be able to replace less than 30% of pretax earnings. This contrasts to only one in eight workers with a DC plan who will have such a low replacement rate.

Again with a mean projection of investment returns, without any other income, only 10% of the workers with a DC plan would be able to obtain a pre-retirement level of earnings after retirement just by contributing to a DC plan and being eligible for Social Security. This compares with less than 1% of the workers without a DC plan who could achieve an adequate retirement.

These low replacement rates are due to projecting retirement income based on DC plan and Social Security only. Moreover, the retirement income from a DC plan plus a Social Security pension compared to annual pretax earnings just before retirement is substantially higher for those in a DC plan compared to those without a DC plan.

3. Retirement Adequacy of Households Versus Workers

A major conclusion of this study is that these findings underscore the importance of considering all household resources, not just workers' DC accounts and Social Security, when considering projected retirement adequacy. Many households have other investments, such as real estate and investments outside of DC plans, which can be utilized in retirement. Also, many workers have spouses with

significant resources. When household resources are included many more workers will have adequate assets at retirement.

To illustrate this point, consider that only 10% of workers (not households) with a DC plan will be able to obtain a pre-retirement level of earnings after retirement (see Table 14) while 72% of households (not workers) with a DC will be similarly situated (see Table 8). Thus, studies on retirement adequacy of workers who have DC plans that do not include all household resources provide a limited and invalid perspective of reality.

4. Importance of Defined Contribution Accounts

These results show how important defined contribution accounts are in helping households achieve retirement adequacy. Workers with DC plans are almost twice as likely as those without a DC plan, approximately 70% compared to 40%, to have financial resources equal to or higher than their retirement needs. However, about 25% to 30% of workers with DC plans will have insufficient financial assets at retirement. Therefore, these workers need to increase saving and investing for retirement. Furthermore, our analyses of retirement adequacy assume that households use their investment assets for retirement and not for other purposes. Therefore, plan sponsors should create new workplace financial education to communicate the importance of increasing saving to workers nearing retirement age.

5. Investment Returns and Retirement Adequacy for Those with DC Plans

Seven in ten workers with DC plans will be able to maintain their pre-retirement level of living in retirement based on mean projections of investment returns. Those proportions are similar when based on pessimistic returns. Of course, retirement adequacy can be reduced for those nearing retirement age if investment returns are much lower than average.

6. Impact of Stock Market Fluctuations on Household Investments

Many workers near retirement have a high allocation of their DC accounts in stocks. However, stocks represent a lower proportion of total investments and of total assets. Therefore, stock market declines will not necessarily have a devastating impact on most workers nearing retirement. However, it would be desirable to increase worker awareness of the need to shift away from stocks as they approach retirement.

Accordingly, the Profit Sharing/401K Council of America should consider attempting to persuade plan sponsors to take a different and more focused educational approach when communicating about investment returns with pre-retirees. The resulting messages expected for pre-retirees are, one, they need to

save and invest more, and two, they must invest appropriately during their status as pre-retirees and eventual retirees.

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Appendix A
Variables in the Survey of Consumer Finances

The SCF dataset includes numerous variables in the following categories: demographics, financial characteristics, other financial and nonfinancial assets, types and amounts of debts, and opinions/attitudes.

Demographic Variables Available in the SCF, such as
Age,
Gender,
Education,
Marital status,
Race/ethnicity,
Number of related children,
Household size,
Current employment status,
Employment history,
Occupation,
Size of employer,
Etc.

Financial Characteristics Variables Available in the SCF, such as
Annual household income,
Ownership and amount of various financial and nonfinancial assets (checking, savings, money market accounts, brokerage call accounts, CDs, mutual funds, stocks, bonds, IRAs/Keoghs, thrift-type plans [including 401K, 403B, thrift, savings, IRA], future pensions),
Cash value of whole life insurance,
Annuities,
Trusts,
Vehicles,
Residence and real estate,
Business interests,
Etc.

Other Financial and Nonfinancial Assets Variables Available in the SCF, such as
Loans,
Future proceeds,
Royalties
Non-public stocks
Deferred compensation,
Oil/gas/mineral investment,
Jewelry,
Coin collections,
Antiques,

Art objects, etc.

Types and Amounts of Debts Available in the SCF, such as
Housing debt,
Debt on other residential and non-residential real estate,
Credit card debt,
Installment loans,
Loans vs. pensions,
Loans vs. life insurance,
Margin loans,
Number and type of financial institutions they use,
How far away are these financial institutions,
Ownership of debit card,
Use of direct deposit,
Use of direct payment,
Ownership of "smart card,"
Whether applied for credits or loans,
Whether turned down,
Type and number of credits and loans applied for
Whether and how often payoff balances,
Ownership and type of health insurance, etc.

Opinions/Attitudes Variables Available in the SCF, such as
Expectation for the future (US economy better or worse),
Expectation of the future interest rates (higher/about the same/lower than today),
Reasons for saving,
Expectation of major expenses in the next five to ten years,
Whether saving for those expenses now,
Savings horizon,
Preferences of financial risks,
Whether shop around for information on financial institutes,
How they shop around for that information,
Saving habits,
Perceived adequacy of retirement income,
Spending behavior (more/less than/equal to income),
Perception of own health,
Income increase relative to prices,
Feelings about credit,
Feelings about whether financially lucky,
Whether spend money if own assets increase in value, etc.

Appendix B
About the Survey of Consumer Finances*

The Survey of Consumer Finances (SCF) is conducted every three years to provide detailed information on the finances of U.S. families. No other study for the country collects comparable information. Data from the SCF are widely used, from analysis at the Federal Reserve and other branches of government to scholarly work at the major economic research centers.

The study is sponsored by the Federal Reserve Board in cooperation with the Department of the Treasury. Since 1992, data have been collected by the National Opinion Research Center at the University of Chicago (NORC).

To ensure the representativeness of the study, respondents are selected randomly using procedures described in the technical working papers on the NORC web site. A strong attempt is made to select families from all economic strata.

Participation in the study is strictly voluntary. However, because only about 4,500 families are interviewed in the main study, every family selected is very important to the results. To retain the scientific validity of the study, interviewers are not allowed to substitute respondents for families that do not participate. Thus, if a family declines to participate, it means that families like theirs may not be represented clearly in national discussions.

The confidentiality of the information provided in the study is of the highest importance to NORC and the Federal Reserve. Strenuous efforts are made to protect the privacy of participants, and in the history of the survey, there has never been a leak. The names of the participants in the survey are known only to NORC, which has more than 50 years of successful experience in collecting confidential information.

*Source: Federal Reserve Board

Appendix C
Use of the Survey of Consumer Finances[2]

The Survey of Consumer Finances (SCF) is a triennial survey of consumers sponsored by the Board of Governors of the United States Federal Reserve System with the cooperation of the U.S. Department of Treasury. It is designed to provide detailed information on the balance sheets of the U.S. households, including their use of financial services, expected defined benefit pensions, labor force participation, and demographic characteristics.

Survey of Consumer Finances
The SCF is the best dataset available in terms of the scope and depth of information about the financial situation of households. Not other large dataset is as useful. The SCF also includes some important attitudinal variables related to investments and retirement planning, including planned retirement age, savings goals, risk tolerance, and investment horizon. In one professional journal, Financial Counseling and Planning, over forty articles using the SCF datasets have been published in recent years.

Two Alternative Datasets
Two alternative datasets sometimes used by researchers are the Survey of Income and Program Participation (SIPP) and Health and Retirement Study (HRS) datasets. For some research purposes, these datasets have the advantage of being longitudinal, in that the datasets describe households' changes over time. Each dataset has pluses and minuses according to the research questions posed.

Survey of Income and Program Participation (SIPP). The SIPP is a survey done by the Bureau of the Census is designed primarily to provide estimates of household income and participation in government programs, such as food stamps, and to provide statistics on the distribution of income in the United States.

The duration of each SIPP panel ranges from 2 ½ to 4 years. Therefore, the researchers observe households during different time intervals. This dataset does include some demographic variables such as age, gender, education, marital status, and race/ethnicity. However, SIPP provides relatively limited financial information about households. The SIPP survey asks households about their ownership of certain assets, such as U.S. government savings bonds, IRAs, Keogh accounts, 401k accounts, thrift plans, mutual funds, and stocks. There are some questions that ask about financial data, such as, "What is the average amount that you and your spouse had in this/these jointly held asset names?"

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And, the choices available for that question were, "Is it: (1) Less than $ 500, (2) $ 500 to $1,000, (3) $1,001 to $5,000, (4) More than $5,000. However, the exact balances of these assets are not available, and neither are the allocations between stocks and other investments, such as bonds.

The focus of the SIPP survey is on income sources, not assets. The information on assets, particularly financial assets, is much less detailed than the information on the SCF dataset. Thus, the important point is that there is not information in the SIPP data to assess retirement adequacy. Also, the opinion/attitude variables available in the SCF are not available in the SIPP dataset.

Health and Retirement Study (HRS). The HRS survey is supported by the National Institute on Aging. The study describes an aging America's physical and mental health, insurance coverage, financial status, family support systems, labor market status, and retirement planning. This dataset includes some demographic variables, such as age, education, marital status, and race/ethnicity. The age range of respondents in the HRS is limited, because only people over the age of 50 are interviewed. Thus, comparisons cannot be made with younger working adults.

There is very limited detailed information about financial assets in the HRS dataset. The survey asks whether the respondents were included in a pension or retirement plan, or in any tax-deferred savings plan; the balance in such plans; whether the money in the account was invested mostly in stocks, mostly in interest earning assets, or about evenly split between these. But no detailed breakdown of the portfolio is available, thus, there is insufficient information about retirement preparation.

The only available opinion/attitude variables about retirement in the HRS dataset are the self-perceived good and bad things about retirement and whether retirement would be better than current year. Only the SCF dataset provides a inclusive set of opinion/attitude variables, and these have been found in previous studies to have effects on households' financial behavior. Moreover, there is not as much detailed data available in HRS as is available in the Survey of Consumer Finances.

Conclusion

For the purpose of the research with the Profit Sharing/401k Council of America, the cross-sectional Survey of Consumer Finances (SCF) dataset is more than adequate for the purpose of providing a representative benchmark for retirement account accumulations. Neither the SIPP or HRS datasets include sufficient information on financial status or opinion variables to make comparisons or analyze effects. Thus, analyses that use the nationally representative sample of U.S. workers using the Federal Reserve Board's Survey of Consumer Finances are appropriate.

Appendix D
Empirical Methodology

The data analyzed in this study are from the public use tape of the 1998 Survey of Consumer Finances (SCF). Income and wealth are both in 1998 dollars. This study investigates how well were households prepared for retirement in the year of 1998.

In the analyses of households and workers, we grouped our observations according to respondent's/worker's age. We used the 3-year couplings of ages because we wanted to examine how age could affect households' retirement adequacy and workers' income replacement rates, but we did not want to have too few observations in each age category.

Empirical projection of retirement adequacy for total households

This study replicates Yuh, Hanna and Montalto (1998)'s projection of accumulated retirement resources and retirement needs. Both their mean and pessimistic projection methods were used.

Mean and pessimistic projections
Mean projection of retirement accounts and other investment assets used the geometric inflation-adjusted mean of the historical rates of return on different assets (from 1926 to 1998) published by the Ibbotson Associates yearbooks. The pessimistic projection was based on lognormal projection based on the inflation-adjusted mean rates of return and standard deviations. The pessimistic annualized inflation-adjusted rate of return was calculated for the number of years until retirement for the 10th percentile (90% of the time, the return would be higher) and then that pessimistic return was used to project the pessimistic accumulation. See Appendix E for details of lognormal projection.

Projection of retirement adequacy
Accumulated retirement resources included financial assets, nonfinancial assets including housing wealth, and retirement income from defined contribution plans, defined benefit plans and Social Security.

The value of retirement needs is the present value of a stream of pre-retirement spending during retirement. The pre-retirement spending level was used to proxy the desired spending at retirement because the SCF does not have the desired spending variable. The life expectancy of households was determined by the Actuarial Annuity Tables published by the Internal Revenue Service in 1998.

We compared the retirement resource and retirement needs at retirement for each household. If the household's retirement resource is more than or equal to its retirement needs, then this household is defined to be adequately prepared for retirement.

Method
For households without a positive DC balance, we assumed that they do not
have such plan. The 1998 interview began in the middle of the year and did not
end until towards the end of the year. For those who had a positive DC balance
and were planning to retire in 1998, we assumed that they would still contribute
half of the annual amount they put into their DC plan. This is because although
we know how often they contribute to the DC plan, we do not have information on
which month they were expecting to retire.

A two-way table of households' retirement adequacy and respondents' age was
examined. A list of ratio categories and the percentage of each household that
fall in each category was presented.

Empirical projection of income replacement rate for individual workers

Projection of income replacement rate
We added up individual workers' contribution and their employer's contribution to
get a total annual contribution. We then found the future value of these yearly
contributions at the point of retirement. We also found the current balance in
each worker's DC plan and found its future value at retirement. Thus we
annuitized the DC wealth into an annual income over the expected lifetime after
retirement, which was based on the IRS actuarial tables. Then we assumed all
workers were eligible for Social Security and found their annual income from
Social Security according to the Social Security Bulletin, Annual Statistical
Supplement (1998). Since our workers in this analysis are from 50 to 61, we
assumed their real income would stay the same until just before retirement.

We divided a worker's retirement income generated only by defined contribution
Accounts and Social Security by his/her income just before retirement. This is our
definition of the income replacement rate.

Method
We analyzed and compared workers with at least one positive defined
contribution plan balance and those without a positive balance.

For households or workers without a positive DC balance, we assumed that they
do not have such plan. The 1998 interview began in the middle of the year and
did not end until towards the end of the year. For those who had a positive DC
balance and were planning to retire in 1998, we assumed that they would still
contribute half of the annual amount they put into their DC plan. This is because
although we know how often they contribute to the DC plan, we do not have
information on which month they were expecting to retire.

A two-way table of workers' retirement adequacy and their age was examined. A
list of ratio categories and the percentage of each worker that fall in each

category was presented. There were a total of 923 workers that met the above sample selection criteria for workers who will retire at their expected retirement age.

Lognormal Projection of Investment Assets[3]

Projection of future rates of return
Total wealth available for retirement from financial assets, nonfinancial assets, and defined contribution plans was projected using future real rates of return for each asset category. Future real rates of return were projected separately for stocks, bonds, money market instruments, business assets, and real estate assets using data on historical rates of return and a lognormal forecasting model (Ibbotson Associates, 1995). The lognormal forecasting model was used because, unlike the normal model, the lognormal model does not project negative values and therefore may produce more plausible predictions.

The lognormal forecasting model.
The lognormal distribution is defined as the distribution of a random variable whose natural logarithm is normally distributed. In the lognormal forecasting model, the natural logarithms of asset return relatives (i.e., one plus the total return, $e^r = 1+r_e$) are assumed to be normally distributed. If E_1 and V_1 are the mean and variance of the asset return relatives ($e^r = 1+r_e$) for one year, then the mean and variance of the asset return relatives over t years are $E_t = E_1{}^t$ and $V_t = (V_1 - E_1{}^2)^t - E_1{}^{2t}$ respectively. Since the lognormal distribution is skewed to the right, the expected value, or mean, is greater than the median. Furthermore, if return relatives (e^r) are lognormally distributed, returns (r_e) cannot fall below negative 100%. The smallest possible value for r_e is -1 or -100%. These properties of the lognormal distribution make it a more accurate characterization of the behavior of market returns than the normal distribution. Moreover, in all normal distributions, the probability of an observation falling below the mean by as much as one standard deviation equals the probability of falling above the mean by as much as one standard deviation; both probabilities are about 34%. In a lognormal distribution, these probabilities differ and depend on the parameters of the distribution (Ibbotson Associates, 1995).

Using the lognormal model, it is straightforward to form probabilistic forecasts of both compound rates of return and ending period wealth values. Wealth at time n (assuming reinvestment of all income and no taxes) is:

$$W_n = W_0 (1+r_1)(1+r_2).....(1+r_n) \tag{5}$$
where: W_n = the wealth value at time n
     W_0 = the initial investment at time 0
     $r_1, r_2.....r_n$ = the total returns on the portfolio for the rebalancing period ending at times 1,2, and n.

The compound rate of return or geometric mean return over the same period, rG, is:

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[3] Much of this discussion is taken from Yuh, Hanna and Montalto's article in *Financial Services Review*, 1998, although the rates of return have been updated.

$rG = (W_n / W_0)^{1/n} - 1$ (6)

where: rG = the geometric mean return

n   = the inclusive number of periods.

By assuming that all of the $(1+r_n)$s are lognormally distributed with the same expected value and standard deviation and are all statistically independent of each other, it follows that W_n and $(1+rG)$ are lognomally distributed. In fact, even if the $(1+r_n)$s are not themselves lognormally distributed but are independent and identically distributed (iid), W_n and $(1+rG)$ are approximately lognormal for large enough values of n. This "central-limit theorem" means that the lognormal model can be useful in long-term forecasting even if short-term returns are not well described by a lognormal distribution (Ibbotson Associates, 1995).

In the lognormal forecasting model, the expected value (m) and standard deviation (s) of the natural logarithm of the return relative of the portfolio can be calculated from the expected return and standard deviation of the portfolio. Given the logarithmic parameters of a portfolio (m and s), a time horizon (n), and the z-score of a percentile (z), the percentile of the compound rate of return for an asset i is calculated as:

$R_i = \exp \{ m_i + z (s_i / n^{1/2}) \} - 1$ (9)

where: R_i =Percentile of compound real rate of return of asset i

m_i = expected value of natural logarithm of the return relative of asset i

s_i = standard deviation of natural logarithm of the return relative of asset i

z   = the z-score of the percentile

n   = investment horizon

Using this equation, it is possible to calculate the various percentiles of compound returns over various time horizons. In order to compare adequacy under mean and pessimistic conditions, rates of return at the 50th percentile and the 10th percentile are selected. The rate of return for the 50th percentile of each asset is used as the projected return for the mean portfolio performance, and the rate of return for the 10th percentile is used as the projected return for the pessimistic portfolio performance.

To employ the lognormal forecasting model, information is needed on the mean and variance of the rate of return. Data for historical rates of return for 1926-1998 from the *Stocks, Bonds, Bills and Inflation Yearbook* published by Ibbotson Associates (1999) were used to provide information on the mean and variance of the real rate of return for specific asset categories. The 1999 Yearbook provides historical return data from January 1, 1926 through December 31, 1998 for six categories of financial assets: small capitalization stocks, large stocks (S&P 500), corporate bonds, intermediate government bonds, long term government bonds, and Treasury bills. Real estate returns from 1947 to 1998 estimated by Ibbotson and Siegel (1984) and unpublished Ibbotson data were used to produce lognormal projections of future real rates of return for real estate assets. This real

estate dataset is comparable to the historical return data in the Ibbotson Yearbook, and is the longest period of annual return data for real estate available. Information is available for residential real estate, farm real estate, business real estate, and composite real estate (average of the three categories).

The following is the SAS code used to produce the mean annual inflation-adjusted returns:

```
*Asset specific rates of return -- Ibbotson data;
  rl=0.0701;     *large stocks;
  rs=0.0920;     *small stocks;
  rb=0.0221;     *long-term corporate bonds;
  rt=0.008;     *Treasury bills;
  re=0.0653;     *real estate;
```

The following is the SAS code used to produce the pessimistic annual inflation-adjusted returns:

```
*note that for pessimistic projection, we start with arithmetic mean, not
geometric, for mean projection we start with geometric means;
   rla=0.099;     *large stocks;
   rsa=0.139;     *small stocks;
   rba=0.031;     *long-term corporate bonds;
   rta=0.008;     *Treasury bills;
   rea=0.075;     *real estate;
   *Standard deviation - inflation-adjusted;
   rls=0.204;     *large stocks;
   rss=0.331;     *small stocks;
   rbs=0.099;     *long-term corporate bonds;
   rts=0.041;     *Treasury bills;
   res=0.034;     *real estate;
*z=critical value of z or t statistic for percentile, e.g., for 10th
percentile;
z=1.28;
n=yrsret;   *Number of years until retirement;
if n> 0 then rln=exp(rla-z*rls/(n**.5))-1;
   else rln=0;
if n> 0 then rsn=exp(rsa-z*rss/(n**.5))-1;
 else rsn=0;
if n> 0 then rbn=exp(rba-z*rbs/(n**.5))-1;
 else rsn=0;
if n> 0 then rtn=exp(rta-z*rlt/(n**.5))-1;
 else rtn=0;
if n> 0 then ren=exp(rea-z*res/(n**.5))-1;
 else ren=0;
```

Note the following annual returns for the mean annual inflation-adjusted returns, the one year pessimistic inflation-adjusted returns, five year annualized pessimistic inflation-adjusted returns, and the 10 five year annualized pessimistic inflation-adjusted returns:

		Pessimistic Annualized Return (10th Percentile)		
Investment	Mean	1 Year	5 Years	10 Years
Large Stocks	7.0%	-24.7%	-8.0%	-3.6%
Small Stocks	9.2%	-37.4%	-14.8%	-8.3%
Corporate Bonds	2.2%	-14.9%	-5.6%	-3.2%
Real Estate	6.5%	1.0%	4.5%	5.4%

Appendix F
Sample Selection Criteria

For households
The sample selected for the retirement adequacy analysis included households with heads' age between 50 and 61 in 1998. We included the households if at least one of the respondent and the spouse/partner was currently working for pay. Those households that did not indicate the age at which the respondent planned to stop full time work were deleted from the sample. Our sample households must have a non-negative number of years until retirement. Only those households with positive non-investment income and total annual household income above the poverty threshold were included in the sample. If households' business equity is less than zero, we set its value equal to zero. We also analyzed and compared households with at least one positive defined contribution plan balance and those with no such plan.

For Workers
The sample selected for the retirement adequacy analysis included workers who were between ages 50 and 61 in 1998. We included workers if they were currently working for pay. Those who did not indicate the age at which the respondent planned to stop full time work were deleted from the sample. Only those with positive household non-investment income and total annual household income above the poverty threshold were included in the sample. If households' business equity was less than zero, we set its value equal to zero. We also analyzed and compared workers with a defined contribution plan balance and those with no such plan.

Appendix G
Definitions of Selected Variables

Total Assets = Financial Assets + Non-financial Assets

Financial Assets include:
checking accounts
savings accounts
money market deposit accounts
money market mutual funds
call accounts at brokerages
certificates of deposit
stock mutual funds
tax-free bond mutual funds
government bond mutual funds
other bond mutual funds
combination and other mutual funds
stocks
bonds(other than bond funds or savings bonds counted included elsewhere)
IRAs
thrift-type plans(including401k, 403b, thrift
savings,SRA, etc.)
pensions
cash value of whole life insurance
annuities
trusts
other financial assets(including loans, future
proceeds, royalties, non-public stock, deferred
compensation, oil/gas/mineral invest, etc.)

Nonfinancial Assets include:
vehicles
primary residence
other residential real estate
net equity in non-residential real estate
business interests
other non-financial assets

Investment Assets:

Greninger et al. (1996) define investment assets as all assets other than liquid
(monetary) assets that are held for investment purposes, use assets and
equity in one's personal residence. Monetary assets are defined as cash and
cash equivalents, checking accounts, savings accounts, money market accounts,

money market mutual funds, and Certificates of Deposit (CDs) with maturities of less than or equal to six months.

The investment assets in this paper include total directly-held mutual funds (excluding money market mutual funds), individually held stocks and bonds, retirement accounts, IRAs and thrift accounts, cash value of whole life insurance, other managed assets (e.g. annuities and trusts), selected other financial assets, other residential assets (not including vacation homes), net equity in nonresidential real estate, business interests and selected other non-financial assets.

DC Assets include:
Total balance in Defined Contribution account(s) at the time of interview in1998.

Stock Assets include:

Total stock assets includes total directly or indirectly-held stocks inside and outside the DC account(s).

DC stock assets are stocks inside DC.