IN THE CIRCUIT COURT FOR THE SEVENTH JUDICIAL CIRCUIT
SANGAMON COUNTY ILLINOIS

IN RE: PENSION LITIGATION	)	No. 2014 MR 1
	)	Honorable John W. Belz
	)	

APPENDIX TO DEFENDANTS' STATEMENT OF FACTS
IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

Exhibit	Description
1	Tom Terry Expert Report
2	Jonathan Arnold Expert Report
3	Paula Worthington Expert Report
4	Jessica Basham Expert Report
5	John Lowder Expert Report
6	John Sinsheimer Expert Report
7*	COGFA 2013 Analysis of Pension Cost as a Percentage of Total General Funds
8*	COGFA April 1994 General Funds Revenue Report
9*	COGFA August 1998 General Funds Revenue 5-Year Outlook
10*	COGFA August 2000 Report on General Funds Revenue 5-Year Outlook
11*	COGFA August 2001 Report on General Funds Revenue 5-Year Outlook
12*	COGFA January 2006 Report on the 90% Funding Target of PA 88-0593
13*	COGFA March 28, 2007 Report on Fiscal-Year 2008 Revenue Forecast and Updated Fiscal-Year 2007 Revenue Estimate
14*	COGFA February 2008 Report on the Financial Condition of the Illinois State Retirement Systems
15*	COGFA March 2011 Report on Financial Condition of Illinois State Retirement Systems as of June 30, 2010
16*	COGFA Analysis of Change in State Pension Unfunded Liability—1985 through 2012

* Full copies of documents provided on separate disk.

Exhibit	Description
17*	COGFA State of Illinois Budget Summary, Fiscal Year 2012
18*	COGFA March 12, 2013 FY 2014 Economic Forecast and Revenue Estimate and FY 2013 Revenue Update
19*	COGFA August 2002 Report, FY 2002: A Retrospective of Economic and General Revenue Performance
20*	COGFA March 2014 Report on Financial Condition of Illinois State Retirement Systems as of June 30, 2013
21*	Illinois Office of Management and Budget Report on Budget Cuts for Fiscal Years 2009 – 2015 http://www2.illinois.gov/gov/budget/Documents/Cuts_to_Budget_FY09-FY15.pdf
22*	Illinois Comptroller Executive Summary, June 30, 2011 http://ledger.illinoiscomptroller.com/ledger/assets/File/Ex%20Sum%202011.pdf
23*	Illinois Comptroller Quarterly Notes, July 6, 2012, "Backlog Persists Despite New Revenue," http://www.ioc.state.il.us/index.cfm/resources/comptrollers-quaterly/quaterly-edition-06-july-2012-revenue-grows-bill-backlog-remains/
24*	Illinois Comptroller Reports 2005: http://www.ioc.state.il.us/index.cfm/resources/fiscal-focus/february-2005-pensions/ 2007: http://www.ioc.state.il.us/index.cfm/resources/fiscal-focus/january-2007-pensions/
25*	December 20, 2013 Actuarial Impact Analysis of PA 98-0599 by Gabriel Roeder Smith & Company for SURS
26*	Federal Reserve Analysis on Median Household Income in the U.S. http://research.stlouisfed.org/fred2/series/MEHOINUSA672N
27*	We Are One Illinois Press Release, December 12, 2012
28*	Record of Committee Witnesses, Illinois House of Representatives and Illinois Senate, May 2005
29*	1970 United States Census Report https://www.census.gov/dmd/www/resapport/states/illinois.pdf

* Full copies of documents provided on separate disk.

Exhibit	Description
30*	Congressional Budget Office Report, "Update to the Budget and Economic Outlook: 2014 to 2024" http://cbo.gov/sites/default/files/cbofiles/attachments/45653-OutlookUpdate_2014_Aug.pdf
31*	Alexis Sturm Affidavit
32*	Tom Terry Documents
33*	Jonathan Arnold Documents
34*	Paula Worthington Documents
35*	Jessica Basham Documents
36*	Jessica Basham Documents – pension reform scoring scenarios
37*	John Lowder Documents

* Full copies of documents provided on separate disk.

CERTIFICATE OF SERVICE

I, Joshua D. Ratz, an attorney, hereby certify that on October 3, 2014, true and correct copies of the foregoing Appendix to Defendants' Statement of Facts in Support of Motion for Summary Judgment were served by United States Mail, first class postage prepaid, upon all counsel of record as follows:

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IN THE CIRCUIT COURT FOR THE SEVENTH JUDICIAL CIRCUIT
SANGAMON COUNTY, ILLINOIS

IN RE: PENSION LITIGATION

No. 2014 MR 1

Honorable John W. Belz

DECLARATION OF THOMAS S. TERRY

The undersigned, Thomas S. Terry, being sworn under oath, states as follows:

1. I have personal knowledge of the facts alleged herein, and if called under oath, could testify competently to the following facts.

2. I am currently the Chief Executive Officer and founder of The Terry Group. I began my professional career at Towers Perrin in 1975. In 1991, I founded CCA Strategies LLC, which was acquired by J.P. Morgan in 2006. In 2010, I founded The Terry Group, which consults to organizations on pensions, employee benefits, and compensation.

3. I currently serve as President of the American Academy of Actuaries, the national association of actuaries practicing in the United States with responsibility for practice advancement, professionalism, and public policy. I also serve as vice chair of the Pensions and Employee Benefits Committee of the International Actuarial Association.

4. The opinions and conclusions contained in my expert report dated August 29, 2014 (revised September 26, 2014) (the "Report"), are based on my years of work experience and the documents cited in the Report. Copies of the Report and the documents I relied upon are attached hereto.

5. Under penalties as provided by law pursuant to Section 1-109 of the Illinois Code of Civil Procedure. the undersigned certifies that the statements set forth in this instrument and my Report are true and correct, except as to matters therein stated to be on information and belief and as to such matters the undersigned certifies as aforesaid that he verily believes the same to be true.

Executed this 29th day of Sept., 2014.

Thomas S. Terry

Expert Report

Prepared by

Thomas S. Terry, FSA

August 29, 2014
Revised September 26, 2014

Expert Report of Thomas S. Terry

1. I am the Chief Executive Officer of The Terry Group and was retained as an expert in connection with the State of Illinois' pension reform litigation. I submit this report in that regard.

2. Except as otherwise indicated, all facts set forth in this declaration are based upon: my personal knowledge, my review of relevant documents and published reports, and my professional opinion. If called upon to testify, I would testify competently to the facts set forth in this report.

1. Qualifications and Assignment

3. I am currently the Chief Executive Officer and founder of The Terry Group. I began my professional career at Towers Perrin in 1975. In 1991, I founded CCA Strategies LLC, which was acquired by J.P. Morgan in 2006. In 2010, I founded The Terry Group, which consults to organizations on pensions, employee benefits, and compensation.

4. In addition, I am active in the volunteer leadership of the actuarial profession in the United States and internationally. I currently serve as President of the American Academy of Actuaries, the national association of actuaries practicing in the United States with responsibility for practice advancement, professionalism, and public policy. I also serve as vice chair of the Pensions and Employee Benefits Committee of the International Actuarial Association.

5. I hold a Bachelor's Degree in Math and Physics from Tufts University and a Masters of Actuarial Science from the University of Michigan. A copy of my curriculum vitae, which details my employment history, publications I have authored, selected presentations to regional and national gatherings, and matters in which I have testified in the last four years, was previously submitted to the parties.

6. I have more than thirty-five years of experience consulting on the design and financing of employee pension programs, including pension plans. My consulting has required me to evaluate pension programs and proposals, analyze carefully and critically pension issues, and find creative solutions to pension challenges facing plan sponsors today in both the public and private sectors.

7. I currently serve as chair of the Board of Actuaries, which has actuarial oversight responsibilities for the Civil Service Retirement System and the Federal Employees Retirement System. These systems combined cover over five million non-military federal employees and retirees.

8. I have been asked to review the pension reform law PA 98-599 (the Act) to assess its impact on State employees and retirees and to provide analysis related to the impact of the Act on the assets and liabilities of the Teachers' Retirement System of the State of Illinois (TRS), the State Universities Retirement System of Illinois (SURS), the State Employees' Retirement System of Illinois (SERS), and the General Assembly Retirement System of Illinois (GARS), (collectively, Illinois' "Retirement Systems" or "the Systems").

9. In my current consulting activities, I rely upon my own professional experience, professional standards of practice, industry knowledge gleaned at professional conferences, as well as published studies and reports. All of the reports upon which I have relied in preparing this report are listed in the Appendix to this report.

10. In addition to my own research and professional experience, I considered and/or relied upon the following materials in preparing this declaration: actuarial valuation reports prepared for the Systems by the their actuaries, Gabriel Roeder Smith & Co. (for SURS and SERS) and Buck Consultants, LLC (for TRS), the Systems' Comprehensive annual Financial Reports (CAFRs), and other materials listed in the Appendix.

2. Overview of This Report and My Analysis

11. Illinois' pension systems are deeply troubled. Their solvency metrics are among the worst in the nation. From an actuarial perspective, the recently passed pension reform act (PA-98-599) represents a first step toward putting the State's troubled retirement systems back on a financially sustainable track.

12. The State's decades-long policy of underfunding has been a big problem. But funding policy is in no way the whole story. The systems' unfunded liabilities in large part stem from unanticipated and devastating external circumstances that have dealt their own serious financial blows by adding tens of billions of dollars to the systems' unfunded liabilities.

13. The 2008-2009 financial market meltdown and economic crisis has been an extraordinary setback for Illinois' pension systems. The obvious devastating impact on invested assets has been accompanied by the less obvious but just as critical diminished financial outlook for investment markets going forward. I examine these effects in depth in my report.

14. Longevity improvements have provided yet another, albeit quieter, unexpected shock to Illinois' pension systems. I examine the longevity improvements and their unfortunate and significant financial effects in my report.

15. Automatic annual pension increases represent a significant part of the systems' liabilities. The current form of increases was enacted in 1989 during a period of relatively high inflation. Inflation has fallen precipitously since then and the outlook for future inflation is low. I examine this topic in depth and identify the serious financial impact associated with automatic increases providing purchasing power protection to a much greater degree than when enacted in 1989.

16. Finally, I examine the benefit impact of pension reform on both retirees and active members.

3. Background

Most state and local government-sponsored pension plans are defined benefit pension plans.

17. Pension plans sponsored by state and local governments are generally defined benefit (DB) pension plans. In a defined benefit plan, the pension benefit is defined by a formula. That formula is typically based on the employee's age, years of service, and pay. The specific plan features are often negotiated and/or legislated.

18. The State of Illinois sponsors various retirement systems (plans) that are the subject of this report. These systems are the Teachers' Retirement System of the State of Illinois (TRS), the State Universities Retirement System of Illinois (SURS), the State Employees' Retirement System of Illinois (SERS), and the General Assembly Retirement System of Illinois (GARS).

19. For purposes of this report I have relied on annual actuarial valuation reports prepared by the systems' actuaries, Comprehensive Annual Financial Reports (CAFRs) and other data for TRS, SURS and SERS. Because GARS is so much smaller than the other three systems, I have not included GARS in my review or analysis.

Pension plans are advance-funded. This means money to pay future pension benefits is set aside in advance in a pension fund.

20. In a defined benefit pension plan such as those in Illinois, money to pay benefits is set aside over time into a pension fund or trust to ensure that money will be there to pay pension benefits when they are due. Cash is contributed regularly by both the sponsoring entity (e.g., the state) and by employees. These contributions are supplemented by investment returns earned by the

accumulating assets. Pension fund assets are typically invested in a diversified portfolio of investments.

Actuaries perform annual calculations that value the earned pensions so as to determine the amount and timing of necessary sponsor contributions.

21. The ultimate cost of a pension plan is simple in concept. It's equal to the actual pension benefits paid, plus any expenses of the plan. The ultimate cost will depend on how long plan members will work, how much they are paid during their careers, when they will retire, how long they'll live, and a host of other similar factors.

22. Actuaries perform calculations to estimate the value of members' future pensions and then determine the amount and timing of contributions necessary to fund those pensions. These calculations are performed each year as part of the annual actuarial valuation.

Actuarial assumptions are essential elements in the actuary's calculations.

23. Actuarial assumptions are essential elements in the actuary's calculations. Estimating future pension payments necessitates making assumptions about all the various factors that influence the amount and value of future pension payments. For example, actuarial assumptions include assumptions regarding the rate of employee turnover, the rate of employee pay growth, the age of retirement, and the rate or probability of death at various ages – both during the member's working career and, very importantly, during the member's retirement years when pensions are paid. These assumptions are all essential to projecting the amount and timing of future pension payments.

24. Another essential actuarial assumption is the interest rate used to discount future projected pension payments in determining the actuarial accrued liability. The interest rate used by public pension plans is typically the expected investment return assumption.

25. Actuarial science embodies well-established principles and disciplines. One of those disciplines involves this process of establishing actuarial assumptions for valuing pension plans. When setting actuarial assumptions, actuaries in the U.S. adhere to Actuarial Standards of Practice as promulgated by the Actuarial Standards Board.

26. Certain concepts of statistics and risk management are embraced as important principles of actuarial science. For example, the law of large numbers directs actuaries to identify the expected average outcome for a group of plan members when setting actuarial assumptions. Similarly, risk pooling anticipates

the average outcome for a group, even when the behaviors or impacts of individual group members may be varied.

Actuarial assumptions are based on professional judgment.

27. An actuarial assumption is used to estimate possible future outcomes of uncertain events. The actuary will use professional judgment to develop a reasonable assumption according to relevant plan and environmental characteristics. The professional judgment will take into account both past experience as well as future expectations. [1]

28. Some deviations in actual plan experience when compared to the underlying actuarial assumption are expected. While anticipating deviations may seem paradoxical, the process of measuring and tracking such deviations is a well-established aspect of the actuarial process. In actuarial science, this is called actuarial gain and loss analysis. Actuaries establish their assumptions in what is often referred to as a best estimate fashion that is intended to minimize any significant methodological bias. As a result, when actuarial assumptions are set appropriately, actuarial gains and losses will generally tend to cancel each other out over time.

29. "A reasonable assumption is one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period."[2]

Reasonable assumptions for pension valuations are long-term and so are established so as to be valid indefinitely.

30. The measurement period for a pension plan is very long term. For example, pension plans often have members in their 20s. These members might live to 100 or older. Thus, the measurement period referred to in the paragraph above could be 70 or 80 years or even longer. For actuarial assumptions to meet the criterion of minimal cumulative actuarial gains and losses, such assumptions must essentially be established as if they are to be valid indefinitely, even if the degree of uncertainty may rise with the passage of time.

31. Measurements of actuarial gains and losses each year will assuredly reveal deviations, but the underlying presumption of minimal methodological bias

[1] Actuarial Standard of Practice No. 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations, paragraph 3.1

[2] Actuarial Standard of Practice No. 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations, paragraph 3.1

compels the establishment of actuarial assumptions in a manner that anticipates the off-setting of actuarial gains and losses over time. This premise is workable only if the assumption is set on a foundation of permanence.

32. Put another way, actuarial assumptions are established for the long run. They are established with the expectation that they will not change. This presumption of permanence is an important perspective for setting of assumptions as part of an actuarial process that is essential to the integrity of any actuarially based system.

33. Actuarial assumptions are established based on considerations that balance past experience with future expectations. This dual perspective is informed by annual analysis of actuarial gains and losses, along with periodic in-depth review and analysis of actual plan experience. In addition, the actuary will incorporate the best information and thinking from other plan stakeholders in order to inform his or her judgment about future expectations. Relevant stakeholders in this context would include plan administrators, plan trustees, and other plan advisors with first-hand, relevant knowledge of the plan, its members, and other relevant factors.

34. In certain instances, entities other than the actuary will establish assumptions to be used in actuarial calculations. In such situations, actuaries will nearly always have significant input into the considerations associated with the assumption setting process, and will seek to ensure that appropriate actuarial processes are followed.

35. In general, the emerging plan experience associated with certain actuarial assumptions is not expected to vary significantly from year to year. Such assumptions are influenced by the law of large numbers and so average plan experience is not expected to deviate much from year to year. Demographic assumptions such as mortality fall into this category.

36. Certain economic assumptions such as assumptions regarding inflation, pay growth, and investment returns manifest somewhat different qualities. Emerging plan experience with these critical economic assumptions tends to show greater year-to-year deviation, but the discipline associated with setting such assumptions, along with the presumption of permanence, means that over time, actuarial gains and losses will tend to be off-setting and the long term experience will orient toward the average or expected outcomes.

37. Thus, while certain economic assumptions may demonstrate more year-to-year deviation, the actuarial process is built with this in mind and so these deviations are managed in a disciplined and systematic manner.

The actuarial process is designed to anticipate and manage the expected deviations between actuarial assumptions and actual experience.

38. Actuarial calculations performed as part of the annual actuarial valuation quantify the deviations between actuarial assumptions and actual experience by identifying actuarial gains and/or losses. An actuarial process will typically provide for the evening out or "smoothing" of such gains and/or losses over time. For example, a large loss in a particular year might be smoothed out by recognizing the loss over several years, with a portion of the loss being recognized each year, rather than recognizing the entire loss in a single year. Recognizing these gains and/or losses over time helps enhance the predictability and stability of costs from year to year.

39. The actuarial process typically includes a periodic, in-depth experience study. Sometimes an experience study will be called for when a pattern of experience is developing that calls into question the continued reasonableness of the underlying actuarial assumption. Other times, the mere passage of time will be sufficient reason for the review of plan experience.

40. Regardless of the reason, an experience study is a means by which the actuary can tabulate data from member experience such as employment termination rates, retirement age, etc. Except for such a detailed tabulation, emerging patterns of change may not be evident to the actuary.

41. It is not uncommon for an experience study to result in a review of the related actuarial assumptions. As noted earlier, when establishing an actuarial assumption, an actuary's professional judgment will take into account both past experience as well as future expectations.

42. If an experience study reveals information about past experience that alters the actuary's professional judgment, then an assumption change may be called for.

43. The process of establishing an actuarial assumption, monitoring deviations by annually analyzing actuarial gains and/or losses, conducting periodic experience studies, and occasionally changing the actuarial assumption is normal and expected. Changing an actuarial assumption in this way is in no way an indication that the choice of the original assumption represented poor professional judgment.

44. In summary, some deviations in actual plan experience when compared to the underlying actuarial assumption are expected. These deviations are, on a year-to-year basis, captured in the actuarial valuation and identified in the actuarial process as an actuarial gain or loss. Periodic experience studies and actuarial assumption reviews are conducted so as to inform the professional judgment

that goes into establishing the underlying actuarial assumptions. It is entirely common and even expected that actuarial assumptions will be changed from time to time as a result of this process. This process is entirely consistent with, and in fact depends upon, adherence to the concept that actuarial assumptions are long-term in nature and are established on a foundation of permanence.

Unexpected shocks to a pension plan can occur.

45. Unexpected disruptions to a pension plan can occur when there is either an extraordinary change in plan experience or an extraordinary change in future expectations – or both.

46. An extraordinary change in plan experience would be characterized by a shock to the system that was not anticipated and, further, would not have been accounted for as a reasonable deviation from expectations. Such a change might have a significant effect on plan assets and/or liabilities.

47. An extraordinary change in future expectations would be characterized by a distinct alteration in the paradigm for thinking about the future. Such a paradigm change might alter professional judgment about reasonable actuarial assumptions and so have an unexpected effect on plan liabilities.

48. The implications of such unexpected shocks can be several and severe. Potentially large and unexpected changes in plan assets, plan liabilities, and employer contributions are just some of the implications of such shocks to a pension plan. Standard actuarial processes will generally continue to be valid under the new circumstances, but the results of applying such standard processes can be abnormal, and certainly unexpected.

The investment return assumption is a particularly important factor in actuarial calculations.

49. At the core, the actuarial valuation of a pension plan involves estimating future benefit payments to members, and then, using present value concepts, discounting those future benefits to a given point in time to determine the liability as of that point in time. The discounting of future benefits to arrive at a value of those benefits as of a particular point in time uses the mathematics of compound interest and the principle of the time value of money.

50. The mathematics of compound interest can be illustrated by this example: $100 invested today that earns interest of 10% per year will be worth $110 at the end of one year. At the end of two years, interest will have been earned not only on the original dollar but also on the interest earned in year one, so the total will

be $121. After five years, the total amount, reflecting this compounding effect, will be $161.

51. The principle of the time value of money is very much related to the mathematics of compound interest. From today's standpoint, a dollar tomorrow is worth less than a dollar today. This is because I might only need to "invest" 91 cents today to "grow" to a dollar in one year, assuming a 10% interest rate. So, using the time value of money concept, the dollar tomorrow is only worth 91 cents today. Put another way, the 91 cents today is the "present value" of a dollar tomorrow.

52. In the context of pensions, if a pension benefit is to be paid in the future, then the value of that pension benefit today is less than the nominal amount of the pension benefit payable at that future date. Taking this one step further, the higher the assumed interest rate, the lower the value today using the present value concept. A pension plan would need assets equal to that present value to be in the pension trust today in order to have enough money to pay that benefit when due in the future. This is the pension "liability."

53. Applying this to an entire pension system, the higher the rate of investment earnings, the less money that must be set aside in the trust for future benefits. Likewise, the lower the rate of investment earnings, the more money that needs to be set aside now for future benefits.

54. For purposes of determining pension liabilities and contributions for public pension plans, the value today of benefits paid in the future is determined based on an *assumption* about the future investment return that assets in the pension trust will earn. That assumed rate of investment return is used to discount the future benefit payments in determining plan liabilities.

55. If it is assumed that assets will earn a *higher* amount of investment income over the years to come, then *less* money needs to be set aside to meet the future benefit obligations. The value today of future benefits, the liability, is lower.

56. If it is assumed that assets will earn a *lower* amount of investment income over the years to come, then *more* money must be set aside to meet the future benefit obligations. The value today of future benefits, the liability, is higher.

57. Because investment returns and the investment return assumption have such a significant impact on costs and the pension plan's funded status, it merits special attention. To illustrate this, a common actuarial rule of thumb is that a 1% increase or decrease in the expected rate of return will typically result in a decrease or increase in the actuarial present value of a pension obligation of 10% to15%.

For many public pension plans, employer contributions are determined according to an actuarial cost method.

58. "An actuarial cost method is a procedure for allocating the actuarial present value of projected benefits (and expenses, if applicable) to time periods, usually in the form of a normal cost and an actuarial accrued liability." The actuarial present value of projected benefits takes into account not only the time value of money but also the probability that the benefit will be paid. (Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions, Paragraph 2.2)

59. While public pension plans may choose from among an array of different actuarial cost methods for determining employer contributions, most actuarial cost methods have in common the attribution of costs to past years, the current year, and future years.

60. The cost attributable to **past years** (also sometimes referred to as past service cost, liability, or actuarial accrued liability) can be thought of as referring to the cost attributable to service rendered by members from their date of hire up to the current year.

61. The **normal cost** refers to the cost of the benefits accruing or being earned in the current year.

62. The cost attributable to **future years** is sometimes referred to as the present value of future normal costs.

63. Under an actuarial cost method, the annual employer contribution is typically composed of two parts:

    - The cost of the benefits earned in the current year (the normal cost), plus
    - A portion relating to any *unfunded* costs attributable to past years.

    That second part of the contribution is referred to as the "amortization" of the unfunded actuarial accrued liability (UAAL). This amortization payment represents a *portion* of the amount needed to fully fund the UAAL. The amortization of the UAAL includes payment of both principal and "interest" on the UAAL. At a minimum, the interest component is necessary to hold the UAAL steady; it represents the additional earnings the assets would have had if the liability were fully funded. It is common to see such unfunded past costs funded, or amortized, over 30 years.

64. Several types of costs make up the UAAL and are amortized. When experience deviations (referred to earlier as actuarial gains or losses) arise, then those gains or losses, are amortized. An additional cost resulting from an actuarial loss is gradually paid off over a future period of some years. Unfunded amounts requiring amortization can also arise when benefit improvements are made. Similarly, an actuarial gain is gradually recognized over a future period of some years

The funded status of a pension plan is an indicator of the plan's current financial health.

65. A pension plan's "funded status" at a point in time is an indicator as to the degree to which costs attributable to past service, or the actuarial liability, is "covered" by invested assets. One specific measure of funded status that is commonly used by public pension plans is the dollar difference between the plan's assets and its liabilities.

66. If a plan's assets are greater than its liabilities, the plan is said to have a surplus. If a plan's liabilities are greater than its assets, the plan is said to have a deficit.

67. Another measure of funded status is the funded ratio. Generally speaking, the funded ratio is the ratio of plan assets to plan liabilities. Funded ratios are an easy metric for comparison of one plan to another.

In addition to calculating a plan's funded status at the current date, actuaries also develop forecasts of funded status in future years.

68. The primary purpose of the annual actuarial valuation of a pension plan is to determine the plan's annual employer contribution amount as well as different measures of funded status. Another purpose of the actuarial valuation is often to project such amounts into the future in a manner that provides the plan sponsor a forward look at future funding requirements as well as a look at how the funded status may change in future years.

Public pensions: Many public pension plans are poorly funded and virtually all of them have reduced pensions in some manner.

69. Public pension plans are generally poorly funded. The reasons for this are varied and include inadequate employer contributions, the challenging financial markets of the 2000's and unexpected demographic changes. A 2013 study of 126 large public pension plans with $2.3 trillion in assets shows an aggregate funded ratio of 73.5%. This is the lowest level since the first survey data were made available in 1990. (National Association of State Retirement

Administrators and the National Council on Teacher Retirement; 2013 Public Fund Survey)

70. Most states have reacted to their situation in recent years by cutting benefits for new hires as well as for current members. A study of 32 public pension plans with a wide variety of funded statuses disclosed that 29 had enacted reforms. The most common reforms were to adjust age and tenure requirements, change the average salary period and reduce cost-of-Living adjustments (COLAs). A reduction in COLAs was the most common change to apply to all employees, as opposed to making changes for future new hires only. (Center for Retirement Research at Boston College, State and Local Pension Costs: Pre-Crisis, Post-Crisis and Post-Reform, February, 2013)

71. A separate research study on COLA reductions found that 35% of public plans have fixed COLA provisions, like Illinois' Automatic Annual Increase (AAI) benefit, and that the vast majority of COLA reductions were to reduce these fixed percentage increases. (Center for Retirement Research at Boston College, COLA Cuts in State/Local Pensions, May 2014)

Illinois' pension plans are more poorly funded than most other state systems.

72. Table 1 shows that Illinois' funded status (based on market value of assets) was a deficit of $96 billion as of June 30, 2013.[3]

Table 1: Illinois system funded status as of June 30, 2013 ($ millions)

	Market Value of Assets	Actuarial Liability Prior to 98-599	Funded Status Pension Surplus (Deficit)
TRS	$39,859	$93,887	($54,028)
SERS	12,400	34,721	(22,321)
SURS	15,037	34,373	(19,336)
Total	**67,296**	**162,981**	**(95,685)**

Source: Systems' actuarial valuation reports as of June 30, 2013

[3] For TRS, SERS and SURS, the fiscal year is July 1 to June 30.

73. In a survey of the 100 largest public pension systems in the U.S. the Illinois systems are listed with the funded ratios shown in Table 2.

Table 2: Funded ratios for Illinois pensions plans as of June 30, 2012, based on market value of assets

	Funded Percentage
TRS	41%
SERS	33%
SURS	41%

Source: Milliman 2013 Public Pension Funding Study

74. From the same survey, Table 3 shows the only other funds among the top 100 in the study with funded ratios less than 40%.

Table 3: Among the 100 largest pension funds with funded ratios less than 40%, based on market value of assets

	Funded Percentage*
Municipal Employees of Chicago	38%
Connecticut State Employees	37%
Kentucky State Employees	29%
Puerto Rico Teachers	21%
Puerto Rico Government Employees	4%

Source: Milliman survey 2013 Public Pension Funding Study
*Funded percentages are as of fiscal year end 2012, except for Puerto Rico Teachers. The funded percentage for Puerto Rico Teachers is reported as of 12/31/2011.

75. Almost without exception, public pension systems across the U.S. are financially troubled to a significant degree and are poorly funded. Illinois' retirement systems are among the largest and most poorly funded systems in the nation.

Until recent pension reform, employer contributions to Illinois' pension systems have been based on legislation passed in 1994 (PA 88-593) and a subsequent legislative revision in 2005 (94-004).

76. In 1994 the Illinois legislature passed PA 88-593, which created a funding ratio target of 90% to be achieved by 2045 (the "'94 funding law"). The '94 funding law was based on the concept of contributing an equal percentage of payroll every year. The systems' actuaries project assets and the AAL into the future and determine the percent of payroll to be contributed that will result in the 90% funding ratio in 2045. The law included a 15-year ramp-up or phase-in from a lower contribution percentage until the full level contribution percentage was reached in 2010.

77. In 2003, PA 93-0002 authorized the issuance of $10 billion in pension obligation bonds. The proceeds of these bonds were contributed to the pension plan, which had the effect of accelerating contributions.

78. In 2005, the Illinois legislature passed PA 94-004, which temporarily reduced the level of contributions to the Systems for 2006 and 2007.

Employer contributions to Illinois' pension systems are now subject to an enhanced funding policy under PA 98-599 (Senate Bill 1)

79. In 2013, the Illinois legislature passed PA 98-599, which set the long term funding target at 100% of the actuarial accrued liability by 2044 – essentially 30 years out. Importantly, the new law also prescribed that the targeted liability be determined using "entry age normal" cost method, which is generally a more robust liability measure and one that is more commonly used than the current method.

The recent, dramatic increase in Illinois' pension systems' unfunded actuarial accrued liabilities was not anticipated.

80. Illinois systems' actuaries have routinely calculated, as part of their annual actuarial valuation process, long-term projections of *future* Unfunded Actuarial Accrued Liabilities (UAAL). In fact, Illinois' statutory pension funding method under the '94 funding law depended on such long-term projections of the plans' UAAL.

81. For purposes of actuarial funding calculations, the market value of assets is frequently adjusted to smooth out short-term investment return volatility. The adjusted asset value is referred to as the "actuarial value of assets." The projection of UAAL calculated by the Retirement Systems' actuaries is based on the actuarial value of assets. As of June 30, 2013, the UAAL of $99 billion is developed using the actuarial value of assets, while the UAAL of $96 billion is developed using the market value of assets. In this section, UAAL is based on the actuarial value of assets unless otherwise noted.

82. Relying on the detailed information in the systems' actuarial reports going back to 1990, I have developed relevant projections of the systems' 2013 UAAL from the perspective of each year from 1990 to 2013. For some years and for certain of the plans, the anticipated 2013 UAAL was actually calculated. For other years and/or for other plans, I used interpolation or extrapolation techniques to develop reasonable approximations of the anticipated 2013 UAAL figures.

83. To further illustrate the meaning of these projections and estimates, consider the amounts illustrated in Table 4 which shows direct or implied 1990 calculations of both the 1990 UAAL as well as the anticipated 2013 UAAL.

Table 4: Illinois' UAAL calculations from the 1990 actuarial valuation reports ($ millions)

	1990 Calculation of 1990 UAAL	1990 Calculation of 2013 UAAL
TRS	$5,583	$14,563
SERS	1,743	3,665
SURS	2,938	9,332
Total	$10,264	$27,560

Source: Terry Group estimates based on TRS, SERS, and SURS actuarial valuation reports, 1990. See Appendix E for the data underlying the table. Unfunded liability amounts are based on actuarial value of assets.

84. As Table 5 shows, in 1990, the Illinois systems' UAAL for that year was $10 billion, and the estimate (from the perspective of 1990) of the anticipated the UAAL 23 years later (by the year 2013) was $28 billion.

85. In fact, we now know that the 2013 UAAL, calculated as part of the 2013 actuarial valuation, is dramatically higher than that which was anticipated in 1990 – $99 billion versus $28 billion. Table 5 compares the 2013 UAAL that was anticipated in 1990 with the actual 2013 UAAL calculated in 2013.

Table 5: Illinois' pension plans – Comparison of 2013 UAAL anticipated in 1990 versus 2013 UAAL calculated in 2013 actuarial valuation ($millions)

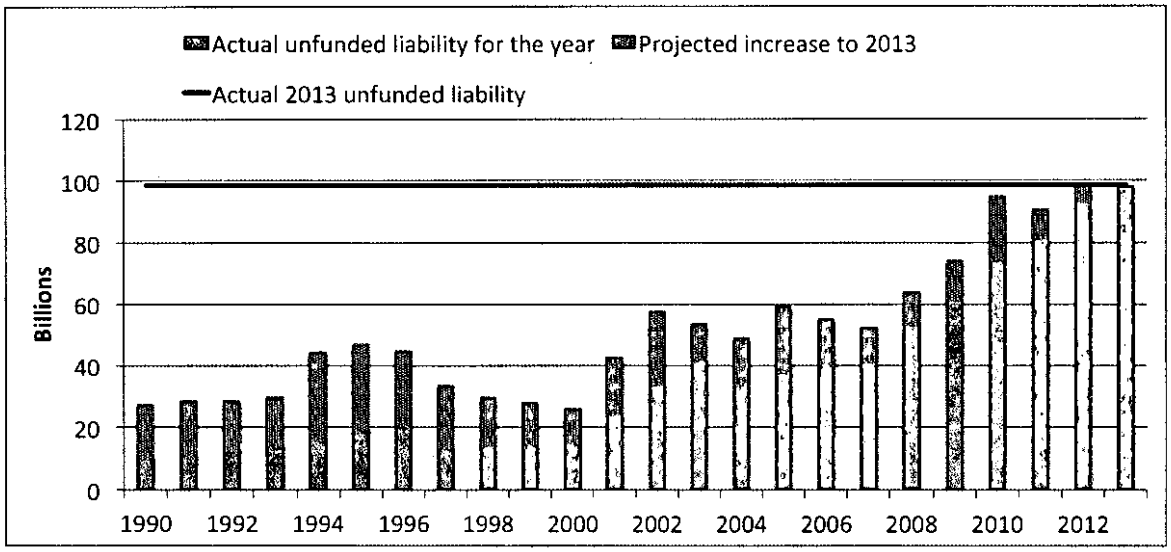
	1990 Calculation of 1990 UAAL	1990 Calculation of Anticipated 2013 UAAL	2013 Calculation of 2013 UAAL
TRS	$5,583	$14,563	$55,732
SERS	1,743	3,665	22,843
SURS	2,938	9,332	20,110
Total	$10,264	$27,560	$98,685

Source: Terry Group estimates based on 1990 and 2013 TRS, SERS, and SURS actuarial valuation reports. See Appendix E for the data underlying the table. Unfunded liability amounts are based on actuarial value of assets.

86. Figure 1 is an extension of Table 5. Each bar in Figure 1 is representative of the same numbers shown in Table 5 for 1990, but for each of the years from 1990 to 2013. In other words, each bar in Figure 1 shows amounts based on the actuarial valuations for the indicated year (1990, 1991, 1992, etc.), where the blue portion of the bar is the UAAL for that year, and the total height of the bar (the blue plus the red) represents the anticipated 2013 UAAL based on the best

information available in that indicated year. The horizontal blue line shows the ultimate, actual 2013 UAAL.

Figure 1: The Unfunded Actuarial Accrued Liability (UAAL) has grown much faster than expected: TRS, SERS, and SURS combined, 1990 to 2013



Source: Terry Group estimates based on TRS, SERS, and SURS actuarial valuation reports, 1990 – 2013. See Appendix E for the data underlying the graph. Unfunded liability amounts are based on actuarial value of assets.

87. It is obvious and logical that, as the indicated years progress from left to right in Figure 1, the height of the bars (the blue portion plus the red portion) gets closer and closer to the blue horizontal line. Said another way, as the period from the indicated date to 2013 gets shorter and shorter, the difference between the anticipated 2013 UAAL and the actual 2013 UAAL diminishes and ultimately disappears.

88. From Figure 1, we can see that as recently as 2000, the actual UAAL for the State pension systems was $15 billion, and it was anticipated that the UAAL would grow by $11 billion to be $26 billion in 2013. This is in stark contrast to today's reality, however. The State systems are, in fact, underfunded by $99 billion as of June 30, 2013, representing an almost four-fold increase in the systems' unfunded actuarial accrued liability, compared to what was expected, in the space of only 13 years.

89. Examining Figure 1 further, the actuarial projections from the 1990s consistently showed an anticipated 2013 UAAL in the range of $26 billion to $47 billion. Even as recently as 2007, after the effects of the 2001 recession, the anticipated 2013 UAAL was only $53 billion, about half of what it turned out to be just six years later.

90. For most of the years from 1990 through 2007, there is a $50 to $70 billion difference between the anticipated 2013 UAAL and the actual 2013 UAAL of $99 billion.

Illinois pensions: The rapid and unanticipated growth in Illinois' UAAL occurred independent of Illinois' funding policy or of Illinois' actual pattern of funding.

91. For the calculations of anticipated 2013 UAAL in Tables 4 and 5 and in Figure 1, it was assumed the State would contribute to the plans pursuant to the relevant statutory funding policy and that plan assets would earn the expected return in all future years. The unanticipated UAAL growth depicted in Figure 1, which for each year is depicted as the gap between the *anticipated* 2013 UAAL (the top of the bar) and the *actual* 2013 UAAL (the horizontal blue line) is independent of plan funding.[4]

Illinois pensions: The rapid and unanticipated growth in Illinois' UAAL can be tracked to unexpected developments in the years prior to 2013.

92. The following sections in this report detail my assessment of the impact of unexpected developments on the retirement systems' assets and liabilities. My analysis uses June 30, 1997 as the starting point for quantifying the impact of these unexpected developments. I chose this date because it was the "as of" date for comprehensive experience studies that were performed by the three major Illinois retirement systems (TRS, SERS and SURS). In part based on the results of the experience studies, the plans' actuarial assumptions were reviewed and revised as of June 30, 1997. In addition, and very critically, the method for determining actuarial value of assets was changed as of that date from using book value (historic cost) to using current market value.

93. The cumulative impact of these unexpected developments on plan assets and liabilities is significant. These impacts are important ingredients in tracking the growth in UAAL over recent years and in helping understand why significant portions of the current UAAL were completely unexpected.

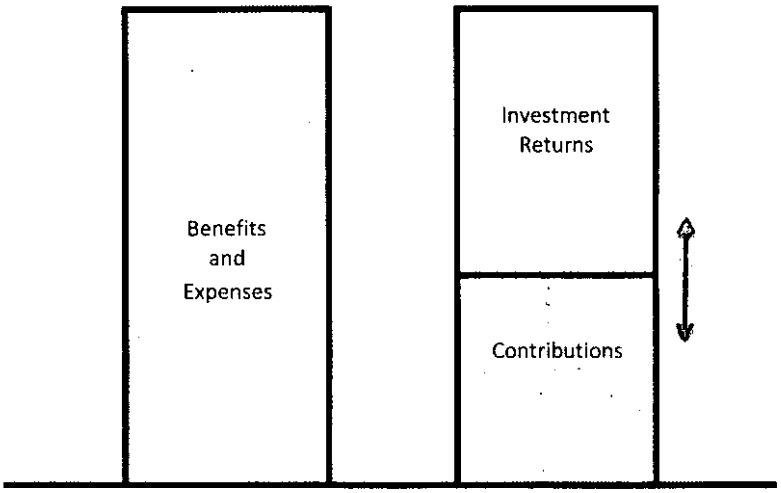
[4] If a different funding policy that resulted in additional contributions above the statutory requirement were taken into consideration in the projection of UAAL, the projected and actual UAAL would each decrease by the same amount, and the gap between the anticipated 2013 UAAL and the actual 2013 UAAL would remain unchanged.

4. Investment Returns

Investment returns have a significant impact on pension costs and liabilities.

94. Pension benefits are financed from two sources: contributions (from both the employer and from plan members), and investment returns. Investment returns typically comprise more than half of a pension plan's long term financing over the long term. There is a direct tradeoff between contributions and investment returns. Higher investment returns will decrease required future contributions. Lower investment returns will increase required contributions. The tradeoff is depicted visually in Figure 2.

Figure 2: Pension benefits are financed from two sources – contributions and investment returns



Note: From 1982 to 2011, 61% of financing of public pension plans has come from investment returns. (NASRA Issue Brief, April 2014)

95. Investment returns factor into actuarial calculations and the amount of unfunded liability in two ways: **Historical investment returns** affect the level of **assets** in the plan today. **Future investment return expectations** affect the determination of the plan's actuarial accrued **liability**. (As explained above, actuarial accrued liability minus assets equals unfunded actuarial accrued liability, or UAAL). In the following sections I will describe first the impact of historical investment returns and, next, the impact of changes in future return expectations.

Historical investment returns - the 2008 - 2009 market collapse had a devastating and lasting impact on pension plans across the U.S.

96. Generally, public pension funds are invested primarily in equities and bonds. While returns from other asset classes can and do impact overall investment performance, returns from these two asset classes are the most significant. Equities tend to have the largest allocation in the typical portfolio. Because this is the most volatile asset class, and because equities will usually have higher returns than other asset classes over long time periods, the return on equities is the most significant factor in determining performance of public pension funds.

97. Equities experienced a long period of generally high returns during the 1980s and 1990s and a period of lower and more volatile returns in the 2000's. Returns in the 2000's included two periods of large drops in the equity market – 2000-2002 and 2008-2009. The drop in 2008-2009 was extreme.

98. From October 9, 2007 to March 9, 2009, U.S. equity prices dropped by 57%, as indicated by a drop in the S&P 500 index from 1,565 to 677. There had been no drop in U.S. equity prices this severe since the 1930s.[5]

99. In a survey of 138 large public pension plans, the total market value of assets was shown to drop from $2.9 trillion at the end of fiscal 2007 to $2.1 trillion at the end of fiscal 2009.[6] This is a drop of 28%.

100. In that same survey of large public plans, the average funded status dropped from 95% in 2007 to 70% in 2012.[7]

Illinois' pension assets have been negatively impacted by lower returns in the 2000's and plummeted in 2008-2009. As a result, pension assets today are lower by close to $30 billion.

101. Illinois pension assets were impacted severely by the market collapse in 2008-2009. I examined actual versus expected investment returns for Illinois' pension trusts during the period from 1997 to 2013. Table 6 shows Illinois pension funds starting with a market value of approximately $32 billion in 1997 and, net of contributions and benefit payments, growing with actual investment returns to approximately $67 billion at the end of 2013.

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[5] Historical S&P 500 index values are available from Yahoo Finance.

[6] Compiled by Terry Group from Boston College's Public Plan Database.

[7] Compiled by Terry Group from Boston College's Public Plan Database.

Table 6: Value of Illinois pension assets (TRS, SERS, and SURS) – starting with July 1, 1997 market value and accumulated since July 1, 1997 with actual market returns ($ thousands)

Fiscal Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	Actual End of Year Assets
1998	31,817,482	931,469	818,589	2,171,954	5,428,605	36,824,191
1999	36,824,191	1,190,421	1,238,856	2,365,300	4,098,074	40,986,242
2000	40,986,242	1,312,570	1,006,915	2,610,894	4,761,381	45,456,214
2001	45,456,214	1,434,854	1,038,942	2,903,145	(2,681,258)	42,345,607
2002	42,345,607	1,549,575	1,129,667	3,248,573	(1,921,398)	39,854,878
2003	39,854,878	1,702,630	1,263,529	3,805,775	1,326,272	40,341,534
2004	40,341,534	9,111,599	1,212,287	4,284,247	7,740,043	54,121,216
2005	54,121,216	1,768,397	1,223,024	4,746,389	5,563,318	57,929,566
2006	57,929,566	1,048,348	1,266,043	5,222,736	6,638,621	61,659,842
2007	61,659,842	1,473,473	1,313,372	5,601,492	11,128,732	69,973,927
2008	69,973,927	2,104,466	1,379,504	6,074,617	(3,370,866)	64,012,414
2009	64,012,414	2,830,448	1,391,701	6,478,130	(13,714,296)	48,042,137
2010	48,042,137	4,044,291	1,420,574	6,958,054	6,098,209	52,647,157
2011	52,647,157	4,227,510	1,423,956	7,548,457	11,965,857	62,716,023
2012	62,716,023	4,938,490	1,435,020	8,146,026	239,149	61,182,656
2013	61,182,656	5,793,904	1,414,734	8,852,902	7,757,778	67,296,170
2014	67,296,170					

Source: Terry Group projection based on compilation of data from actuarial valuation reports 1997 – 2013

102. Table 7 is similar to Table 6, in that it represents the accumulation of assets starting with market value in 1997. However, instead of accumulating at the actual market rates of return, the assets accumulate at the expected rates of return. Table 7 shows that, starting with the same $32 billion in 1997 and, also with the same contributions and the same benefit payments, the assets for the Illinois pension systems would have grown to $93 billion (instead of $67 billion) in 2013, if returns had met expectations.

Table 7: Value of Illinois pensions assets (TRS, SERS, and SURS) – starting with July 1, 1997 market value, and accumulated since July 1, 1997 based on expected investment returns ($ thousands)

Fiscal Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	Expected End of Year Assets
1998	31,817,482	931,469	818,589	2,171,954	2,686,555	34,082,141
1999	34,082,141	1,190,421	1,238,856	2,365,300	2,899,701	37,045,819
2000	37,045,819	1,312,570	1,006,915	2,610,894	3,136,510	39,890,920
2001	39,890,920	1,434,854	1,038,942	2,903,145	3,372,481	42,834,052
2002	42,834,052	1,549,575	1,129,667	3,248,573	3,616,698	45,881,419
2003	45,881,419	1,702,630	1,263,529	3,805,775	3,864,237	48,906,040
2004	48,906,040	9,111,599	1,212,287	4,284,247	4,413,698	59,359,377
2005	59,359,377	1,768,397	1,223,024	4,746,389	4,970,961	62,575,370
2006	62,575,370	1,048,348	1,266,043	5,222,736	5,195,302	64,862,327
2007	64,862,327	1,473,473	1,313,372	5,601,492	5,393,675	67,441,355
2008	67,441,355	2,104,466	1,379,504	6,074,617	5,622,413	70,473,121
2009	70,473,121	2,830,448	1,391,701	6,478,130	5,894,336	74,111,476
2010	74,111,476	4,044,291	1,420,574	6,958,054	6,236,015	78,854,302
2011	78,854,302	4,227,510	1,423,956	7,548,457	6,374,907	83,332,218
2012	83,332,218	4,938,490	1,435,020	8,146,026	6,746,936	88,306,638
2013	88,306,638	5,793,904	1,414,734	8,852,902	6,906,301	93,568,675
2014	93,568,675					

Source: Terry Group projection based on compilation of data from actuarial valuation reports 1997 – 2013

103. The difference in Illinois pension assets in 2013 due to lower than expected investment returns since 1997, is dramatic. As Table 8 shows, this difference is about $26 billion. Illinois pension assets were nearly 30% lower in 2013 than the value of assets that would have been expected in 1997 if the funds had earned the expected returns over the full period.

Table 8: Growth in Illinois pension funds (TRS, SERS, and SURS) from 1997 to 2013 assuming actual (market) versus expected investment returns ($ thousands)

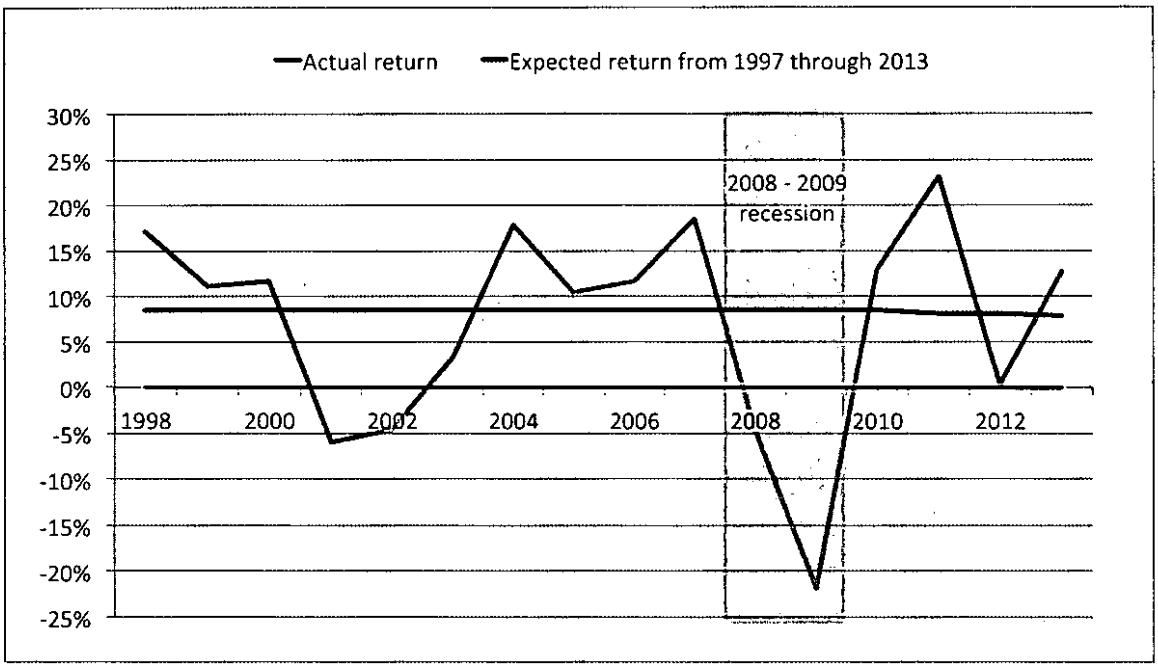
	(1) Reflecting Actual Market Investment Returns	(2) Reflecting Expected Investment Returns	(3) Difference (3) = (1) – (2)
Assets in 1997	$31,817,482	$31,817,482	$0
Assets in 2013	67,296,170	93,568,675	(26,272,505)
Difference: growth since 1997	35,478,688	61,751,193	(26,272,505)

Source: Terry Group projection based on compilation of data from actuarial valuation reports 1997 – 2013

Investment return volatility is normal, but the market collapse of 2008-2009 was not normal.

104. Investment returns are expected to fluctuate from year to year. Indeed, Figure 3 shows that Illinois saw a range of investment return fluctuations from 1997 to 2013. The investment returns in 2008 and 2009 were clearly not normal. They were, in fact, devastatingly poor.

Figure 3: Comparison of actual versus expected rates of return on Illinois pension assets (TRS, SERS and SURS combined), 1997 to 2013



Source: Calculated by the Terry Group using data from annual actuarial valuation reports for TRS, SERS and SURS.

105. The cumulative rate of return for the period 1997 to 2013 was 6.5%, dragged down by the devastating returns of 2008-2009.

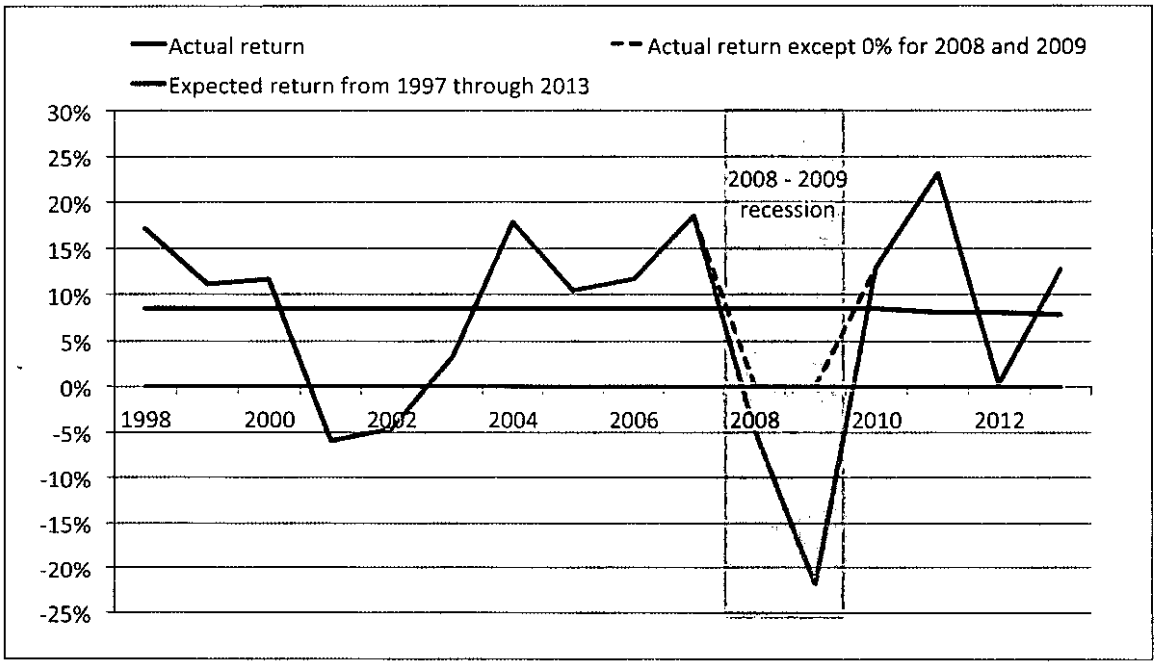
106. If the rates of investment returns for 2008-2009 had been merely poor, rather than abysmal, the cumulative rate of return over the period would have been more in line with expectations: 8.4% for most of that period of time from 1997 to 2013. For example, if we substituted returns of 0% for both 2008 and 2009 (which is itself poor by historical standards), the cumulative return for 1997 to 2013 would have been 8.5%, which is completely in line with expectations.

107. In other words, 0% rates of return for 2008 and 2009 would have been representative of serious investment volatility, but at the same time would have fulfilled normal expectations given the resulting cumulative return of 8.5% over the period 1997 to 2013. However, as severe as two successive years of 0%

would have been, the actual performance in those two years was considerably worse and represented an unprecedented shock to the Illinois pension plans.

108. Figure 4 shows the same information as Figure 3, but indicating, with the dotted line, the returns in 2008-2009 that would have been extremely poor investment years but nowhere near as devastating as the actual experience in those two years.

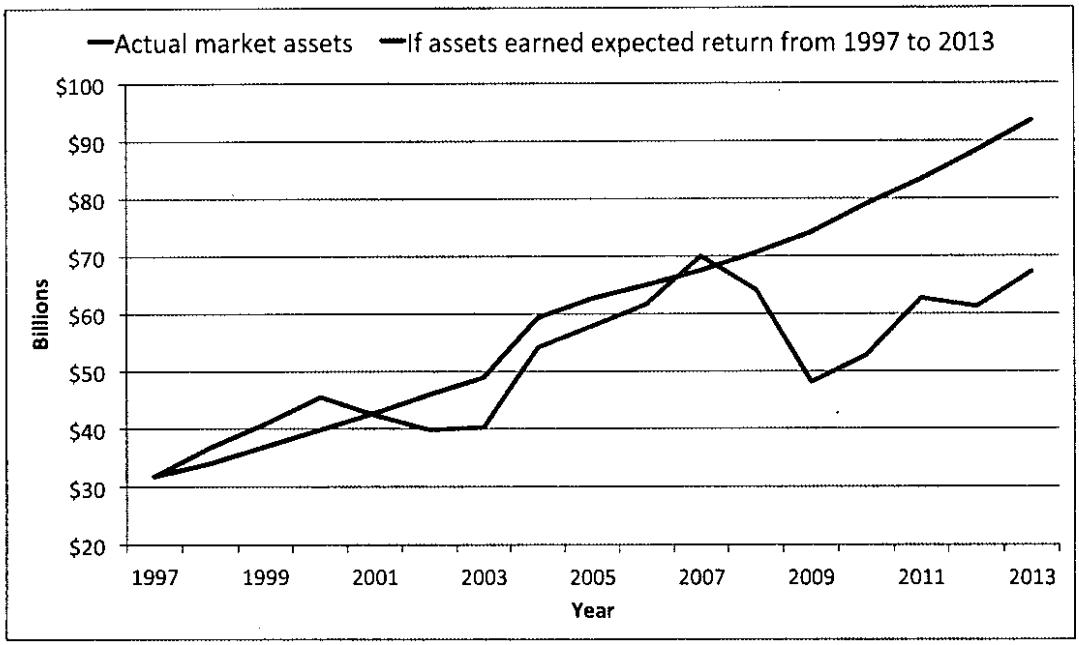
Figure 4: Comparison of actual versus expected rates of return on Illinois pension assets (TRS, SERS and SURS combined), 1997 to 2013, indicating hypothetical "severe" volatility in 2008-2009 as opposed to the devastating returns actually experienced in those years



Source: Calculated by the Terry Group using data from annual actuarial valuation reports for TRS, SERS and SURS.

109. To further compare and contrast the impact of normal returns versus the extraordinarily bad investment returns of 2008-2009, consider Figures 5 and 6. Figure 5 contrasts the growth in assets at actual market rates with the expected growth in assets from 1997 to 2013. It shows a degree of normal volatility from 1997 until 2008 when the market melt-down occurs.

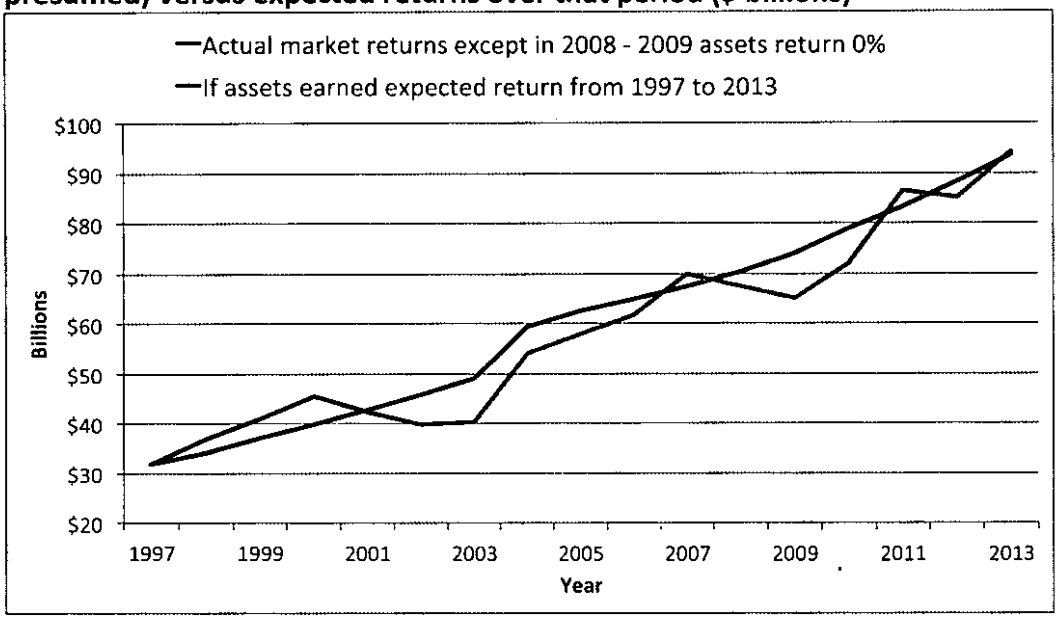
Figure 5: Illinois pension asset values from 1997 to 2013, contrasting the impact of market returns versus expected returns over that period ($ billions)



Source: Calculated by the Terry Group using data from annual actuarial valuation reports for TRS, SERS and SURS.

110. Figure 6 is the same as Figure 5 except that, for the growth of assets as depicted by the market return (blue) line, I used 0% returns for both 2008 and 2009 in place of the actual devastating investment returns of both those years. Back-to-back years of 0% returns are, of course, very poor investment years, but not necessarily out of line with normal fluctuations that can be expected to occur from time to time. Figure 6 shows that if 2008 and 2009 had been "normal" down years as depicted here with 0% returns in each year, then the assets over the period 1997 to 2013 would accumulate to a level similar to the accumulated assets under the hypothetical scenario where assets earn the expected return each year.

Figure 6: Illinois pension asset values from 1997 to 2013, contrasting adjusted market returns (market in all years except 2008-2009 where 0% were presumed) versus expected returns over that period ($ billions)

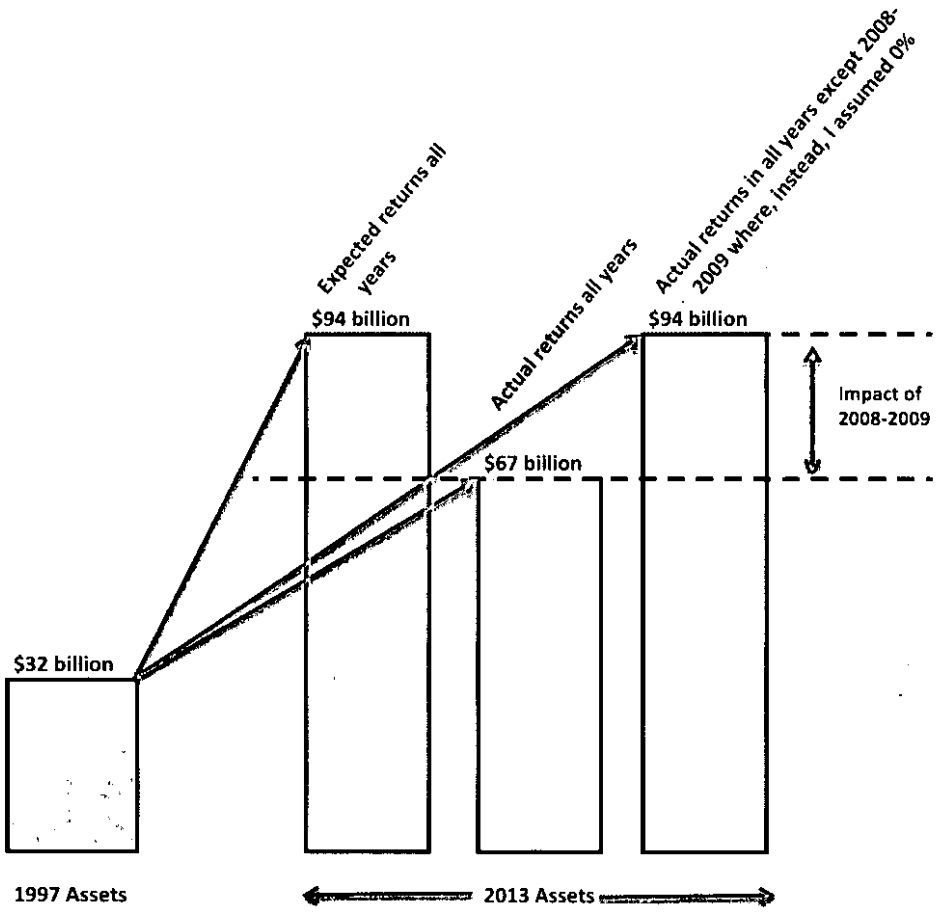


Source: Calculated by the Terry Group using data from annual actuarial valuation reports for TRS, SERS and SURS.

111. To summarize, my examination of these various investment return scenarios reveals that, except for the devastating impact of the investment results of 2008-2009, the Illinois investment performance over the years 1997 to 2013 was largely on target. The normal ups and downs of year-to-year investment performance does not change the fact that, except for the devastating "shock" effect of 2008-2009, the cumulative return was very much in line with expectations. The clear, ruinous outlier years are the years 2008 and 2009.

112. The graph in Figure 7 shows yet another perspective on the devastating impact of 2008-2009 returns. It shows that the assets in 1997 would have been expected to grow to $94 billion, but in fact grew to only $67 billion. The far right bar, however, depicts the fact that the mere substitution of 0% returns for the actual devastating returns of 2008-2009 actually would have resulted in the expected asset level in 2013 of $94 billion.

Figure 7: Growth in Illinois pension assets from 1997 to 2013 (market value)



Source: Source: Terry Group projection based on compilation of data from actuarial valuation reports 1997 – 2013

113. The impact on the 2013 UAAL of actual versus expected investment returns over the period 1997 to 2013 is the difference in assets as of that date between the scenarios depicted in Table 8. This difference is $26 billion. As I indicate in paragraphs 96 to 111 above, this difference is completely explained by the catastrophic market events in 2008-2009.

Pension liabilities are affected by investment return expectations.

114. In paragraphs 49 to 57, I explain how pension liabilities are affected by the investment return assumption which, is based on future investment return expectations. A lower investment return assumption will result in a higher measure of the actuarial accrued liability.

115. Investment return expectations for a public pension plan are directly related to the allocation of plan assets among asset classes (e.g., stocks versus bonds) and

the long-term outlook for each asset class based on current market conditions and long-term market expectations.

The investment return assumption is a long-term assumption established according to actuarial standards of practice.

116. Pensions represent a long-term cash flow stream over a very long period – 75 years or more for a young worker entering the workforce today. The investment return assumption is the interest rate used to discount those future pension benefits, so it is appropriately a very long-term assumption.

117. According to accepted actuarial practice standards, "the investment return assumption reflects anticipated returns on the plan's current and future assets." (Actuarial Standard of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, paragraph 3.6)

118. Actuarial practice standards describe data to be used in setting an investment return assumption:

"3.6.1. Data – The actuary should review appropriate investment data. These data may include the following:

a. current yields to maturity of fixed income securities such as government securities and corporate bonds;
b. forecasts of inflation and of total returns for each asset class;
c. historical investment data, including real risk-free returns, the inflation component of the return, and the real return or risk premium for each asset class; and
d. historical plan performance."[8]

119. Changes in this important assumption are not made often and never taken lightly. Such changes are made only when there is a fundamental shift in the long-term economic outlook that is believed to manifest itself in a commensurate shift in long-term investment return expectations.

The long-term future investment outlook has changed since the economic crisis of 2008-2009.

120. In general, the outlook for long-term future investment returns has been altered dramatically since the economic crisis of 2008-2009.

[8] Actuarial Standard of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, paragraph 3.6.1

121. Interest rates have been in a long and steady decline since the 1980s. Most recently, interest rates have been pushed down further actions of the Federal Reserve in response to the 2008-2009 recession and the slow economic growth and high unemployment that have persisted since then. Because interest rates are so low and are unlikely to drop much further, returns on bond investments are expected to be substantially lower in the future than they have been in the past.

122. Lower future equity return expectations are another result of the environment of low growth, low inflation and low interest rates.

123. The overall change in economic outlook and, more specifically, the lower expectations for future returns for both bonds and stocks, contribute to diminished investment return expectations for pension plans.

Investment return assumptions are dropping.

124. Actuaries and sponsors of public pension plans have responded to these economic conditions and diminished market expectations by re-assessing their public pension plan investment return expectations and generally lowering investment return assumptions.

125. Table 9, summarizes information from a large survey of public pension plans that shows that over half of public pension plans have lowered their investment return assumptions since 2007.

Table 9: A majority of large public pension plans has lowered their investment return assumptions since the 2008-2009 market melt-down

Fiscal Year	No Change to Investment Return Assumption	Number of Plans that Lowered their Investment Return Assumption: Up to 25 bp	26 bp - 50 bp	Over 50 bp	Cumulative Total	Number of Plans that Increased Investment Return Assumption	Cumulative Percentage of Plans that Lowered Investment Return Assumption
2007	144	2	0	4	6	0	4%
2008	136	9	1	0	10	4	7%
2009	129	9	7	0	16	5	11%
2010	113	15	10	9	34	3	23%
2011	86	27	21	13	61	3	41%
2012	72	23	35	17	75	3	50%
2013	63	29	36	19	84	3	56%

Source: Boston College Public Plan Database

126. Another survey of public pension plan assumptions revealed that more than 80% of the respondents used an assumption of 8.0% or higher in 2001. By 2009,

still more than 70% of the respondents used an assumption of 8.0% or higher. However, the updated survey information for 2013 revealed that less than 40% of plans now use an assumption of 8.0% or higher.[9]

Illinois has recently dropped its investment return assumptions.

127. Consistent with national trends, the Illinois' pension systems and their actuaries recently lowered their investment return assumptions. Specifically, SERS and SURS lowered their investment return assumptions from 8.50% to 7.75% in 2010, while TRS lowered its investment return assumption from 8.50% to 8.00% in 2012. These changes are significant. They come on the heels of the 2008-2009 economic crisis and reflect a substantial change in the future economic and investment outlook for each of these plans.

128. In 2013, the State Actuary endorsed these 2010 and 2012 assumption changes by the systems' actuaries and recommended that the assumptions be further reduced by 50 basis points (0.5%) in order to appropriately reflect new future investment return expectations.[10] All three systems recently adopted those recommended changes.

Illinois' actuarial accrued liabilities in 2013 are higher by approximately $17 billion as a result of the recently-adopted reductions to investment return assumptions.

129. The impact on the 2013 actuarial accrued liabilities attributable to the reductions in 2010 and 2012 investment return assumptions is estimated to be $10 billion. This estimate is based on the actuaries' calculations of liability impact from the relevant TRS, SERS and SURS actuarial valuation reports, adjusted forward to the 2013 valuation date. Details of the adjustment methodology are shown in Appendix I.

130. The impact on the 2013 actuarial accrued liabilities attributable to the additional 50 basis points (0.5%) reductions to the investment return assumptions is estimated to be $7 billion. This estimate is based on information reported in the respective 2013 actuarial valuation reports and further adjustments to reflect the assumption change. Details of the adjustment methodology are shown in Appendix J.

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[9] NASRA 2013 Public Funds Survey, NASRA Issue Brief: Public Pension Plan Investment Return Assumptions, Updated April 2014

[10] State Actuary's Report, "The Actuarial Assumptions and Valuations of the Five State-funded Retirement Systems," December 2013

Summary of Investment Return Impact

131. In summary, the economic crisis and financial market melt-down of 2008-2009 were extraordinary, unexpected events. The resulting changes in the economic climate and financial market expectations have impacted both the actual investment returns to date and the expectations for future returns. The combined impact of these unexpected events is $43 billion and is summarized in Table 10:

Table 10: Combined impact on Illinois pension plans of unexpected changes in the economic climate and financial markets

Impact on pension assets of market collapse	$ 26 billion
Impact on liabilities of lower investment return assumptions	10 billion
Anticipated impact on liabilities of anticipated further reductions in investment return assumptions	7 billion
Total	$43 billion

Source: Estimated by the Terry Group based on information provided in systems' annual actuarial valuation reports

5. Contribution increases as a result of the 2008 - 2009 recession

132. In the aftermath of the 2008-2009 recession, the combined impact of lower pension assets and higher actuarial accrued liabilities caused the required State contributions to the pension systems to increase dramatically compared to what was expected before the recession. In 2006, the *projected* state contributions to TRS, SERS, and SURS for 2013 totaled $3.8 billion. The *actual* certified state contributions for 2013 totaled $5.7 billion, an increase of 50%, or almost $2 billion. (see Appendix D for additional details).

133. In the 2006 projection, the 2013 contribution was expected to be 21% of payroll. The actual 2013 contribution is 33% of payroll. If Tier 2 benefits were not introduced in 2010, the actual 2013 certified state contribution would have been even higher.

Table 11: Projected and actual state contributions to TRS, SERS, and SURS

($millions)	Projected in 2006	Projected in 2009	Actual 2013 Contributions
Projected 2013 contributions	$3,770	$4,945	$5,682
Projected 2013 contributions as a percent of payroll	21%	27%	33%

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS and SURS, 2006 - 2013.

6. Longevity

Pension plan member longevity has a significant impact on pension liabilities and costs.

134. Pension benefits are paid out over a retiree's lifetime. It follows, therefore, that pension liabilities and costs are highly dependent on life expectancies as reflected in the underlying actuarial assumption regarding mortality. Simply put, the longer members and retirees live, the more pension benefits they receive, and the greater the size of the pension liabilities and costs

135. The mortality assumption is a typically defined as a table of probabilities of death at each age up to a maximum age, such as 110. Pension actuaries, working with pension plan sponsors, take into account relevant past experience and best estimates for the future in establishing a pension plan's mortality assumption. Reference to standardized, widely published mortality tables is usually helpful in establishing the mortality assumption.

Longevity improvements in recent decades have been significant. These improvements have largely been unanticipated by demographers, actuaries and other experts. Pension plan mortality assumptions have fallen behind the pace of change and so these longevity improvements have resulted in unexpected increases in pension liabilities.

136. Life expectancies have increased consistently over the last couple of centuries. However, at any point in time, there has always been debate and disagreement over whether and for how much longer significant improvements in longevity can continue. The dramatic increase in the rate of improvement in the last couple of decades has surprised actuaries and other experts.

137. The science of predicting longevity improvement has confounded the world's experts for decades. This is often because much longer life expectancies than the world is experiencing at any particular time in history seem implausible, even to experts. Virtually no one predicted the rapid longevity improvements we've seen in recent years. Even the world's top longevity experts have only understood these longevity improvements *after the fact*.

138. This phenomenon has important implications for setting actuarial assumptions for pension liability measurement. It has been the focus of study by several prominent policy and research organizations.

139. According to an economic research report from the International Monetary Fund (IMF),[11] forecasters' estimates of longevity improvement have been understated. Over a 20-year forecast period, average life expectancies in several developed countries were underestimated by an average of three years. Such an underestimate has important implications for pension liability measurement.

140. The IMF research analyzes mortality assumptions used in actuarial valuations of pension plans. They report that pension mortality assumptions in many countries have not captured the full amount of longevity improvement that ultimately materialized. For example, typical pension mortality assumptions used in the U.S. in 1990 anticipated a modest life expectancy increase of only 0.9 years compared to average life expectancies at that time. Yet, for the period between 1990 and 2012, life expectancy actually increased by 2.4 years.

141. A paper published by the Organization for Economic Cooperation and Development (OECD) similarly commented on the unanticipated longevity improvements and their impact on pension obligations.[12] The author also observed that pension plans generally did not fully anticipate or account for the dramatic future improvements in longevity.

142. The Society of Actuaries (SOA) is just completing a multi-year, comprehensive study of mortality experience of uninsured private retirement plan participants in the U.S.[13] An outcome of this study is a new mortality table (RP-2014) with a new mortality improvement projection scale (MP-2014) that is expected to replace existing mortality tables commonly in use today. The study reveals a dramatic improvement in observed longevity during the study period (2004 to 2008) and, when finalized, the resulting mortality table is expected to be widely adopted across the US by pension actuaries and pension plan sponsors.

Recent and expected future longevity improvements result in dramatically longer life expectancies and increases in pension liabilities.

143. Table 12 illustrates the dramatic increase in life expectancy for a 65 year-old male, using an older SERS table to represent life expectancy in 1990, a more common table in use today, and the new RP-2014 table (with improvement defined by MP-2014) that is described in the preceding paragraph.

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[11] John Kiff, Global Financial Stability Report, International Monetary Fund, April 12, chapter 4.

[12] Pablo Antolin, 2007, "Longevity Risk and Private Pensions", OECD Working Papers on Insurance and Private Pensions, No. 3, OECD Publishing.

[13] Exposure Draft on RP-2014 Mortality Tables, Society of Actuaries, February 2014 and Exposure Draft on Mortality Improvement Scale MP-2014, Society of Actuaries, February 2014.

Table 12: Illustrative life expectancy based on different mortality tables

	Mortality table used for SERS in 1990	Common mortality table used today	Mortality table based on 2014 SOA study
Life expectancy for 65 year-old male	81	85	87
Chance of 65-year old male living to age 90	13%	19%	25%

Source: Terry Group calculation

144. The impact of longevity improvement has a significant impact on pension liabilities. Table 13 shows OECD's estimates of the impact on a hypothetical pension plan of unexpected improvement in life expectancy of 1 year per decade. The table below shows that the impact can be as much as 10%.

Table 13: OECD estimates of the impact on pension values of a 1-year per decade improvement in life expectancy.

Table 5 The increase in the net present value of annuity payments[1]
(percentage increase)

Age in 2005					Hypothetical pension fund		
25	40	55	65	70	(1)	(2)	(3)
23.6	15.3	7.3	3.3	2.4	10.4	9.6	8.2

Source: OECD calculations.

Notes: 1. Increase resulting from comparing the net present value at 2005 of annuity payments from 2005 'till 2090 when life expectancy at birth improves by 1.2 years per decade and life expectancy at 65 by 0.8 years per decade, with the NPV at 2005 of annuity payments when the latest available mortality tables (2005) are used without allowing for improvements in mortality.

(1) Membership structure in 2005: 65% aged 25-49; 20% aged 50-59; 10% aged 60-69; and 5% aged 70 or more.

(2) Membership structure in 2005: 60% aged 25-49; 20% aged 50-59; 15% aged 60-69; and 5% aged 70 or more.

(3) Membership structure in 2005: 50% aged 25-49; 20% aged 50-59; 20% aged 60-69; and 10% aged 70 or more.

Source: Pablo Antolin, 2007, "Longevity Risk and Private Pensions", OECD Working Papers on Insurance and Private Pensions, No. 3, OECD Publishing

145. The SOA, in their analysis of the financial impact for the new 2014 mortality table RP-2014 with their new mortality projection scale MP-2014, compares their new table and improvement scale against their old table and improvement scale, RP-2000 and scale AA.[14] For a retirees between ages 55 and 75, the increase in liability from adopting the new mortality assumption is between 3% and 10%, depending on age and gender.

[14] Exposure Draft on RP-2014 Mortality Tables, Society of Actuaries, February 2014 and Exposure Draft on Mortality Improvement Scale MP-2014, Society of Actuaries, February 2014.

Changes in Illinois' mortality assumptions since 1997 have increased the actuarial accrued liability by approximately $4 billion.

146. The Illinois systems' 1997 experience study and comprehensive actuarial assumption review resulted in the adoption of up-to-date mortality assumptions reflecting the known and expected life expectancy circumstances at that time. The assumptions adopted in 1997 are shown in Table 14.

Table 14: Illinois mortality assumptions adopted in 1997, by system

TRS	1995 George B. Buck Mortality Tables for annuitants; and for beneficiaries the 1995 George B. Buck Mortality Tables set forward one year
SERS	1983 Group Annuity Mortality Table, one-year setback for males and no setback for females
SURS	Uninsured Pensions Mortality Table for 1994 (UP94) without adjustment

Source: compiled from relevant actuarial valuation reports

147. Illinois mortality assumptions were changed from time to time since 1997. These changes can be viewed in Appendix C. The most recent changes occurred in 2011 for all three plans. As of 2013, the mortality assumptions for the three systems are shown in Table 15.

Table 15: Illinois mortality assumptions current as of 2013, by system

TRS	RP-2000 White Collar Table projected nine years using scale AA, with two-year age setback for men and no age setback for women. Rates for women are further adjusted for ages 63-77 by 65% and 78-87 by 85%. Future generational rates are projected from 2009 based on scale AA
SERS	RP2000 Combined Healthy mortality table, sex distinct, with rates projected to 2015 with scale AA
SURS	RP2000 Combined Mortality table, projected with scale AA to 2017, sex distinct, with rates multiplied by 0.80 for males and 0.85 for females

Source: compiled from relevant actuarial valuation reports

148. The impact on the 2013 actuarial accrued liabilities attributable to the changes in mortality assumptions since 1997 is estimated to be $4 billion. This estimate is based on the actuaries' calculations of liability impact from the relevant TRS, SERS and SURS actuarial valuation reports, adjusted forward to the 2013 valuation date. Details of the adjustment methodology are shown in Appendix K.

Further updating of Illinois' mortality assumptions to reflect the new 2014 Society of Actuaries' mortality table would increase the actuarial accrued liability by $5 billion.

149. The 2014 Society of Actuaries study, as previously described, included a comprehensive review of recent pensioner mortality experience as well as a careful examination of mortality improvement trends. The resulting revised standard mortality table and its accompanying longevity improvement scale, when finalized, is expected to be widely adopted across the US. This new table incorporates dramatic improvements in observed mortality as well as a stronger provision for longevity improvement in the future.

150. The impact on the 2013 actuarial accrued liabilities attributable to the anticipated strengthening of the mortality to reflect fully up-to-date mortality tables and current thinking about future mortality improvement, is estimated to be $5 billion. This estimate is based on information reported in the respective 2013 actuarial valuation reports and further adjustments to reflect the assumption change. Details of the adjustment methodology are shown in Appendix K.

Summary of Longevity Improvement Impact

151. In summary, the dramatic longevity improvements in the last couple of decades has been an unexpected surprise to actuaries and other experts. The corresponding recognition of such improvements in the mortality assumptions since 1997 and as well as the anticipated future improvements increase the actuarial accrued liabilities of the Illinois pension systems by a total of $9 billion.

Table 16: Combined impact on Illinois pension plans of unexpected changes in recent and expected future longevity improvements

Impact on liabilities of strengthened mortality assumptions between 1997 and 2013	$ 4 billion
Anticipated impact on liabilities of anticipated further strengthening of mortality assumptions	5 billion
Total	$9 billion

Source: Estimated by the Terry Group based on information provided in systems' annual actuarial valuation reports

7. Other Demographic Factors

Demographic factors other than mortality also have a significant impact on pension liabilities and costs.

152. The determination of pension liabilities and costs is dependent on a number of assumptions other than the investment return and mortality assumptions. The

mortality assumption is one of several demographic assumptions essential to the actuarial valuation, and implications of that assumption were discussed in the previous section of this report.

153. Other demographic assumptions relevant to the actuarial valuation include these:

- the retirement assumption, which indicates the ages at which plan members are expected to retire;
- the pay increase assumption, which indicates the assumed rates of pay increase for plan members (this is also often described as an economic assumption);
- the amount of unused sick leave service at retirement; and
- assumed amount of service credits purchased by members.

154. The annual actuarial valuation captures the impact on plan liabilities of deviations between actual demographic experience versus the experience anticipated by the actuarial assumption. Actuarial losses occur when liabilities increases faster than expected due to actual experience less favorable than expected. Similarly, actuarial gains occur when liabilities increase slower than expected due to actual experience more favorable than expected.

155. Typically, every three to five years an in-depth experience study is conducted. When an experience study (or other information related to future events) reveals a trend that is likely to continue, an assumption change is made. For this reason, assumption changes may be considered unexpected while actuarial gains or losses that occur independent of an assumption change are likely considered expected deviations from the assumed experience anticipated by properly developed actuarial assumptions.

156. For these demographic factors, all of the assumption changes that I have considered have already been made and are included in the accrued actuarial liability calculations prepared by the system actuaries as of June 30, 2013.

Changes to Illinois' demographic assumptions (other than mortality) since 1997 have increased the actuarial accrued liability by approximately $3 billion.

157. Changes in demographic assumptions are made relatively infrequently in Illinois, as the Table 17 below indicates. In particular, Table 17 shows year-by-year impacts on actuarial accrued liability of annual actuarial gains and losses due to all demographic sources (including mortality), as well as due to changes in demographic assumptions. Since, 1997, demographic losses totaling $10.8 billion were observed and demographic assumption changes totaling $4.2 billion were made.

Table 17: Tabulation of liability increases (decreases) for Illinois' pension plans due to actuarial gains or losses or due to the impact of actuarial assumption changes due to demographic assumptions ($ millions)

Year	Actuarial Accrued Liability Increases (Decreases)	
	Annual Demographic (Gains)/Losses	Actuarial Assumption Changes
1997	$271.9	-
1998	106.3	-
1999	1,074.6	-
2000	613.9	-
2001	1,261.4	-
2002	1,159.5	$307.3
2003	1,238.6	-
2004	537.4	-
2005	1,338.1	26.4
2006	(169.2)	711.0
2007	1,440.8	2,735.2
2008	115.1	-
2009	897.9	-
2010	527.9	-
2011	222.1	529.9
2012	(82.6)	-
2013	261.4	(157.0)
Total 1997 - 2013	10,815.1	4,152.8

Source: Compiled from TRS, SERS, SURS actuarial valuation reports.

158. The demographic losses of $10.8 billion, while significant, are not necessarily unexpected.

159. Similarly, the $4.2 billion of liability impact of actuarial assumptions changes is also not necessarily unexpected. The previous section of this report identifies a portion of the assumption change impact that was clearly unexpected – that which is attributable to strengthening of mortality assumptions. However, it is likely that some of the other demographic assumption changes are appropriately categorized as *not* unexpected. A further in-depth analysis of Illinois' demographic assumption changes, and an understanding of the circumstances that led to those changes, would shed light on this question. This analysis has not been done.

160. While the sum of the liability impact of the demographic assumption changes from 1997 to 2013 is $4.2 billion, the impact of these changes on the 2013 actuarial accrued liability is estimated to be $7 billion. Subtracting out the estimated impact of the strengthened mortality assumptions, $4 billion (as described in the preceding section of this report), leaves $3 billion. This $3 billion, then, is the estimated portion of the 2013 actuarial accrued liability that is attributable to non-mortality demographic assumption changes.

8. Inflation and Purchasing Power

The compound 3% Automatic Annual Increase (AAI) provided retirees with a degree of purchasing-power protection against inflation.

161. The Automatic Annual Increase (AAI) provides Illinois retirees with annual pension increases after retirement. Beginning in 1990, the annual increases to Illinois retirees' pensions have been 3% per year, compounded.

162. In general, post-retirement pension increases protect retirees against the loss of purchasing power due to inflation. Pension increases are often tied to rates of actual or expected inflation. For example, the U.S. Social Security system annually increases Social Security benefits according to increases in the Consumer Price Index, which has long been regarded as a credible indicator of price inflation.

The 1989 perspective on inflation and the need for and amount of purchasing power protection

163. In the decade leading up to 1989, consumer purchasing power was eroding at the annual compounded rate of 5.5%, according to the Consumer Price Index for All Urban Consumers (CPI-U).[15] The CPI-U rose at the rate of 5.0% in 1989.

164. The Illinois systems' actuaries were using annual inflation assumptions of between 4% and 4.5% in 1990.[16]

165. The 1989 Act fixed the AAI at 3% per year compounded. This rate of pension increase provided protection against a portion of the loss of purchasing power at that time. 3% was lower than actual inflation as well as future inflation expectations at the time of the 1989 Act.

[15] Bureau of Labor Statistics

[16] Illinois pension systems' actuarial valuation reports

Inflation has declined significantly since 1989.

166. In the years since 1989, inflation has fallen significantly. Table 18 compares rates of inflation (observed and expected) for the periods before the 1989 Act to the periods following the Act. The contrast is stark: annual inflation for the period 1980 to 1989 averaged 5.5%, while the average annual rate of inflation from 1989 to 2013 was 2.7%, less than half the earlier rate.

167. Table 18 also shows that, from the perspective of 1989/1990, the 3% AAI provided protection against a *portion* of purchasing power erosion based on both observed inflation prior to 1989/1990 as well as inflation expectations as documented in the 1990 actuarial reports. Yet, it has turned out that the AAI has actually provided for pension increases in excess of inflation since 1989/1990.

Table 18: Comparisons of fixed AAI rate to various observed and expected inflation rates

Period of years	Rate of inflation	Basis for inflation	Fixed AAI rate according to 1989 Act	Difference between inflation rate and the fixed AAI rate
1980 to 1989	5.5%	CPI-U for period	3.0%	(2.5%)
1989 only	5.0%	CPI-U for 1989	3.0%	(2.0%)
1989 only	4.5%	1989 SURS and SERS CAFRs[17] reflecting expectations	3.0%	(1.5%)
1989 only	4.0%	1989 TRS CAFR[18] reflecting expectations	3.0%	(1.0%)
1989 to 2013	2.7%	CPI-U for period	3.0%	0.3%
1997 to 2013	2.4%	CPI-U for period	3.0%	0.6%

Source: CPI-U data from the Bureau of Labor Statistics. Inflation expectations in 1989 are drawn from actuarial assumptions for TRS, SERS and SURS as disclosed in CAFRs. See footnotes for further information on these assumptions.

Current expectations for future inflation are that it will remain low.

[17] 4.5% inflation assumption reported in 1989 SURS and SERS CAFRs. The context is the future salary increase assumption of 7.0%, which is broken down as 4.5% for inflation and 2.5% for seniority and merit. The 1989 SERS CAFR reports a future salary increase assumption of 6.5%, which is identical to the salary increase assumption described in the 1985 SERS actuarial report in which the 6.5% salary increase assumption was described as including a 4.5% assumption for future inflation.

[18] 4.0% inflation assumption reported in 1989 TRS CAFR. The context is future salary increase assumption of 7.0%, which is broken down as 4.0% for inflation and 3.0% for merit adjustments.

168. The latest Survey of Professional Forecasters, a survey of 42 forecasters by the Federal Reserve Bank of Philadelphia, shows that the median inflation expectation is 1.9% in 2014, 2.0% in 2015, 2.1% in 2016, and 2.25% for the 10-year period from 2014 to 2023.[19]

169. Economic projections prepared by staff economists for the Federal Open Market Committee (FOMC) for their March 2014 meeting show that Personal Consumption Expenditure (PCE) inflation, a preferred measure used by FOMC, is expected to be 1.4% to 1.6% in 2014, 1.5% to 2.0% in 2015, 1.7% to 2.0% in 2016, and 2.0% in the longer run.[20]

170. The Social Security trustees in their intermediate long range projection expect the CPI to be 1.61% in 2014, 1.95% in 2015, 2.18% in 2016, and gradually rise to 2.70% in 2020 and thereafter.[21]

171. The 30-year breakeven inflation rate as of July 1, 2014 is 2.35%.[22] The breakeven inflation rate is equal to the difference in yield on 30-year Treasury securities and 30-year Treasury Inflation-Indexed securities. It is an estimate of the inflation rate for the next 30 years expected by market participants. The 10-year breakeven inflation rate as of July 1, 2014 is 2.26%.

172. From the expert inflation forecasts above, we conclude that a reasonable consensus estimate of long-term future inflation is 2.5%.

The 3% AAI has provided and is expected to continue to provide annual compounded pension increases at rates in excess of actual inflation as well as in excess of the expected purchasing power protection provided by the 1989 Act.

173. During the period July 1997 to July 2013, inflation averaged 2.4% per year. This is much lower than the level of inflation of 5.5% experienced during the 1980s, and also dramatically lower than the future inflation expectation of 4.0% to 4.5% in 1989. [23]

174. As Table 18 shows, the 1989 Act established the 3% AAI at a time when future inflation expectations were in the 4.0% to 4.5% range. The expected purchasing

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[19] Survey of Professional Forecasters, Federal Reserve Bank of Philadelphia, May 16, 2014

[20] Economic Projections of the Federal Reserve Board Members and Federal Reserve Bank Presidents, March 2014, released with the FOMC minutes

[21] The 2014 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds

[22] 30-year and 10-year breakeven inflation rates are available from the Federal Reserve Bank of St. Louis. (available at http://research.stlouisfed.org/fred2/release?rid=304)

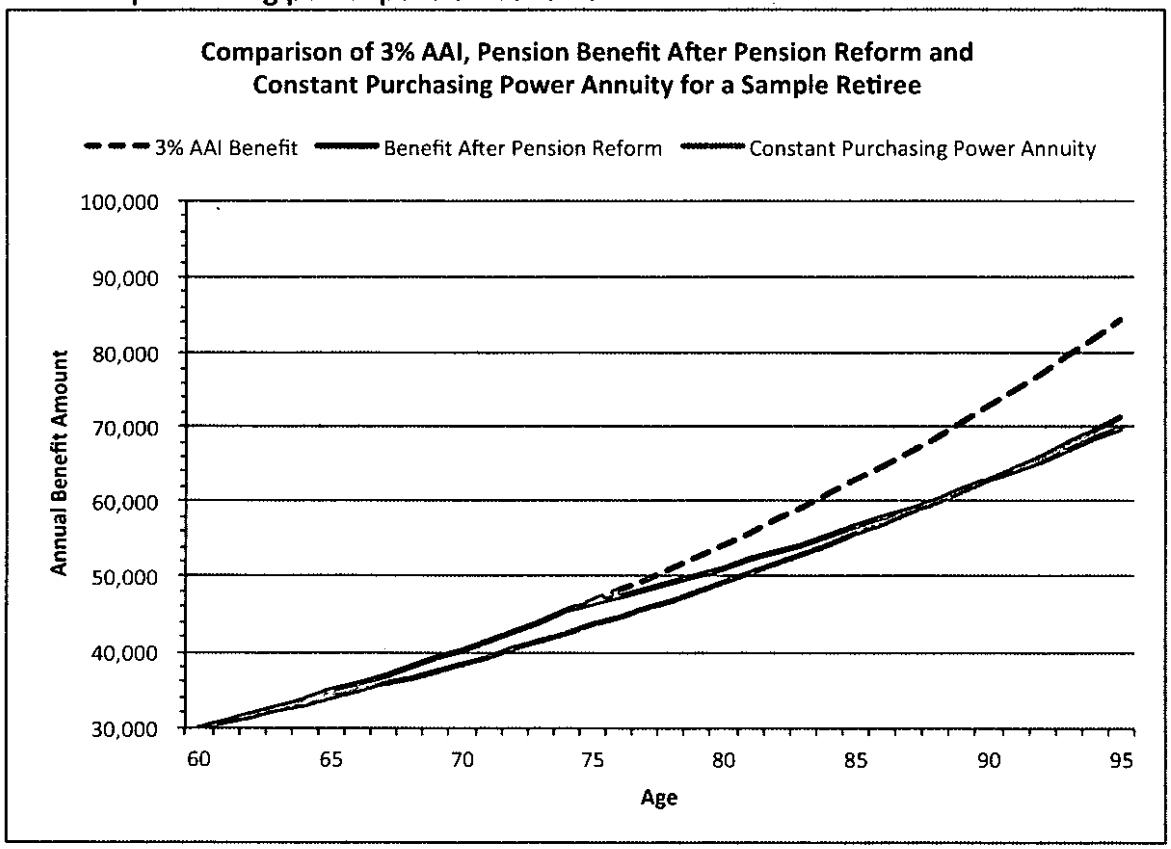
[23] Inflation figures are all drawn from Table 18.

power protection provided in the 1989 Act was inflation minus 1.0% or 1.5%. For purposes of illustrations in this report, the purchasing power protection of inflation minus 1.0% is used.

175. For the period 1997 to 2013, the primary period of analysis for this report, the COLA level that reflects the level of expected purchasing power protection provided in the 1989 Act is 2.4% minus 1.0%, or 1.4%. For purposes of illustrations generated in analysis later in this report, 1.5% will be used.

176. Figure 8 shows the pension benefit amount for an illustrative Illinois retiree under the AAI. Figure 8 also shows the level of pension that would be required to preserve full purchasing power given current inflation expectations of 2.5%. Figure 8 shows that pensions increasing at the AAI's 3% compounded rate have resulted in unexpected increase in purchasing power.

Figure 8: Comparison of 3% AAI, pension benefits after pension reform and constant purchasing power pension benefits



Source: Terry Group

The financial impact of providing the 3% compounded AAI versus providing an annual increase that maintains full or partial purchasing power protection can be quantified.

177. The level of purchasing power protection provided by the 3% AAI is much higher than the purchasing power protection that would have resulted if inflation continued at the levels experienced just prior to 1990..

178. Quantifying the impact of providing the higher level of benefit increase involves identifying the **impact on both today's plan assets and liabilities from pensions already paid** in excess of anticipated pension levels, and the **impact on liabilities of future pensions** to be paid in excess of anticipated pension levels.

179. To understand the magnitude of the unexpected inflation protection provided by the compounded 3% AAI, I compared it to annual increases in line with actual inflation.

180. As already described above, based on the inflation environment and expectations in 1990, the level of expected purchasing power protection provided by the 3% AAI in 1990 would have been approximately 100 basis points (1 percentage point) below actual inflation. As indicated above, this rate is 1.5%.

Pension assets for the Illinois systems would be approximately $9 billion higher if 1.5% annual increases (inflation minus 1%) had been granted instead of the 3% AAI.

181. To calculate the difference in *assets*, I estimated an adjusted level of total annuity payments each year based on 1.5% annual increases rather than the 3% AAI. The difference in annuity payments is accumulated with actual trust return to June 30, 2013 in the table below. With 1.5% increases, the assets would have been about $5 billion higher for TRS and $2 billion higher each for SERS and SURS, for a total of $9 billion.

Table 19: Cumulative impact on plan asset of 3% AAI instead of 1.5% (inflation minus 1%); total of TRS, SURS and SERS ($ millions)

Year	Annuity Payments based on 3% AAI	Annuity Payments based on 1.5% COLA	Difference in Annuity Payments	Accumulated Difference in Annuity Payments (with actual investment return[24])
1997	1,951.16	1,951.16	-	-
1998	2,091.49	2,062.84	28.65	31.07
1999	2,293.31	2,234.25	59.06	96.79
2000	2,544.32	2,452.25	92.07	205.18
2001	2,874.13	2,745.90	128.23	317.88
2002	3,311.01	3,142.29	168.72	468.69
2003	3,991.92	3,776.88	215.03	704.00
2004	4,378.69	4,108.20	270.49	1,112.70

[24] Actual investment returns each year are shown in Appendix N. Since they are somewhat different from plan to plan, they are not shown here.

2005	4,868.22	4,537.33	330.89	1,576.84
2006	5,225.06	4,819.34	405.72	2,190.59
2007	5,695.55	5,219.41	476.14	3,113.13
2008	6,072.97	5,520.94	552.03	3,496.76
2009	6,516.05	5,884.16	631.88	3,303.74
2010	7,006.09	6,289.51	716.58	4,485.44
2011	7,550.52	6,743.87	806.65	6,417.16
2012	8,239.94	7,337.03	902.92	7,352.78
2013	8,545.47	7,537.84	1,007.63	9,368.49

Source: Terry Group estimate based on TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

Illinois pension liabilities would be approximately $12 billion lower if 1.5% annual increases (inflation minus 1%) had been granted from 1997 to 2013 instead of the 3% AAI.

182. If there had been 1.5% annual increases instead of the 3.0% AAI from 1997 to 2013, then annual benefit payments as of June 30, 2013 would be lower by about $1 billion (as shown in Table 19) and the *actuarial liability* would therefore be lower. The difference in AAL would be approximately a $12 billion reduction as of June 30, 2013.

Illinois pension liabilities would be an additional $15 billion lower if *future* annual increases were 1.5% (inflation minus 1%) rather than the 3% AAI.

183. The impact on the 2013 actuarial accrued liabilities attributable to providing 1.5% annual increases in the future instead of 3% is estimated to be a reduction of $15 billion. This estimate is based on the actuaries' calculations of liabilities from the relevant TRS, SERS and SURS actuarial valuation reports, adjusted for relevant interest and COLA differentials. Details of the adjustment methodology are shown in Appendix O.

Summary of Inflation and Purchasing Power

184. In summary, the unanticipated purchasing power has had a significant impact on Illinois' pension plans. The impact since 1997 and going forward, as reflected in terms of 2013 asset and liabilities is $36 billion, as shown in Table 20.

Table 20: Combined impact on Illinois pension plans of unanticipated purchasing power protection

Impact on 2013 assets of unanticipated purchasing power protection from 1997 to 2013	$9 billion
Impact on 2013 liabilities of unanticipated purchasing power protection from 1997 to 2013	$12 billion
Impact on 2013 liabilities of unanticipated purchasing	$15 billion

power in the future	
Total	$36 billion

Source: Estimated by the Terry Group based on information provided in systems' actuarial valuation reports

9. Total impact of significant unexpected developments

185. The table below summarizes the impact of significant unexpected developments on the unfunded accrued actuarial liability (based on a market value of assets) as of June 30, 2013.

Table 21: Unexpected and Unanticipated Effects on UAAL ($ billions)

Impact on 2013 Assets and Liabilities		Impact of Future but Known Changes on 2013 Liabilities	
Impact of market collapse (assets)	$26	Impact of anticipated reduction in future investment returns (liabilities)	$ 7
Impact of lower investment return assumptions (liabilities)	10	Impact of anticipated further strengthening of mortality assumptions (liabilities)	5
Impact of strengthened mortality assumptions (liabilities)	4		
Total	**$40**	**Total**	**$12**

Table 22: Unanticipated Purchasing Power Protection ($ billions)

Present Value of Unanticipated Inflation Protection	
Impact on 2013 assets of unanticipated purchasing power protection from 1997 to 2013	$ 9
Impact on 2013 liabilities of unanticipated purchasing power protection from 1997 to 2013	12
Impact on 2013 liabilities of unanticipated purchasing power protection in the future	15
Total	**$36**

10. Illinois Pension Reform: Impact of benefit reductions on actuarial accrued liability

186. In assessing the impact of PA 98-599 on the actuarial accrued liability, I have reviewed the analysis by the Commission on Government Forecasting and Accountability (COGFA),[25] the analysis of PA 98-599 performed by the Segal Company,[26] the State Actuary's Report on the actuarial assumptions and valuations of the five state-funded retirement systems,[27] and the actuarial valuation reports of TRS, SERS, and SURS. I have reviewed the results, assumptions and methods for consistency and reasonableness, but have not tried to replication the results by performing independent actuarial valuations and projections.

187. I find the results prepared by the systems' actuaries and COGFA to be consistent and comparable. Except as noted in the State Actuary's Report, the assumptions and methods used in the calculation of actuarial accrued liability appear to be appropriate for the purpose of assessing the impact of PA 98-599 on the retirement system's actuarial accrued liability. Therefore, using these sources, the impact of PA 98-599 is a reduction of $23 billion in the retirement systems' actuarial accrued liability, measured as of July 1, 2013 using the Projected Unit Credit (PUC) cost method.

188. This amount takes into account the change in AAI provisions for current and future retirees, the salary cap for Tier 1 members, the increase in retirement age for Tier 1 members, and the change in Effective Interest Rate for SURS and the rate of regular interest for TRS.

189. Additionally, PA 98-599 calls for a 1% reduction in employee contributions effective July 1, 2014. I estimate the present value of the reduction in employee contributions to be $3 billion. This amount takes into account the effect of the salary cap and the changes to retirement eligibility ages on employee contributions.

190. The assumptions and methods documented in 2013 actuarial valuation reports are used to calculate the impact of PA 98-599, except the SERS and SURS system actuaries adjusted the retirement rate assumption based on the new retirement eligibility rules. They increased the assumed retirement rate at the time that employees first become eligible to retire because employees will need to wait longer to be retirement eligible under the new eligibility rules. This is a reasonable adjustment to the anticipated retirement behavior.

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[25] Report on the Financial Condition of the State Retirement Systems FY 2013, March 2014

[26] "Baseline Projections Using July 1, 2013 Actuarial Valuations and Cost Projections Under PA 98-599", Segal Company, March 21, 2014

[27] "The Actuarial Assumptions and Valuations of the Five State-Funded Retirement Systems ", State Actuary Report, December 2013

191. Two other factors might influence the liability impact of PA 98--599. Both factors tend to reduce the liability impact of PA 98--599.

192. First, the actuaries did not appear to take into account the effect of a potential "benefit rush" - the effect of employees accelerating retirements to lock in more favorable annual automatic increases. The effect of "benefit rush" is to increase the liability post pension reform, and reduces the liability impact of PA 98-599. That is, the financial savings from PA 98-599 may be slightly lower due to accelerated retirements.

193. Second, historically the Effective Interest Rate for SURS is set at a level between 7% and 8%, close to the expected return on assets. This interest rate is used to credit employee contribution accounts and convert the employee contribution money purchase accounts into annuity amounts for eligible employees,[28] irrespective of actual asset performance. Retiree benefits are based on these alternative annuity amounts if they are higher than the benefits calculated with the standard formula. When higher interest rates are credited to these accounts and used to convert the accounts to annuity amounts, higher annuity amounts are the result.

194. The pension reform sets these interest rates at the 30-year Treasury rate plus 75 basis points (0.75 percentage points), which will reduce the amounts provided by the money purchase accounts. My understanding is that prior to the pension reform, these interest rates were not fixed by statute and the comptroller always had the ability to set these interest rates at a lower level. Thus the true impact of this change might be deemed to be less than has been calculated.

195. Thus the net impact of PA 98-599 is $20 billion: $23 billion reduction in actuarial accrued liability less $3 billion reduction in the present value of employee contributions. The impact might be somewhat lower as described above, but $20 billion is a reasonable representation of the impact of the legislation on AAL due to changes in the benefit provisions for the TRS, SURS and SERS.

[28] Employees hired prior to 7/1/2005 are eligible for this benefit.

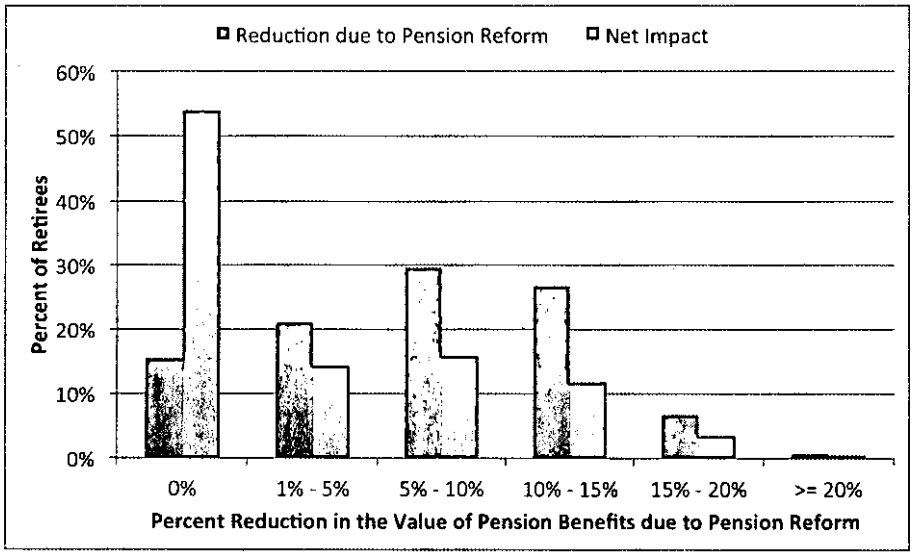
11. Illinois Pension Reform: Impact on Employee and Retiree Cohorts

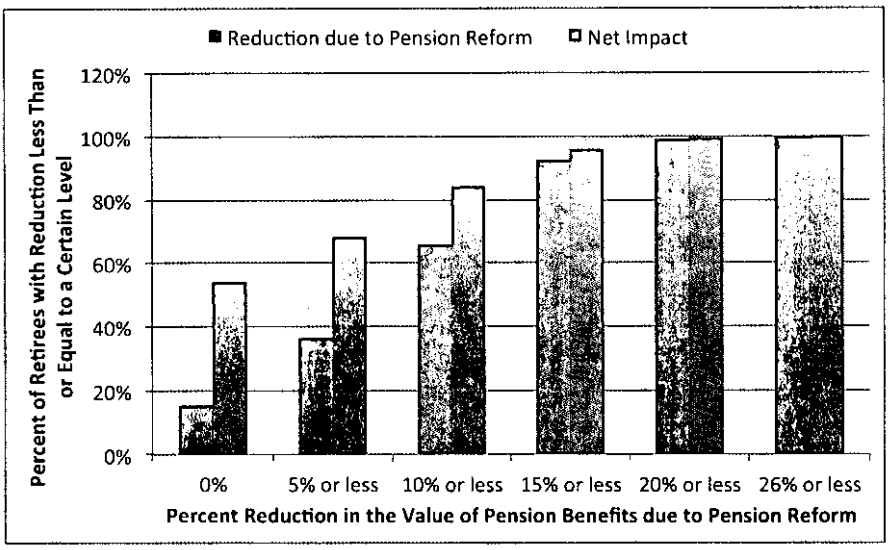
Retiree analysis

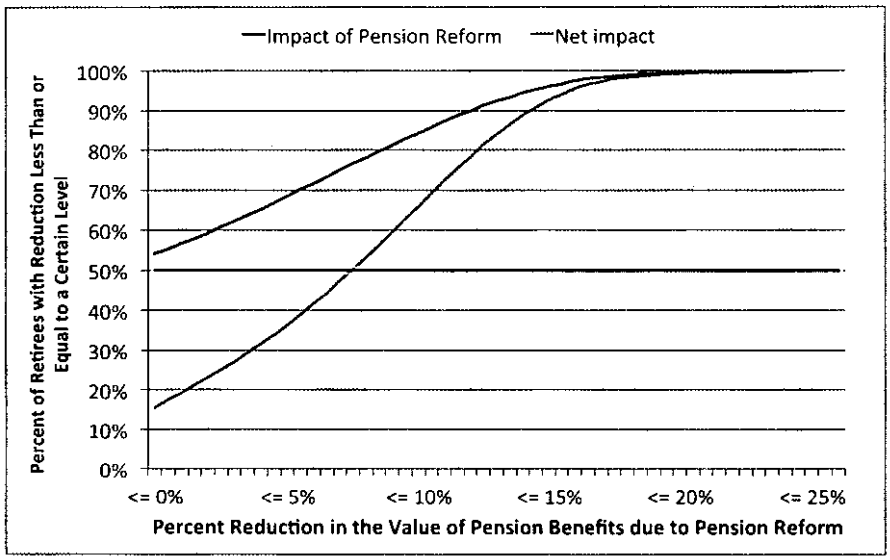
196. I have analyzed the impact of PA 98-599 on retiree pension benefits. To compare the relative value of benefits before and after pension reform, I calculated the actuarial present value of pension benefits, taking into account future benefit increases and life expectancy. The discount rate and mortality assumptions are the same as those used in the 2013 actuarial valuations of the respective retirement systems, consistent with the other analysis presented in this report.

197. For the majority of retirees, the value of their future pension benefits is reduced by 8% or less. If we offset this impact of pension reform by the excess value of the 3% AAI over the anticipated level of purchasing power protection provided in the 1989 Act since 1997 (1.5%, which is currently projected inflation minus 1%), then we establish a "net impact." This net impact is 0% for a majority of retirees. Figure 9 provides detail on the distribution of value reductions, including the "net impact."

Figure 9: Reduction in the value of pension benefits due to pension reform: current retirees



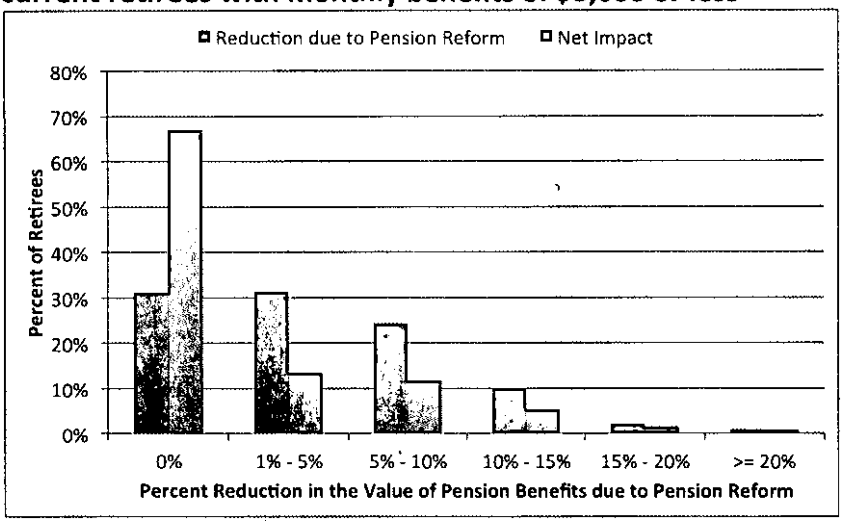


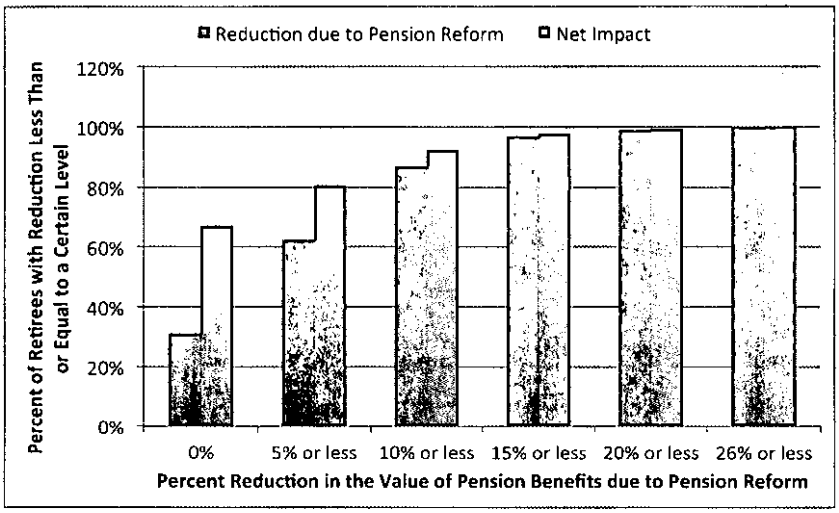


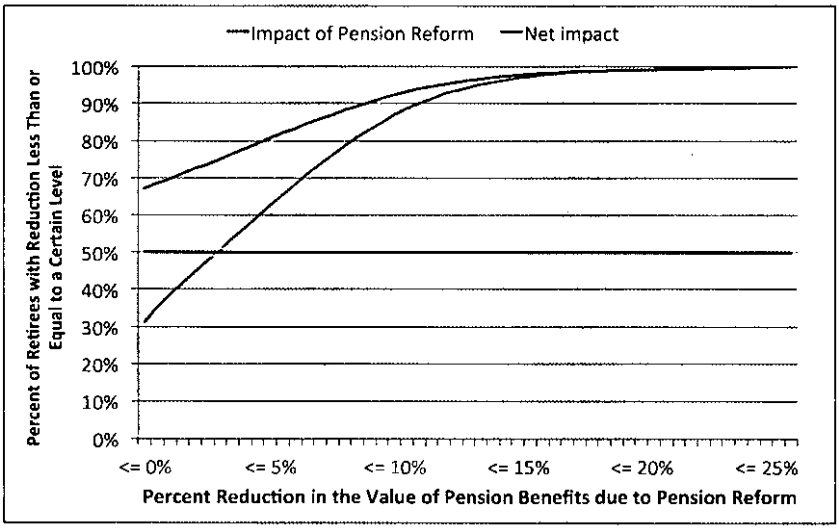
Source: Terry Group analysis based on census of retirees provided by the retirement systems.

198. The pension reform included a reduction in future AAI. This reduction has less impact for retirees with lower benefits. For the majority of retirees with monthly benefits of $3,000 or less, the value of their future pension benefits is reduced by 3% or less. The net impact, after adjusting for expected purchasing power protection, is 0% for the majority of these retirees. Figure 10 provides detail on the distribution of value reductions for these retirees, including the "net impact."

Figure 10: Reduction in the value of pension benefits due to pension reform: current retirees with monthly benefits of $3,000 or less





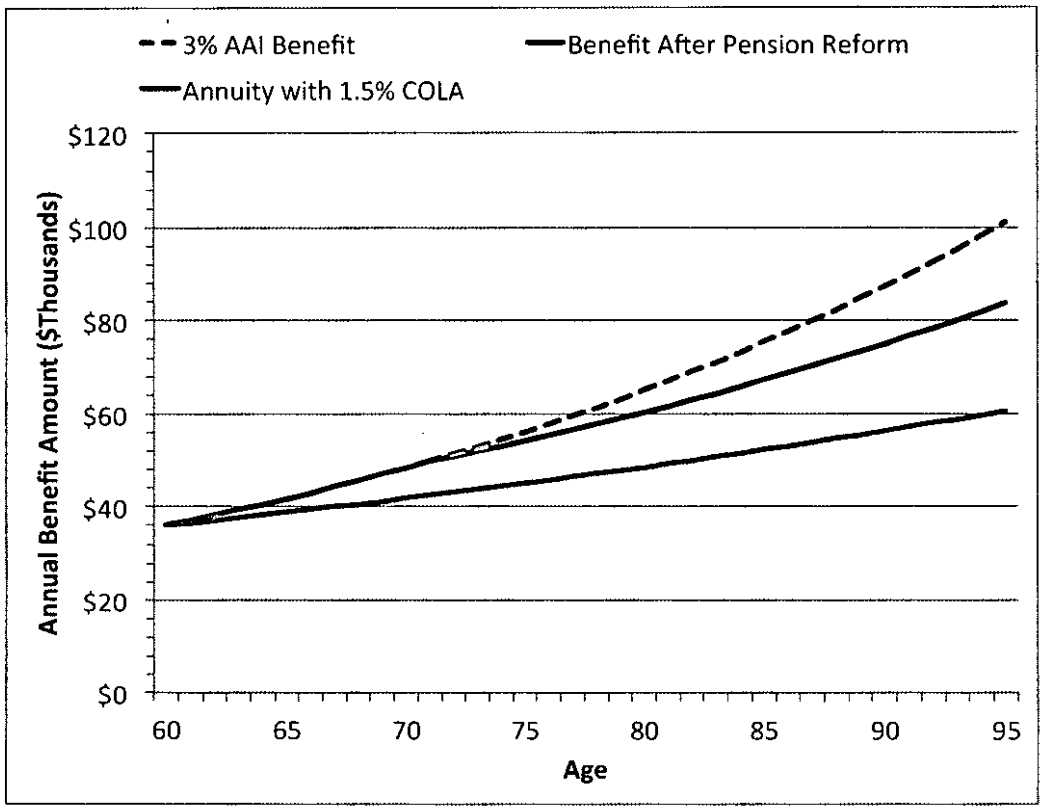


Source: Terry Group analysis based on census of retirees provided by the retirement systems

199. Figure 11 shows the comparison of the growth of an illustrative pension benefit under three different post-retirement increase rates:

- 3% AAI
- AAI after pension reform
- 1.5% (inflation minus 1%)

Figure 11: Illustrative pension benefit growth under three different growth rates[29]



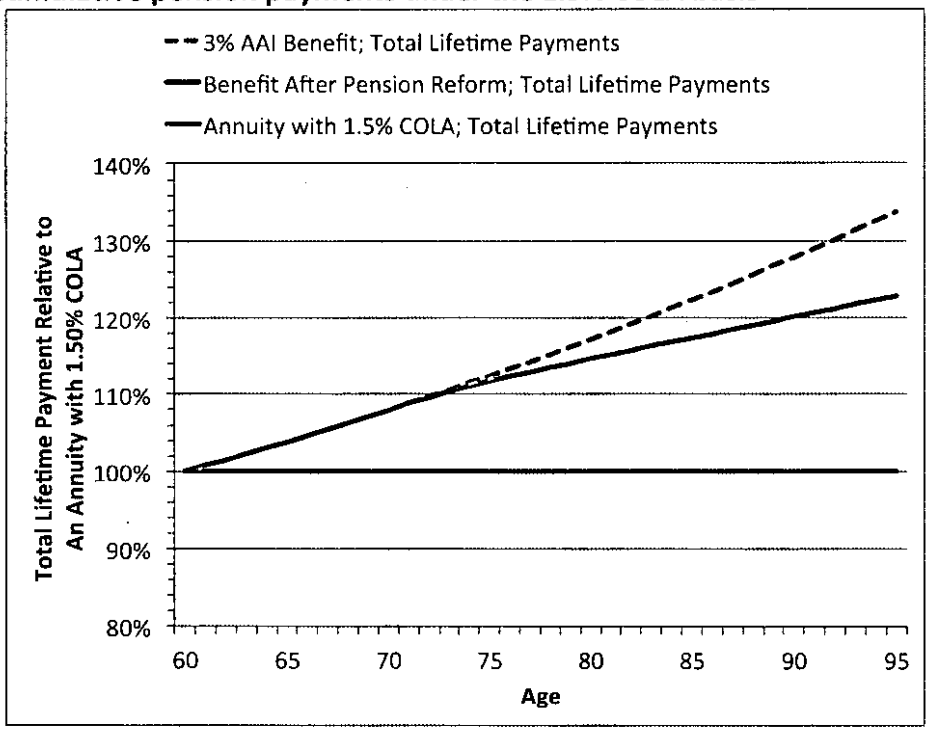
Source: Terry Group illustration

200. Figure 12 offers the same comparison as in Figure 11 but on the basis of cumulative pension payments. Cumulative pension payments are the sum of annual pension benefits received through a particular age. This chart shows the relative value of the total lifetime payments that have accumulated through the

[29] This is an illustrative retiree assumed to retire in 2003 at age 60 with a $36,000 annual pension, based on 35 years of service and not covered by Social Security. For the pension reform increase scenario, the pension increases at 3% until 2014 and then by $1,050 per year (indexed by inflation) after 2014.

indicated ages, under the three different increase rates. A pension increasing annually at 1.5% compounded is used as the benchmark.[30] As a reminder, 1.5% is the expected purchasing power protection provided in the 1989 Act. For example, the value of the 3% AAI benefit line is approximately 110% at age 73. This means that through age 73, the total payments received from a 3% AAI is 10% higher than the total payments received from a 1.5% cost of living increase.

Figure 12: Cumulative pension payments expressed as a percentage of the cumulative pension payments under the 1.5% COLA basis[31]



Source: Terry Group illustration

201. Both figures show that for an average retiree, the pension benefit after the pension reform is still well above the life annuity with a 1.5% cost of living increase. This is true for over 90% of the retirees. Appendix Q provides more examples of retirees with different benefit amounts, service, and retirement ages.

202. In order to compare the value of the pension benefit after the pension reform with the value of an annuity with cost-of-living increases of inflation minus 1%, I calculated the actuarial present value of the pensions, adjusted for the excess value of a 3% AAI over a cost-of living increase of inflation minus 1% (or 1.5%)

[30] The cumulative payments under a 3% AAI or a 3% AAI modified by the pension reform 98-599 is divided by the cumulative payments of the pension increasing at 1.5%. This provides a relative value, expressed as a percentage, of the cumulative indicated pensions to the 1.5% cost of living increase benchmark.
[31] Same illustrative employee as in preceding figure.

since 1997. The impact depends on age, because the older the retirees are, the greater the pension benefit increase they have received under the 3% AAI. The result is shown in the table below. For nearly all retirees (97%), the actuarial present value of pension benefits after pension reform will still be above the actuarial present value of a pension indexed with a 1.5% cost of living increase.

Table 23: Pension benefits after pension reform compared to 1.5% COLA pensions (TRS, SERS, SURS combined)

Age	Percent of retirees with pension value after pension reform greater than the present value assuming an increase rate of 1.5% Shown by retirees' age		Percent of retirees (with monthly benefit of $3,000 or less) with pension value after pension reform greater than the present value assuming an increase rate of 1.5% Shown by retirees' age	
	Number of retirees	Percentage above a 1.5% COLA pension	Number of retirees	Percentage above a 1.5% COLA pension
50 - 54	2,447	55.6%	1,077	50.6%
55 - 59	14,085	91.1%	5,391	87.7%
60 - 64	41,564	97.6%	16,993	96.9%
65 - 69	49,971	99.2%	22,494	98.8%
70 - 74	35,743	99.8%	17,620	99.5%
75 - 79	23,387	99.8%	12,458	99.8%
80 - 84	16,250	99.9%	9,634	99.8%
85 - 89	10,290	100.0%	7,043	100.0%
90 - 94	4,748	100.0%	3,830	100.0%
95 - 99	1,306	100.0%	1,153	100.0%
Overall	200,397	97.4%	98,253	98.1%

Source: Terry Group analysis based on census data provided by the pension systems.

Active member analysis

203. To analyze the impact of pension reform on Tier 1 active employees, I considered four areas of change: first, the change to the COLA provisions, including the COLA cap and COLA skipping; second, the 1% reduction in employee contributions; third, the impact of the salary cap on pensionable earnings; and finally the change in the "regular interest rate" for TRS and the "effective interest rate" for SURS on their money purchase formulas.

204. Similar to the retiree analysis, I compare the present value of projected pension benefits after pension reform against the current pension benefit with a 1.50% cost of living increase.

205. Additionally, to project pension benefits for active employees, I assume a salary growth of 3% per year.

206. Section 15-136 of Illinois' pension code, which applies to SURS, provides that the annuity derived from the Money Purchase Formula is made on an "actuarially equivalent basis". However, for SURS, the total of the accumulated member contributions and the imputed employer match is converted into an annuity without regard to the 3% automatic annual increases (See 2013 actuarial valuation report for SURS and the annuity conversion factors in SUR's Member Guide for Traditional Benefits). As a result, the value of the Money Purchase Formula benefit for SURS is approximately 30% higher than the accumulated member contributions and the imputed employer match. In other words, currently the benefit provided by the Money Purchase Formula is *not* actuarially equivalent to the accumulated member contributions and the imputed employer match. (The same statutory standard applies to the similar annuity formula for TRS members.)

207. To assess the impact of PA 98-599 on active employees I analyzed sample active employees from TRS, SERS, and SURS that are representative of typical employees of the respective retirement systems. They include recent hires, mid-career employees and employees close to retirement. The information on these representative employees is summarized in Tables 24 and 25.

Table 24: Characteristics of sample employees as of June 30, 2014

	Age	Service	Compensation
TRS Employee #1	44	12	65,879
TRS Employee #2	29	4	49,530
TRS Employee #3	59	34	93,852
SERS Employee #1	49	14	74,798
SERS Employee #2	29	4	53,488
SERS Employee #3	59	29	83,024
SURS Employee #1	49	11	61,792
SURS Employee #2	39	7	59,177
SURS Employee #3	64	29	96,504

Source: Terry Group Illustration

Table 25: The impact of PA98-599 on representative active employees

	Value of a 3% AAI relative to a 1.5% COLA	Impact of new COLA Provisions: COLA skipping and COLA cap	1% reduction in employee contributions	Impact of salary cap	Impact of "regular interest" and "effective interest rate" on money purchase formula
TRS Employee #1	10%	-10%	3%	0%	-21%
TRS Employee #2	14%	-10%	7%	0%	0%
TRS Employee #3	13%	-12%	0%	0%	-7%
SERS Employee #1	12%	-12%	3%	0%	0%
SERS Employee #2	14%	-11%	7%	0%	0%
SERS Employee #3	14%	-12%	0%	0%	0%
SURS Employee #1	11%	-10%	3%	0%	-10%
SURS Employee #2	12%	-12%	6%	0%	0%
SURS Employee #3	12%	-12%	0%	0%	-3%

Source: Terry Group Illustration

208. The analysis of these sample employees shows that the impact of the new COLA provision is approximately equal to the value of a 1.5% COLA relative to a 3% AAI.

209. The impact of the salary cap on employees' benefit depends on their current salary and how close they are to the retirement age. For sample employees shown above, the salary cap does not have any impact on their pension benefit. However, based on the census data provided by systems' actuaries, I estimated that less than 15% of the active employees will see their pensionable earning limited by the salary cap by 10% or more. Those members are the ones at the top of the salary scale they retire.

210. For SURS participants who are eligible for the money purchase formula, the value of the pre-reform benefit is 30% above the "actuarially equivalent" value. Thus I do not consider pension reform changes to be a reduction when the excess value is taken into account.

211. Therefore the result of my analysis is that over 85% of the active employees will see their pension benefits reduced by less than 10% relative to the current benefit with a 1.5% cost of living increase. This is mostly due to the impact of the salary cap and is largely limited to system members with the highest salaries.

Appendices

Appendix A. Actuarial Information

Purpose of this section

Appendix A provides background pertaining to the actuarial information included or referred to in my report. Specifically, much of the financial information included in my report comes from the actuarial reports prepared by the systems' actuaries, or is derived from those reports using actuarial estimation procedures. Some data have been adjusted, projected, extrapolated from, interpolated between, or otherwise modified in order to be useful and relevant to my findings.

My actuarial analysis was conducted for purposes of addressing the specific matters I discuss in my report. Specifically, the analysis is intended to provide a high-level understanding of the magnitude and direction of various changes to Illinois' pension systems. The analysis and the results contained in my report should not be relied on by other parties or for any other purpose.

I am a member of the American Academy of Actuaries and I meet the Qualification Standards of the American Academy of Actuaries to prepare the actuarial opinion contained in this report.

Reliance on systems' actuaries

In assessing the impact of PA 98-599 and the quantification of unexpected and unanticipated events, I have relied on information developed and reported by the actuarial firms who provide services directly for the Illinois systems (as detailed below). Consistency in the actuarial methods and assumptions used is relevant in assuring consistent and comparable actuarial estimates. In order to make meaningful comparisons when evaluating the impact of a specific event or a specific change, all variables were kept constant and only the variables in question were changed.

In practice, the relative financial impact of the events or changes I have evaluated will be substantially similar, regardless of the underlying actuarial basis (actuarial methods and assumptions). Therefore, I have not rendered an opinion on elements of the actuarial basis where others generally may have different professional opinions. For example, there is generally a range of opinions on how to determine the discount rate for valuing pension promises. Different discount rates might change the value of actuarial liabilities significantly. However, any single liability measurement, on its own, has little meaning for purposes of this testimony. Instead, I have focused on differences in liabilities. Thus, consistency in liability measures has been a primary focus.

I have not attempted to re-determine the estimates made by the systems' own actuaries – Buck Consultants for TRS, and Gabriel Roeder Smith for SERS and SURS. These professionals have the expertise, the computer software programmed specifically for the Illinois systems, and the experience with the Illinois systems, such that relying on their extensive experience and hours of work to develop appropriate methods and systems is entirely reasonable and appropriate for the purpose of this report.

Neither have I attempted to audit the information provided by the actuaries for the systems. The State Actuary performed an extensive review of assumptions and methods being used by the systems' actuaries in 2013. I have no reason to believe that those methods and assumptions do not provide a reasonable basis for the analysis and conclusions in my testimony. Nor do I have any reason to expect that any material error might exist in the calculations performed by the systems' actuaries.

Source Material

In preparing my analysis, I have relied upon the results, methods and assumptions contained in the reports listed in Appendix S.

Measurement Date

In general, results have been presented as of June 30, 2013 unless otherwise stated. This date may not be appropriate for other purposes.

Summary of Plan Provisions

Unless otherwise noted, all results of my analysis are based upon the plan provisions documented in the 2013 actuarial valuation reports of TRS, SERS and SURS.

Summary of Participant Data

All results in my analysis are based on the participant data summaries shown in the 2013 actuarial valuation reports and in the 2013 Comprehensive Annual Financial Reports of TRS, SERS and SURS. Individual-level participant data were not used to assess the impact of unexpected and unanticipated events. Individual-level participant data were used for the cohort analysis in Appendix R and in the report.

Summary of Actuarial Assumptions

Unless otherwise noted, the actuarial assumptions documented in the 2013 actuarial reports of TRS, SERS, and SURS are used.

Summary of Actuarial Methods

For the purpose of my analysis, I relied on and used the actuarial methods set forth in the actuarial valuation reports of TRS, SERS, and SURS. Actuarial methods include actuarial cost methods, asset smoothing methods, amortization methods, and contribution allocation methods.

The Projected Unit Credit (PUC) actuarial cost method was used for the actuarial accrued liability.

I have generally used the market value of assets to assess the funded status of the systems, while the unfunded actuarial accrued liability reported by the systems, which is occasionally referred to in my report, is based on an actuarial value of assets. The method used to determine the actuarial value of assets has changed during the period covered in the testimony.

Actuarial Estimates

Relative changes in liabilities due to changes in discount rates or mortality assumptions were estimated by applying actuarial adjustment factors to the June 30, 2013 liabilities as reported in the respective actuarial valuation reports.

To develop the adjustment factors, I first created participant profiles for the population of active employees and retirees based on the participant data summaries in the 2013 actuarial valuation reports and the 2013 CAFRs of TRS, SERS, and SURS. For active profiles, I used the age/service/compensation tables included in the respective actuarial reports to create databases that captured the participant count and average compensation for each age/service combination. For retiree profiles, I used the distribution of retiree ages and benefit amounts in the respective actuarial reports and CAFRs to create databases that captured these demographic characteristics. Separate participant databases were prepared for active and retired participants in each retirement system. Deferred vested participants were ignored since their demographic information is not in the reports and their liabilities are small. The databases were then assessed to ensure that they were appropriate for the purpose of developing liability adjustment factors.

Next, I used commercially available pension valuation software to perform calculations using the participant databases I developed and the actuarial assumptions and plan provisions documented in the 2013 actuarial valuation reports. In order to calibrate the system, I replicated the liabilities calculated by the systems' actuaries and compared my calculations with the numbers reported in the various actuarial valuation reports. The

resulting liabilities were generally close to within a 5% margin, which I deem to be a reasonable basis for assessing the impact of different assumptions and plan provisions for purposes of my analysis.

To assess the impact of changing assumptions, I re-calculated the liabilities by changing the discount rate and mortality assumptions one at a time while keeping all other assumptions unchanged. The actuarial adjustment factors are the ratio of the liabilities before and after the change. Different adjustment factors were developed for active employees and retirees and for each retirement system for each assumption.

The actuarial adjustment factors were then applied to the reported June 30, 2013 liabilities for active employees and retirees in each retirement system to identify the impact of changing assumptions for each group. The resulting impacts for the different groups were summed in order to identify the total impact.

B. Historical information since 1990

This section shows actuarial information that represents the historical development of actuarial liability, assets, and contributions. This information was prepared by the Systems' actuaries and found in their reports.

Table B-1: TRS, SERS, SURS combined historical accrued liability, assets and funded ratio 1990 - 2013 ($thousands)

Year	Accrued Liability	MVA	AVA	Funded Ratio-MVA	Funded Ratio - AVA
1990	24,438,929	15,972,140	14,175,422	65.4%	58.0%
1991	26,738,715	16,968,976	15,258,297	63.5%	57.1%
1992	29,619,713	18,774,174	16,991,727	63.4%	57.4%
1993	32,368,541	20,685,793	18,564,611	63.9%	57.4%
1994	36,834,508	21,271,255	20,161,057	57.7%	54.7%
1995	40,347,522	23,854,090	21,238,249	59.1%	52.6%
1996	43,687,725	27,228,412	23,309,571	62.3%	53.4%
1997	45,052,009	31,817,482	31,817,482	70.6%	70.6%
1998	50,666,234	36,824,191	36,824,191	72.7%	72.7%
1999	55,821,218	40,985,842	40,985,842	73.4%	73.4%
2000	60,478,392	45,456,214	45,456,214	75.2%	75.2%
2001	66,654,237	42,345,607	42,345,607	63.5%	63.5%
2002	73,992,718	39,854,878	39,854,878	53.9%	53.9%
2003	82,552,512	40,341,534	40,341,534	48.9%	48.9%
2004	88,468,716	54,121,216	54,121,216	61.2%	61.2%
2005	95,729,576	57,929,566	57,929,566	60.5%	60.5%
2006	101,560,455	61,659,842	61,659,842	60.7%	60.7%
2007	111,291,412	69,973,927	69,973,927	62.9%	62.9%
2008	117,391,347	64,012,414	64,012,414	54.5%	54.5%
2009	124,641,744	48,042,137	63,307,996	38.5%	50.8%
2010	136,723,062	52,647,157	62,367,275	38.5%	45.6%
2011	144,209,053	62,716,023	62,875,270	43.5%	43.6%
2012	156,286,331	61,182,656	63,372,566	39.1%	40.5%
2013	162,980,853	67,296,170	64,295,231	41.3%	39.4%

Table B-2 TRS, SERS, SURS combined historical normal cost, Annual required contributions (ARC), employer and employee contributions, and benefit payments and expenses, 1990 – 2013 ($thousands)

Year	Nomal Cost	Normal Cost + Interest	Annual Required Contributions (ARC)	Employer Contributions	Employee Contributions	Benefit Payments & Expenses
1990	422,380	1,166,975		514,218	537,083	1,018,444
1991	504,936	1,326,026		527,139	583,613	1,068,730
1992	594,589	1,506,395		479,548	663,198	1,229,957
1993	586,944	1,597,183		548,195	659,077	1,367,150
1994	632,149	1,736,463		744,898	724,947	1,584,827
1995	701,299	2,035,175		862,874	748,318	1,889,196
1996	736,383	2,265,125		683,132	733,310	1,939,568
1997	739,273	2,286,656	1,571,567	761,401	764,605	2,037,360
1998	739,972	1,864,907	1,480,438	931,469	818,589	2,171,954
1999	822,632	1,999,205	1,548,856	1,190,421	1,238,856	2,365,300
2000	877,903	2,138,910	1,627,994	1,312,570	1,006,915	2,610,894
2001	970,521	2,247,405	1,723,293	1,434,854	1,038,942	2,903,145
2002	1,039,664	3,105,897	1,905,072	1,549,575	1,129,667	3,248,573
2003	1,148,258	4,049,974	2,474,368	1,702,630	1,263,529	3,805,775
2004	1,077,355	4,665,289	2,984,197	9,111,599	1,212,287	4,284,247
2005	1,150,555	4,070,093	3,018,440	1,768,397	1,223,024	4,746,389
2006	1,193,025	4,406,025	3,014,080	1,048,348	1,266,043	5,222,736
2007	1,290,224	4,681,776	3,582,099	1,473,473	1,313,372	5,601,492
2008	1,365,650	4,877,637	3,643,374	2,104,466	1,379,504	6,074,617
2009	1,526,277	6,063,486	3,986,913	2,830,448	1,391,701	6,478,130
2010	1,612,962	6,826,331	4,662,527	4,044,291	1,420,574	6,958,054
2011	1,829,710	7,891,189	5,291,271	4,227,510	1,423,956	7,548,457
2012	1,893,592	9,250,148	6,488,128	4,938,490	1,435,020	8,146,026
2013	1,864,767	9,195,783	6,872,606	5,793,904	1,414,734	8,852,902

C. Assumptions and methods used since 1990

This section shows certain key assumptions used by the Systems' actuaries from 1990 through 2013. Assumptions are shown separately for TRS, SERS and SURS.

Table C-1: TRS historical valuation assumptions, 1990 – 2013

Year	Discount Rate	Inflation	Cost Method	Mortality	AVA Basis
1990	8.00%		Projected Unit Credit	UP-1984 Table with 5-year setback	Book
1991	8.00%		Projected Unit Credit	UP-1984 Table with 6-year setback	Book
1992	8.00%		Projected Unit Credit	(same as 1991)	Book
1993	8.00%		Projected Unit Credit	(same as 1991)	Book
1994	8.00%	4.00%	Projected Unit Credit	(same as 1991)	Book
1995	8.00%	4.00%	Projected Unit Credit	(same as 1991)	Book
1996	8.00%	4.00%	Projected Unit Credit	(same as 1991)	Book
1997	8.50%	4.00%	Projected Unit Credit	1995 George B. Buck Mortality Tables (rated forward 1 year for beneficiaries)	Market
1998	8.50%	4.00%	Projected Unit Credit	(same as 1998)	Market
1999	8.50%	4.00%	Projected Unit Credit	(same as 1998)	Market
2000	8.50%	4.00%	Projected Unit Credit	(same as 1998)	Market
2001	8.50%	4.00%	Projected Unit Credit	(same as 1998)	Market
2002	8.50%	3.50%	Projected Unit Credit	95.6% of 1995 George B. Buck Mortality Table for males and 100% of the George B. Buck Mortality Tables for females.	Market
2003	8.50%	3.50%	Projected Unit Credit	(same as 2002)	Market
2004	8.50%	3.50%	Projected Unit Credit	(same as 2002)	Market
2005	8.50%	3.50%	Projected Unit Credit	(same as 2002)	Market
2006	8.50%	3.50%	Projected Unit	(same as 2002)	Market

			Credit		
2007	8.50%	3.50%	Projected Unit Credit	1995 George B. Buck Mortality Tables projected 16 years for males and 1 year for females. Mortality improvements with Scale AA.	Market
2008	8.50%	3.50%	Projected Unit Credit	(same as 2007)	Market
2009	8.50%	3.50%	Projected Unit Credit	(same as 2007)	Smoothed
2010	8.50%	3.50%	Projected Unit Credit	(same as 2007)	Smoothed
2011	8.50%	3.50%	Projected Unit Credit	(same as 2007)	Smoothed
2012	8.00%	3.25%	Projected Unit Credit	RP-2000 White Collar Table, projected 9 years using Scale AA, with a two-year setback for men, and no setback for women. Rates for women are further adjusted by 65% for ages 63-77 and 85% for ages 78-87. Future mortality improvements with Scale AA.	Smoothed
2013	8.00%	3.25%	Projected Unit Credit	(same as 2012)	Smoothed

Table C-2: SERS historical valuation assumptions, 1990 - 2013

Year	Discount Rate	Inflation	Cost Method	Mortality	AVA Basis
1990	8.00%	4.50%	Projected Unit Credit	1986 Projected Experience Table	Book
1991	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1992	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1993	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1994	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1995	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1996	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1997	8.50%	3.50%	Projected Unit Credit	1983 Group Annuity Mortality Table (setback 1 year for males, no setback for females)	Market
1998	8.50%	3.50%	Projected Unit	(same as 1997)	Market

			Credit		
1999	8.50%	3.50%	Projected Unit Credit	(same as 1997)	Market
2000	8.50%	3.50%	Projected Unit Credit	(same as 1997)	Market
2001	8.50%	3.50%	Projected Unit Credit	(same as 1997)	Market
2002	8.50%	3.50%	Projected Unit Credit	(same as 1997)	Market
2003	8.50%	3.00%	Projected Unit Credit	(same as 1997)	Market
2004	8.50%	3.00%	Projected Unit Credit	(same as 1997)	Market
2005	8.50%	3.00%	Projected Unit Credit	(same as 1997)	Market
2006	8.50%	3.00%	Projected Unit Credit	1994 Group Annuity Mortality Table	Market
2007	8.50%	3.00%	Projected Unit Credit	(same as 2006)	Market
2008	8.50%	3.00%	Projected Unit Credit	(same as 2006)	Market
2009	8.50%	3.00%	Projected Unit Credit	(same as 2006)	Smoothed
2010	7.75%	3.00%	Projected Unit Credit	(same as 2006)	Smoothed
2011	7.75%	3.00%	Projected Unit Credit	RP2000 Combined Healthy table, projected to 2015 with Scale AA.	Smoothed
2012	7.75%	3.00%	Projected Unit Credit	(same as 2011)	Smoothed
2013	7.75%	3.00%	Projected Unit Credit	(same as 2011)	Smoothed

Table C-3: SURS historical valuation assumptions, 1990 - 2013

Year	Discount Rate	Inflation	Cost Method	Mortality	AVA Basis
1990	8.00%	4.50%	Projected Unit Credit	1986 Projected Experience Table (set back 3 years for males, 2 years for females)	Book
1991	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book

1992	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1993	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1994	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1995	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1996	8.00%	4.50%	Projected Unit Credit	(same as 1990)	Book
1997	8.50%		Projected Unit Credit	UP94	Market
1998	8.50%		Projected Unit Credit	(same as 1997)	Market
1999	8.50%		Projected Unit Credit	(same as 1997)	Market
2000	8.50%		Projected Unit Credit	(same as 1997)	Market
2001	8.50%		Projected Unit Credit	(same as 1997)	Market
2002	8.50%	4.00%	Projected Unit Credit	1994 Group Annuity Mortality Table, set back 1 year for males	Market
2003	8.50%	4.00%	Projected Unit Credit	(same as 2002)	Market
2004	8.50%	4.00%	Projected Unit Credit	(same as 2002)	Market
2005	8.50%	4.00%	Projected Unit Credit	(same as 2002)	Market
2006	8.50%	4.00%	Projected Unit Credit	(same as 2002)	Market
2007	8.50%	3.75%	Projected Unit Credit	1994 Group Annuity Mortality Table, set back 2 years for males	Market
2008	8.50%	3.75%	Projected Unit Credit	(same as 2007)	Market
2009	8.50%	3.75%	Projected Unit Credit	(same as 2007)	Smoothed
2010	7.75%	3.75%	Projected Unit Credit	(same as 2007)	Smoothed
2011	7.75%	2.75%	Projected Unit Credit	RP2000 Combined Mortality, projected to 2017 with Scale AA. Rates adjusted to 80% for males, 85% for females.	Smoothed

2012	7.75%	2.75%	Projected Unit Credit	(same as 2011)	Smoothed
2013	7.75%	2.75%	Projected Unit Credit	(same as 2011)	Smoothed

D. Projected and Actual State Contributions

This section shows the projected and actual state contributions based on 2006, 2009 and 2013 valuations for TRS, SERS, SURS and in total.

Table D-1 TRS projected and certified state contributions ($millions)

	Projected from 2006		Projected from 2009		Projected from 2013	
	Amount	% of payroll	Amount	% of payroll	Amount	% of payroll
2011	$1,829	20.4%	$2,357	25.1%	$2,357	25.1%
2013	1,976	20.4%	2,549	25.1%	2,702	28.1%
2020	2,629	20.4%	3,545	25.5%	4,009	32.9%
2030	4,076	20.4%	5,606	25.5%	5,858	32.6%
2045	7,992	20.4%	10,907	25.5%	8,582	34.6%

Source: Terry Group compilation from the actuarial valuation reports of TRS, 2006, 2009 and 2013. Shaded cells represent actual state contributions.

Table D-2 SERS projected and actual state contributions ($millions)

	Projected from 2006		Projected from 2009		Projected from 2013	
	Amount	% of payroll	Amount	% of payroll	Amount	% of payroll
2011	$1,052	24.8%	$1,193	28.4%	$1,193	28.4%
2013	1,134	24.8%	1,366	30.2%	1,578	36.1%
2020	1,468	24.8%	1,870	32.2%	2,028	39.7%
2030	2,101	24.8%	2,643	32.0%	2,711	39.3%
2045	3,797	24.8%	5,196	35.0%	4,247	42.5%

Source: Terry Group compilation from the actuarial valuation reports of SERS, 2006 – 2013. Shaded cells represent actual state contributions. For projections made from 2006 and 2009, the projected 2013 contributions are interpolated from projected 2011 and projected 2015 contributions.

Table D-3 SURS projected and actual state contributions ($millions)

	Projected from 2006		Projected from 2009		Projected from 2013	
	Amount	% of payroll	Amount	% of payroll	Amount	% of payroll
2011	$613	19.2%	$844	23.6%	$774	23.2%
2013	660	19.8%	1,030	27.1%	1,401	41.1%
2020	873	21.4%	1,469	30.3%	1,673	40.0%
2030	1,371	22.6%	2,263	30.2%	2,156	40.1%
2045	2,837	23.0%	4,705	30.3%	3,168	41.2%

Source: Terry Group compilation from the actuarial valuation reports of SURS, 2006, 2009 and 2013. Shaded cells represent actual state contributions. Excludes SMP contributions.

Table D-4 Projected and actual state contributions: TRS, SERS and SURS combined ($millions)

	Projected from 2006		Projected from 2009		Projected from 2013	
	Amount	% of payroll	Amount	% of payroll	Amount	% of payroll
2011	$3,493	21.3%	$4,394	25.6%	$4,324	25.6%
2013	3,770	21.4%	4,945	26.8%	5,682	32.6%
2020	4,969	21.7%	6,884	28.0%	7,710	35.9%
2030	7,548	21.9%	10,511	27.8%	10,725	35.5%
2045	14,626	21.9%	20,808	28.4%	15,997	37.7%

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS and SURS, 2006 - 2013. Shaded cells represent actual state contributions. Excludes SMP contributions for SURS.

E. Projected and actual unfunded actuarial accrued liability since 1990

This section shows the actual unfunded actuarial accrued liability (UAAL) and the projected UAAL from past years for all the retirement systems combined.

Table E-1 TRS, SERS, and SURS total projected and actual UAAL 1990 – 1994 ($millions)

	Projected from 1990	Projected from 1991	Projected from 1992	Projected from 1993	Projected from 1994
1990	10,264	10,264	10,264	10,264	10,264
1991	10,937	11,480	11,480	11,480	11,480
1992	11,692	12,464	12,628	12,628	12,628
1993	12,276	13,108	13,518	13,804	13,804
1994	13,129	14,012	14,448	15,155	16,674
1995	14,023	14,944	15,402	16,272	18,542
1996	14,674	15,622	16,094	16,997	20,056
1997	13,621	14,600	15,089	16,016	19,897
1998	14,267	15,272	15,781	16,735	21,463
1999	14,928	15,959	16,482	17,467	23,071
2000	15,599	16,655	17,193	18,202	24,714
2001	16,607	17,361	17,912	18,946	26,368
2002	17,619	18,422	18,640	19,697	28,048
2003	18,636	19,475	19,707	20,449	29,744
2004	19,649	20,525	20,756	21,549	31,451
2005	20,658	21,569	21,799	22,625	33,155
2006	21,651	22,598	22,827	23,686	34,782
2007	22,603	23,591	23,819	24,709	36,362
2008	23,514	24,539	24,771	25,690	37,889
2009	24,355	25,412	25,646	26,620	39,350
2010	25,131	26,219	26,455	27,452	40,724
2011	25,924	27,044	27,282	28,302	42,000
2012	26,734	27,886	28,127	29,169	43,301
2013	27,559	28,744	28,987	30,051	44,623

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS, and SURS, 1990 – 2013

Notes: Shaded cells represent actual UAAL – the difference between actuarial accrued liability and actuarial value of assets. For TRS, projections from 1990 – 1994 were performed for 10 years only. TRS projections after 10 years were estimated from the 1995 TRS projection. For SURS, the projections were first available in 1996. The 1996 projection for SURS was used for years 1990 – 1995. When projected UAAL was not available for a particular year but was available for years before and after that year, the UAAL for that year was interpolated. For example, if the projected UAAL was available for years 2010 and 2015, but not for the years in between, then the projected UAAL for years in between were geometrically interpolated from the UAAL in 2010 and 2015.

Table E-2 TRS, SERS, and SURS total projected and actual UAAL 1995– 1999 ($millions)

	Projected from 1995	Projected from 1996	Projected from 1997	Projected from 1998	Projected from 1999
1990	10,264	10,264	10,264	10,264	10,264
1991	11,480	11,480	11,480	11,480	11,480
1992	12,628	12,628	12,628	12,628	12,628
1993	13,804	13,804	13,804	13,804	13,804
1994	16,674	16,674	16,674	16,674	16,674
1995	19,109	19,109	19,109	19,109	19,109
1996	20,734	20,378	20,378	20,378	20,378
1997	20,624	19,478	13,234	13,234	13,234
1998	22,246	21,044	16,192	13,841	13,841
1999	23,907	22,652	17,344	15,019	14,835
2000	25,609	24,287	18,533	16,060	15,695
2001	27,325	25,945	19,735	17,132	16,655
2002	29,075	27,636	20,966	18,212	17,635
2003	30,843	29,343	22,217	19,311	18,614
2004	32,618	31,058	23,485	20,424	19,580
2005	34,400	32,767	24,762	21,544	20,547
2006	36,119	34,437	25,969	22,636	21,494
2007	37,794	36,074	27,169	23,723	22,424
2008	39,417	37,659	28,344	24,763	23,295
2009	40,974	39,179	29,479	25,794	24,128
2010	42,447	40,612	30,566	26,785	24,947
2011	43,908	42,042	31,650	27,785	26,001
2012	45,403	43,502	32,754	28,806	27,084
2013	46,930	44,993	33,879	29,848	28,196

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS, and SURS, 1990 – 2013

Notes: Shaded cells represent actual UAAL – the difference between actuarial accrued liability and actuarial value of assets. For TRS, projections from 1997 and 1998 were not available. The TRS projections for 1997 and 1998 were estimated from the 1996 TRS projection. For SURS, the projections were first available in 1996 and were unavailable for years 1999 - 2002. The 1996 projection for SURS was used for years 1990 – 1995. The SURS projections for years 1999 – 2002 were estimated from the SURS 1998 projection. When projected UAAL was not available for a particular year but was available for years before and after that year, the UAAL for that year was interpolated. For example, if the projected UAAL was available for years 2010 and 2015, but not for the years in between, then the projected UAAL for years in between were geometrically interpolated from the UAAL in 2010 and 2015.

Table E-3 TRS, SERS, and SURS total projected and actual UAAL 2000– 2004 ($millions)

	Projected from 2000	Projected from 2001	Projected from 2002	Projected from 2003	Projected from 2004
1990	10,264	10,264	10,264	10,264	10,264
1991	11,480	11,480	11,480	11,480	11,480
1992	12,628	12,628	12,628	12,628	12,628
1993	13,804	13,804	13,804	13,804	13,804
1994	16,674	16,674	16,674	16,674	16,674
1995	19,109	19,109	19,109	19,109	19,109
1996	20,378	20,378	20,378	20,378	20,378
1997	13,234	13,234	13,234	13,234	13,234
1998	13,841	13,841	13,841	13,841	13,841
1999	14,835	14,835	14,835	14,835	14,835
2000	15,022	15,022	15,022	15,022	15,022
2001	15,845	24,309	24,309	24,309	24,309
2002	16,758	25,548	34,137	34,137	34,137
2003	17,677	27,171	36,543	42,211	42,211
2004	18,572	28,812	38,896	35,960	34,347
2005	19,455	30,465	41,235	38,307	34,710
2006	20,314	32,124	43,536	40,609	36,856
2007	21,150	33,737	46,094	42,805	38,899
2008	21,927	35,278	47,792	44,904	40,862
2009	22,675	36,833	49,814	46,796	42,654
2010	23,363	38,343	51,750	48,532	44,232
2011	24,355	39,887	53,676	50,209	45,784
2012	25,377	41,472	55,652	51,944	47,389
2013	26,425	43,097	57,676	53,699	49,007

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS, and SURS, 1990 – 2013

Notes: Shaded cells represent actual UAAL – the difference between actuarial accrued liability and actuarial value of assets. For SURS, the projections were unavailable for years 1999 - 2002. The SURS projections for years 1999 – 2002 were estimated from the SURS 1998 projection. When projected UAAL was not available for a particular year but was available for years before and after that year, the UAAL for that year was interpolated. For example, if the projected UAAL was available for years 2010 and 2015, but not for the years in between, then the projected UAAL for years in between were geometrically interpolated from the UAAL in 2010 and 2015.

Table E-4 TRS, SERS, and SURS total projected and actual UAAL 2005 – 2009 ($millions)

	Projected from 2005	Projected from 2006	Projected from 2007	Projected from 2008	Projected from 2009
1990	10,264	10,264	10,264	10,264	10,264
1991	11,480	11,480	11,480	11,480	11,480
1992	12,628	12,628	12,628	12,628	12,628
1993	13,804	13,804	13,804	13,804	13,804
1994	16,674	16,674	16,674	16,674	16,674
1995	19,109	19,109	19,109	19,109	19,109
1996	20,378	20,378	20,378	20,378	20,378
1997	13,234	13,234	13,234	13,234	13,234
1998	13,841	13,841	13,841	13,841	13,841
1999	14,835	14,835	14,835	14,835	14,835
2000	15,022	15,022	15,022	15,022	15,022
2001	24,309	24,309	24,309	24,309	24,309
2002	34,137	34,137	34,137	34,137	34,137
2003	42,211	42,211	42,211	42,211	42,211
2004	34,347	34,347	34,347	34,347	34,347
2005	37,800	37,800	37,800	37,800	37,800
2006	43,109	39,901	39,901	39,901	39,901
2007	46,447	43,319	41,317	41,317	41,317
2008	49,489	46,059	43,676	53,379	53,379
2009	51,905	48,324	45,815	55,859	61,333
2010	53,787	50,042	47,475	57,859	64,516
2011	55,604	51,799	49,221	59,881	67,832
2012	57,447	53,573	50,897	61,958	71,155
2013	59,307	55,386	52,649	64,051	74,454

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS, and SURS, 1990 – 2013

Notes: Shaded cells represent actual UAAL – the difference between actuarial accrued liability and actuarial value of assets. When projected UAAL was not available for a particular year but was available for years before and after that year, the UAAL for that year was interpolated. For example, if the projected UAAL was available for years 2010 and 2015, but not for the years in between, then the projected UAAL for years in between were geometrically interpolated from the UAAL in 2010 and 2015.

Table E-5 TRS, SERS, and SURS total projected and actual UAAL 2010 – 2013 ($millions)

	Projected from 2010	Projected from 2011	Projected from 2012	Projected from 2013
1990	10,264	10,264	10,264	10,264
1991	11,480	11,480	11,480	11,480
1992	12,628	12,628	12,628	12,628
1993	13,804	13,804	13,804	13,804
1994	16,674	16,674	16,674	16,674
1995	19,109	19,109	19,109	19,109
1996	20,378	20,378	20,378	20,378
1997	13,234	13,234	13,234	13,234
1998	13,841	13,841	13,841	13,841
1999	14,835	14,835	14,835	14,835
2000	15,022	15,022	15,022	15,022
2001	24,309	24,309	24,309	24,309
2002	34,137	34,137	34,137	34,137
2003	42,211	42,211	42,211	42,211
2004	34,347	34,347	34,347	34,347
2005	37,800	37,800	37,800	37,800
2006	39,901	39,901	39,901	39,901
2007	41,317	41,317	41,317	41,317
2008	53,379	53,379	53,379	53,379
2009	61,333	61,333	61,333	61,333
2010	74,356	74,356	74,356	74,356
2011	81,164	81,334	81,334	81,334
2012	88,318	86,503	92,914	92,914
2013	95,342	91,006	99,067	98,685

Source: Terry Group compilation from the actuarial valuation reports of TRS, SERS, and SURS, 1990 – 2013

Notes: Shaded cells represent actual UAAL – the difference between actuarial accrued liability and actuarial value of assets.

F. Expected and actual market value of assets for TRS, SERS and SURS since 1997

The following tables show the expected and actual market value of assets for TRS, SERS and SURS since 1997. To estimate what the market value of assets would have been if the assets earn expected return every year, all cash flows are kept the same except the investment returns are recalculated using expected return on assets. Table F-1 through F-6 details the calculation for TRS, SERS and SURS.

Table F-1 Market Value of Assets for TRS – Actual Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	17,393,108	502,934	441,016	1,244,272	2,873,101	19,965,887
1999	19,965,887	636,596	866,376	1,320,811	2,089,661	22,237,709
2000	22,237,709	730,597	619,623	1,442,734	2,336,218	24,481,413
2001	24,481,413	821,625	643,563	1,615,701	(1,015,254)	23,315,646
2002	23,315,646	907,358	681,152	1,813,884	(723,987)	22,366,285
2003	22,366,285	1,021,263	732,020	2,055,597	1,060,852	23,124,823
2004	23,124,823	5,489,426	768,661	2,323,910	4,485,729	31,544,729
2005	31,544,729	1,055,562	761,790	2,606,902	3,330,039	34,085,218
2006	34,085,218	657,848	799,034	2,950,501	3,993,290	36,584,889
2007	36,584,889	853,586	826,249	3,186,731	6,831,325	41,909,318
2008	41,909,318	1,171,789	865,400	3,501,370	(2,014,414)	38,430,723
2009	38,430,723	1,603,921	876,182	3,724,811	(8,654,703)	28,531,312
2010	28,531,312	2,252,150	899,401	4,003,539	3,644,460	31,323,784
2011	31,323,784	2,326,028	909,578	4,322,662	7,234,539	37,471,267
2012	37,471,267	2,561,259	917,661	4,657,469	224,107	36,516,825
2013	36,516,825	2,860,491	921,423	5,001,739	4,561,768	39,858,768
2014	39,858,768					

Source: Terry Group compilation from TRS actuarial valuation reports and CAFRs 1997 – 2013

Table F-2 Market Value of Assets for TRS – Expected Investment Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	17,393,108	502,934	441,016	1,244,272	1,465,650	18,558,436
1999	18,558,436	636,596	866,376	1,320,811	1,585,209	20,325,806
2000	20,325,806	730,597	619,623	1,442,734	1,723,762	21,957,054
2001	21,957,054	821,625	643,563	1,615,701	1,859,953	23,666,494
2002	23,666,494	907,358	681,152	1,813,884	2,002,074	25,443,194
2003	25,443,194	1,021,263	732,020	2,055,597	2,149,823	27,290,703
2004	27,290,703	5,489,426	768,661	2,323,910	2,486,912	33,711,792
2005	33,711,792	1,055,562	761,790	2,606,902	2,831,946	35,754,188
2006	35,754,188	657,848	799,034	2,950,501	2,975,628	37,236,197
2007	37,236,197	853,586	826,249	3,186,731	3,101,033	38,830,334
2008	38,830,334	1,171,789	865,400	3,501,370	3,238,351	40,604,504
2009	40,604,504	1,603,921	876,182	3,724,811	3,398,483	42,758,279
2010	42,758,279	2,252,150	899,401	4,003,539	3,598,244	45,504,535
2011	45,504,535	2,326,028	909,578	4,322,662	3,821,685	48,239,164
2012	48,239,164	2,561,259	917,661	4,657,469	4,050,241	51,110,856
2013	51,110,856	2,860,491	921,423	5,001,739	4,040,075	53,931,106
2014	53,931,106					

Source: Terry Group estimates from TRS actuarial valuation reports and CAFRs 1997 – 2013

Table F-3 Market Value of Assets for SERS – Actual Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	6,048,027	200,742	155,898	420,407	1,080,235	7,064,495
1999	7,064,495	315,525	159,580	461,289	908,122	7,986,433
2000	7,986,433	340,873	164,792	512,460	931,263	8,910,901
2001	8,910,901	366,029	173,779	561,744	(612,304)	8,276,661
2002	8,276,661	386,117	196,915	639,689	(546,111)	7,673,893
2003	7,673,893	396,067	285,209	868,078	15,020	7,502,111
2004	7,502,111	1,864,673	199,826	998,337	1,421,914	9,990,187
2005	9,990,187	427,435	209,334	1,086,387	953,579	10,494,148
2006	10,494,148	210,500	214,109	1,132,135	1,113,231	10,899,853
2007	10,899,853	358,787	224,723	1,184,361	1,779,907	12,078,909
2008	12,078,909	587,732	249,955	1,240,470	(680,760)	10,995,366
2009	10,995,366	774,910	242,227	1,325,755	(2,208,896)	8,477,852
2010	8,477,852	1,095,546	246,173	1,417,636	799,896	9,201,831
2011	9,201,831	1,127,887	254,201	1,543,375	1,930,209	10,970,753
2012	10,970,753	1,391,416	259,123	1,666,579	5,975	10,960,688
2013	10,960,688	1,531,932	248,170	1,841,727	1,501,237	12,400,300
2014	12,400,300					

Source: Terry Group compilation from SERS actuarial valuation reports and CAFRs 1997 – 2013

Table F-4 Market Value of Assets for SERS – Expected Investment Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	6,048,027	200,742	155,898	420,407	511,372	6,495,632
1999	6,495,632	315,525	159,580	461,289	552,716	7,062,164
2000	7,062,164	340,873	164,792	512,460	599,995	7,655,364
2001	7,655,364	366,029	173,779	561,744	649,774	8,283,202
2002	8,283,202	386,117	196,915	639,689	701,664	8,928,209
2003	8,928,209	396,067	285,209	868,078	750,959	9,492,366
2004	9,492,366	1,864,673	199,826	998,337	852,163	11,410,691
2005	11,410,691	427,435	209,334	1,086,387	950,800	11,911,873
2006	11,911,873	210,500	214,109	1,132,135	982,439	12,186,786
2007	12,186,786	358,787	224,723	1,184,361	1,010,341	12,596,276
2008	12,596,276	587,732	249,955	1,240,470	1,053,565	13,247,058
2009	13,247,058	774,910	242,227	1,325,755	1,112,884	14,051,324
2010	14,051,324	1,095,546	246,173	1,417,636	1,191,136	15,166,543
2011	15,166,543	1,127,887	254,201	1,543,375	1,169,157	16,174,413
2012	16,174,413	1,391,416	259,123	1,666,579	1,252,895	17,411,268
2013	17,411,268	1,531,932	248,170	1,841,727	1,346,986	18,696,629
2014	18,696,629					

Source: Terry Group estimates from SERS actuarial valuation reports and CAFRs 1997 – 2013

Table F-5 Market Value of Assets for SURS – Actual Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	8,376,347	227,793	221,675	507,275	1,475,269	9,793,809
1999	9,793,809	238,300	212,900	583,200	1,100,291	10,762,100
2000	10,762,100	241,100	222,500	655,700	1,493,900	12,063,900
2001	12,063,900	247,200	221,600	725,700	(1,053,700)	10,753,300
2002	10,753,300	256,100	251,600	795,000	(651,300)	9,814,700
2003	9,814,700	285,300	246,300	882,100	250,400	9,714,600
2004	9,714,600	1,757,500	243,800	962,000	1,832,400	12,586,300
2005	12,586,300	285,400	251,900	1,053,100	1,279,700	13,350,200
2006	13,350,200	180,000	252,900	1,140,100	1,532,100	14,175,100
2007	14,175,100	261,100	262,400	1,230,400	2,517,500	15,985,700
2008	15,985,700	344,945	264,149	1,332,777	(675,692)	14,586,325
2009	14,586,325	451,617	273,292	1,427,564	(2,850,697)	11,032,973
2010	11,032,973	696,595	275,000	1,536,879	1,653,853	12,121,542
2011	12,121,542	773,595	260,177	1,682,420	2,801,109	14,274,003
2012	14,274,003	985,815	258,236	1,821,978	9,067	13,705,143
2013	13,705,143	1,401,481	245,141	2,009,436	1,694,773	15,037,102
2014	15,037,102					

Source: Terry Group compilation from SURS actuarial valuation reports and CAFRs 1997 – 2013

Table F-6 Market Value of Assets for SURS – Expected Investment Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	8,376,347	227,793	221,675	507,275	709,533	9,028,073
1999	9,028,073	238,300	212,900	583,200	761,776	9,657,849
2000	9,657,849	241,100	222,500	655,700	812,753	10,278,502
2001	10,278,502	247,200	221,600	725,700	862,754	10,884,356
2002	10,884,356	256,100	251,600	795,000	912,960	11,510,016
2003	11,510,016	285,300	246,300	882,100	963,455	12,122,971
2004	12,122,971	1,757,500	243,800	962,000	1,074,623	14,236,894
2005	14,236,894	285,400	251,900	1,053,100	1,188,215	14,909,309
2006	14,909,309	180,000	252,900	1,140,100	1,237,235	15,439,344
2007	15,439,344	261,100	262,400	1,230,400	1,282,301	16,014,745
2008	16,014,745	344,945	264,149	1,332,777	1,330,497	16,621,559
2009	16,621,559	451,617	273,292	1,427,564	1,382,969	17,301,873
2010	17,301,873	696,595	275,000	1,536,879	1,446,635	18,183,224
2011	18,183,224	773,595	260,177	1,682,420	1,384,065	18,918,641
2012	18,918,641	985,815	258,236	1,821,978	1,443,800	19,784,514
2013	19,784,514	1,401,481	245,141	2,009,436	1,519,240	20,940,940
2014	20,940,940					

Source: Terry Group estimates from SURS actuarial valuation reports and CAFRs 1997 – 2013

G. Expected market value since 1997 if assets return 0% in 2008 and 2009

The dramatic impact of 2008 – 2009 recession on retirement system assets can be seen in another way. If the investment return in 2008 and 2009 were 0%, while in other years were the same as the actual investment returns, then the market value of assets at June 30, 2013 is approximately equal to the expected assets. The tables below detail the calculations.

Table G-1 Market Value of Assets for TRS, SERS, and SURS – Actual Returns, Except the Investment Returns in 2008 and 2009 were assumed to be 0% ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	31,817,482	931,469	818,589	2,171,954	5,428,605	36,824,191
1999	36,824,191	1,190,421	1,238,856	2,365,300	4,098,074	40,986,242
2000	40,986,242	1,312,570	1,006,915	2,610,894	4,761,381	45,456,214
2001	45,456,214	1,434,854	1,038,942	2,903,145	(2,681,258)	42,345,607
2002	42,345,607	1,549,575	1,129,667	3,248,573	(1,921,398)	39,854,878
2003	39,854,878	1,702,630	1,263,529	3,805,775	1,326,272	40,341,534
2004	40,341,534	9,111,599	1,212,287	4,284,247	7,740,043	54,121,216
2005	54,121,216	1,768,397	1,223,024	4,746,389	5,563,318	57,929,566
2006	57,929,566	1,048,348	1,266,043	5,222,736	6,638,621	61,659,842
2007	61,659,842	1,473,473	1,313,372	5,601,492	11,128,732	69,973,927
2008	69,973,927	2,104,466	1,379,504	6,074,617	0	67,383,280
2009	67,383,280	2,830,448	1,391,701	6,478,130	0	65,127,299
2010	65,127,299	4,044,291	1,420,574	6,958,054	8,298,066	71,932,176
2011	71,932,176	4,227,510	1,423,956	7,548,457	16,434,249	86,469,434
2012	86,469,434	4,938,490	1,435,020	8,146,026	334,951	85,031,869
2013	85,031,869	5,793,904	1,414,734	8,852,902	10,818,519	94,206,124
2014	94,206,124					

Source: Terry Group compilation from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

Table G-2 Market Value of Assets for TRS, SERS, and SURS – Expected Investment Returns ($Thousands)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	31,817,482	931,469	818,589	2,171,954	2,686,555	34,082,141
1999	34,082,141	1,190,421	1,238,856	2,365,300	2,899,701	37,045,819
2000	37,045,819	1,312,570	1,006,915	2,610,894	3,136,510	39,890,920
2001	39,890,920	1,434,854	1,038,942	2,903,145	3,372,481	42,834,052
2002	42,834,052	1,549,575	1,129,667	3,248,573	3,616,698	45,881,419
2003	45,881,419	1,702,630	1,263,529	3,805,775	3,864,237	48,906,040
2004	48,906,040	9,111,599	1,212,287	4,284,247	4,413,698	59,359,377
2005	59,359,377	1,768,397	1,223,024	4,746,389	4,970,961	62,575,370
2006	62,575,370	1,048,348	1,266,043	5,222,736	5,195,302	64,862,327
2007	64,862,327	1,473,473	1,313,372	5,601,492	5,393,675	67,441,355
2008	67,441,355	2,104,466	1,379,504	6,074,617	5,622,413	70,473,121
2009	70,473,121	2,830,448	1,391,701	6,478,130	5,894,336	74,111,476
2010	74,111,476	4,044,291	1,420,574	6,958,054	6,236,015	78,854,302
2011	78,854,302	4,227,510	1,423,956	7,548,457	6,374,907	83,332,218
2012	83,332,218	4,938,490	1,435,020	8,146,026	6,746,936	88,306,638
2013	88,306,638	5,793,904	1,414,734	8,852,902	6,906,301	93,568,675
2014	93,568,675					

Source: Terry Group estimates from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

H. Expected market value of assets under different contribution policy

The dramatic impact of 2008 – 2009 recession on retirement system assets is largely independent of the contribution policy. If the retirement system were to contribute normal cost plus interest on UAAL (based on market value of assets), the market value of assets as of June 30, 2013 would have been $31 billion lower than expected ($99 billion versus $130 billion), mostly due to the 2008 – 2009 recession. See tables H-1 and H-2 for details. If the retirement system were to contribute the annual required contributions (ARC) the assets as of June 30, 2013 would have been $29 billion lower than expected ($78 billion versus $107 billion), mostly due to the 2008 – 2009 recession. See tables H-3 and H-4 for details.

Table H-1 Market Value of Assets for TRS, SERS, and SURS – Actual Returns
($Thousands)
Contribution Policy: Normal Cost + Interest on UAAL (Based on Market Value of Assets)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	31,817,482	1,864,907	818,589	2,171,954	5,507,320	37,836,344
1999	37,836,344	1,913,172	1,238,856	2,365,300	4,244,152	42,867,224
2000	42,867,224	1,978,992	1,006,915	2,610,894	5,008,395	48,250,633
2001	48,250,633	2,009,880	1,038,942	2,903,145	(2,836,086)	45,560,224
2002	45,560,224	2,832,655	1,129,667	3,248,573	(2,066,886)	44,207,087
2003	44,207,087	3,680,036	1,263,529	3,805,775	1,539,613	46,884,491
2004	46,884,491	4,109,137	1,212,287	4,284,247	8,462,474	56,384,142
2005	56,384,142	3,877,744	1,223,024	4,746,389	5,914,798	62,653,319
2006	62,653,319	4,004,506	1,266,043	5,222,736	7,371,498	70,072,630
2007	70,072,630	3,966,689	1,313,372	5,601,492	12,916,516	82,667,715
2008	82,667,715	3,798,665	1,379,504	6,074,617	(4,036,111)	77,735,156
2009	77,735,156	4,897,053	1,391,701	6,478,130	(16,927,796)	60,617,983
2010	60,617,983	7,054,982	1,420,574	6,958,054	7,910,109	70,045,595
2011	70,045,595	7,266,543	1,423,956	7,548,457	16,340,475	87,528,112
2012	87,528,112	6,508,697	1,435,020	8,146,026	334,412	87,660,215
2013	87,660,215	7,279,377	1,414,734	8,852,902	11,258,841	98,760,265
2014	98,760,265					

Source: Terry Group estimates from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

Table H-2 Market Value of Assets for TRS, SERS, and SURS – Expected Investment Returns ($Thousands)

Contribution Policy: Normal Cost + Interest on UAAL (Based on Market Value of Assets)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	31,817,482	1,864,907	818,589	2,171,954	2,726,226	35,055,250
1999	35,055,250	1,913,172	1,238,856	2,365,300	3,013,132	38,855,110
2000	38,855,110	1,978,992	1,006,915	2,610,894	3,318,622	42,548,746
2001	42,548,746	2,009,880	1,038,942	2,903,145	3,622,835	46,317,258
2002	46,317,258	2,832,655	1,129,667	3,248,573	3,967,301	50,998,308
2003	50,998,308	3,680,036	1,263,529	3,805,775	4,383,212	56,519,311
2004	56,519,311	4,109,137	1,212,287	4,284,247	4,848,221	62,404,709
2005	62,404,709	3,877,744	1,223,024	4,746,389	5,319,461	68,078,549
2006	68,078,549	4,004,506	1,266,043	5,222,736	5,788,709	73,915,071
2007	73,915,071	3,966,689	1,313,372	5,601,492	6,269,120	79,862,760
2008	79,862,760	3,798,665	1,379,504	6,074,617	6,750,236	85,716,548
2009	85,716,548	4,897,053	1,391,701	6,478,130	7,277,858	92,805,029
2010	92,805,029	7,054,982	1,420,574	6,958,054	7,952,921	102,275,453
2011	102,275,453	7,266,543	1,423,956	7,548,457	8,417,096	111,834,591
2012	111,834,591	6,508,697	1,435,020	8,146,026	9,144,204	120,776,486
2013	120,776,486	7,279,377	1,414,734	8,852,902	9,528,676	130,146,371
2014	130,146,371					

Source: Terry Group estimates from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

Table H-3 Market Value of Assets for TRS, SERS, and SURS – Actual Returns
($Thousands)
Contribution Policy: Annual Required Contributions (ARC)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Actual Investment Return	End of Year Assets
1998	31,817,482	1,480,438	818,589	2,171,954	5,474,695	37,419,250
1999	37,419,250	1,548,856	1,238,856	2,365,300	4,179,819	42,021,481
2000	42,021,481	1,627,994	1,006,915	2,610,894	4,893,098	46,938,594
2001	46,938,594	1,723,293	1,038,942	2,903,145	(2,760,453)	44,037,231
2002	44,037,231	1,905,072	1,129,667	3,248,573	(1,986,671)	41,836,726
2003	41,836,726	2,474,368	1,263,529	3,805,775	1,432,514	43,201,362
2004	43,201,362	2,984,197	1,212,287	4,284,247	7,705,041	50,818,640
2005	50,818,640	3,018,440	1,223,024	4,746,389	5,290,166	55,603,881
2006	55,603,881	3,014,080	1,266,043	5,222,736	6,488,605	61,149,873
2007	61,149,873	3,582,099	1,313,372	5,601,492	11,243,842	71,687,694
2008	71,687,694	3,643,374	1,379,504	6,074,617	(3,480,302)	67,155,653
2009	67,155,653	3,986,913	1,391,701	6,478,130	(14,521,516)	51,534,621
2010	51,534,621	4,662,527	1,420,574	6,958,054	6,632,109	57,291,777
2011	57,291,777	5,291,271	1,423,956	7,548,457	13,184,825	69,643,372
2012	69,643,372	6,488,128	1,435,020	8,146,026	265,294	69,685,788
2013	69,685,788	6,872,606	1,414,734	8,852,902	8,906,181	78,026,407
2014	78,026,407					

Source: Terry Group estimates from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

Table H-4 Market Value of Assets for TRS, SERS, and SURS – Expected Investment Returns ($Thousands)
Contribution Policy: Annual Required Contributions (ARC)

FY Year	Beginning of the year assets	Employer Contributions	Employee Contributions	Benefit Payments	Expected Investment Return	End of Year Assets
1998	31,817,482	1,480,438	818,589	2,171,954	2,709,887	34,654,442
1999	34,654,442	1,548,856	1,238,856	2,365,300	2,963,581	38,040,435
2000	38,040,435	1,627,994	1,006,915	2,610,894	3,234,458	41,298,908
2001	41,298,908	1,723,293	1,038,942	2,903,145	3,504,419	44,662,417
2002	44,662,417	1,905,072	1,129,667	3,248,573	3,787,217	48,235,800
2003	48,235,800	2,474,368	1,263,529	3,805,775	4,097,158	52,265,080
2004	52,265,080	2,984,197	1,212,287	4,284,247	4,438,802	56,616,119
2005	56,616,119	3,018,440	1,223,024	4,746,389	4,790,910	60,902,104
2006	60,902,104	3,014,080	1,266,043	5,222,736	5,136,618	65,096,109
2007	65,096,109	3,582,099	1,313,372	5,601,492	5,503,163	69,893,251
2008	69,893,251	3,643,374	1,379,504	6,074,617	5,896,227	74,737,739
2009	74,737,739	3,986,913	1,391,701	6,478,130	6,305,978	79,944,201
2010	79,944,201	4,662,527	1,420,574	6,958,054	6,758,072	85,827,320
2011	85,827,320	5,291,271	1,423,956	7,548,457	6,988,193	91,982,283
2012	91,982,283	6,488,128	1,435,020	8,146,026	7,516,534	99,275,939
2013	99,275,939	6,872,606	1,414,734	8,852,902	7,814,375	106,524,752
2014	106,524,752					

Source: Terry Group estimates from TRS, SERS, and SURS actuarial valuation reports and CAFRs, 1997 – 2013

I. The impact of 2010 and 2012 investment return assumption change on 2013 actuarial accrued liability

Each year the systems' actuaries quantified the impact on actuarial accrued liability (AAL) due to

(1) all sources of change: gains, losses, assumption changes and plan changes
(2) investment return assumption change, if applicable

These two items are shown in column (1) and (2) of the following table. The impact of the investment return assumption change on AAL was calculated by the systems' actuaries when the change was made. For SERS and SURS, the impact was calculated on 2010 AAL. For TRS, the impact was calculated on 2012 AAL. This section shows the details of how I estimated the impact of the investment return assumption change on 2013 AAL based on its impact on prior year's AAL.

In 2009, 2010, 2011 and 2012, the systems' actuaries also projected the AAL to 2013. By calculating the difference in the projected 2013 AAL between the current year projection and the prior year projection, I obtained an estimate for the change in projected 2013 AAL for the current year. This is shown in column (3) of the following table.

The change in 2013 AAL due to the investment return assumption change is estimated as a pro-rata portion of the change in projected 2013 AAL (= (3) / (1) x (2)). The result is $10 billion.

Table I-1: Impact of 2010 and 2012 investment return assumption changes on projected 2013 AAL ($ thousands)

Plan and Fiscal Year	(1) Liability change due to gains, losses, assumption changes and plan changes	(2) Change in liability due to investment return assumption change	(3) Change in projected 2013 liability	(4) Estimated change in projected 2013 liability due to investment return assumption change (4) = (3) / (1) x (2)
SERS, 2010	$2,685,100	$2,606,300	$2,824,000	$2,741,000
SURS, 2010	2,511,600	2,413,900	2,685,000	2,581,000
TRS, 2012	4,032,695	4,624,966	4,637,000	5,318,000
Total	$9,229,395	$9,645,166	$10,146,000	$10,641,000

Source: Terry Group estimate based on respective actuarial valuation reports, 2009 - 2012

J. The impact of additional 50 basis points change in investment return assumption on 2013 actuarial accrued liability

To estimate the impact of the additional 50 basis points change in the investment return assumption on 2013 actuarial accrued liability (AAL), I calculated the impact separately for the active and retiree liabilities and adjusted the reported 2013 AAL accordingly.

The actuarial adjustment factors were developed based on the information in the 2013 actuarial valuation reports, assuming all other assumptions stay the same except for the investment return assumption. See the Actuarial Estimate section of Appendix A for the methodology used in developing the actuarial adjustment factors.

The resulting increase in AAL is $7 billion. See Table J-1

Table J-1: Impact of Additional 50 basis point reduction in investment return assumption on 2013 AAL ($ thousands)

Plan	(1) Active/deferred liability	(2) Estimated 50 basis points interest rate adjustment factor for active liability	(3) Retiree liability	(4) Estimated 50 basis points interest rate adjustment factor for retiree liability	(5) Estimated change in liability (5) = (1) x (2) + (3) x (4)
TRS	$33,257,403	1.8%	$60,629,585	4.5%	$3,300,000
SERS	12,617,927	9.9%	22,102,837	4.5%	2,200,000
SURS	12,273,210	7.1%	22,099,894	4.5%	1,900,000
Total	$58,148,540		$104,832,316		$7,400,000

Source: Terry Group estimate based on respective 2013 actuarial valuation reports

K. The impact of longevity improvement on 2013 actuarial accrued liability

In this section the impact of longevity improvement on 2013 actuarial accrued liability (AAL) is quantified. Table K-1 estimates the impact of updating mortality assumption since 1997. Table K-2 estimates the impact of mortality projection scale MP-2014 on 2013 AAL.

To estimate the longevity improvement impact, the actuarial adjustment factors were developed based on the information in the 2013 actuarial valuation reports, assuming all other assumptions stay the same except for the mortality assumptions. See the Actuarial Estimate section of Appendix A for the methodology used in developing the actuarial adjustment factors. The actuarial adjustment factors were applied to active and retiree liability separately and then summed.

Table K-1 Impact of updating mortality assumptions since 1997 ($million)

Plan	(1) Active liability	(2) Estimated adjustment factor for mortality assumption change for active liability	(3) Retiree liability	(4) Estimated adjustment factor for mortality assumption change for retiree liability	(5) Estimated change in liability (5) = (1) x (2) + (3) x (4)
TRS	$33,257	1.8%	$60,630	1.5%	$1,500
SERS	12,618	1.3%	22,103	1.0%	390
SURS	12,273	5.9%	22,100	7.4%	2,400
Total	$58,149		$104,832		$4,290

Source: Terry group estimate based on respective 2013 actuarial valuation reports

Table K-2 Impact of Mortality Projection Scale MP-2014 on 2013 Liability ($million)

Plan	(1) Active liability	(2) Estimated adjustment factor for mortality assumption change for active liability	(3) Retiree liability	(4) Estimated adjustment factor for mortality assumption change for retiree liability	(5) Estimated change in liability (5) = (1) x (2) + (3) x (4)
TRS	$33,257	1.1%	$60,630	4.4%	$3,000
SERS	12,618	1.1%	22,103	4.4%	1,100
SURS	12,273	1.1%	22,100	4.4%	1,100
Total	$58,149		$104,832		$5,200

Source: Terry group estimate based on respective 2013 actuarial valuation reports

L. Social Security cost of living increase

The table below shows the Social Security cost of living increases since 1975. Prior to 1975, Social Security benefit increases were set by legislation.

Table L-1 Social Security cost of living increase since 1975

Year	COLA	Year	COLA	Year	COLA
1975	8.0%	1990	5.4%	2005	4.1%
1976	6.4%	1991	3.7%	2006	3.3%
1977	5.9%	1992	3.0%	2007	2.3%
1978	6.5%	1993	2.6%	2008	5.8%
1979	9.9%	1994	2.8%	2009	0.0%
1980	14.3%	1995	2.6%	2010	0.0%
1981	11.2%	1996	2.9%	2011	3.6%
1982	7.4%	1997	2.1%	2012	1.7%
1983	3.5%	1998	1.3%	2013	1.5%
1984	3.5%	1999	2.5%		
1985	3.1%	2000	3.5%		
1986	1.3%	2001	2.6%		
1987	4.2%	2002	1.4%		
1988	1.0%	2003	2.1%		
1989	4.7%	2004	2.7%		

Source: Social Security Administration

M. Consumer Price Index – All Urban Consumers (CPI-U) for the last 50 years

The table below shows the annual CPI-U change for the last 50 years. The annual CPI-U change is calculated as the percent change from July of the previous year to July of the current year.

Table M-1 CPI-U change for the last 50 years

Year	CPI-U change	Year	CPI-U change	Year	CPI-U change
1963	1.3%	1983	2.5%	2003	2.1%
1964	1.3%	1984	4.2%	2004	3.0%
1965	1.6%	1985	3.6%	2005	3.2%
1966	2.8%	1986	1.6%	2006	4.1%
1967	2.8%	1987	3.9%	2007	2.4%
1968	4.5%	1988	4.1%	2008	5.6%
1969	5.4%	1989	5.0%	2009	-2.1%
1970	6.0%	1990	4.8%	2010	1.2%
1971	4.4%	1991	4.4%	2011	3.6%
1972	2.9%	1992	3.2%	2012	1.4%
1973	5.7%	1993	2.8%	2013	2.0%
1974	11.5%	1994	2.8%		
1975	9.7%	1995	2.8%		
1976	5.4%	1996	3.0%		
1977	6.8%	1997	2.2%		
1978	7.7%	1998	1.7%		
1979	11.3%	1999	2.1%		
1980	13.1%	2000	3.7%		
1981	10.8%	2001	2.7%		
1982	6.4%	2002	1.5%		

Source: US Census Bureau, Consumer Price Index – All Urban Consumers, not seasonally adjusted. The annual CPI-U change is calculated as the percent change from July of the previous year to July of the current year

N. Calculation of the difference in the market value of assets if 1.5% cost of living increases had been granted in the past instead of 3% AAI since 1997

The following tables show the difference in the market value of assets if 1.5% cost of living increases had been granted in the past instead of 3% AAI since 1997.

First, I estimate the proportion of annual annuity benefit payments provided to continuing annuitants and to new annuitants. Based on the average retirement age of the retirees, I assumed that approximately 2% to 3% of the annual annuity payments are for new annuitants. The benefit payments associated with continuing annuitants are increased with a 1.5% cost of living increase instead of a 3% AAI. This amount is combined with the benefit payments for new annuitants to arrive at an estimate of what the annuity benefit payment would have been if a 1.5% cost of living increases had been granted since 1997.

Then the difference in annuity payments is calculated and accumulated with actual trust return to June 30, 2013. Tables I-1, I-2, I-3 show the calculation details for TRS, SERS, and SURS.

Table N-1 Impact of 1.5% COLA Versus 3% AAI – TRS ($million

Year	Annuity Payments – 3% AAI	Annuity Payments – 1.5% COLA	Difference in Annuity Payments	Actual Trust Return	Difference in Annuity Payments Accumulated with Actual Trust Return
1997	1,166.46	1,166.46	-	17.93%	-
1998	1,212.69	1,195.55	17.14	16.72%	18.51
1999	1,317.31	1,282.53	34.78	10.44%	57.00
2000	1,452.72	1,398.98	53.74	10.53%	119.50
2001	1,639.63	1,565.25	74.38	-4.16%	187.34
2002	1,925.41	1,827.95	97.46	-3.12%	277.43
2003	2,176.42	2,052.08	124.33	4.78%	417.96
2004	2,432.79	2,278.36	154.43	16.46%	653.41
2005	2,796.72	2,608.77	187.95	10.69%	920.99
2006	3,016.86	2,785.83	231.03	11.98%	1,275.81
2007	3,342.35	3,070.69	271.66	19.07%	1,815.54
2008	3,549.17	3,232.94	316.23	-4.89%	2,035.16
2009	3,812.55	3,449.67	362.87	-22.89%	1,887.96
2010	4,107.59	3,695.10	412.49	12.97%	2,571.25
2011	4,418.02	3,952.61	465.41	23.50%	3,692.70
2012	4,780.74	4,258.87	521.88	0.61%	4,238.70
2013	4,811.37	4,228.56	582.81	12.70%	5,395.72

Source: Terry group estimate based on TRS actuarial valuation reports and CAFRs, 1997 - 2013

Table N-2 Impact of 1.5% COLA Versus 3% AAI – SERS ($million)

Year	Annuity Payments – 3% AAI	Annuity Payments – 1.5% COLA	Difference in Annuity Payments	Actual Trust Return	Difference in Annuity Payments Accumulated with Actual Trust Return
1997	359.90	359.90	-	18.50%	-
1998	402.80	397.53	5.27	18.00%	5.72
1999	440.90	429.80	11.10	12.80%	18.25
2000	484.50	467.09	17.41	11.70%	38.78
2001	547.00	522.77	24.23	-6.88%	59.49
2002	619.00	587.14	31.86	-6.60%	86.36
2003	955.90	915.42	40.48	0.30%	127.15
2004	997.70	943.87	53.83	16.40%	206.08
2005	1,051.30	983.71	67.59	9.76%	297.01
2006	1,100.70	1,017.02	83.68	10.98%	417.78
2007	1,156.00	1,057.52	98.48	16.79%	594.34
2008	1,226.40	1,112.60	113.80	-5.73%	670.78
2009	1,318.40	1,188.53	129.87	-19.56%	656.06
2010	1,408.00	1,261.10	146.90	9.48%	871.95
2011	1,512.90	1,348.06	164.84	21.16%	1,237.90
2012	1,687.70	1,503.75	183.95	0.05%	1,422.51
2013	1,824.70	1,619.44	205.26	13.74%	1,836.87

Source: Terry group estimate based on SERS actuarial valuation reports and CAFRs, 1997 - 2013

Table N-3 Impact of 1.5% COLA Versus 3% AAI – SURS ($million)

Year	Annuity Payments – 3% AAI	Annuity Payments – 1.5% COLA	Difference in Annuity Payments	Actual Trust Return	Difference in Annuity Payments Accumulated with Actual Trust Return
1997	424.80	424.80	-	21.00%	-
1998	476.00	469.76	6.24	20.00%	6.84
1999	535.10	521.92	13.18	11.50%	21.54
2000	607.10	586.18	20.92	14.00%	46.90
2001	687.50	657.88	29.62	-8.80%	71.05
2002	766.60	727.20	39.40	-6.10%	104.90
2003	859.60	809.38	50.22	2.90%	158.89
2004	948.20	885.97	62.23	17.00%	253.21
2005	1,020.20	944.85	75.35	10.44%	358.84
2006	1,107.50	1,016.49	91.01	11.70%	497.00
2007	1,197.20	1,091.20	106.00	18.30%	703.25
2008	1,297.40	1,175.40	122.00	-4.50%	790.82
2009	1,385.10	1,245.96	139.14	-19.70%	759.72
2010	1,490.50	1,333.31	157.19	15.00%	1,042.24
2011	1,619.60	1,443.20	176.40	23.80%	1,486.56
2012	1,771.50	1,574.41	197.09	0.50%	1,691.57
2013	1,909.40	1,689.84	219.56	12.50%	2,135.90

Source: Terry group estimate based on SURS actuarial valuation reports and CAFRs, 1997 - 2013

O. The impact on 2013 actuarial accrued liability if the 3% AAI is replaced with a 1.5% cost of living increase in the future

In appendix N, I quantified the amount of asset that would have remained in the pension fund if the 3% AAI is replaced with a 1.5% COLA since 1997. Appendix N also shows that the amount of annual annuity payments will be reduced by 11% to 12% today if the 1.5% COLA was in effect since 1997. These are the historical impact of granting a 1.5% COLA instead of a 3% AAI from 1997 through 2013.

In this section I estimated the impact on 2013 actuarial accrued liability if the 3% AAI is replaced with a 1.5% cost of living increase (COLA) in the future.

To estimate the impact of a 1.5% COLA on 2013 actuarial accrued liability (AAL), I calculated the impact separately for the active and retiree liabilities and adjusted the reported 2013 AAL accordingly.

The actuarial adjustment factors were developed based on the information in the 2013 actuarial valuation reports, assuming all other assumptions stay the same except for the COLA assumption. See the Actuarial Estimate section of Appendix A for the methodology used in developing the actuarial adjustment factors.

The resulting increase in AAL is approximately $15 billion. See Table O-1.

Table O-1: Impact of a 1.5% COLA instead of 3% AAI on 2013 AAL ($ million)

Plan	Active liability (1)	Estimated COLA change for active liability (2)	Retiree liability (3)	Estimated COLA change for retiree liability (4)	Retiree annuity payments with 1.5% COLA (5)	Estimated change in liability (5) = (1) x (2) + (3) x (4) x (5)
TRS	33,257	2.4%	60,630	13%	88%	7,700
SERS	12,618	13%	22,103	12%	89%	4,000
SURS	12,273	6.7%	22,100	12%	89%	3,200
Total	58,148		104,833			14,900

Source: Terry group estimate based on respective 2013 actuarial valuation reports

P. The impact of Public Act 98-599 on the actuarial accrued liability.

The following tables show the impact of PA 98-599 on the retirement system's actuarial accrued liability and the present value of employee contributions. These impacts are measured as of June 30, 2013. Projected unit credit cost method is used for actuarial accrued liability.

Table P-1 The impact of PA 98-599 on the actuarial accrued liability ($ millions)

	Actuarial Liability pre-PA 98-599	Actuarial Liability Post-PA 98-599	Reduction in Actuarial liability due to 98-599
TRS	$93,887	$79,536	$14,351
SERS	34,721	30,940	3,781
SURS	34,373	29,822	4,551
Total	$162,981	$140,298	$22,683

Source: Information obtained from retirement systems' actuaries

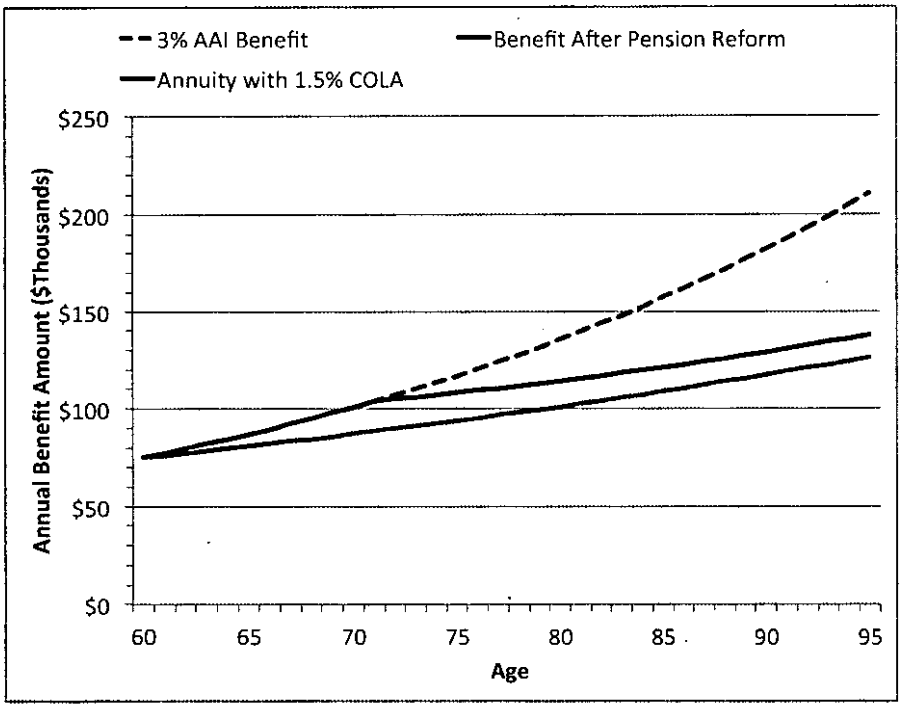
Table P-2 The present value of the reduction in employee contributions to the retirement systems ($ millions)

	Lower Present Value of Employee Contributions due to PA 98-599
TRS	$2,220
SERS	423
SURS	304
Total	$2,947

Source: Information obtained from retirement systems' actuaries

Q. Examples of the impact of pension reforms on retirees

Figure Q-1 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $75,000; service = 35; age retired = 60; year retired = 2003



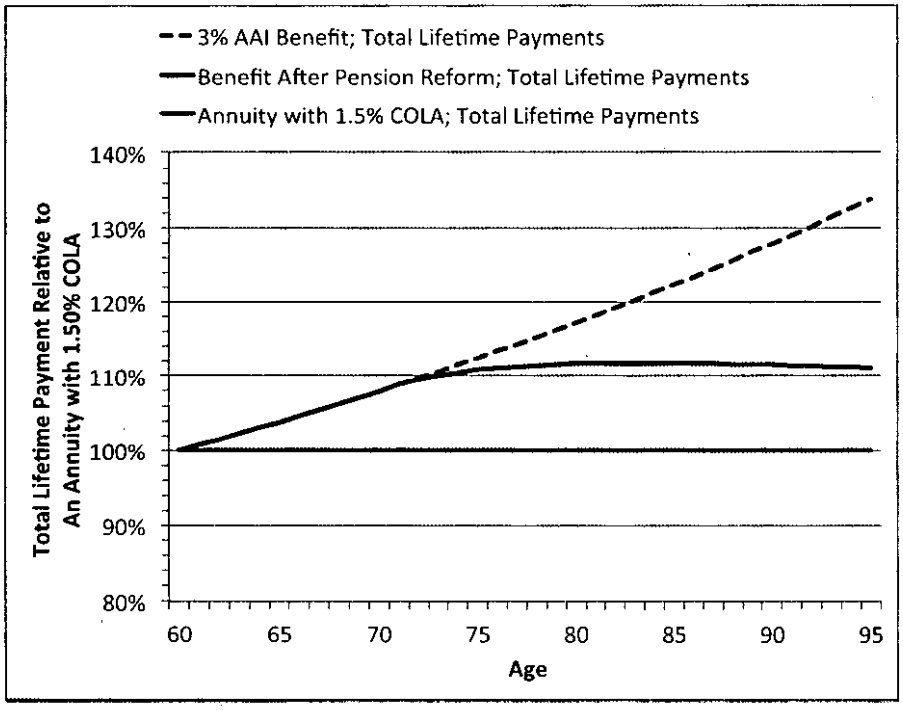
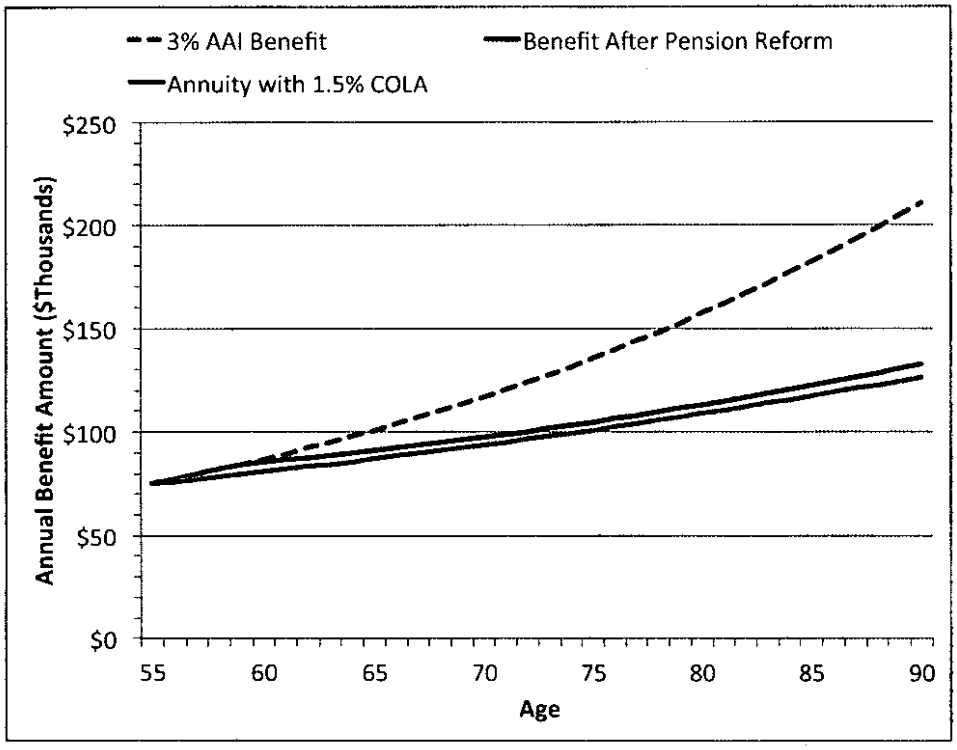


Figure Q-2 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $75,000; service = 35; age retired = 55; year retired = 2010



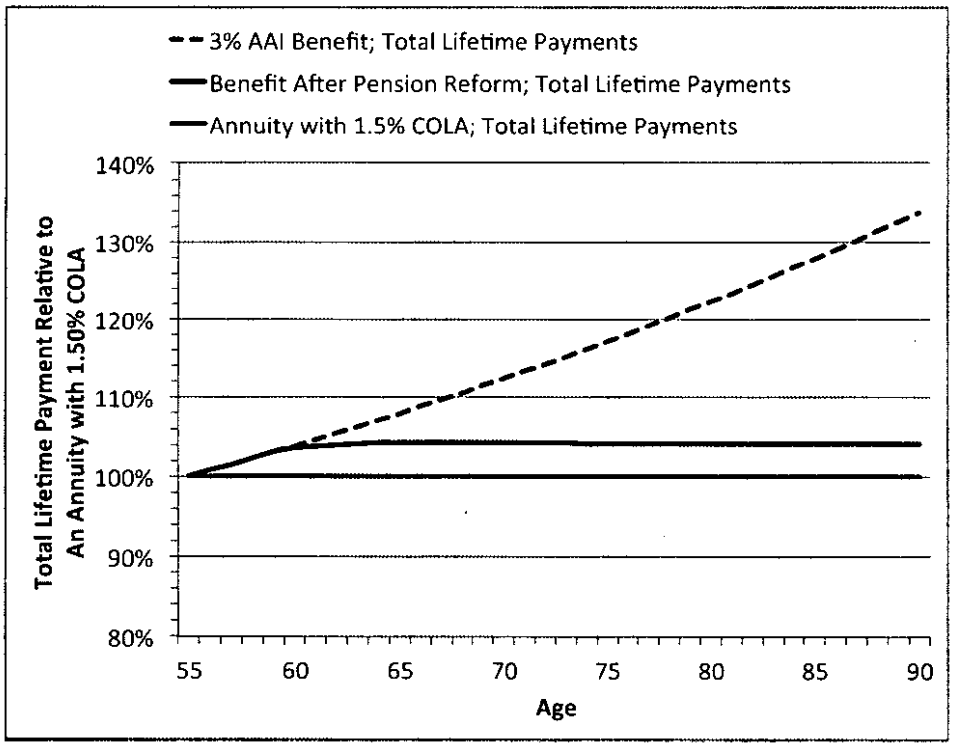
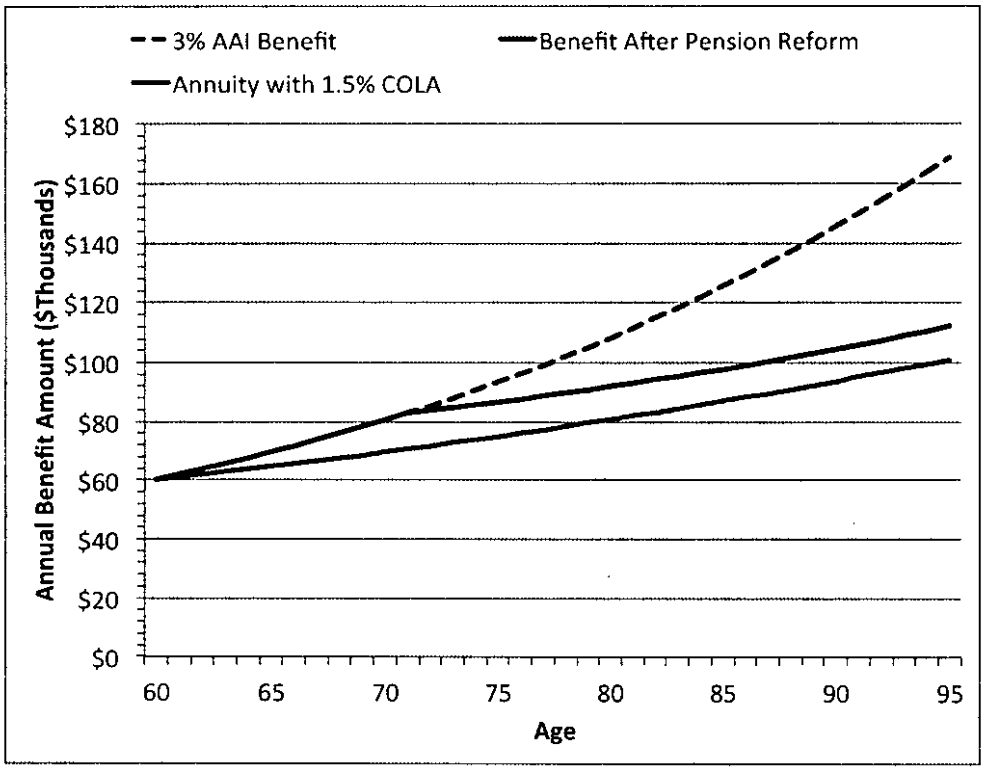


Figure Q-3 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $60,000; service = 30; age retired = 60; year retired = 2003



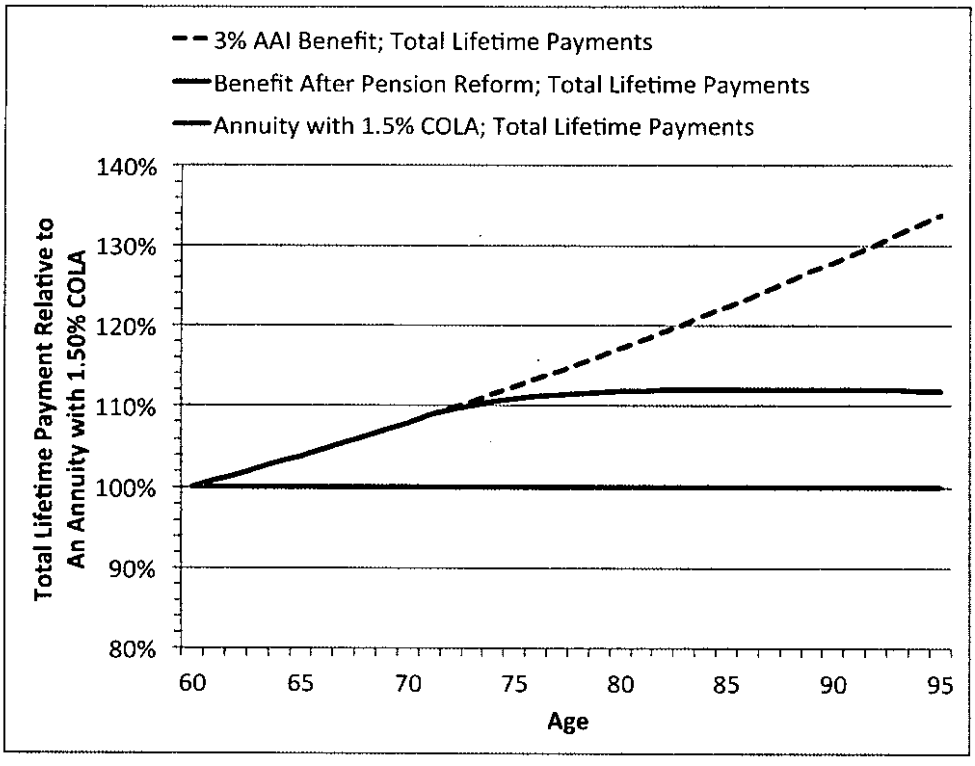
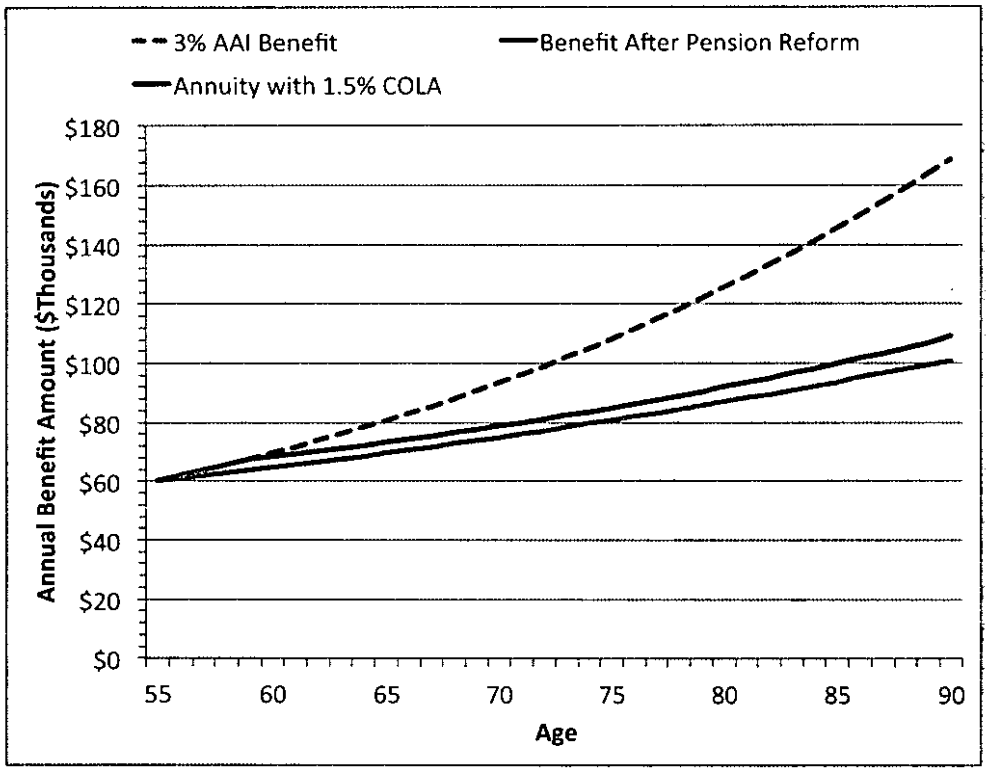


Figure Q-4 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $60,000; service = 30; age retired = 55; year retired = 2010



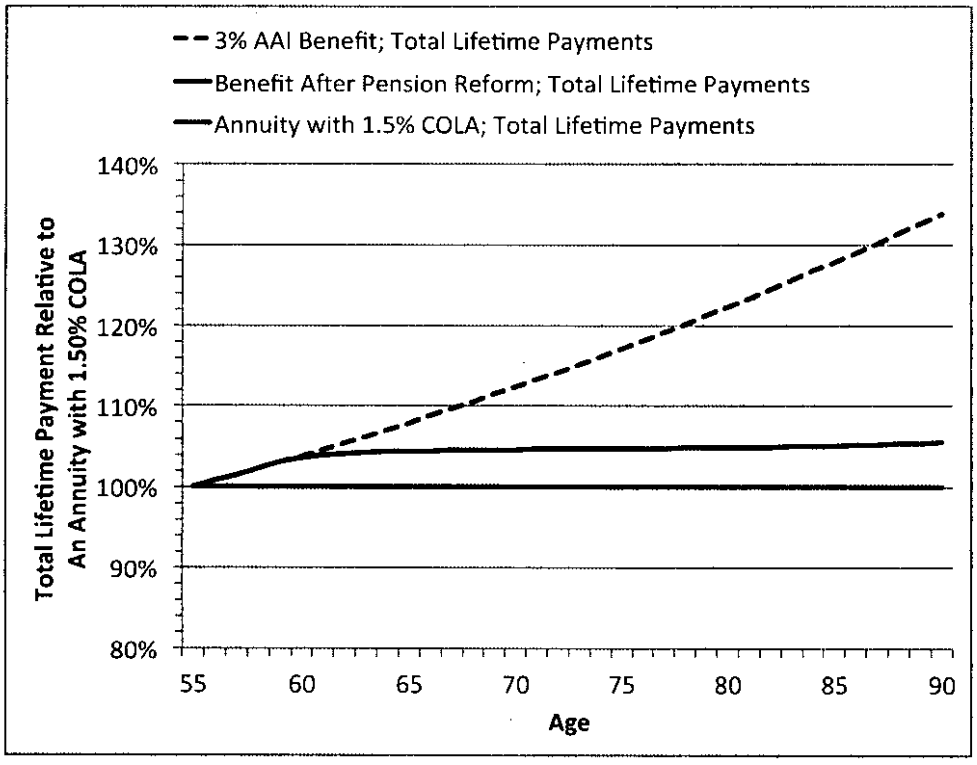
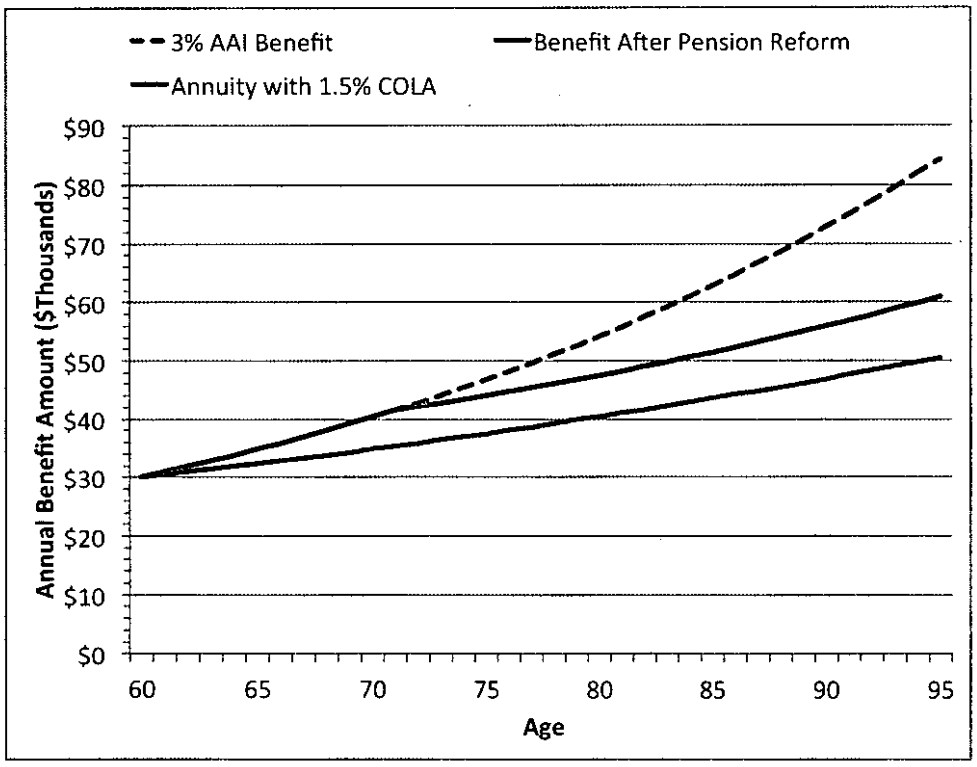


Figure Q-5 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $30,000; service = 20; age retired = 60; year retired = 2003



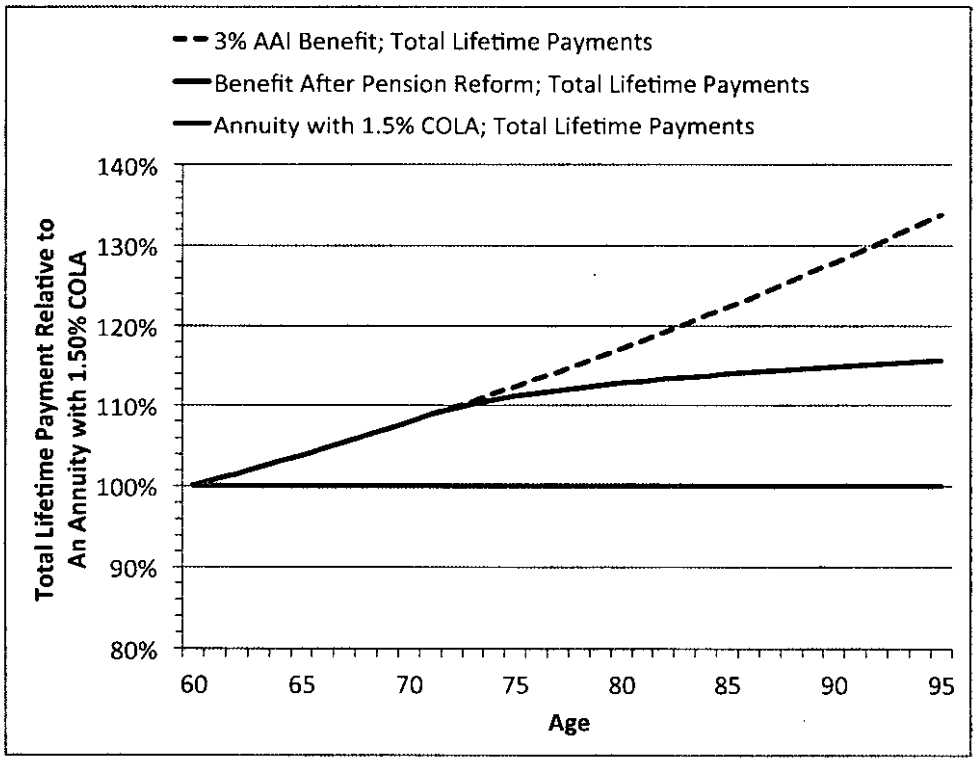
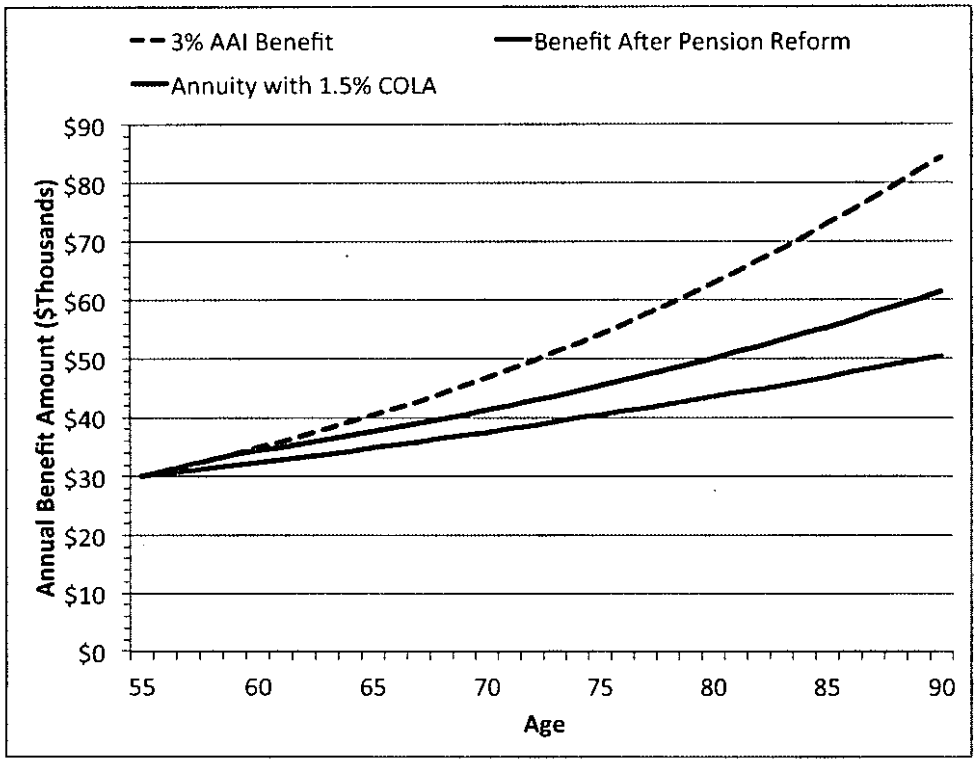


Figure Q-6 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $30,000; service = 20; age retired = 55; year retired = 2010



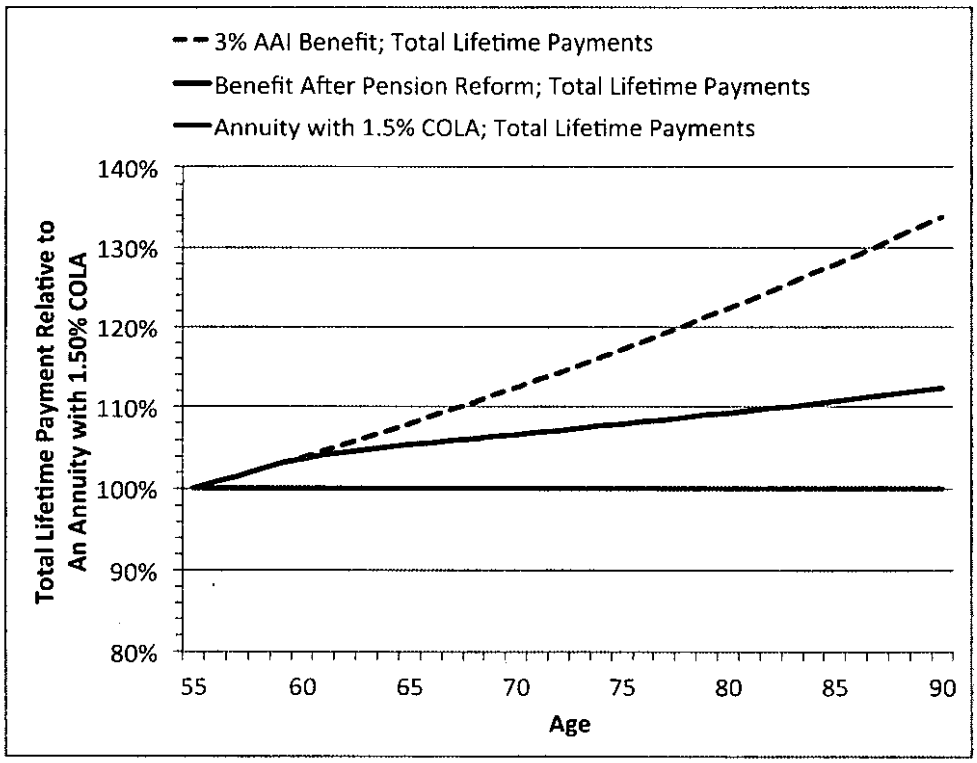
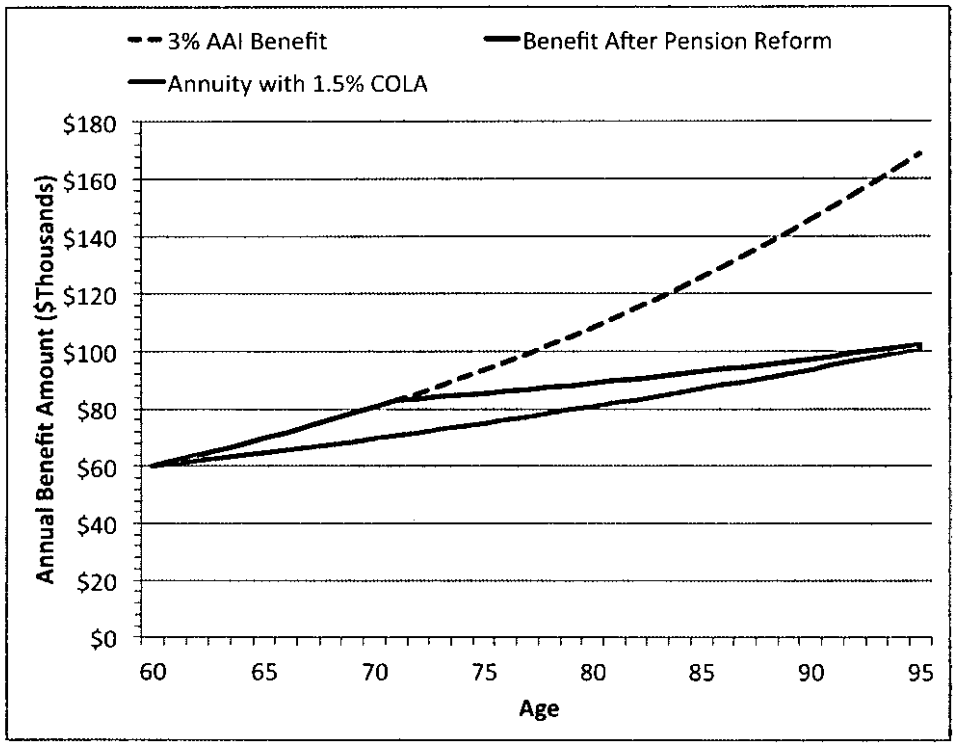


Figure Q-7 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $60,000; service = 20; age retired = 60; year retired = 2003



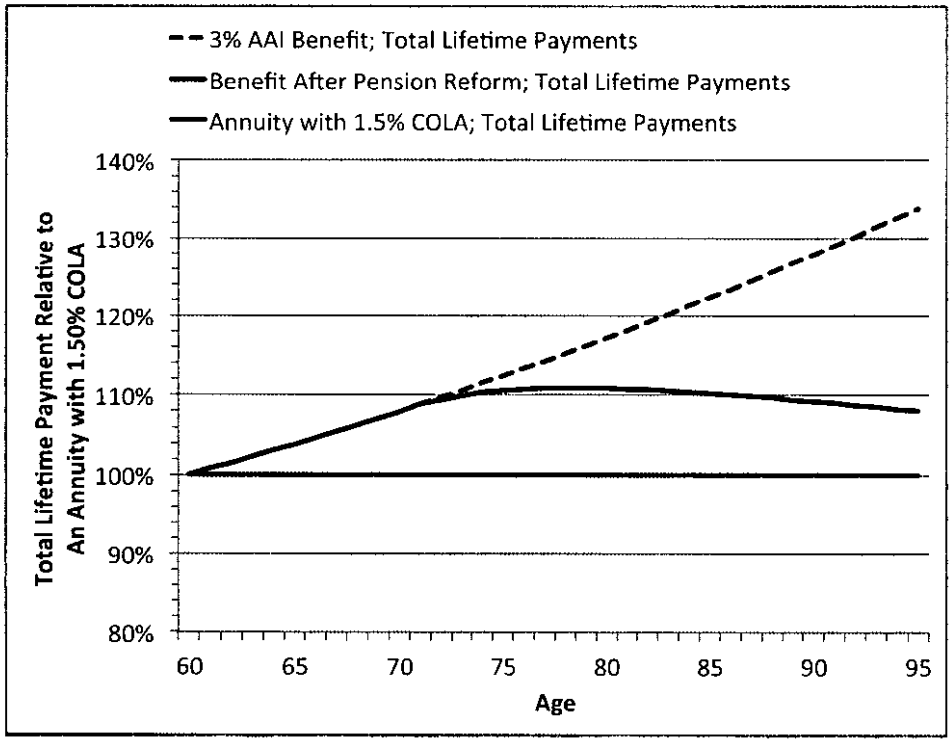
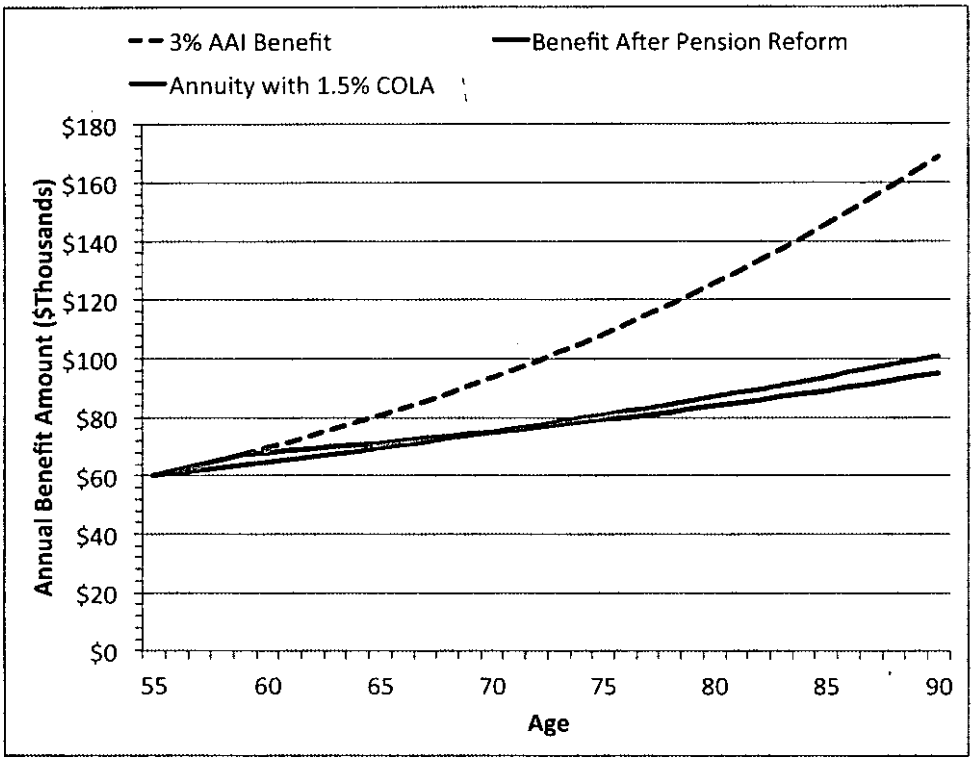
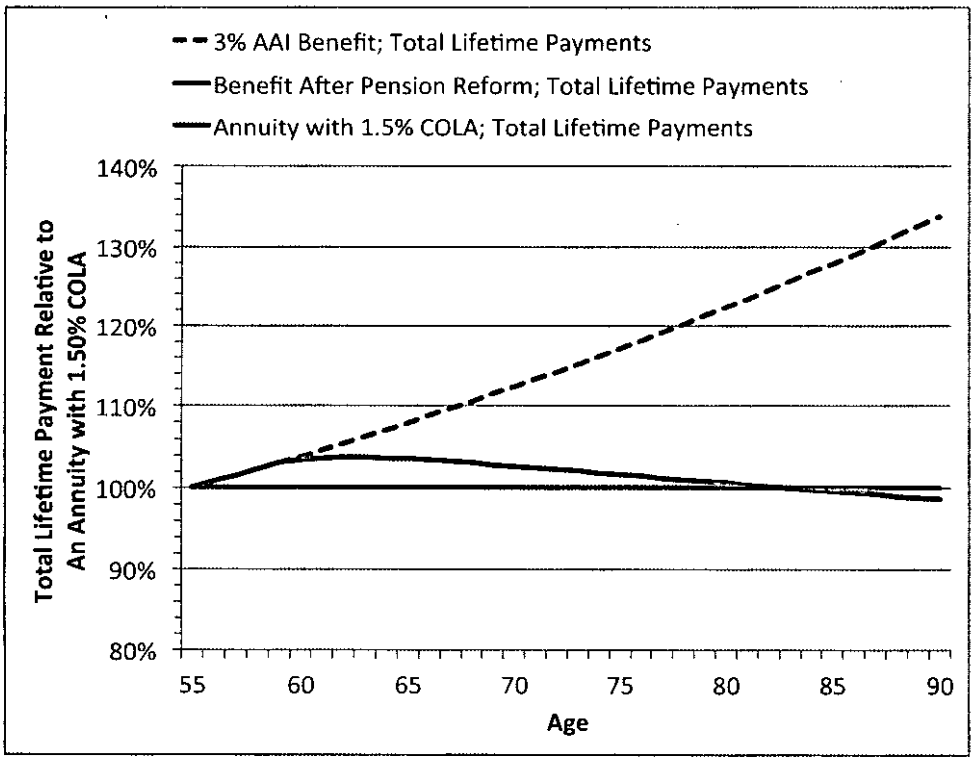


Figure Q-8 Comparison of 3% AAI, pension benefit after pension reform and an annuity with 1.5% COLA for a sample retiree not covered by Social Security: initial benefit = $60,000; service = 20; age retired = 55; year retired = 2010





R. Methodology for calculating the impact of PA 98-0599 for retirees

Retiree census data were received from the retirement systems. The present value of benefits were calculated for the following three post-retirement benefit increases: current benefit with a 3% Automatic Annual Increase (AAI), benefits under a 1.5% cost of living increase (COLA) and benefits after the pension reform. An illustration of the calculation is shown below.

For this illustration I considered a female retiree with an initial benefit of $36,000, with 35 years of service, retiring at age 60 in 2003, and not covered by Social Security. The discount rate is 8%, inflation is assumed to be 2.5% per year and the mortality is RP2000 generational mortality with projection scale AA. Table R-2 shows the projected benefits under a 3% AAI, a 1.5% cost of living increase, and after the pension reform. Table R-3 shows the probability of survival and the interest discount.

The present value of pension benefits is sum of the benefit amount each year multiplied by the probability of survival and the interest discount. Table R-1 shows the present value of future benefits for the three post-retirement benefit increases calculated as of 2014. In this example, the present value of pension benefits after pension reform is approximately 6% below the present value of pension benefits with a 3% AAI, but 23% above the present value of the benefits with a 1.5% cost of living increase (not counting the additional payments received from 2003 to 2013).

For the retiree impact presented in my report, the present value of benefits is calculated for each retiree under the three post-retirement benefit increases. The results for all retirees are then summarized. The accumulated value of a 3.0% AAI over a 1.5% cost of living increase from benefit commencement to 2014 is also calculated. The impact of pension reform is calculated as the percent change of the present value before and after the pension reform. The net impact referenced in my report compares the present value of pension benefits after the pension reform plus the accumulated value of a 3.0% AAI over a 1.5% cost of living increase from benefit commencement to 2014, with the present value of benefits with a 3% AAI.

Table R-1 Present value of pension benefits under a 3% AAI, a 1.5% cost of living increase and after pension reform

Post-retirement benefit increases	Present value of pension benefits as of 2014
3.0% automatic annual increase	$557,964
1.5% cost of living increase	425,958
Benefits after pension reform	524,252

Table R-2 Pension benefits under a 3% AAI, a 1.5% cost of living increase and after pension reform

Year	Age	Benefits under a 3% AAI	Benefits under a 1.5% COLA	COLA cap	COLA increase after pension reform	Benefits After Pension Reform
2003	60	36,000	36,000	-		36,000
2004	61	37,080	36,540	-		37,080
2005	62	38,192	37,088	-		38,192
2006	63	39,338	37,644	-		39,338
2007	64	40,518	38,209	-		40,518
2008	65	41,734	38,782	-		41,734
2009	66	42,986	39,364	-		42,986
2010	67	44,275	39,954	-		44,275
2011	68	45,604	40,554	-		45,604
2012	69	46,972	41,162	-		46,972
2013	70	48,381	41,779	-		48,381
2014	71	49,832	42,406	35,000	1,050	49,832
2015	72	51,327	43,042	35,875	1,076	50,882
2016	73	52,867	43,688	36,772	1,103	51,959
2017	74	54,453	44,343	37,691	1,131	53,062
2018	75	56,087	45,008	38,633	1,159	54,193
2019	76	57,769	45,683	39,599	1,188	55,352
2020	77	59,503	46,369	40,589	1,218	56,540
2021	78	61,288	47,064	41,604	1,248	57,757
2022	79	63,126	47,770	42,644	1,279	59,005
2023	80	65,020	48,487	43,710	1,311	60,285
2024	81	66,971	49,214	44,803	1,344	61,596
2025	82	68,980	49,952	45,923	1,378	62,940
2026	83	71,049	50,702	47,071	1,412	64,318
2027	84	73,181	51,462	48,248	1,447	65,730
2028	85	75,376	52,234	49,454	1,484	67,177
2029	86	77,637	53,018	50,690	1,521	68,661
2030	87	79,966	53,813	51,958	1,559	70,182
2031	88	82,365	54,620	53,257	1,598	71,740
2032	89	84,836	55,439	54,588	1,638	73,338
2033	90	87,381	56,271	55,953	1,679	74,976
2034	91	90,003	57,115	57,352	1,721	76,654
2035	92	92,703	57,972	58,785	1,764	78,375
2036	93	95,484	58,841	60,255	1,808	80,138
2037	94	98,349	59,724	61,761	1,853	81,946
2038	95	101,299	60,620	63,305	1,899	83,799
2039	96	104,338	61,529	64,888	1,947	85,698

2040	97	107,468	62,452	66,510	1,995	87,645
2041	98	110,692	63,389	68,173	2,045	89,640
2042	99	114,013	64,340	69,877	2,096	91,685
2043	100	117,433	65,305	71,624	2,149	93,782

Table R-3 Probability of survival and interest discount

Year	Age	Benefits under a 3% AAI	Benefits under a 1.5% COLA	Benefits After Pension Reform	Probability of Survival	Interest discount
2014	71	49,832	42,406	49,832	1.000000	1.000000
2015	72	51,327	43,042	50,882	0.982922	0.925926
2016	73	52,867	43,688	51,959	0.964363	0.857339
2017	74	54,453	44,343	53,062	0.944567	0.793832
2018	75	56,087	45,008	54,193	0.923227	0.735030
2019	76	57,769	45,683	55,352	0.900772	0.680583
2020	77	59,503	46,369	56,540	0.876826	0.630170
2021	78	61,288	47,064	57,757	0.850842	0.583490
2022	79	63,126	47,770	59,005	0.823241	0.540269
2023	80	65,020	48,487	60,285	0.793965	0.500249
2024	81	66,971	49,214	61,596	0.762973	0.463193
2025	82	68,980	49,952	62,940	0.730240	0.428883
2026	83	71,049	50,702	64,318	0.695753	0.397114
2027	84	73,181	51,462	65,730	0.659524	0.367698
2028	85	75,376	52,234	67,177	0.621596	0.340461
2029	86	77,637	53,018	68,661	0.580922	0.315242
2030	87	79,966	53,813	70,182	0.537533	0.291890
2031	88	82,365	54,620	71,740	0.491615	0.270269
2032	89	84,836	55,439	73,338	0.445027	0.250249
2033	90	87,381	56,271	74,976	0.396861	0.231712
2034	91	90,003	57,115	76,654	0.349534	0.214548
2035	92	92,703	57,972	78,375	0.303899	0.198656
2036	93	95,484	58,841	80,138	0.260780	0.183941
2037	94	98,349	59,724	81,946	0.219425	0.170315
2038	95	101,299	60,620	83,799	0.182178	0.157699
2039	96	104,338	61,529	85,698	0.149339	0.146018
2040	97	107,468	62,452	87,645	0.120971	0.135202
2041	98	110,692	63,389	89,640	0.095955	0.125187
2042	99	114,013	64,340	91,685	0.075330	0.115914
2043	100	117,433	65,305	93,782	0.058617	0.107328
2044	101	120,956	66,284	73,415	0.045283	0.099377
2045	102	124,585	67,278	75,250	0.034196	0.092016
2046	103	128,323	68,288	77,131	0.025493	0.085200
2047	104	132,172	69,312	79,060	0.018711	0.078889

2048	105	136,137	70,352	81,036	0.013490	0.073045
2049	106	140,222	71,407	83,062	0.009536	0.067635
2050	107	144,428	72,478	85,139	0.006600	0.062625
2051	108	148,761	73,565	87,267	0.004470	0.057986
2052	109	153,224	74,669	89,449	0.002962	0.053690
2053	110	157,821	75,789	91,685	0.001921	0.049713
2054	111	162,555	76,926	93,977	0.001220	0.046031
2055	112	167,432	78,079	96,327	0.000761	0.042621
2056	113	172,455	79,251	98,735	0.000467	0.039464
2057	114	177,628	80,439	101,203	0.000283	0.036541
2058	115	182,957	81,646	103,733	0.000171	0.033834
2059	116	188,446	82,871	106,327	0.000102	0.031328
2060	117	194,099	84,114	108,985	0.000061	0.029007
2061	118	199,922	85,375	111,709	0.000037	0.026859
2062	119	205,920	86,656	114,502	0.000022	0.024869
2063	120	212,098	87,956	117,365	0.000013	0.023027

S. Source Material

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