Preliminary draft. Comments welcome.

The Market Value of Accrued Social Security Benefits

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Latest revision: December 2007

We thank Ryan Chahrour, Theodore Papageorgiou, and Sami Ragab for research assistance, and Mark Broadie, Deborah Lucas, Kent Smetters, and seminar participants at the Conference on Measuring and Managing Federal Financial Risk (Kellogg School) and at Columbia University for helpful comments and suggestions.

This research was supported by the U.S. Social Security Administration through grant #10-P-98363-1-04 to the National Bureau of Economic Research as part of the SSA Retirement Research Consortium. The findings and conclusions expressed are solely those of the author(s) and do not represent the views of SSA, any agency of the Federal Government, or the NBER.

This draft summarizes the work thus far on a longer term project. We describe what we have accomplished to date and what remains to be done.

The Market Value of Accrued Social Security Benefits

One measure of the health of the Social Security system is the difference between the market value of the trust fund and the present value of benefits accrued to date. How should present values be computed for this calculation in light of future uncertainties? The Office of the Chief Actuary estimates the present value of expected benefits. We think it is important to use market value. Since claims on accrued benefits are not currently traded in financial markets, we cannot directly observe market value. We therefore use a model to estimate what the market value would be if these claims were traded.

One key issue in this valuation is how to adjust for risk. The traditional actuarial approach is to ignore risk and compute expected value. If benefits are risky and this risk is "priced" by the market, then the actuarial estimates will differ from market value. Effectively, market valuation uses a discount rate that incorporates a risk premium.

The exact adjustment for risk requires a careful examination of the stream of future benefits. The U.S. Social Security system is "wage-indexed", i.e. future benefits depend directly on the realization of the future economy-wide average wage index. We assume that there is a positive long-run correlation between average labor earnings and the stock market. We then use derivative pricing methods standard in the finance literature to compute the market price of individual claims on future benefits, which depend on age and on the macro state variables. Finally, we aggregate the market value of benefits across all cohorts to arrive at an overall value of accrued benefits.

We find that the difference between market valuation and "actuarial" valuation is large, especially when valuing the benefits of younger cohorts. Overall, the market value of accrued benefits is only 3/4 of that implied by the actuarial approach. Ignoring retirees (for whom the valuations are the same), market value is only 2/3 as large as that implied by the actuarial approach.

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I. Introduction and related literature

The Office of the Chief Actuary in the Social Security Administration is regularly required to estimate the present value of outstanding Social Security liabilities. To this end, the SSA computes several different measures, including the present value of accrued benefits. These can be used for a variety of purposes, including calculating the total cost of transitioning to a personal account system ("maximum transition cost") and calculating the difference between the present value of expected inflows and outflows ("the actuarial imbalance"). The magnitude of these SSA estimates already has, and will continue to have, enormous influence on the perceived need for social security reform, and indeed on the contours of that reform.

Nevertheless, the methodology used by the SSA for arriving at these estimates does not take into account the uncertainty about the projections in the way investors would if they regarded social security payments as dividends on assets, or liabilities of their own business. We propose to estimate what the market value of these liabilities would be if they were traded.

The market value of current social security liabilities turns out to be quite different from the expected present values calculated by the SSA. This difference by itself might evidently change the public's view of the transition cost and of the actuarial imbalance of the system, and is therefore reason enough to pursue a measure of market value. In Section II below we describe other reasons that having a market estimate is important.

FASAB

Recently, the Federal Accounting Standards Advisory Board (FASAB) has published a preliminary statement on new standards for Social Insurance Accounting for entries on the Balance Sheet of the United States (FASAB, 2006). The document describes two views. The Primary View, held by the majority of the board, would recognize every accrued benefit as a liability of the system.[1] Under this view, liabilities should be based on expected benefits "attributable" to earnings to date, using current benefit formulas. In contrast, the Alternative View advocates continuing the current

[1] Accrued benefits would be those earned by fully-insured participants (e.g. social security participants who have achieved 40-quarters of covered earnings, the minimum to receive benefits) based on their earnings histories to date.

practice of acknowledging only those benefits that are "due and payable" at time of valuation. Essentially, under the alternative view only current-period benefits not yet paid to beneficiaries (an amount close to zero) would be counted as a liability.

Supporters of the Primary View argue that recognizing the new liability is most consistent with the principal of accounting based on accrual, as opposed to cash flows, and best captures the economic costs incurred by social insurance programs each year. Supporters of the alternative view argue that given political and economic uncertainty regarding Social Security, such obligations are neither legally guaranteed nor reliably estimable. They also worry that, because of the large size of the obligation, incorporating it as a liability may make other important spending choices appear inconsequential.

Whether or not one wishes to characterize future benefit obligations as “liabilities”, it is useful to compute their present value. Even the Alternative View would require the Social Security Administration to report the present value of future cash flows, although not on the balance sheet. If the Primary View is adopted, the results of our paper will be particularly important, because the Social Security Administration and Office of the Actuary will be charged with the task of computing the present value of accrued benefits and reporting it on the balance sheet. Proper valuation of these risky liabilities will be essential to the new guidelines' efficacy in accurately portraying the financial status of the Social Security program. Additionally, the fact that risk-corrected valuations are significantly smaller than standard risk-free valuations may reduce (but probably not eliminate) the concern that the size of the accrued benefit obligation will overwhelm other information in the balance sheet.

Our paper is structured as follows. In section II we describe why we think market valuation is the appropriate measure for estimating social security obligations. Section III describes how our previous work can be used to describe accrued benefits in terms of units of a potentially tradable financial security (a PAAW). Section IV shows how to price this security, incorporating the market price of risk. In Section V, we estimate the quantity of PAAWs outstanding by cohort, and in Section VI we combine the information in IV and V to arrive at an estimate of the market value of accrued Social Security benefits. Section VII concludes.

II. The importance of market valuation

A market price for social security liabilities would provide important information to households, governments, private pension plans, and other market participants.

The liabilities of the system are the aggregate of benefits accrued by individuals of different ages. The accrued benefits of an older person are clearly more valuable than a younger worker because they are payable sooner, meaning they are discounted less by interest and by survival probability. We provide estimates of market prices of benefits by cohort, and then aggregate to estimate total social security liabilities.

A market price for cohort benefits would give people information about the market value of their own benefits, helping them with their financial planning decisions regarding saving and asset allocation. It would allow households to compare the value of their tax contributions with the value of their new benefit accruals. Workers could compute a market-based "money's worth" measure such as the ratio of the PV of benefits to the PV of contributions (for a further description of money's worth measures, see Geanakoplos, Mitchell, and Zeldes, 1999). A market value for benefits would also make it more difficult for the government to take them away, thus further enhancing property rights.

At the aggregate level, if we can find the market value of the social security liabilities, then we must also be able to figure out how to hedge them (since valuation and hedging are dual computations). This would be a valuable guide to determining the optimal portfolio of the social security trust fund, assuming that someday it was allowed to be diversified out of government bonds.

The benefits to an individual worker become closer to a (real) annuity as he nears retirement. Our valuation methods would thus shed some light on the pricing of individual annuities and of securities tied to aggregate longevity.

Finally, as we have argued elsewhere, it is conceivable that Social Security benefits will be traded in the future. Buyers and sellers of these new securities would be forced to make the same kind of computations we propose here. The government conceivably could purchase securities from the private sector that would replicate some of the benefits promised by the social security system.

III. Translating accrued benefits into units of new securities (PAAWs)

Under current Social Security rules, workers and employers together contribute 12.4% of "covered earnings" (i.e. all labor income below the earnings cap, currently equal to $102,000). Upon retirement, workers receive benefits that are linked to their earnings history. In particular, earnings are "wage-indexed", meaning that at the time benefits are computed (usually age 62), past earnings from each year are divided by the average economy-wide wage index from that year, and then multiplied by the average economy-wide wage index in the computation year. As we shall see, the fact that benefits are directly related to the average economy-wide wage index in the computation year has important implications for computing market value.

We want to measure "accrued benefits" as of a point in time. By definition, accrued benefits can rise, but never fall (under the accrual rule). In Geanakoplos and Zeldes (2007), we show that there are a variety of feasible accrual rules and describe two natural ones in detail. For simplicity, we focus here on the fastest (and simplest) accrual rule: accrued benefits at any point in time equal the benefits that the individual would be entitled to if he had zero labor earnings from that date on.[2]

In Geanakoplos and Zeldes (2007), we described how to create a system of personal accounts that achieves many of the core goals of supporters of the current system, including risk-sharing and redistribution. We called these "Progressive Personal Accounts." One step in that process was to show that personal accounts could be structured to exactly mimic the benefits promised under the current system. This involved the creation of a new financial security which we named a Personal Annuitized Average Wage security, or PAAW for short. ### Whether or not Progressive Personal Accounts are adopted, the notion of a PAAW turns out to be helpful for describing and valuing accrued benefits.

We define a Personal Annuitized Average Wage security or PAAW as a security that pays its owner one inflation-corrected dollar for every year of his life after a fixed date t_R (the year he hits the statutory retirement age R), multiplied by the economy-wide average wage at t_R. PAAWs are tied to specific individuals (i) and to the year of the first payout on the security (t_R), and we use the notation PAAW(i,t_R) to capture this.

Each additional dollar that an individual earns generates additional accrued

[2] See Jackson (2004) for a further discussion of accrual accounting.

benefits or PAAWs. At any point in time t, an individual's accrued benefits can be summarized completely by the number of PAAWs owned. The present value of accrued benefits is therefore equal to the quantity of accrued PAAWs (known at time t) multiplied by the present value of a PAAW(i, t_R). The next section examines how to price PAAWs for each cohort, and the following section provides our estimates of the outstanding quantity of PAAWs for each cohort.

IV. The price of a PAAW

In Geanakoplos and Zeldes (2007), we argued that if the Social Security system either required workers to sell a small fraction of their securities or issued extra securities, the securities could be pooled together and sold to financial markets. Here we try to determine what the market price of these pooled PAAWs would be if they were traded. To do this, we need an asset-pricing model.[3] One simple model would be to assume risk neutrality. This corresponds to the standard actuarial approach for computing present value. We review this approach here (see Geanakoplos and Zeldes, 2007 for more details). We then describe an alternative model that incorporates aversion to risk and the corresponding risk premium built into the discount rate for taking present values.

A. **Pricing PAAWs assuming risk neutrality**

Under risk neutrality, the value of an individual PAAW depends on assessments of 1) the growth in average wages, 2) the future path of interest rates, 3) individual survival probabilities. For our calculations below, we follow the 2005 Social Security Trustees Report by assuming a long-run growth in real wages of 1.1% and a long-run real interest rate of 3%. We use the cohort life tables from Social Security Actuarial Study 116 and assume for now that all individuals of the same age face the same conditional survival probabilities[4], i.e. that there is no heterogeneity or private information about these probabilities. Finally we make the assumption that the individuals are fully rational and have the correct expectations on the average wage growth rate.

Based on these assumptions, we compute an estimate of the market price of one

[3] Of course, once the market is thriving, one could simply observe market prices. But this still begs the question of how market participants would price PAAWs.

[4] For the calculations presented, we used the survival probabilities for males born in 1980.

PAAW(i,t_R), measured in average wage units. We then convert this to current dollars. Figure 1 (beige bars) plots a cross-sectional view of these PAAW prices for each cohort. Note that the prices differ across cohorts because the PAAWs are indexed by retirement year – a PAAW for a 40 year old obviously represents a different set of cash flows than a PAAW for a 65 year old.

B. Allowing for risk aversion

In this section, we develop a valuation model that adjusts for risk.

Methodology

PAAW payouts are tied to average economy-wide wages in a specific year in the future. They are therefore tied to the macroeconomy and potentially to the stock market. Lucas and Zeldes (2006) showed how to value defined-benefit pension liabilities when payouts are tied to future wages of the individual. We apply that approach here, modifying it to take into account the specifics of the Social Security benefit rules.[5]

The cash flow stream on a PAAW(i, t_R) depends on the economy-wide average earnings index at time t_R (W_{tR}) as well as the lifespan of individual i. A key issue that arises, therefore, is the correlation across different horizons between W and the value of the stock market. We assume the process used in Benzoni, et al, (2007) that generates a positive long-run relationship between average economy-wide wages and the stock market. Specifically we assume that the stock price S follows a standard process:

$$S_{t+h} = S_t \exp\left((r_s - div - .5\sigma_s^2)h + \sigma_s\sqrt{h}(dz_s)\right)$$

and that W and S are cointegrated, so that they are uncorrelated in the short run, but strongly positively correlated in the long run.

$$\ln(W_{t+h}) = \ln(W_t) + h * kappa(\ln tau - \ln(W_t / S_t)) + \left(\sigma_w\sqrt{h}(dz_w)\right)$$

We assume that the mean stock return (r_s) equals 7%, the dividend yield (div) equals 5.5%, the standard deviation of the stock return (σ_s) equals 16%, the speed of adjustment (kappa) equals .15, and the standard deviation of the earnings innovation

[5] One important difference is that under private DB pensions, the accrued benefit obligation (ABO) depends only on past labor earnings, while the promised benefit obligation (PBO) depends on future labor earnings. Due to the wage-indexing of Social Security, even the ABO measure depends on future (economy-wide) labor earnings.

(σ_w) equals 5%.

Following Lucas and Zeldes (2006), we assume that the risk unrelated to the stock market is unpriced, ignore aggregate longevity and interest rate risk, and use risk-neutral Monte Carlo derivative pricing techniques to price a PAAW as a derivative on the stock market. We use this methodology to compute the current market value of a PAAW. For each cohort (birth year), the PAAW price will be a function of current average labor earnings and the current value of the stock market.

Results

Figure 2 shows the ratio of risk-corrected to naïve (non-risk adjusted) PAAW prices for each cohort. For cohorts that have already retired, the risk-adjustment has no impact on the valuation. For younger cohorts, however, there is a significant difference between the two methods. For the cohort of median age of 40 and younger, the risk-adjusted measure is less than half of the naïve valuation.

V. The quantity of PAAWs outstanding

In this section we compute the stream of future benefits that have been accrued by each cohort at a point in time based on contributions to date. It turns out that these can be neatly described with a single summary statistic: the number of PAAWs accrued by the cohort.

We use two separate data sources for our calculations. First, we use data from the Office of the Actuary (OACT) at the Social Security Administration. Second, we use date from the Continuous Work History Sample (CWHS) a 1% sample of workers and beneficiaries.[6]

Methodology for OACT data

The Office of the Actuary provided us with their estimates of the future annual benefit flows by cohort, on an open group basis. These do not correspond to our notion of accrued benefits, because they include future benefit flows due to *future* contributions. However, with an estimate of the pattern of PAAWs accrual over the

[6] We are grateful to Jae Song and Wojciech Kopczuk for providing us with summary statistics from the CWHS.

lifetime of a cohort, we can back out an estimate for the quantity of PAAWs. We do this as follows. For each cohort, we define OUTGO_70 as the OACT projection for benefit payments at age 70, and Wage_65 as the projected average wage index at retirement age. Next, we define F is the ratio of PAAWs accrued as of the valuation date (2004) to the estimated PAAWs that will be accrued by the retirement date for that cohort. Finally we define P as the probability that a cohort member will survive to age 70. To convert the OACT open group estimate to our estimate of accrued benefits, we compute for each cohort (OUTGO_70/Wage_65)*(F/P). This formula can be seen as estimating PAAWs owned at cohort age 70 and then "shrinking" this value to the present based on lifetime accrual patterns and survival probabilities. For cohorts where retirement wages are known we substitute actual values. For cohorts with median age over 70 in 2004, we substitute 2004 projected benefits for OUTGO_70. These cohorts require no shrinking; F/P equals 1.

Wages projections are based on the 2007 Social Security Trustees Report "Intermediate Assumptions" and conditional survival probabilities are also based on the most recent OACT actuarial estimates. Our estimate of F is based on the Social Security Public Use (SSPU) dataset, a 1% sample of current retirees' benefits and income histories. To estimate F, we follow individuals in the one-year cohort born in 1933, for each year computing PAAWs accrued assuming zero earnings for future years. Individual accruals are then aggregated to get the percentage series, F. Implicitly, we are assuming the profile of PAAWs accrual is similar across cohorts.

Methodology for CWHS data

Our estimates from the CWHS sample, which is similar the SSPU except that it contains current workers, are a cross-sectional version of our calculation for F. All of our PAAWs estimates are based on the Primary Insurance Amount (PIA) formula. For current workers, we estimate accrual by assuming no future earnings beyond 2004. This corresponds to the “fastest accrual method” defined in Geanakoplos and Zeldes, (2007). (Similar calculations could be done based on the “straight line accrual method”.) Note that both the OACT and CWHS methodologies include this assumption; it is incorporated into the OACT-based estimates via our estimate of F. For current retirees, PAAWs accrued are based on the final PIA, no future earnings assumptions are needed.

Estimates of PAAW quantities by cohort

Figure 3 shows alternative estimates of PAAWs earned through 2004 for 5-year cohorts of current workers. The first series (blue bars) are based on Office of the Actuary (OACT) projections for future benefit payments through 2075. The second series (red bars) is based on the Continuous Work History Sample, a one-percent sample of current OASI participants.

The two series are remarkably close. Some differences exist, however. The OACT series is everywhere larger than the CWHS series. This is not surprising, as the computations based on the CWHS do not consider beneficiaries, mainly spouses, who earn benefits based other participants' earning records. Since this method ignores a significant portion of benefits, it should be considered a lower-bound on the quantity of outstanding PAAWs.[7]

VI. The market value of accrued benefits

Once we have computed the price of a PAAW for each cohort, and the quantity of PAAWs outstanding for each cohort, estimating the market value of accrued benefits simply requires multiplying the two and summing across cohorts. Figures 4 and 5 compare the risk-adjusted and the naïve (risk-neutral) valuations by cohort, using the OACT-based and CWHS estimates of quantity, respectively. Note that the risk-adjustment reduces the value of the liability for all of non-retired cohorts, and this includes the five cohorts with the largest number of PAAWs accumulated (ages 40 – 60).

Figure 6 sums across cohorts for an estimate of the total value of accrued liabilities. The larger OACT measure gives a risk-neutral valuation of $14.2 trillion, compared to $10.3 trillion for the risk-corrected. The risk-neutral measure is close to the Office of the Actuary's own estimate, based on the maximum transition cost, of $16.2 trillion of accrued obligations as of January 2005.

Table 1 compares the methods, breaking down the liability for non-retired and retired workers. The risk-neutral estimate for the pre-retired group is much larger than the risk corrected estimate; for both the OACT and CWHS-based quantity estimates,

[7] Note that benefits for widows + spouses represent about 20% of OASI payments.

the ratio is quite close to 2/3. For retired workers, of course, the estimate are the same. Including the entire population (both pre-retired and retired individuals), the risk correction reduces the estimated size of the accrued-benefit liability by about 25% for both measures of PAAWs quantity. Thus, risk correction significantly changes our quantitative assessment of the value of accrued Social Security benefits.

VII. Conclusions, policy implications, and future research

Market value is the appropriate way to measure both assets and liabilities of the Social Security system. Market value calculations adjust correctly for risk, and differ in important ways from the standard actuarial approach that discounts expected cash flows with a risk-free rate and therefore does not adjust for risk. We estimate that adjusting for risk reduces the present value of accrued benefits by 25%.

In continuing work, we plan to estimate other measures of accrued benefits, and also other measures of the solvency of Social Security. In particular, most cash-flow based measures of solvency incorporate future tax inflows as well. Since future taxes are also linked to economy-wide wages, and thus to the stock market, these future taxes would also require a risk adjustment. We leave this for future work.

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Figure 1: Price-per-PAAW

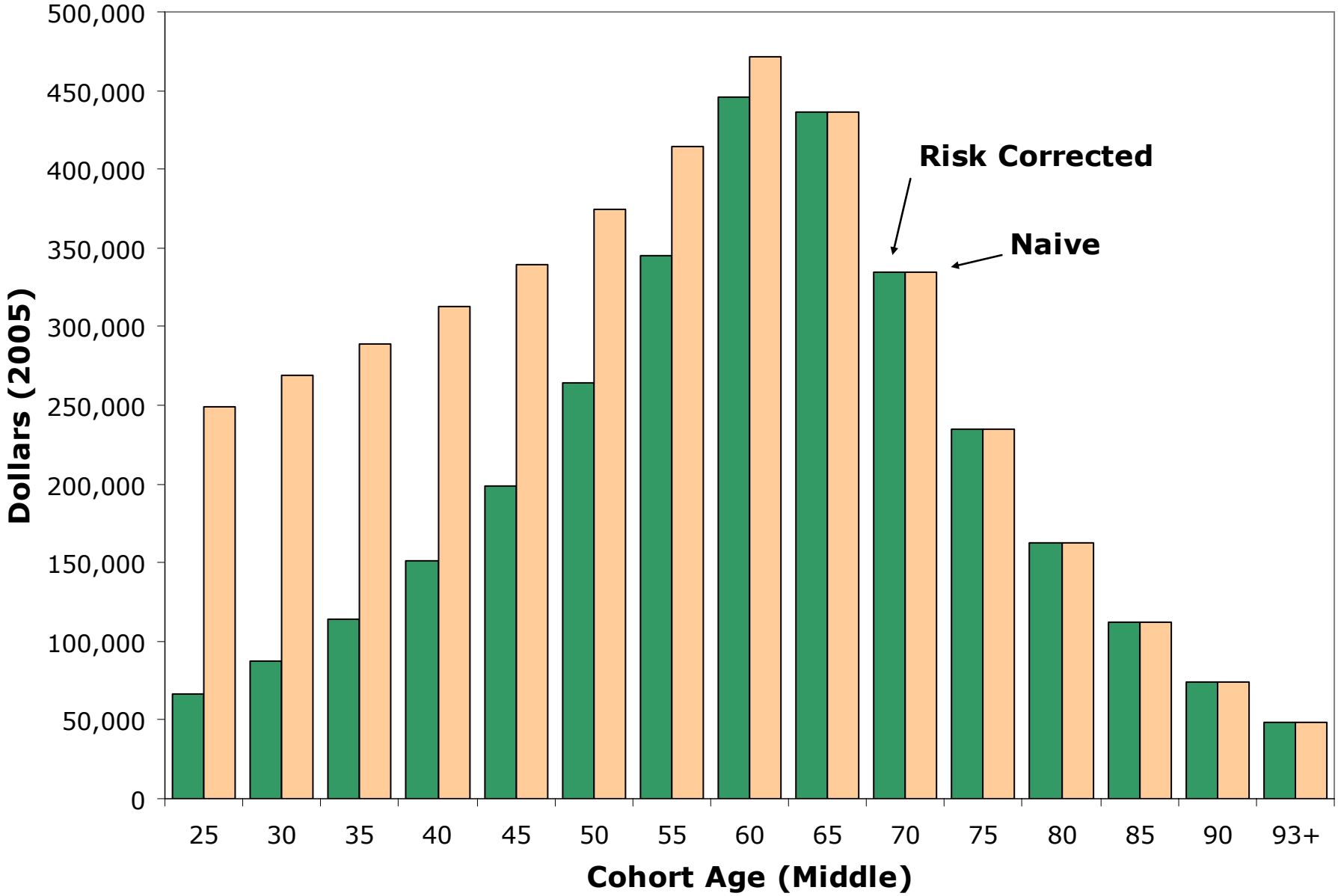

Figure 2: PAAW Price Ratios

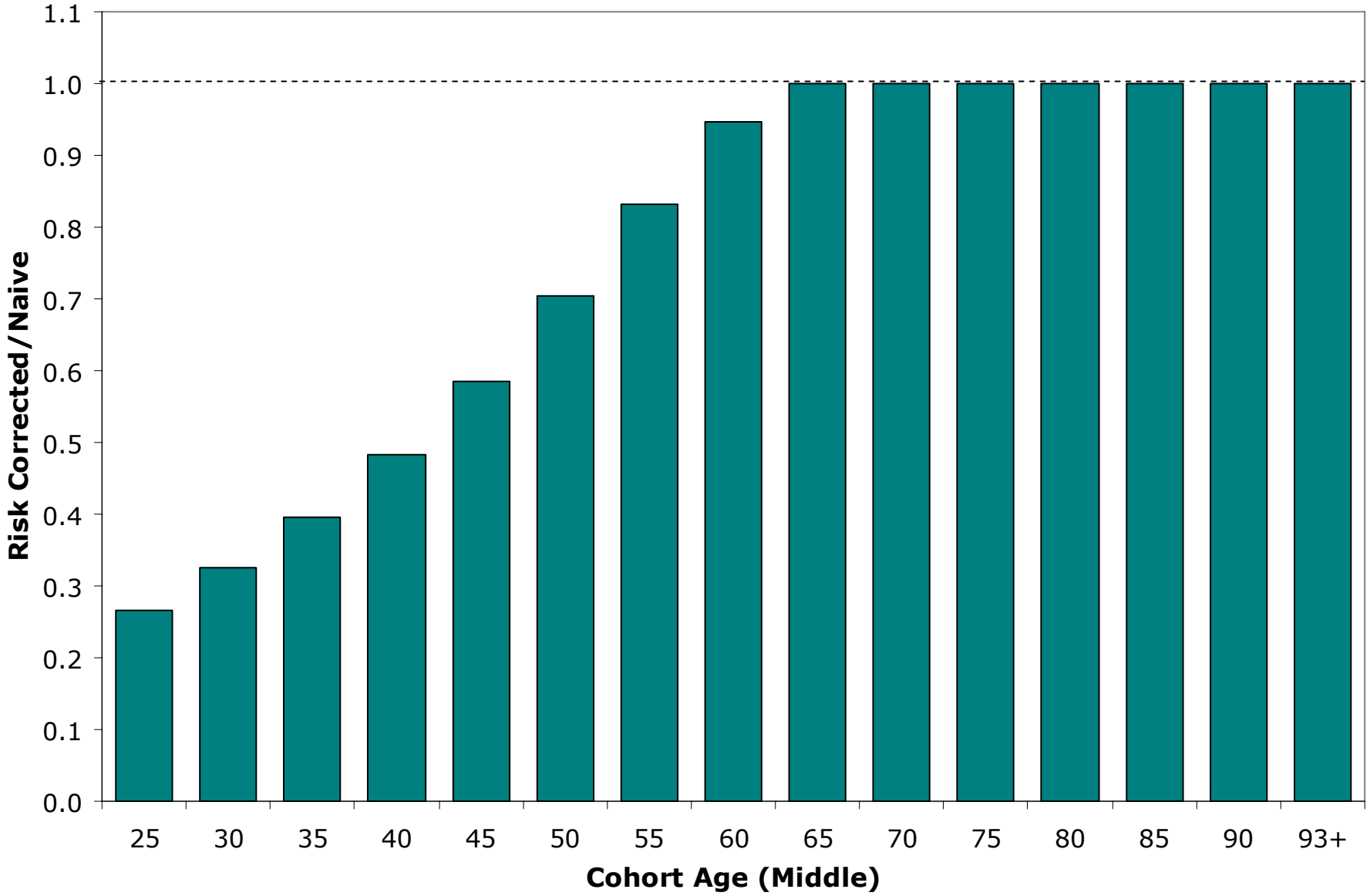

Figure 3: Cohort PAAWs

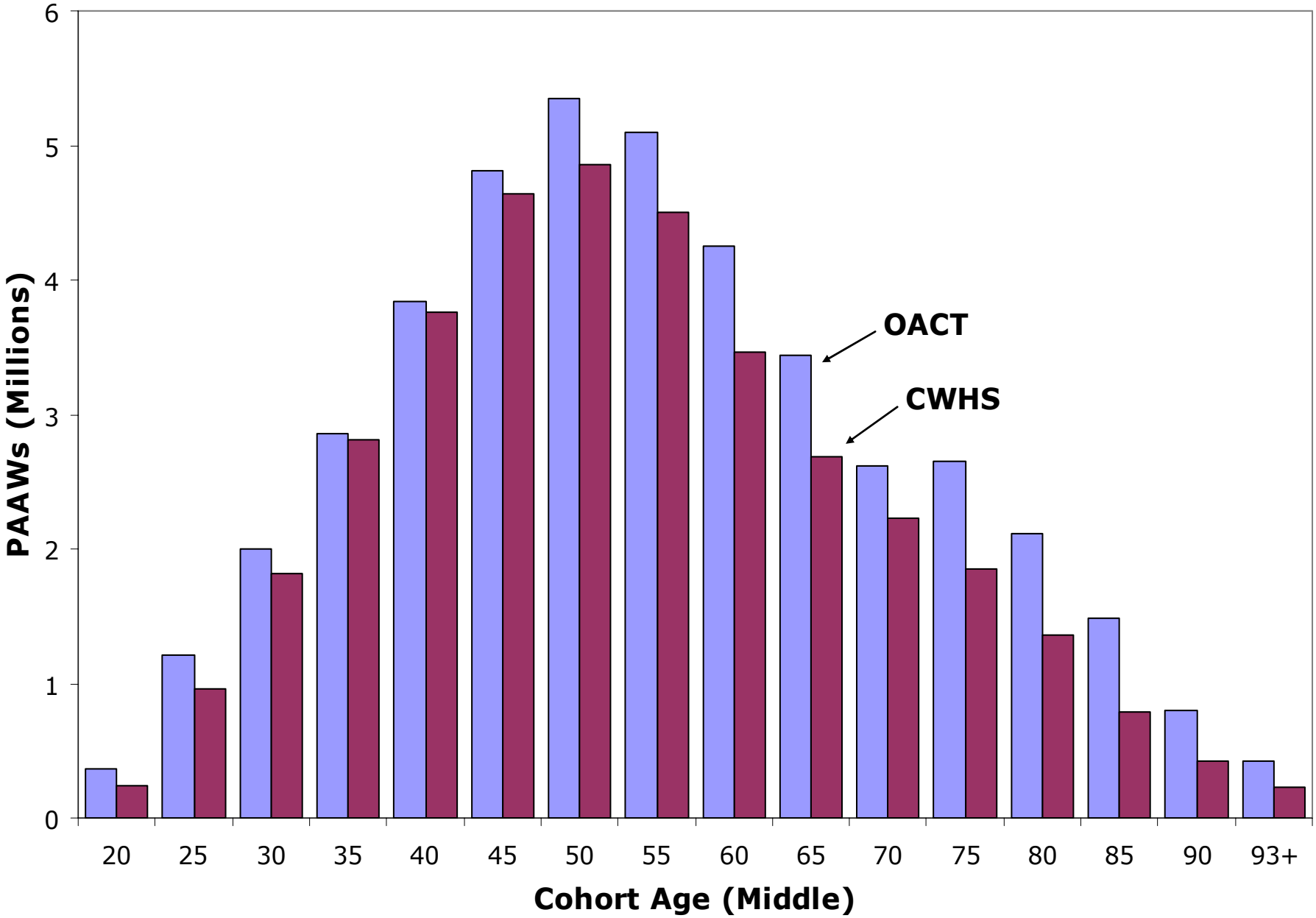

Figure 4: Cohort Value of PAAWs (OACT)

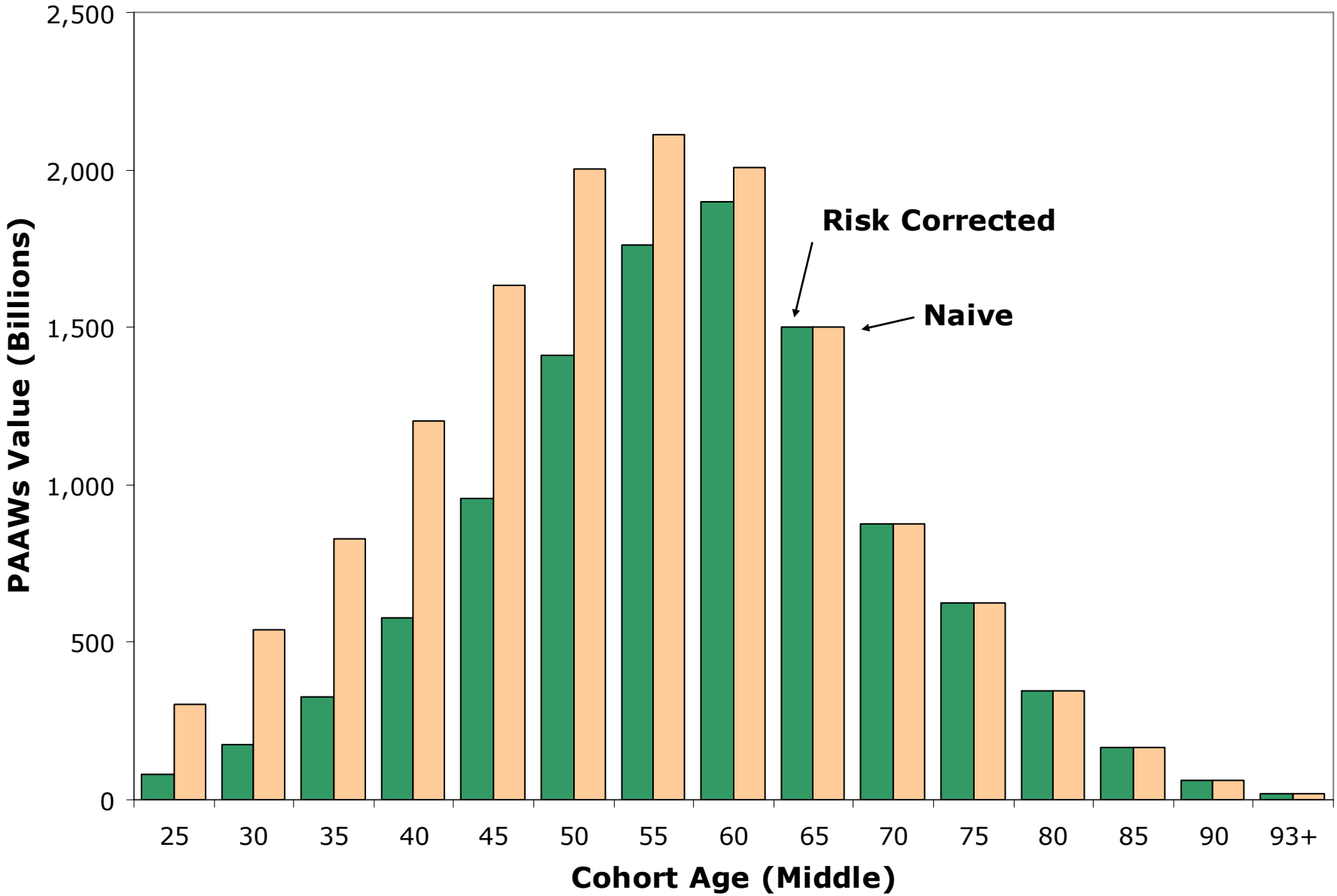

Figure 5: Cohort Value of PAAWs (CWHS)

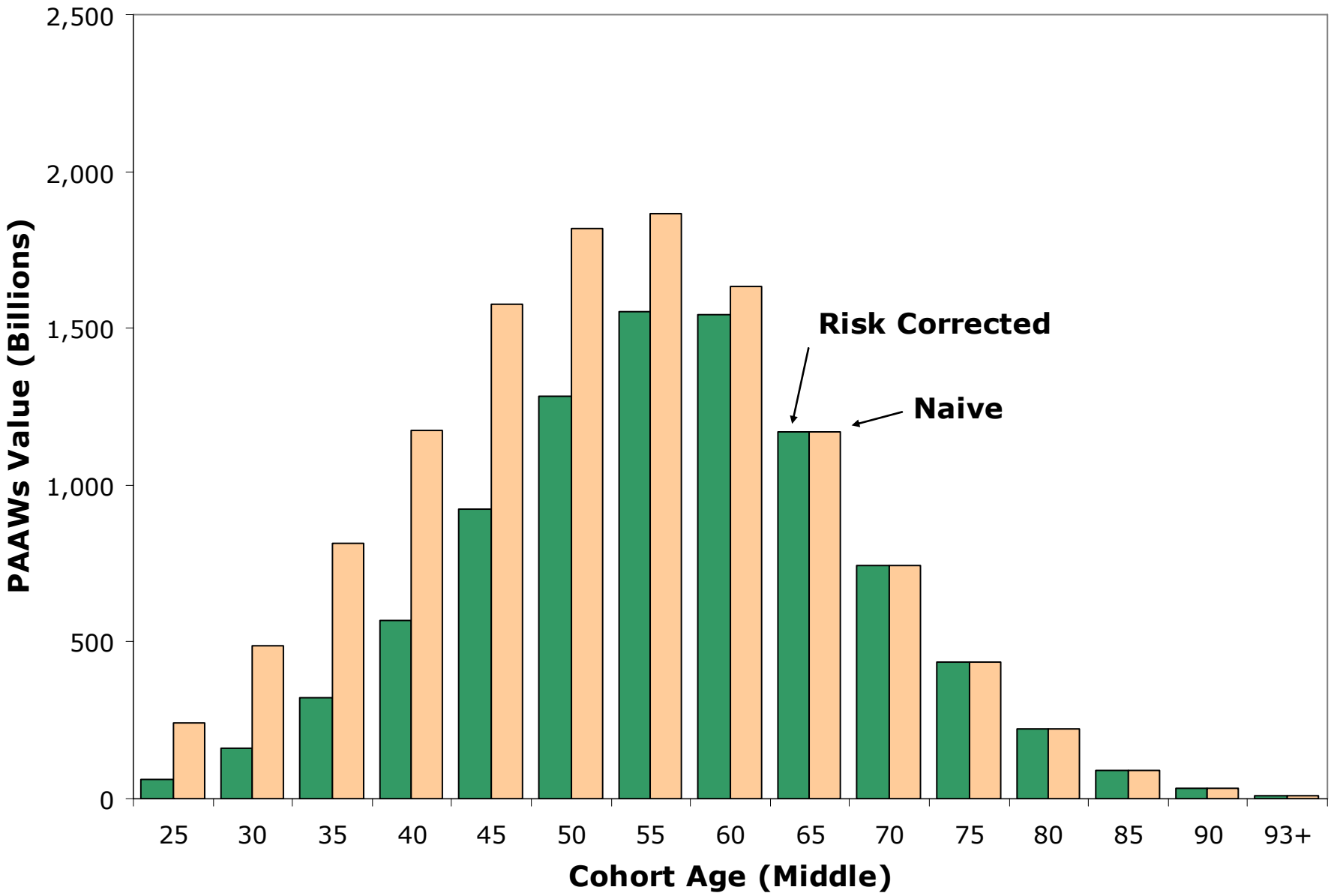

Figure 6: Total Value of PAAWs

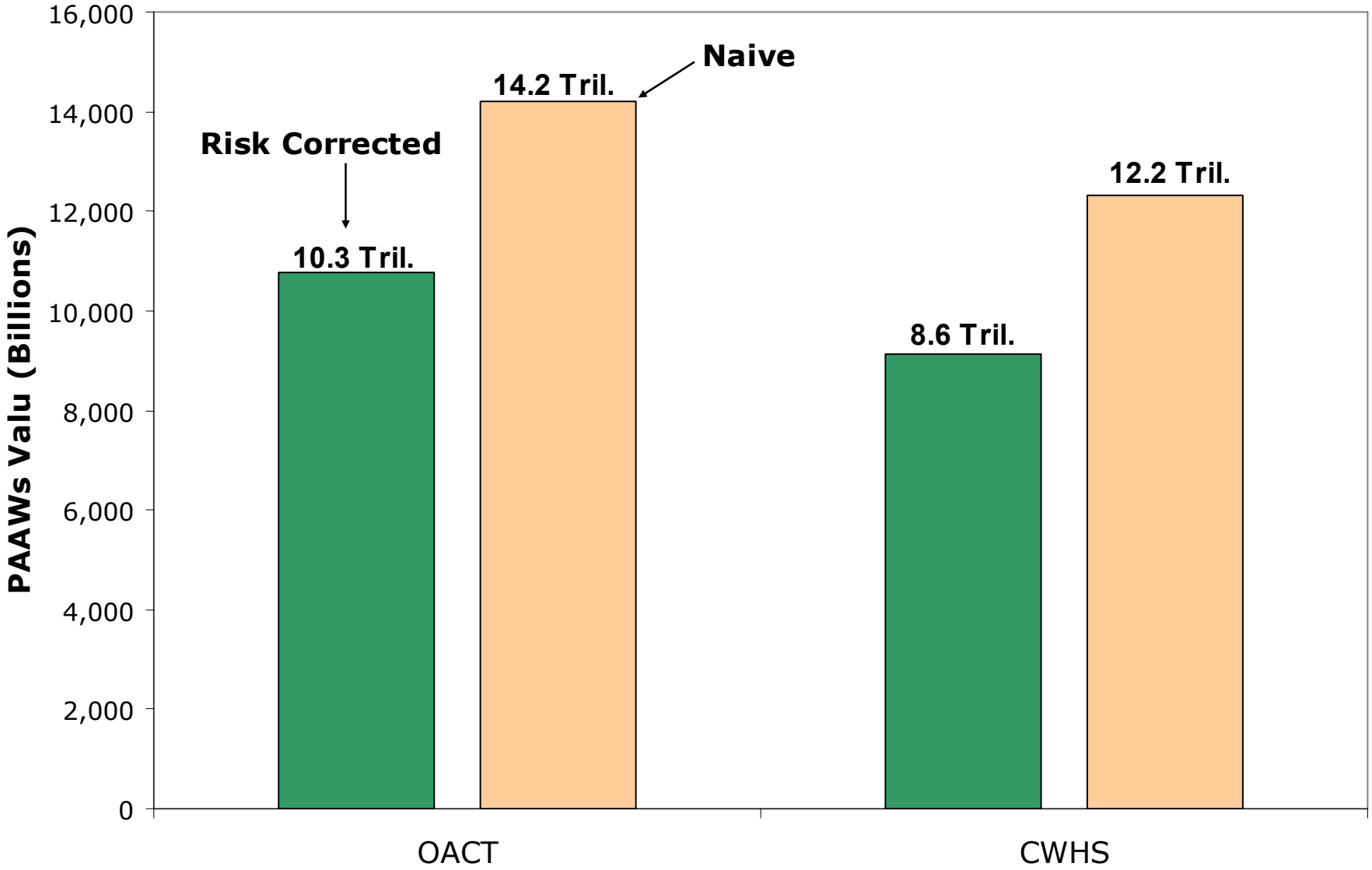

Table 1: Present Value of Accrued Social Security Benefits under Alternative Valuation Methods

		Total Value (Trillions)	Pre-Retirement	Post-Retirement
Risk Corrected				
	SSA Actuary	10.8	7.2	3.6
	CWHS	9.1	6.4	2.7
Naïve				
	SSA Actuary	14.2	10.6	3.6
	CWHS	12.3	9.6	2.7
Risk Corrected/Naïve				
	SSA Actuary	**0.76**	0.68	1.00
	CWHS	**0.74**	0.67	1.00

Note: 2005 OACT Actuarial Note estimate of Max. Trans. Cost + Jan 1st 2005 Trust Fund balance equals 16.2 tril.