Why Did the Costs of Connecticut Teachers' Pensions Rise So Much?

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Introduction and Summary

Rising pension costs are becoming a significant factor in per pupil expenditures in various school systems around the country. As a first step in determining what, if anything, can be done to redirect such expenditures to the classroom (or the taxpayers), it would be helpful to understand not only the extent of the rise, but also the sources thereof. Both of these vary from state to state. In some states these costs are not rising, while in others they are rising dramatically, from a few hundred dollars per pupil to over $2,000. Where they are rising, the sources of the rise also vary, and are not often well understood.

The common candidates for explaining the rise in pension costs are these: Is it because benefits have been enhanced of late? Or is it because states have failed to provide the actuarially determined contributions, so that the bill is belatedly coming due? Have the actuarial practices themselves led to such deferred funding, by design? Or (in a related vein) has the market performance of pension funds fallen short, over extended periods, from the return that has been actuarially assumed?

In this paper, I provide an in-depth analysis of the rise in per pupil pension contributions for the Connecticut State Teachers' Retirement System (CSTRS). Connecticut is an important state in its own right, and its serious teacher pension difficulties bear greater national attention than it currently receives, compared to more well-known cases of troubled pension systems, such as California, New Jersey, or Illinois.[1]

In addition, this analysis may be of wider interest for two reasons: methodological and policy. On the methodological side, although there has been related work in decomposing the rise in unfunded liabilities, to my knowledge there has not been comparable work on the sources of the rise in per pupil pension contributions. The methodology developed below may be applicable to other states.

On the policy side, case studies such as CSTRS can shed light on policies found in these states that arise elsewhere. One such policy that was used in CSTRS is the issuance of pension obligation bonds (POB's) – a controversial policy that has been used in a few other states and is debated in others yet. It will therefore be of interest to see a detailed analysis of how that has worked out so far in Connecticut, based on how the investment returns have compared with the debt service, and what the future burdens of those POB's look like, due to its severe back-loading of debt service.

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[1] Pennsylvania, as mentioned below, is another case that has received less national attention than its dire circumstances would suggest.

A second CSTRS policy, much less visible, has been the actuarial gimmick of setting a longer amortization period for certain accrued actuarial losses and a shorter period for certain actuarial gains. The effect of this shenanigan is to build in a deferred spike in pension contributions when the amortization period for the gains expires. This has been a major factor in the pension disaster that is now befalling the Pennsylvania School Employees' Retirement System (PSERS), as shown below. In CSTRS, this spike has not yet arrived, and is notably smaller in magnitude, but is noteworthy nonetheless, as a demonstration for other states of an unwise practice to avoid.

The plan of the paper is to first review the rise in per pupil pension costs observed in a few other teacher retirement systems, with a brief description (but not a detailed analysis) of the source of the rise in contributions. Related work on the sources of the rise in unfunded liabilities will also be briefly reviewed. Of some controversy in this latter literature is how commonly the problem is due to investment shortfalls from the actuarially assumed return. We then turn to CSTRS, showing first that the public's per pupil contributions have risen from about $500 per pupil in FY02 to over $2,000 per pupil (constant dollars) today (including debt service on the POB's). The proximate sources of the rise are quickly identified, with the predominant role played by the rise in amortization payments on the unfunded accrued liability (UAL). A more detailed decomposition follows, using a series of shift-share devices that attempt to minimize the interaction effects among the different sources and to avoid the distortions that can arise from arbitrary ordering of changes.

The main substantive result of this analysis is that investment shortfalls from the actuarially assumed return of 8.5 percent account for half the rise in per pupil contributions, even after strong market returns for four of the last five years. Actuarial practices – mostly quite prudent -- that accelerate, rather than defer, amortization payments have also played a significant role, but other practices (mentioned above) have built in a deferred contribution spike that will come in FY23. Although there has been no hike in the pension benefit formula over this period, there was a change in the treatment of COLAs that has, by our analysis accounted for about 15 percent of the rise in contributions. Finally, it is of interest to note that the $2 billion of POB's issued by CSTRS in 2008 have not paid off thus far, even with the strong market performance of the last few years; moreover, the state has back-loaded debt service on the POB's, which will more than double in per pupil terms by FY23. In short, the analysis of the rise in CSTRS pension contributions offers several cautionary tales to other states.

Rising Per Pupil Pension Contributions in Other States

The Pennsylvania School Employees Retirement System (PSERS) provides a stunning example of the rise in public per pupil pension contributions. Figure A tells the tale for recent years.[2] PSERS levies contributions on the district (as in most states), but the

[2] The example given there is the School District of Philadelphia, but the same picture holds for all districts in Pennsylvania, since (as in most states) the retirement system is statewide. That is, the contribution rate, as a percent of payroll, is the same for all districts, but the conversion to per pupil contributions

state reimburses half or more, so Figure A depicts the joint contributions (local district and state). As shown, the contribution hovered between $300 and $500 per pupil from FY05 to FY11, but has since skyrocketed and will exceed $2,300 by FY17 (a year chosen for comparison with the CSTRS analysis below).

Figure B, provides a more complete picture, expressed in terms of the contribution as a percent of payroll, for FY00 through FY48, from the annual projections provided by PSERS. The jump from 5 percent in FY11 to 25 percent in FY16 and over 30 percent by FY19 and beyond is the direct result of statutorily deferred amortization payments. As explained in Costrell and Maloney (2013a, pp. 18-22, with gory actuarial details in the endnotes), legislation of 2003 amortized previous investment gains over 10 years and the more recent losses over thirty years. Consequently, this legislation scheduled a spike in contribution rates for FY13, when the gains were fully amortized, but not the losses. In 2010, as the FY13 spike approached, the legislature deferred the costs yet further by various means, while reducing benefits for new hires (as shown by the gradually declining normal cost curve in Figure B). In short, the predominant source of the rise in per pupil pension contributions was the actuarial methods chosen by the legislature to defer contributions. Benefits were actually cut (not raised) during this period, for new hires. Moreover, as Figure B shows, even though market gains well exceeded assumptions over the last two years, the contribution rates projected at the end of 2014 through 2035 exceeded those projected at the end of 2012.

Ohio's State Teachers' Retirement System (STRS) faced a sharp rise in district contributions, from about $900 per pupil in FY12 to about $2,000, absent any change to the plan. State law fixed the district contribution at 13 percent for teachers' pensions, but the actuarially-determined annual required contribution (ARC) rose from 13 percent in FY08 to 30 percent by FY12 and FY13.[3] This rise reflected the rise in the unfunded liability after FY08 and appears to be primarily due to the failure of investments to meet the assumed return. Rather than allow the district contribution to rise, Ohio cut benefits, especially for new hires and raised the employee contribution rate.[4]

As these two examples show, per pupil pension contributions can and have risen, even in the absence of benefit hikes. Although the authors of the above-cited studies did not explore the source of the rise in detail, it appears that investment returns played a significant role in Ohio, while in Pennsylvania, the rise was, in effect, legislatively planned by the adoption of non-standard actuarial schemes.

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varies with payroll/pupil. Figures A and B are updated from Costrell and Maloney, 2013a, "*The Big Squeeze: Retirement Costs and School District Budgets. Paying the Pension Price in Philadelphia*," Fordham Institute.

[3] See Costrell and Maloney, 2013b, "*The Big Squeeze: Retirement Costs and School District Budgets. Ohio Pension Reform in Cleveland: New Teachers Beware*," Fordham Institute.

[4] Indeed, for new hires, the employee contribution rate actually exceeded the value of benefits being accrued, a highly unusual situation.

Methodology for Apportioning the Sources of Rising UAL

Related work has endeavored to parcel out the sources of the rise in systems' unfunded liability. Munnell and her colleagues at the Center for Retirement Research at Boston College[5] have done so using the annual decomposition of the rise in UAL presented in a plan's valuation report. For example, each year the valuation reports the impact on the UAL of market returns that differ from assumed returns. Adding these up, year after year, the Munnell team arrives at a sum that represents the impact of investment shortfalls and calculates the share of the total rise in UAL. For the 150 plans in the Public Plans Database, the Munnell team finds that 60.4 percent of the rise in the UAL from 2001-13 is attributable to the shortfall of investment returns from the assumed returns. The rest of the rise is attributed to contribution shortfalls, changes to and deviations from other actuarial assumptions, benefit changes, and "other."

It is difficult to evaluate this methodology, because the actuarial reports themselves are something of a black box on the allocation of sources for any given year's rise in UAL. Specifically, with numerous deviations from assumptions occurring simultaneously, there are non-trivial interaction effects. Consequently, taking one factor at a time, the sum of their impacts is surely not equal to the impact of them all simultaneously. There are various ways to deal with this, some of which are less satisfactory than others. One way is to add one factor at a time, but as is well-known, the results can depend critically on the order in which factors are added. I do not know if that is the method used in the valuation reports, but there are indications that it is.[6] Alternatively, one may avoid this arbitrariness by using some form of shift-share analysis that distributes the interaction effects among factors. That is the approach of this paper, as detailed in the appendix.

Moreover, there are serious questions about the Munnell team's procedure of simply adding up the year-by-year allocation of the rise in UAL to arrive at an allocation for the total rise in UAL over a multi-year period. As an important example, each year's allocation of the rise in UAL to the investment shortfall begins with the actual starting point of that year. Thus, for an n-year period, the allocation to earning returns of r_t for each year t = 1,…,n instead of the assumed rate of r* each year is actually summing up a series of 1-year allocations, each of which is the impact of r* vs. r_t, given $r_1,\ldots,r_{t-1}$ for all prior years. This is a decidedly different calculation than simulating the impact of r* for the full series of n years vs. the series of actual r_t's. In other words, the approach of Munnell's team ignores the interaction effects over time of investment shortfalls (or of any other single source). That is, there are two interactions to consider: across sources and across time. The impact can be substantial. For example, **using the Munnell team's approach, I calculate that 64 percent of the rise in CSTRS' UAL from FY00 to FY14 is due to investment shortfalls, whereas my simulation approach allocates 93 percent of the rise to that source.**

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[5] Munnell, et. al, 2015, "How Did State/Local Plans Become Underfunded?"

[6] Sabin, 2015, "Backtested Pension Math: An Empirical Look at the Causes of CalPERS Underfunding," *The Journal of Retirement,"* writes that CalPERS' "calculations of liability loss appears to be a catch-all: Whatever losses have not been allocated to another bucket gets put into the liability-loss bucket. It does not appear to be intended as a precise accounting."

The Rise in Per Pupil Contributions to CSTRS: A First Pass

We consider annual state contributions to CSTRS, the pension variable with the most direct impact on public resources available to Connecticut classrooms.[7] In FY02, the state contributed $205 M; this is scheduled to rise to $1,012 M in FY17.[8] Controlling for enrollments and inflation,[9] **this represents $480 per pupil in FY02 and $1,825 per pupil in FY17.** This figure, however, is incomplete, since the state issued pension obligations bonds (POB) in 2008 to pay down $2 billion of the CSTRS unfunded liability. The state, of course, pays annual debt service on those bonds. **Adding in the state's annual debt service payments on the POB, the FY17 figure is $2,042 per pupil, a rise of $1,561 from FY02**.[10] (See Figure 1.[11])

How did this come to be? I shall examine the answer in detail below. Before doing so, however, I first set out a simple accounting framework, to identify the proximate channels comprising this dramatic rise in state contributions per pupil, and then the underlying factors that worked through these channels.

Since pension contributions are calibrated as a percent of covered payroll, the first channel through which per pupil contributions can rise is a rise in real covered payroll per pupil.[12] This channel has no direct connection to the pension system itself – this source of the rise in pension contributions per pupil is essentially a byproduct of any rise in real salaries and/or staffing ratios. By our estimate, **this accounts for $169 or 11 percent of the $1,561 rise in state contributions per pupil from FY02 to FY17.**[13]

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[7] Unlike most states, school districts make no contribution to the pension fund; "employer" contributions are provided by the state. These funds are therefore not available for state aid to school districts.

[8] These data are drawn from the biennial valuation reports for CSTRS, available online from FY02 to FY14. The FY02 report includes some information on the FY00 valuation. The FY17 figure is that year's ARC as calculated in the FY14 valuation report. The state's actual contribution has equaled the ARC since FY08, under state law.

[9] Connecticut enrollments are drawn from NCES Digest of Education Statistics, Table 203.20. Inflation is the US CPI index, all urban consumers, with projections for FY15 and beyond from the CBO Budget and Economic Outlook, January 2015 (Table F-2). Figures here are expressed in FY15 dollars.

[10] The debt service payments are calculated from the bond provisions detailed in the State of Connecticut's disclosure document issuing the POB. Figure 1 depicts these payments net of the $266 million borrowed to pay the initial two years of interest (see note below). Thus, the net payments for FY09 and FY10 were zero, but rose to $121 million by FY12, after these borrowed funds were exhausted. As discussed in more detail below, the debt service schedule is further back loaded by other mechanisms, so these payments will rise considerably in the coming years.

[11] Although Figure 1 presents data from FY97, we confine our analysis below to the period from FY02, due to the availability of underlying data from the posted actuarial reports, beginning with FY02.

[12] This refers to the covered payroll as anticipated by the actuaries in determining the required contribution rate. In general, the actual covered payroll, determined after the fact, tracked the anticipated payroll relatively closely until FY12, when fiscal exigencies apparently led to unanticipated layoffs.

[13] See Appendix for details of this and subsequent calculations, using the shift-share methodologies referred to above.

The second channel is the rise (if any) of "normal cost," the cost of currently accruing benefits (as a percent of payroll).[14] The third channel is the rise in the "amortization" of the unfunded accrued liability, UAL (as a percent of payroll).[15] Amortization payments are the equivalent of debt payments, so we must also add in here the debt service payments on the POB, for a full accounting.

At this level, of proximate channels, the story is fairly simple. The rise in **amortization payments and POB debt service** (net of the impact of the rise in payroll/pupil) **accounts for $1,398, or 90 percent of the $1,561 rise in state contributions per pupil**. As a percent of payroll, these costs rose from 3.62% in FY02 to 22.72 percent in FY17.[16] This is a very large rise, to be examined more closely below. To round out the story of this first pass on the data, the normal cost did not rise at all – it actually fell $5 per pupil, after netting out the rise in payroll/pupil. I will return to the underlying factors driving the rise in per pupil contributions, but first I will discuss the CSTRS funded ratio. It is not a figure that is directly used to parcel out the rise in per pupil contributions, but is related to the rise in amortization payments that are such a big part of our story.

The Fall in CSTRS Funded Ratio

For Fiscal Year 2014 (henceforth FY14), the Connecticut State Teachers' Retirement System (CSTRS) had assets valued at 59.0 percent of accrued liabilities.[17] This "funded ratio" is among the worst in the country, although this has not received much national attention. By way of comparison, the most recently reported funded ratios[18] for some of the better known basket cases among teacher retirement systems were: 66.9 percent for California, 58.2 percent for New Jersey, and 40.6 percent for Illinois.

The decline in CSTRS funding over the last 13 years has been dramatic, even with the last few years of strong market performance. (See Figure 2.) For FY00, its funded ratio

[14] Specifically, we refer here to the employer's portion of the normal cost. The employee also contributes, but that has remained constant at 6.00 percent over the period, so any change in total normal cost (from 9.80 percent to 9.73 percent over this period) was borne by the employer.
[15] In Connecticut, as in most systems, the employee does not contribute to the amortization payments, only the normal cost payments.
[16] The amortization rate is 19.92 percent, excluding the POB payments. The amortization rate (and normal cost) are set for two years by each biennial valuation, so the 19.92 percent rate determined in the FY14 valuation applies to FY16 and FY17.
[17] There are actually two valuation reports for FY14, due to the recent change in the Government Accounting Standards Board (GASB) standards. One report is based on GASB Statement No. 25 and the other is based on GASB's new Statement No. 67. This study uses the series of biennial valuation reports from FY02 – FY14, based on Statement No. 25. This provides for continuity (and is still pertinent because the old GASB standards continue to determine contributions under current CT statute). The FY14 report based on GASB's new Statement No. 67 gives the valuation ratio as 61.6 percent instead of 59.0 percent, for reasons discussed briefly in a further note below.
[18] For California (CalSTRS) and New Jersey (TPAF), the figures are for FY13.

was 83.6 percent.[19,20] Moreover, the decline to the current figure of 59.0 percent does not factor in the debt incurred by the state of Connecticut by floating pension obligation bonds (POB) in FY08 to pay down $2 billion of the unfunded liability.[21] Factoring that debt into the net assets for CSTRS, I calculate that a more inclusive measure of the funded ratio would be 50.1 percent in FY14, as depicted in Figure 2.[22]

Moreover, CSTRS calculates its liabilities with a discount rate of 8.5 percent, representing CSTRS' estimate of likely returns to investment. Fitch Ratings has used a more conservative 7 percent discount rate to evaluate CSTRS in FY12 and FY14, which raises the estimate of accrued liabilities by 16.5 - 16.7 percent. This reduces the FY14 funded ratio from 59.0 percent to 50.6 percent.[23] Factoring in the outstanding debt on the POB as well, I find that the FY14 funded ratio is further reduced to 43.0 percent. As we shall see, CSTRS' assumption of 8.5 percent return has been highly problematic since FY02. Nonetheless, our analysis of contributions below shall use CSTRS' data on liabilities, which are based on this discount rate.

The Potential Sources of the Rise in Per Pupil Contributions

To go beyond the proximate factors identified above, I will parcel out the rise in contributions per pupil (net of the impact of the rise in payroll/pupil) among the following factors. The first four derive from the liability side and the other two from the asset side.

(i) Failure to meet the actuarially assumed investment return of 8.5 percent over FY02 - FY14. This would raise the UAL and associated amortization.

(ii) The impact of actuarial methods, embedded in legislation, that may have accelerated or back-loaded the amortization payments relative to UAL.[24]

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[19] This figure includes the "Cost-of-Living Adjustment Reserve Account" (CLARA) for comparison with the 59.0 percent figure for FY14. That is because the CLARA (discussed below) was rolled into system assets, starting in FY08. The FY00 figure excluding the CLARA is 81.4 percent. The CLARA was originally known as the "excess earnings account" (EEA).

[20] FY00 was a high point for the system's funded ratio. It had risen from 57.6 percent in FY91 to 81.4 percent in FY00. (These figures exclude the EEA since that provision was not enacted until after FY91.)

[21] Authorized by P.A. 07-186, codified in Sec. 10-183qq of Chapter 167a, "Teachers' Retirement System."

[22] The yearly outstanding POB balance is reported in the Annual Information Statement, State of Connecticut, February 28, 2014, revised as of December 8, 2014, p. II-9. The most recent reported balance (June 30, 2014) is $2.333 billion. The initial issue was $2.277 billion, of which $2.000 billion went to the unfunded liability, $11 million was borrowed to pay issuing costs and an additional $266 million was borrowed to pay the first two years' interest, as authorized by the enabling legislation.

[23] This is using the GASB 25 figure for actuarial value of assets. Fitch's report refers to the GASB 67 report for CSTRS, which has a higher value of assets, because it uses market values rather than smoothed values, but the same liabilities. Specifically, Fitch reports that using 7 percent instead of 8.5 percent reduces the GASB 67 funded ratio from 61.6 percent to 52.8 percent, which implies the 16.7 percent increase in liabilities as stated in the text.

[24] In addition, there is considerable back-loading of debt service payments on the POB. As discussed below, much of this back-loading is not slated to show up until some years further in the future.

(iii) Past failures to pay the annual required contribution (ARC), thereby reducing asset accumulation, raising the UAL and associated amortization payments.

(iv) The impact of the decision to pay down $2.0 billion of the UAL using POB's. The net effect of the reduced amortization payments and increased debt service was intended to be a net gain, but this depends on how the actual investment returns (not the assumed return) on the $2.0 billion compares with the interest payments on the POB.

(v) Benefit hikes. These can raise both the normal cost (for currently accruing benefits) and also the UAL, if the benefit hikes enhance previously accrued liabilities, due to prior service.

(vi) Deviations from (or changes to) other actuarial assumptions on liability growth (e.g. demographics). These can affect normal cost and the UAL.

As stated above, the proximate channel for the rise in state contributions is almost entirely through amortization. The details on the rise in UAL and amortization payments are complicated, involving all six causal factors listed above: investment returns, amortization methods, failure to pay ARC, the POB, benefits and other liability assumptions. To parcel these out will require getting into the weeds and some involved detailed simulations. But we can preview here a few of the general conclusions that I reach, regarding the culprits of the case.

The main culprit, I find, is the failure to meet the assumed investment return of 8.5 percent over the period in question (FY02-FY17). This accounted for half the rise in per pupil contributions. The other significant contributors were the acceleration of amortization payments (22 percent), a legislative change in the treatment of COLAs (15 percent) and the rise in payroll/pupil discussed above (11 percent). The failure to pay ARC was not a very significant factor over this period (such failures ceased entirely in FY08), nor were the changes to actuarial liability assumptions (as we shall see, these led to largely offsetting changes in normal cost and amortization). Interestingly, I find that the POB, designed to reduce net costs, actually slightly increased them over this period, accounting for 2 percent of the rise in contributions per pupil, even though the highest debt service payments are yet to come.

We turn now to a more in-depth analysis of the rise in state pension contributions. For more technical detail on these calculations, see the Appendix.

Decomposing the Rise in State Pension Contributions

As stated above, I find that the **rise in real payroll per pupil accounts for $169**, or 11 percent of the rise in state pension contributions. I do not examine the sources of this rise in detail, but the available evidence seems to indicate this is primarily a result of generally rising staffing ratios (especially non-teaching) over this period, rather than rising real salaries.[25] The remainder of the $1,561 rise in per pupil contributions are attributable to the six pension-related developments itemized above. We now turn to these in detail.

(i) Failure to Meet Assumed Investment Return

CSTRS has assumed an annual investment return of 8.5 percent throughout this period. This had been comparable to other public pension plans in the past, but many plans have cut their assumed return in recent years, so CSTRS is now a bit higher than those plans. There remains an active debate between finance economists and actuaries over the appropriate discount rate to use for the valuation of liabilities, but this is not the place to revisit that debate.[26] However, it is a fact that CSTRS has failed to meet the 8.5 percent return, on average, during the period in question (see Figure 3). Specifically, for the 14 years FY01 to FY14 (governing contributions for FY04 to FY17), the annual compound rate of actuarial returns[27] for CSTRS was 5.37 percent, resulting in a total 14-year return of 108 percent, which is well short of the assumed total return of 213 percent (14 years at 8.5 percent).[28] Virtually the same results hold for the compound annual market return (i.e. before smoothing): 5.42 percent, for a total return of 109 percent.

Simulating the impact on the UAL of the failure to meet the assumed return, I find that this accounts for $8.1 billion of the $8.6 billion rise in the UAL from FY00 to FY14 UAL.[29,30] **In dollar terms, the failure to meet assumed investment returns accounts for $775 or 50 percent, of the $1,561 rise in state contributions per pupil from FY02 to FY17.**

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[25] See, for example, 2012 Digest of Education Statistics, Tables 91 and 96.
[26] As discussed above, Fitch Ratings uses 7 percent.
[27] Actuarial returns factor in the system's four-year asset-smoothing algorithm. This is the measure used for the determination of contributions. Over time it should be close to the market return.
[28] This result is somewhat sensitive to the starting point. Using the earliest data readily available, starting in FY99, the annual compound rate for actuarial returns is 6.54 percent, or 175 percent total return over the 16-year period, still well short of the 269 percent assumed total return. The reason I use FY01 as the first year for asset accumulation is that the FY00 starting point (governing FY02 contributions) is the earliest available valuation result (reported in the FY02 report) with the necessary detail for this analysis.
[29] In this (as in all other simulations), I factor in adjustments to the required amortization payments throughout the period. Without such adjustments, the simulated impact of the investment shortfall would be much larger, indeed, well exceeding the actual rise in the UAL.
[30] In assessing the impact of the investment shortfall on the rise in UAL (and, ultimately, on the rise in per pupil contributions), I allocate the impact of each such factor individually as a share of the sum of their individual contributions to the simulated rise in UAL. That sum of simulated individual factors is very close to the actual rise in UAL: $8.685 billion vs. $8.611 billion. Thus, the investment shortfall accounts for 93 percent of the former and 94 percent of the latter.

(ii) Acceleration of amortization payments relative to UAL

Ordinarily, amortization payments are structured to pay off the UAL with a level percent of payroll over a specified amortization period (such as 30 years).[31] Given the assumed growth rate of payroll and the discount rate, standard financial formulas generate the ratio of amortization payments to UAL.[32] For example, with a 30-year amortization period, a discount rate of 8.5 percent, and an assumed growth rate in payroll of 5 percent, the amortization payment would be about 5 percent of UAL.

In many pension systems this ratio would remain constant over time because of the "open interval" amortization method, which holds the remaining amortization period constant (e.g. at 30 years) even as time rolls on. This method has been criticized because the UAL would never be paid off, as the payoff date is postponed every year. CSTRS, however, uses the "closed interval" method, under which the payoff date is constant, so the remaining amortization period decreases with every passing year. This has the effect of accelerating amortization payments relative to UAL. For example, in the final year of a closed interval, the amortization payment is 100 percent of UAL.

CSTRS has also accelerated amortization relative to UAL by reducing the assumed growth rate of payroll (assumed equal to the rate of wage inflation under actuarial standards) from 5 percent to 4 percent in the FY02 valuation and from 4 percent to 3.75 percent in the FY12 valuation. These measures reduced the degree of back-loading in the amortization schedule. For example, with payroll growth of zero percent – the level dollar amortization method – there is no back-loading.

These two features of CSTRS' amortization method – closed interval and reduction in assumed payroll growth – account for most or all of the observed rise in amortization relative to UAL. They represent prudent policy choices. In all, I estimate the **acceleration of amortization relative to UAL accounts for $337 or 22 percent of the rise in per pupil state contributions**. Unlike the other factors underlying the rise in contributions (e.g. excessively optimistic assumed investment returns), this largely represents sound and improved actuarial practice.

There is, however, another feature of CSTRS' amortization method which has a less salubrious effect. All unfunded liabilities attributable to the plan in effect in FY91 (the plan is still in effect today, except for the COLA provisions) are to be amortized over

[31] This method (as opposed to level dollar) has been criticized (particularly in its "open interval" form, discussed below), for failing to cover the interest payments on the UAL for much of the amortization period, and, therefore, leading to a rise in the UAL before any eventual paydown. Thus, Munnell's team evaluates contributions relative to normal cost plus interest on the UAL, rather than comparing contributions with ARC. Thus, their team would apportion more of the rise in UAL to contribution shortfalls and less of the rise in contributions (were they to apportion that) to the acceleration of contributions relative to UAL.

[32] In its simplest form, $AMT/UAL = [(r - g)/(1 + r)]/[1 - (1+g)^T/(1+r)^T]$, where r is the discount rate, g is the assumed growth rate in payroll and T is the amortization period. The actuarial versions of this formula will often be slight variations.

forty years (the maximum actuarial standard existing at the time), i.e. by the end of FY31. This includes the vast majority of all additions to the UAL since FY91. The UAL created by any "act liberalizing the benefits"[33] after that time is subject to thirty-year amortization (in accord with changed actuarial standards), but with a new starting date. Thus, the $1.15 billion added to the UAL by the 2007 legislation discussed below (by virtue of its treatment of the COLA) is to be amortized by the end of FY37. This piece of the UAL has more years remaining than the prior piece, so its amortization rate is lower. Since the overall ratio of amortization to UAL is a weighted average of the different pieces, this measure reduced that overall ratio, decelerating its growth the year of its enactment.

More importantly, the shorter amortization period applied not only to acts "liberalizing" benefits, but also to the 1992 act discussed below that tightened COLA benefits and also raised employee contributions from 5 percent to 6 percent. This generated a significant reduction in the UAL (worth about $2.0 billion by the early 2000's). This, in turn, generates negative amortization payments.[34] More to the point, these negative amortization payments are set at a higher ratio to the corresponding UAL than the vast majority of the positive payments, because this UAL reduction is set to be amortized more rapidly, by FY22 instead of FY31. There are three implications of this. First, the whole level of amortization payments for our period under consideration is lower than it would have been had the UAL reduction attributable to the 1992 legislation been amortized over the same period as the UAL attributable to the plan in effect immediately preceding it. Second, this has contributed slightly to the rise in amortization payments, because the weight attached to it has shrunk as the UAL attributable to the FY91 plan has grown. Finally, a far more significant rise in amortization payments is in store for the state by FY23, when the gains from the 1992 act are fully amortized. That is, **this piece of negative amortization, which currently lowers payments by $374 per pupil, will be gone in FY23.**

(iii) Failure to Pay ARC

We now consider the impact of past failures by the State of Connecticut to pay the annual required contributions (ARC) to CSTRS. These gaps between actual and required payments (as determined by the CSTRS actuaries) are depicted in Figure 1 as the gaps between the dotted black curve and the solid blue curve. Although most of the shortfalls preceded FY02, there were some identifiable shortfalls during the period under consideration. However, since FY08, the state has contributed the full ARC, under provisions of the 2007 act authorizing the POB. The past contribution shortfalls contribute to the rise in contributions since FY02 by reducing the accumulated assets and increasing the unfunded liability, thereby raising the amortization payments. Simulating the asset accumulation if there had been no contribution shortfalls, I find that these shortfalls account for about $290 million of the $8.6 billion rise in UAL from FY00

[33] Connecticut Statute, Chapter 167a, Sec. 10-183z(c).
[34] For example, the current amortization rate (relative to payroll) is 22.80 percent for the UAL attributable to the FY91 plan, and negative 4.84 percent for the 1992 reduction in UAL.

to FY14, which accounts for about $28 in the rise of per pupil contributions. Adding in the $15 deviation from ARC at the starting point (FY02) results in **$43 per pupil, or 3 percent of the $1,561 rise in state contributions, attributable to the relatively few failures to pay ARC since FY02.**

(iv) Pension Obligation Bonds

In 2008, the Connecticut legislature paid down $2.0 billion of the UAL by issuing POB's. This act was a gamble that the interest on the POB's (estimated at 5.88 percent over the 30-year life of the bonds[35]) would be less than the investment income generated by the additional funds for CSTRS. To help insure that the gamble would at least pay off in the short term, the POB's were structured to back-load the interest payments. Indeed, the first two years of interest payments were also borrowed, adding $266 million to the bond issue, for a total of $2.277 billion (including issuing costs of $11 million). In this way, the reduction in amortization payments from the paydown of the UAL had no immediate offset from debt service payments.

By FY11, however, the funds borrowed for interest payment had been exhausted and by FY17, the POB debt service will amount to $216 per pupil. At the same time, investment returns on the bond proceeds invested in CSTRS have fallen short of the assumed 8.5 percent, even with the strong returns since the crash of 2008. Consequently, I estimate that the POB will reduce FY17 amortization payments by only $181 per pupil. **Thus, the POB accounts for a net increase of $36 or 2 percent of the $1,561 rise in state contributions per pupil from FY02 to FY17.**

Moreover, the POB is structured with highly back-loaded debt service. The outstanding debt will not fall to the $2.0 billion originally dedicated to the UAL paydown until FY24. By my estimate (from the bond disclosure), **the debt service payments will rise from $216 per pupil in FY17 to $483 in FY23, in constant dollars**. (See Figure 4.)

(v) Benefits: Initial Pension Payment and COLA

There were no enhancements in basic benefits over the period. The benefit structure of CSTRS is typical of traditional defined benefit (DB) final-average-salary (FAS) plans. Specifically, for "normal retirement," initial pension payment = (2%) x (YOS) x (FAS), where YOS is years of service and FAS is the average of the three highest years of salary. The eligibility conditions for "normal retirement" are age 60 with 20 YOS,[36] or 35 YOS at any age. Thus, a teacher retiring under "35-and-out" would receive 70 percent of FAS. The initial pension payment is capped at 75 percent of FAS (so no further credit for YOS accrues beyond 37.5 years). There are also provisions for "early

[35] State Treasurer Denise L. Nappier, as quoted by Alicia Munnell, et al., "Pension Obligation Bonds: Financial Crisis Exposes Risks," Center for Retirement Research, January 2010, p. 3.
[36] If one leaves service after 20 YOS but before age 60, one has the choice of deferring first pension draw to age 60 or taking reduced payments under the "early retirement" options mentioned below.

retirement," at age 55 with 20 YOS, or 25 YOS at any age, with reductions in the pension calculation.

Connecticut changed *none* of these provisions throughout the period under consideration, neither raising them, nor reducing them for new hires (unlike many state systems that faced comparable stress). Nor has Connecticut raised the employee's contribution rate to help fund these benefits -- it remains at 6.0 percent. Indeed, under the provisions of the 2007 legislation that authorized the $2.0 billion bond issue, the state is barred from reducing benefits for vested members as long as the bonds are outstanding. As a result, there has been no change in the employer "normal cost" – the contributions required to pre-fund currently accruing benefits – due to enhancements of the basic formula, and also no effect on the UAL. Indeed, the employer normal cost was calculated at 3.80 percent in FY02 and was virtually unchanged at 3.73 percent for FY17, due to the constancy of basic benefits, and some off-setting changes in other factors (discussed below).

Although there were no changes in the basic benefit structure, determining the starting pension, there were changes in the annual COLA that teachers receive after retirement. These changes are rather complex, so the lay reader may wish to jump ahead to the end of this sub-section for the bottom line on the COLA changes. For the pension wonks among us, however, here are the details.

To start with, for those who retired before September, 1992, the COLA equals the annual CPI-W increase, but no less than 3 percent and no more than 5 percent. Legislation in 1992 made several changes to the COLA for those retiring after September 1992. First, the formula was changed to follow the Social Security COLA.[37] This meant that the minimum COLA was reduced from 3 percent to Social Security's minimum COLA of zero. The maximum COLA was raised by Connecticut statute from 5 percent to 6 percent, but if the market return on CSTRS assets falls short of the assumed rate of 8.5 percent, the maximum COLA is reduced to 1.5 percent.

In addition, the 1992 legislation created a reserve fund for the COLA, separate from the system's assets, known initially as the "Excess Earnings Account" (EEA), and later as the "Cost of Living Adjustment Reserve Account" (CLARA). This account was funded by the transfer from system assets of any year's earnings that exceeded 11.5 percent. Each year's COLA award (for those retiring after 1992) was made contingent on reserve funds sufficient to finance the present value of all future payments based on that year's COLA. As it turned out, since the reserve was established during the bull market of the 1990s, it built up a balance of $1.6 billion before the market turned down, and no COLA was ever denied for want of funds in the reserve. Thus, this provision had no effect on the COLA benefit.

[37] The Social Security COLA is also based on the CPI-W, so that did not change, but Social Security's timing of the COLA's linkage to CPI-W growth for the preceding year differs from that of the Connecticut statute that had governed CSTRS' COLA. Also, for 2011 and 2012 the Social Security COLA was based on growth of CPI-W from 2008 to the preceding year instead of the preceding year alone.

The COLA reserve system did, however, affect the measurement of CSTRS funding. Specifically, on the asset side, the COLA reserve was separated from the system assets, so CSTRS assets could be measured with or without the COLA reserve. When including the COLA reserve in measured assets, the corresponding liability was set equal to the size of that reserve, since new COLA benefits for post-1992 retirees were contingent on those funds. When excluding the COLA reserve from measured assets, the same quantity was excluded from measured liabilities as well. Figure 2 shows the funded ratio using both measures for the years of available data on both, FY00 – FY06. The funded ratio including the COLA reserve on both the asset and liability side is a few points higher, since, by definition, that portion of the liabilities is 100 percent funded.

The COLA reserve system was terminated by legislation in 2007, as part of the same act that authorized the $2.0 billion POB. The benefit formula is unchanged for those retiring after September 1992 who were system members by July 2007, but their future COLAs are no longer contingent on available funds in the COLA reserve – they are guaranteed. For those who became members after July 2007, the maximum COLA benefit when they retire will be reduced.[38]

The termination of the COLA reserve system affected the measurement of system funding. On the asset side, the COLA reserve, which stood at $2.0 billion on July 1, 2007, was transferred into system assets.[39] This means the asset measurement is the same as the prior version including the COLA reserve (as reflected in the blue line of Figure 2), but there is no longer any measure of assets excluding the reserve (hence the red line of Figure 2 is terminated at FY06). On the liability side, things are a bit more complicated for those retiring after September 1992. Previously, the measurement of their future COLA liability was set at the size of the COLA reserve, since future COLA awards were contingent on the availability of such reserves. Under the new system, COLA awards are not contingent upon COLA reserves, so the liability has to be estimated (the actuaries assume future COLAs of 2.0 percent).

When all is said and done, these changes had two effects on funding: (1) since future COLA awards for those retired after 1992 were now guaranteed instead of contingent, the accrued liability for those awards increased by $1.15 billion in FY08,[40] which in turn increased the amortization rate by 1.9 percent; (2) since future COLA awards for those not yet retired are now guaranteed, they need to be factored into the cost of currently accruing benefits and this raised normal cost about 1.5 percent.[41] Taken together, **the COLA provisions of the 2007 act accounted for $234, or 15 percent, of the $1,561 rise in state contributions per pupil from FY02 to FY17.**

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[38] Specifically, their maximum COLA is cut from 6 percent to 5 percent in years where asset returns exceed 11.5 percent, or 3 percent in years where asset returns fall short of 11.5 percent, or 1.0 percent when returns fall short of the assumed 8.5 percent.
[39] 2008 Valuation, p. B-10.
[40] See p. B-2 and B-4 of the FY08 actuarial report. Although the report characterizes this additional liability as "partially offset[ing]" the impact of the $2 billion POB proceeds (p. B-1), it would perhaps be more informative to observe that ***most* of the POB proceeds were spent on this new liability**.
[41] See p. B-1 of the FY08 actuarial report.

(vi) Other liability assumptions

Every year the actual development of liabilities will differ from the growth previously assumed, generating an actuarial loss or gain, due to deviations from assumptions regarding turnover, retirement and mortality rates, salary growth, and COLAs. In addition, pension systems will periodically undertake an "experience study" to re-assess assumptions.

For CSTRS, among the most significant changes in assumptions during this period were reductions in the assumed rate of wage inflation from 5 percent to 4 percent in the FY02 valuation and from 4 percent to 3.75 percent in the FY12 valuation. A reduction in the assumed rate of wage inflation reduces normal cost (current liability accrual), as each year of service generates fewer future benefits because the projected final average salary is not as high.[42] I calculate that these and other changes or deviations from liability assumptions reduced normal cost by $112 per pupil by FY17.

Over the same period, a variety of other changes and deviations from assumptions raised the UAL by about $850 million by FY14 (of the $8.6 billion rise in UAL). The associated rise in FY17 amortization was about $81 per pupil. Thus, the impact from these other liability factors on normal cost and amortization taken together, is estimated to **have reduced FY17 state contributions by about $31 per pupil**, offsetting about 2 percent of the rise from FY02 to FY17.

Conclusion

The State of Connecticut has incurred a rapid rise in annual payments from FY02 to FY17 to support its teacher retirement system. Although some of this rise is attributable to prudent acceleration of amortization payments, much more of the rise is due to questionable practices, such as the assumed investment return of 8.5 percent. The $2.0 billion pension obligation bond deal has not solved the problem and has, to date, made things worse. Longer term prospects continue to be daunting, due to forthcoming hikes in POB debt service and the end of negative amortization payments previously built into the pension contribution schedule.

[42] On the other hand, this accelerates amortization payments, as discussed above.

Appendix: Methodology for Decomposing the Rise in Per Pupil Contributions

There are several methods for decomposing the rise in a number that can, itself be expressed as a product (or sum of products) of more elementary variables in various ways. Other methods, perhaps equally valid, may parcel out changes differently, but I suspect the general result will be similar, namely the predominant role of the failure to meet assumed investment returns.

I proceed through a series of expressions. The first expression for state contributions (i.e. excluding employee contributions to normal cost, so that "normal cost" below is understood as referring to employer normal cost) is:

(1) contributions/pupil = normal cost/pupil + amortization/pupil + POB payments/pupil,

where each term is in constant 2015 dollars. Drilling down further, I use the following expressions for normal cost (NC)/pupil and amortization (AMT)/pupil:

(2) NC/pupil = (NC/payroll) × (payroll/pupil)

(3) AMT/pupil = (actual AMT)/(ARC AMT) × (ARC AMT)/payroll × (payroll/pupil),

where the ARC is the annual required contribution, as distinct from the actual contribution for AMT (NC has been fully paid throughout this period at CSTRS).

We want to decompose the rise in contributions/pupil from FY02 to FY17. Converting (1) to the rise is straightforward:

(1') Δcont'n/pupil = Δ(NC/pupil) + Δ(AMT/pupil) + Δ(POB/pupil)
$1,561 = $42 + $1,303 + $216

For POB/pupil (derived from the published interest rates and schedule of maturities in the POB disclosure document of the state of Connecticut) and its rise, no further decomposition is necessary. For Δ(NC/pupil), we use a decomposition of two-term products that is exact (i.e. no interaction term): Δ(xy) = ave(y)Δx + ave(x)Δy, where "ave" is the average of the initial and final year (FY02 and FY17). Thus,

(2') ΔNC/pupil = Δ(NC/payroll) × ave(payroll/pupil) + Δ(payroll/pupil) × ave(NC/payroll)
$42 = (-0.07%) × ($7,098) + ($1,240) × (3.77%)
$42 = (-$5) + ($47)

Drilling one step further on the first term, we decomposed the -0.07 percentage point drop in the NC rate from the various actuarial reports. The legislative change in the treatment of the COLA in PA 07-186 of 2007 (the same act that authorized the POB) raised NC by 1.51 percentage point in the FY08 valuation. Changes in, or deviations from, demographic and other liability assumptions over the rest of the period (especially

from experience studies reflected in the FY02 and FY12 valuations, which each reduced the wage inflation assumption), reduced normal cost by 1.58 percentage points. In dollars/pupil, these changes are $107 and -$112 respectively, comprising the -$5 given above in the first term of (2').

Turning now to (3), amortization payments, we first note that actual AMT/pupil was $234 in FY02, only $15 short of the ARC AMT that year (again, all figures are in 2015 dollars). From FY08 on the full ARC was paid (as required under the POB authorization), so the rise in AMT/pupil due to this change was $15. (There is an additional impact of the failure to meet ARC in FY02 and other years, through the UAL, discussed below). Thus, at this point we have:

(3') Δ(AMT/pupil) = (ARC – actual, FY02) + Δ[(ARC AMT/payroll) × (payroll/pupil)]
$1,303 = $15 + $1,289

Here, we find it instructive to isolate the role of UAL (unfunded accrued liability). This will facilitate the analysis of the impact of various factors we are focusing on (e.g. failure to meet assumed investment return) on the rise in AMT/pupil through the UAL. Specifically, we write:

(4) (ARC AMT/pupil) = (ARC AMT)/UAL(t-2) × (UAL(t-2)/payroll) × (payroll/pupil),

where the UAL governs the ARC two years hence (e.g. the UAL from the FY14 valuation report governs the ARC for FY16 and FY17). Breaking out the first two terms is useful, not only because it highlights the role of UAL in the second term, but also because the first term is usually readily calculated from standard finance formulas as the inverse of an annuity factor (with or without growth, over a closed or open interval).

The decomposition of change that we use for a three-term product (as in (4)) is analogous to the two-term decomposition above:

$$\Delta(xyz) = (y_0z_1 + y_1z_0)/2\cdot\Delta x + (x_0z_1 + x_1z_0)/2\cdot\Delta y + (x_0y_1 + x_1y_0)/2\cdot\Delta z + \Delta x\Delta y\Delta z,$$

where subscripts 0 and 1 indicate FY02 and FY17. This decomposition eliminates two-term interactions, but does not eliminate the three-term interaction. In our case, applying to (iv), the three-term interaction is approximately 5 percent of the total change, a relatively small number that we distribute proportionally over the other three terms. Specifically, we calculate:

(4') Δ(ARC AMT/pupil) =
$1,289
a·Δ[(ARC AMT)/UAL(t-2)] + b·Δ[(UAL(t-2)/payroll)] + c·Δ(payroll/pupil),
$337 + $830 + $122

where a, b, and c are calculated as indicated above and the three-way interaction term is proportionally distributed.

Next, we explicitly simulate the evolution of assets and liabilities, from FY00 to FY14 (to determine AMT payments from FY02 to FY16 and FY17), using the algorithms that can be inferred from the CSTRS valuation reports.[43] These simulations allowed us to estimate the impact on the UAL of (i) the failure to meet assumed investment return of 8.5 percent; (iii) the failure to pay ARC in FY02-FY05 and FY07; (iv) the paydown of $2.0 billion from the POB in FY08; (v) the legislative change in the treatment of the COLA (which also affected NC, as mentioned above); and (vi) changes in and deviations from demographic and other liability assumptions.

Taken all together, we estimate that if these changes had not occurred, the UAL would have remained approximately unchanged from FY00 to FY14 (from $2.2 billion to $2.5 billion), as compared with its actual rise to $10.8 billion. That is, these changes, taken together, raised UAL by $8.3 billion compared to what it would have been. Taken individually, and adding them up, they would have raised UAL by a similar amount, $8.7 billion – closer yet to the actual rise of $8.6 billion. We apportion the $830 rise in per pupil amortization in (4') (i.e. the portion attributable to the rise in UAL/payroll) among these five factors in proportion to their simulated individual contributions to the FY14 UAL. Specifically, we estimate:

(4'') Δ(ARC AMT/pupil) due to rise in UAL/payroll ($830) =

Impact of failure to meet 8.5 percent investment return ($775)

+ Impact of failure to pay ARC ($28)

+ Impact of $2.0 billion UAL paydown from FY08 POB ($-181)

+ Impact of COLA change on UAL ($126)

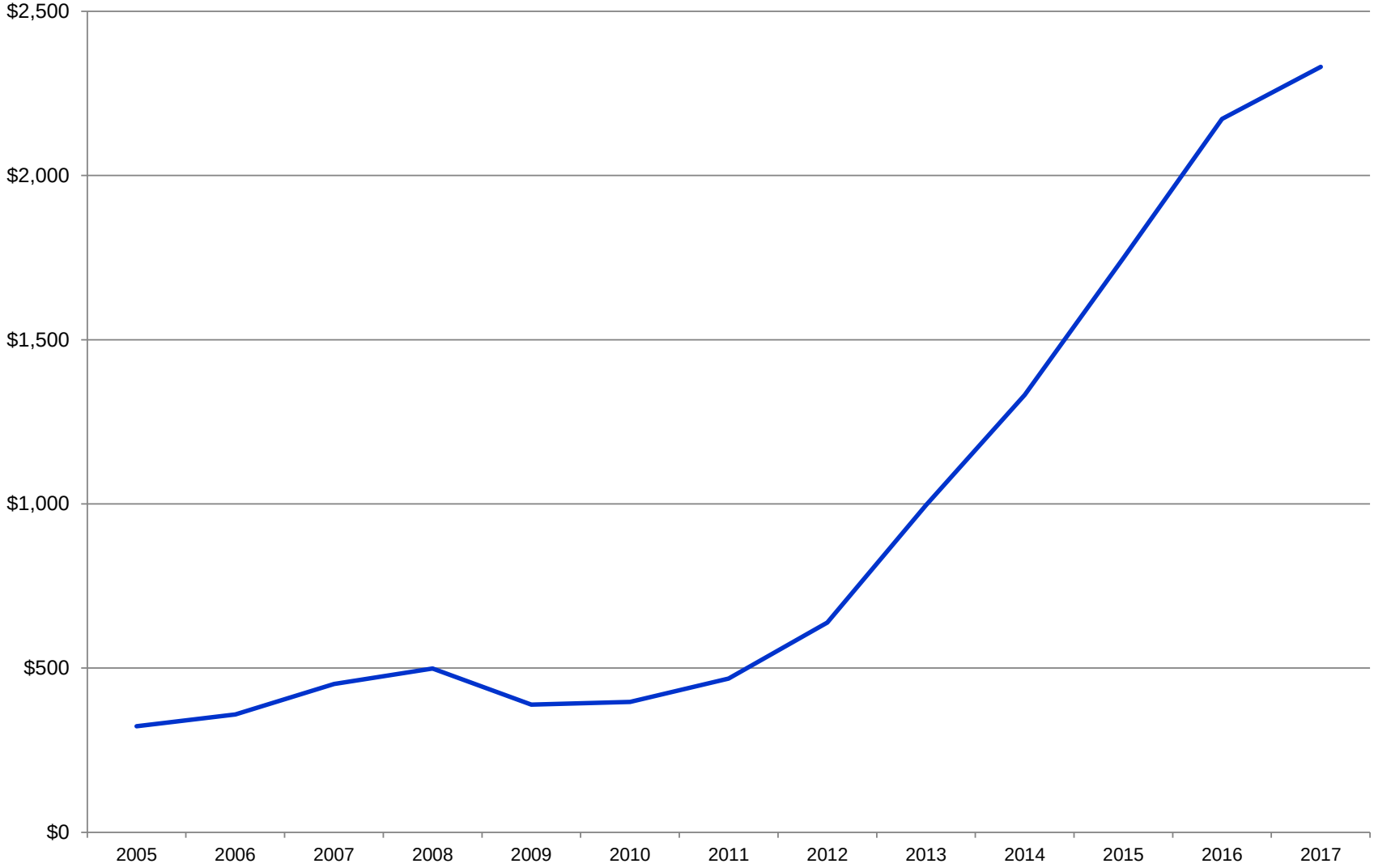
+ Impact of changes in and deviations from liability assumptions ($81)

This is not a perfect procedure, since it does not fully reflect the role of payroll growth, but our simulated results come reasonably close to that which would obtain if UAL/payroll had stayed constant. We should also note that in conducting these simulations, I have worked in the estimated impact of changes in the UAL on amortization contributions in the intervening years. That is, the impact on the FY14 UAL would have been much greater than $8.3 billion ($13.5 billion by my estimate) had there not been a corresponding rise in amortization payments in the interim. Of course, that also means that the $830 per pupil rise in amortization payments per pupil is simply the current annual estimate, not the cumulative estimate.

[43] Among the clearest examples are the tables on pages B-5 and B-7 in the FY08 valuation report, the last year that Gabriel Roeder Smith provided the reports. After Cavanaugh Macdonald took over the reports, for FY10, FY12, and FY14, the asset calculations were provided in Table III-2; the liability calculations were not as transparent as under GRS, but the necessary numbers could be inferred or estimated from other tables in the reports.

Figure A. Employer Contributions per pupil in PA (PSERS)

Philadelphia School District, inflation-adjusted to $2015. State + Local funds.



Source: Costrell and Maloney, *The Big Squeeze: Paying the Pension Price in Philadelphia*, 2013, updated

Fig. B. PA Employer Pension Contribution & Normal Cost, FY00 - FY48

Note: retiree health contribution not included

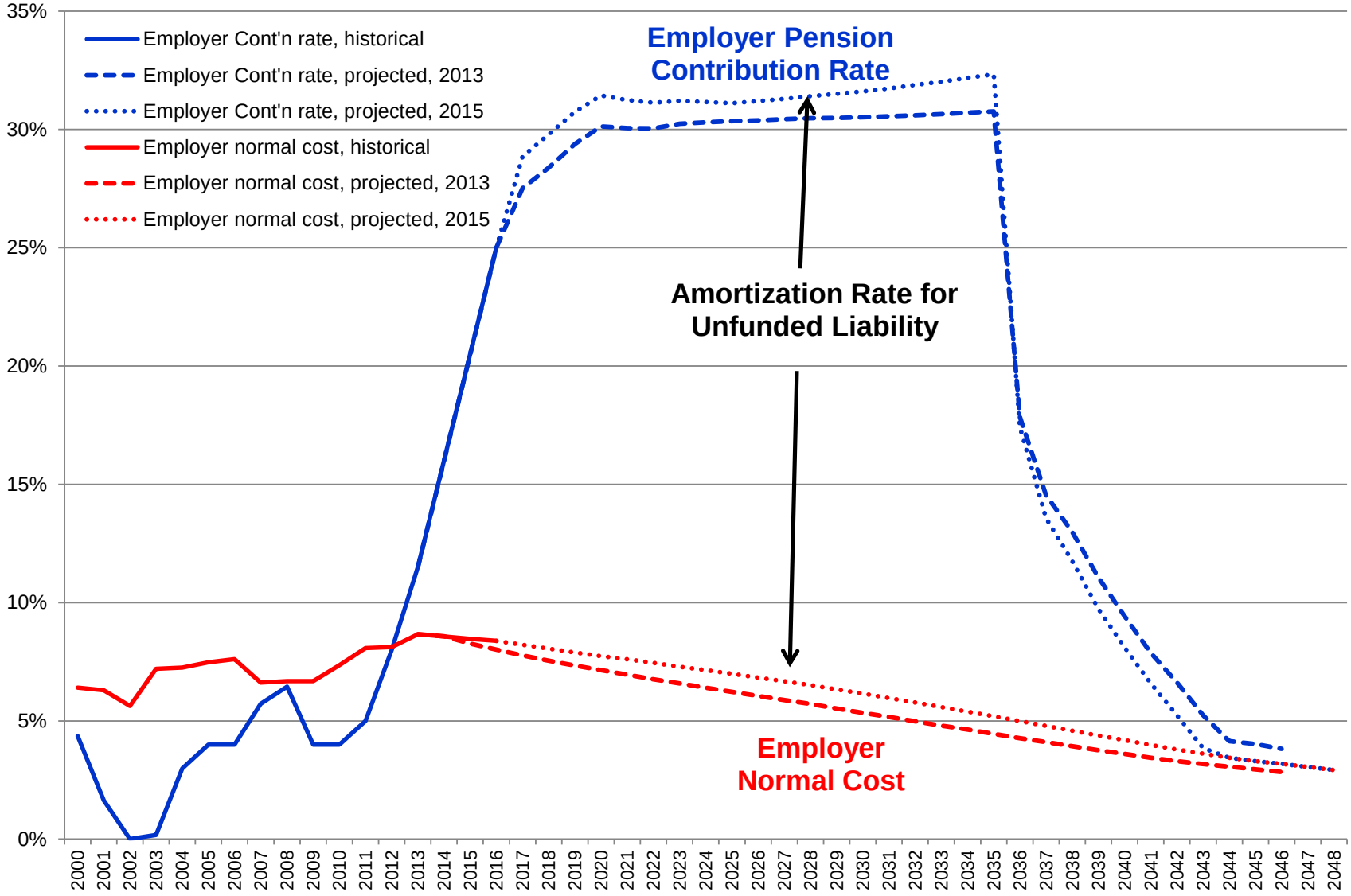


Figure 1. State Contributions, per pupil, to CSTRS, FY97-FY17

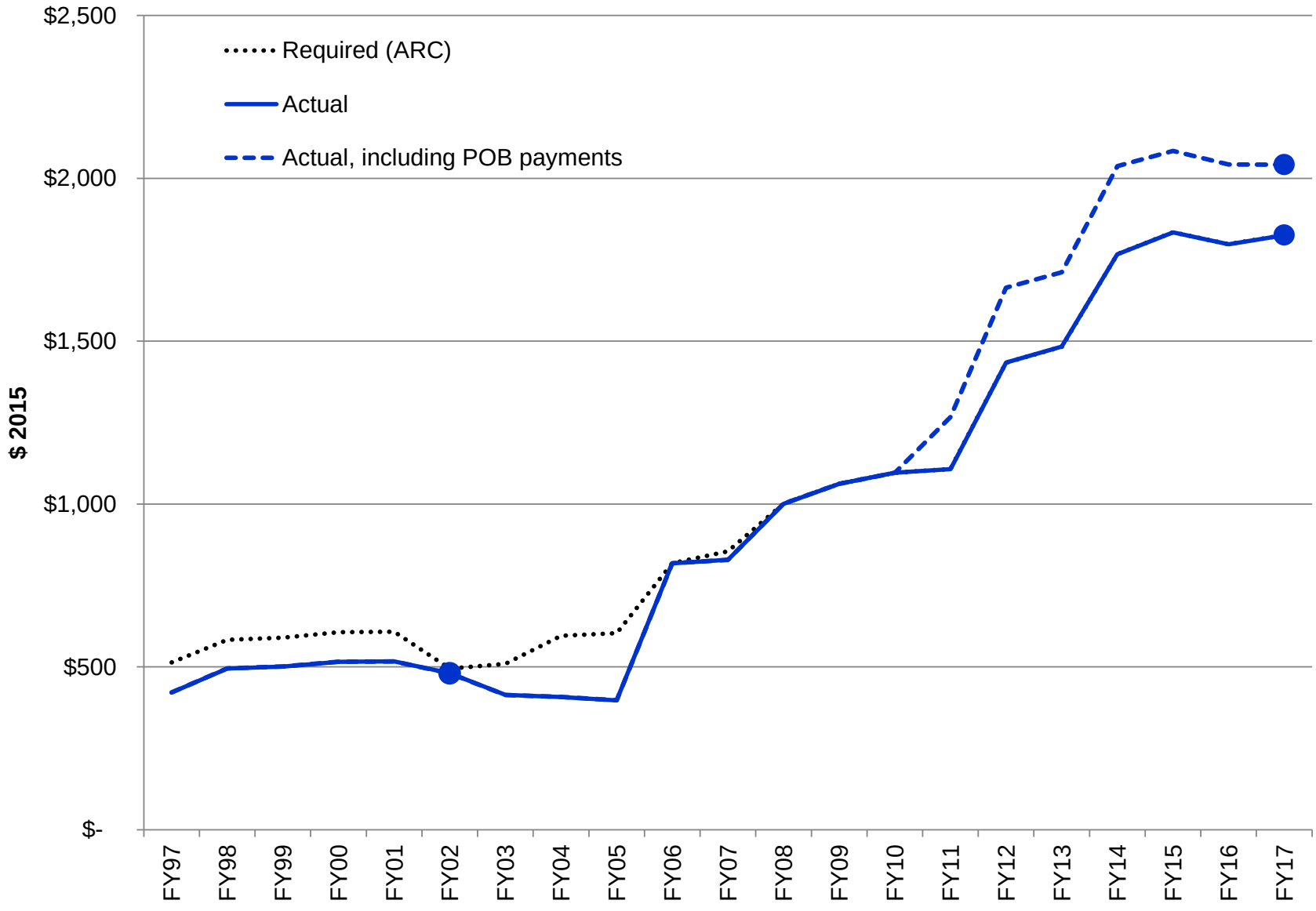


Figure 2: Funded Ratio, CSTRS, FY91-FY14

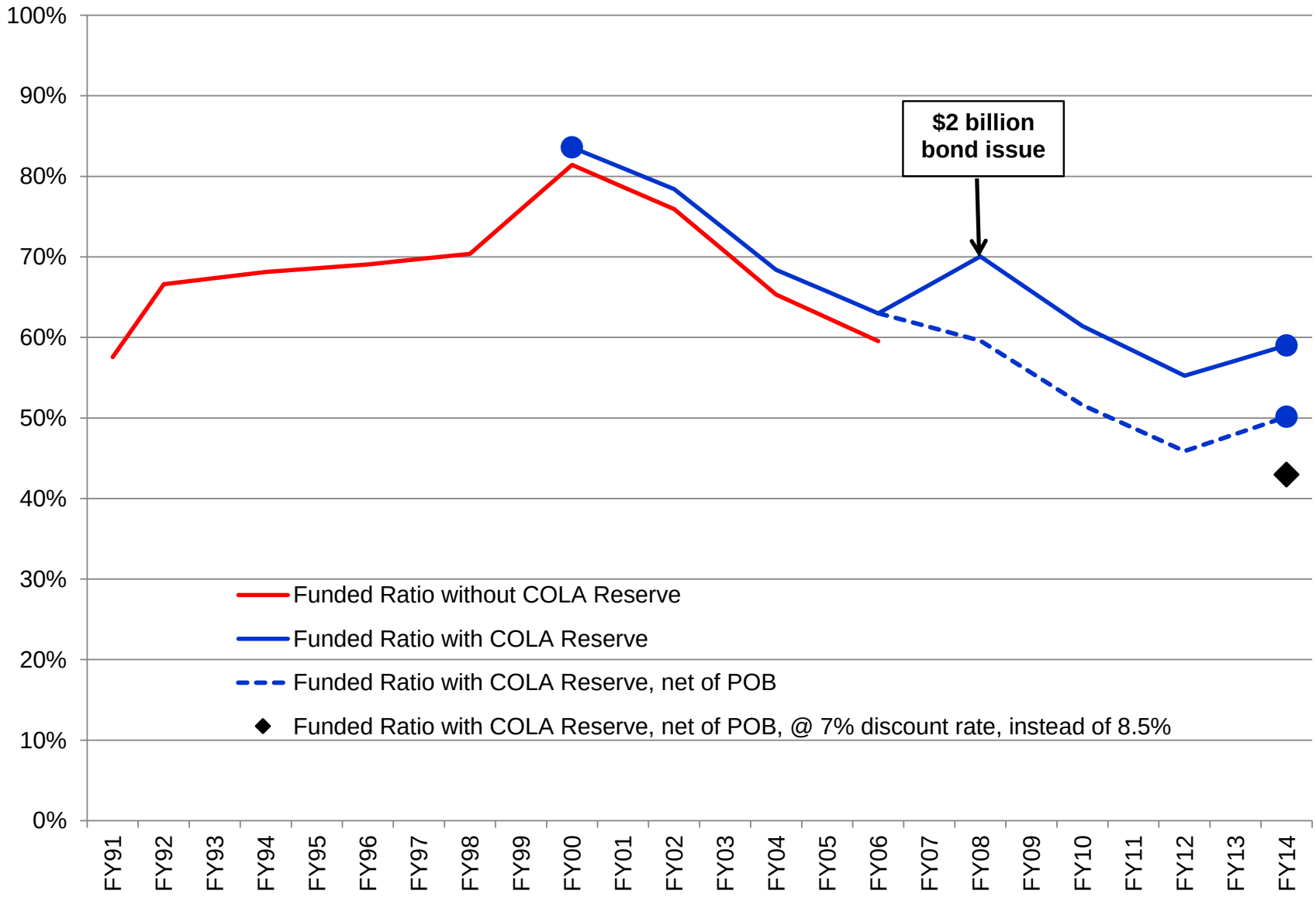
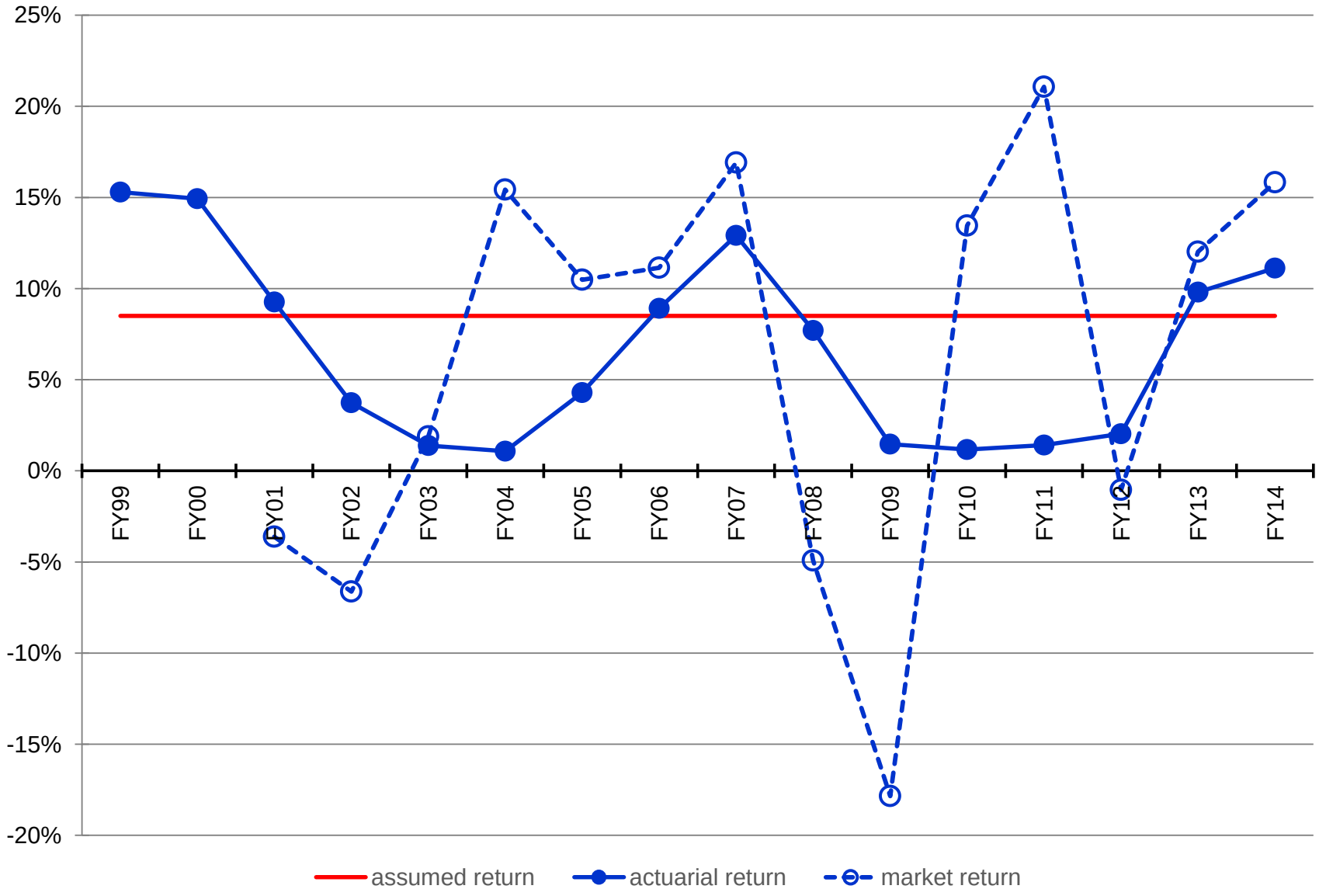


Figure 3: CSTRS Investment Returns, FY99 - FY14



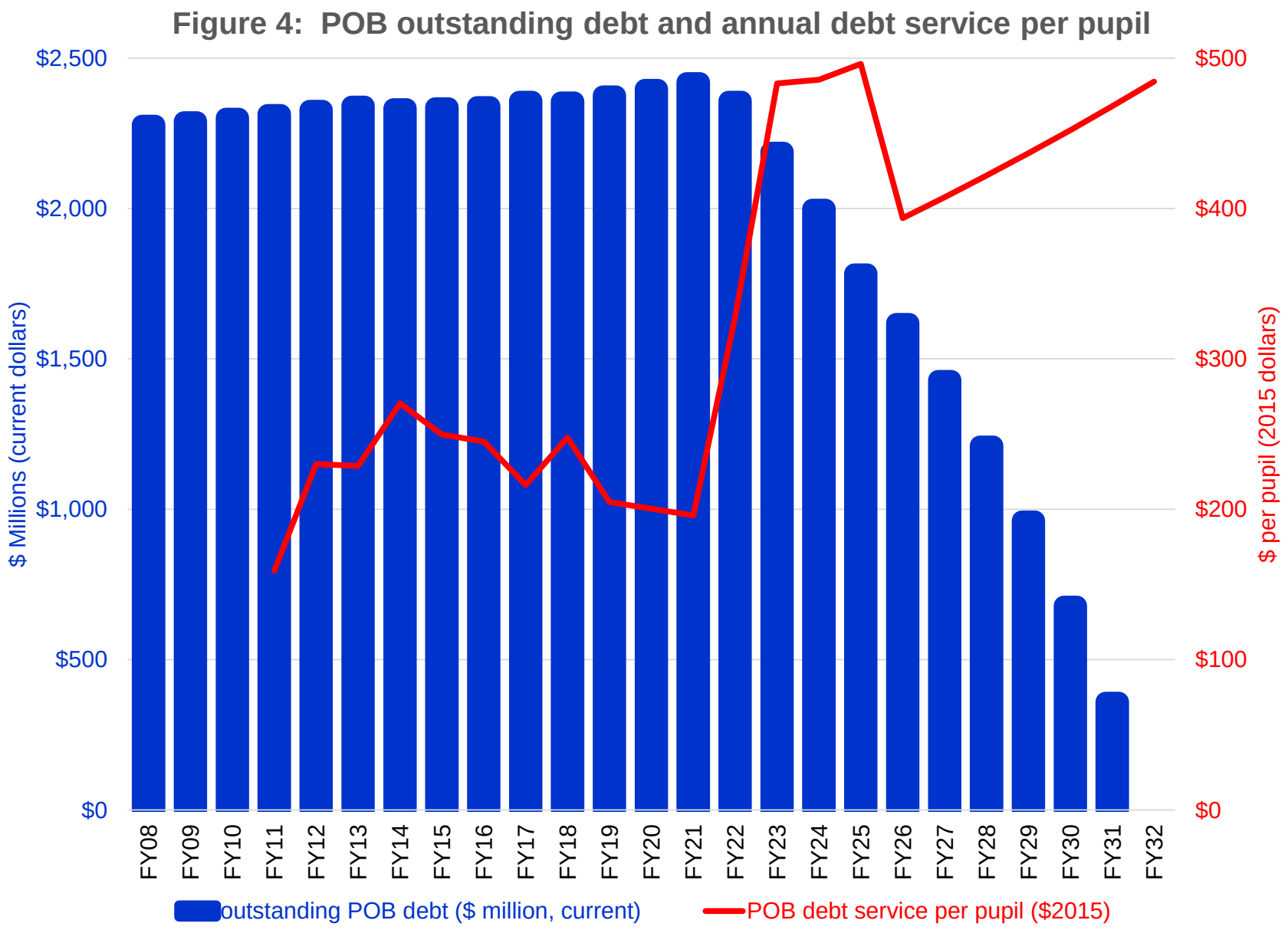


Figure 4: POB outstanding debt and annual debt service per pupil
$2,500
$2,000
$1,500
$1,000
$500
$0
$ Millions (current dollars)
$500
$400
$300
$200
$100
$0
$ per pupil (2015 dollars)
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19
FY20
FY21
FY22
FY23
FY24
FY25
FY26
FY27
FY28
FY29
FY30
FY31
FY32
outstanding POB debt ($ million, current)
POB debt service per pupil ($2015)