CROSS-SUBSIDIZATION OF TEACHER PENSION COSTS IN TRADITIONAL VS. CASH BALANCE PLANS: THE CASE OF KANSAS, THE FIRST TEACHER CB PLAN

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ABSTRACT: This paper builds on previous work (Costrell and McGee, 2019) on the redistribution of teacher pension benefits, as measured by the wide variation in individual normal cost rates by age of entry and exit, and the associated cross-subsidies embedded in the funding plan. As previously shown, these systems of cross-subsidies can be vast and/or idiosyncratic (e.g. CA, Costrell, 2018a; MA, Costrell and Fuchsman, 2018; and AR, Costrell, 2018c). I have argued that such cross-subsidies would vanish under an *idealized* cash balance (CB) plan: the individual normal cost rates would all be identical and equal to a common joint contribution rate if the interest rate equals the assumed rate of return. In this paper I examine how the pattern of cross-subsidies *actually* changes under the first CB plan implemented for teachers, in Kansas.

I find that the cross-subsidies in Kansas' CB plan are much reduced, but not eliminated, from the DB plan it replaced. Since the conversion to CB was no doubt prompted by Kansas' serious underfunding problem, one would expect that the overall level of employer-fund benefits would be cut, but in fact there was already little left to cut. Thus, the spread of individual normal cost rates was shrunk around a lower mean, modestly raising benefits for vested short-termers (by virtue of a guaranteed 4 percent return on retirement accounts), while substantially cutting benefits for career teachers (among new hires only, of course).

In addition, I consider the distribution of the value of the risk borne by the employer. This is the value of the pension guarantee in defined benefit plans. It is quite substantial and highly concentrated in traditional, back-loaded FAS plans (Costrell, 2018b). This was also true for Kansas' FAS plan, but is much reduced, yet more broadly distributed in the CB plan that was adopted. This may form the strongest case for replacing FAS plans with CB. However, it remains the case that this benefit is off the books under current actuarial standards, and does not correspond to employer contributions.

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I. INTRODUCTION

Traditional teacher pension plans provide highly disparate individual benefits, varying widely in value, despite the uniform rate of pension contributions. Most notably, a good portion of the contributions made by and for short-termers go to cross-subsidize back-loaded benefits received by career teachers. In addition, young entrants often cross-subsidize older entrants. In general, benefits are not closely linked to contributions, but are driven instead by formulas of the final average salary (FAS) genre, which typically results in a distribution of benefits that is quite arbitrary. Benefits are not only untethered from contributions, but, indeed, from any compelling human resource rationale (including retention). Throughout the decade-long literature on these inequities,[1] it has often been suggested (by me and others) that the adoption of cash balance (CB) plans – defined benefit plans that tie benefits to contributions – would ameliorate, or, in *idealized*[2] form, even eliminate these inequities. However, until recently, no teacher pension systems have adopted such plans. In this paper I examine how the pattern of cross-subsidies changes under the first *actual* CB plan implemented for teachers, in Kansas. By how much are the inequities reduced, and what are the features of the *actual* CB plan that account for those that remain? Stated differently, how do these features affect the level and distribution of employer-provided benefits, including, importantly, the off-the-books value of the pension guarantee?

To frame this inquiry, it is useful to consider the political context in which such policy changes occur. Taking the issue of inequity in teacher pension benefits *in isolation*, it is not overly surprising that the forces for reform – on behalf of young, mobile teachers – have proven weaker than those for preserving the distributional status quo, notably the unions. However, there

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[1] This line of research dates to Costrell and Podgursky (2008, 2009, 2010a, 2010b).

[2] I do not mean to imply the idealized form is optimal, only that it is the purest and simplest to analyze.

was some hope that the need for reform to address *funding* issues – the issue with far more political salience and urgency – might also provide an opportunity for legislatures to reform plan structure in a way that provided more equity. So it has been somewhat surprising (although perhaps it should not have been) to those of us who advocated such reforms that when systems did move, under funding pressure, to modify benefits, they often did so in a way that exacerbated inequities, back-loading FAS-structured benefits even more (e.g. by raising the normal retirement age). By adopting CB, Kansas has been the exception, so one may ask what Kansas saw that other states did not. Was Kansas uniquely interested in teacher pension equity?

Alternatively, when Kansas, under strenuous funding pressure, moved to trim benefits, it seems they found that adopting a CB structure offered another benefit, arguably more important to the plan: an opportunity to reduce the risk, previously borne by the plan (but never corresponding to actual contributions). That is, the general CB structure was better suited to overall risk-reduction and some degree of risk-sharing than simply trimming benefits under a traditional FAS plan. Stated differently, the plan cut the value of the pension guarantee that is implicit in traditional DB plans (where the cost is off-the-books under standard – albeit misguided – pension accounting), but which is highly concentrated (Costrell, 2018b). As a result of the specific CB provisions adopted, benefits deviate from the purely equitable result of an *idealized* plan, but are more equitable than the FAS plan, especially in the distribution of the value (and unreported cost) of the pension guarantee. The lesson from Kansas may well be that the more compelling reason for legislatures to shift to CB is not so much the improvement to equity – as noble as that would be, and as strongly as I and others have argued this case – but rather the possibilities for risk reduction under CB. These may be the features that fiscally stressed legislatures find attractive, which would have the byproduct of enhancing equity. That is, by moving to CB, they may do well (on risk) by doing good (on equity). But much of the good remains off the books.

The plan of the paper is to first briefly explain the concept of annualized value of individual benefits (i.e. the individual "normal cost"), and the system of cross-subsidies (positive and negative) engendered by the wide variation in benefits under traditional FAS plans (as previously set forth in Costrell and McGee, 2019). Then I will apply this concept to the FAS plan for Kansas teachers that applies to teachers hired before 2015. This will generate the first of several graphs showing how the individual normal cost rates vary by age of entry and exit, and their corresponding cross-subsidies.[3] In the next section, I derive and portray the array of individual cost rates under the CB plan that Kansas implemented for teachers hired since 2015. I will compare this system of benefits with the FAS system it replaced, as well as with the idealized CB plan that would eliminate all variation. I will then examine the features of the actual CB plan that deviate from the idealized version, which account for the variation in benefits that remain. I will then turn to the issue of risk, by depicting the distribution of individual values of the pension guarantee under Kansas' FAS plan, which is highly concentrated (as in other states), and the very different distribution of the value of the guarantee under the CB plan. Concluding remarks will summarize my findings.

II. INDIVIDUAL NORMAL COST RATES AND CROSS-SUBSIDIZATION

Pension benefits are funded by a uniform fringe benefit rate. For example, the annual contribution to the pension fund (employer and employee contributions taken together) may be 15 percent of each teacher's salary. These "normal cost" contributions are designed to fund the

[3] For purposes of comparison, an appendix presents comparable graphs for the FAS plans of three other states (CA, MA, and AR), from prior work (Costrell, 2018a, Costrell and Fuchsman, 2018, and Costrell, 2018c).

future retirement benefits as they are earned,[4] for the system *as a whole*. However, the annual cost of benefits for *individual* teachers may deviate widely from this overall average. For example, early leavers may earn benefits worth 5 percent of salary per year while the benefits of those who retire at the "sweet spot" are worth 25 percent. In effect, there is a large cross-subsidy – 10 percent of pay – from the contributions by or for early leavers to help pay the benefits of career teachers. This is a big part of the funding plan. There are also other patterns of cross-subsidies, e.g. from younger to older entrants or vice versa. In this paper, I present these patterns of *individual* normal cost rates and associated cross-subsidies for school employees under the Kansas Public Employees Retirement System (KPERS), for the traditional FAS plan that applies to teachers hired before January 1, 2015 and the CB plan for those hired afterwards. My first goal in this paper is greater transparency and deeper understanding of the system of winners and losers embedded in the funding plans of traditional teacher pension systems, and how that was changed by the CB plan adopted in Kansas.

Pension plans calculate the normal cost rate at the aggregate level, to fund a cohort's benefits as they accrue. Individual cost rates, based on age of entry and exit are implicitly embedded within the calculation (Costrell and McGee, 2019, Appendix), but they are not publicly reported. Specifically, consider an individual of type *(e,s),* where *e* is the age of entry and *s* (for separation) is the age of exit. For each type *(e,s)*, one can identify an individual normal cost rate, n_{es} that generates a stream of contributions sufficient to fund the individual's

[4] In addition, the employer makes payments for the unfunded liability – benefits earned in the past, but not funded. This is a very large problem, but is not the subject of this paper. The intergenerational cross-subsidies represented by these payments (Backes, et. al. (2016)) are a consequence of the failure to meet actuarial assumptions, particularly the return on investments (Costrell (2018d,e)). In this paper, I take the assumptions as given to analyze the cross-subsidies within generations that are *built into the system's funding plan*, as distinct from the cross-subsidies between generations when the assumptions fail. For analyses that incorporate cross-subsidies across generations that arise from the failure to meet assumed investment returns, see Costrell and McGee (2017).

future benefits. It can readily be shown that n_{es} is the ratio of the present value (PV) of benefits, B_{es}, to the PV of earnings, W_{es} (both evaluated at entry):

(1) $n_{es} = B_{es}/W_{es}$.

This is the rate that, applied to the individual's annual earnings over her career, would prefund her benefits. It represents the value of her benefits earned annually, as a percent of earnings – an *individual* fringe benefit rate for pensions. If we compare individuals with different entry and exit ages, *(e,s)*, we find their cost rates, n_{es}, vary widely. In the simple example above, n_{es} was 5 percent for early leavers and 25 percent for career teachers. The actual results for the full array of entry and exit ages will be shown below for teachers under KPERS' FAS and CB plans.

The joint contribution rate (employee plus employer), n^*, is *uniform* (independent of the individual's normal cost), and is calculated to fund the benefits of the whole entering cohort.[5] This rate is a weighted average of individual costs.[6] The deviations $(n_{es} - n^*)$ are positive and negative, as the cost of funding an individual's benefit exceeds or falls short of the uniform contribution rate, n^*, comprising a system of cross-subsidies. By the nature of averages, the weighted sum of cross-subsidies $(n_{es} - n^*)$ is zero: the negative cross-subsidies provided by the losers fund the positive cross-subsidies enjoyed by winners. To continue with the simple example above, $n^* = 15$ percent, and $(n_{es} - n^*) = -/+ 10$ percent for early leavers and career teachers, respectively: contributions equal to 10 percent of pay are redistributed. The full array of cross-subsidies embedded within KPERS' FAS and CB plans will be shown below.

[5] It can be shown that n^* applies not simply to a single entering cohort, but to any cohort, past or present, or the full set of such cohorts working their way over time through the workforce, under a given benefit formula and set of actuarial assumptions (Costrell and McGee, 2019).

[6] The weights for n_{es} are the share of type *(e,s)* in the cohort's PV of earnings. These are not the exact weights used in actuarial practice, but are consistent with the approach (see Costrell and McGee, 2019, Appendix).

III. Individual Normal Cost Rates in Kansas' Traditional Teacher Plan

I now apply these concepts to Kansas' FAS plan for teachers hired in the years preceding the CB plan – KPERS Tier 2.[7] I estimate the individual normal cost rates, $n_{es} = B_{es}/W_{es}$, for entry ages, e = 25, 30, 35, 40, and 45, and all exit ages, s = 25, … , 70. I base the calculations on the KPERS actuarial assumptions for school employees and the KPERS 2 benefit formula.[8]

Benefits can be in the form of a pension or refund of employee contributions.[9] If a teacher takes the refund she forgoes any future pension and receives, instead, the cumulative value of the employee (but not employer) contributions, with accumulated interest at the rate set by KPERS. Teachers who leave before vesting, without the expectation of returning and becoming eligible for a pension, would certainly take the refund because it is the only benefit to which they are entitled. Teachers who leave after vesting, but too young to draw a pension, may either take the refund or leave the money in the fund to draw a pension in the future, upon reaching an eligible age. KPERS assumes that vested teachers choose the refund or the deferred pension to maximize the PV of their benefits. Teachers who are eligible for the pension upon leaving are assumed to take the pension immediately. I adopt these assumptions, as well.

If a teacher takes the pension, B_{es} is the PV of the stream of pension payments, weighted by her survival probabilities, discounted to entry. The annual pension payments are equal to a multiplier of 1.85% × years of service $(s - e)$ × final average salary (FAS, last 5 years). There is no COLA, since it was eliminated in 2012. Under KPERS 2, teachers are eligible for "normal

[7] Teachers hired between July 1, 2009 and December 31, 2014 are in Tier 2. Those hired earlier are in Tier 1 (also an FAS plan, with different benefit parameters), and those hired later are in the CB plan – Tier 3.
[8] The actuarial assumptions cover wage growth, investment returns, exit rates, and mortality rates. These assumptions are drawn from the 2017 annual valuation report (KPERS 2018), based on the most recent 3-year experience study (KPERS 2016). The benefit formula is delineated in the valuation report and elsewhere. This includes the retirement eligibility conditions, multiplier, employee contribution rate, and interest rate on refunds.
[9] I leave aside death and disability benefits, as well as administrative expenses, which total 0.40 percentage point, about 5 percent of school normal cost under KPERS.

retirement” at age 65, after 5-year vesting, or age 60 with 30 years of service.[10] Thus, for example, a 25-year-old entrant working to 65 retires with a pension of 40 × 1.85 = 74 percent of FAS. Vested teachers who withdraw before normal retirement but do not cash out are assumed by KPERS to defer the pension to the earliest normal retirement age. This formula, together with KPERS mortality assumptions for school employees (I take the female rate), allows one to calculate the PV of benefits, relative to the PV of wages, $n_{es} = B_{es}/W_{es}$, the annual contribution rate required to fund the benefits of an individual entering at age *e* and exiting at age *s*.

Variation in Normal Cost Rates By Age of Exit

Consider first an entrant of age 25. The normal cost rate for such an entrant is depicted in Figure 1, varying by age of exit. Prior to vesting, and for some years beyond, the benefit is the refund of employee contributions. The normal cost rate, therefore, starts at the employee contribution of 6.00 percent: the curve begins at the dashed horizontal line representing that rate. The cost rate then gently declines, falling slowly below the employee contribution rate. That is because the interest credit of 4.00 percent is below the fund’s assumed return, 7.75 percent.[11] The contribution rate needed to cover the refund falls as this difference accumulates.

At a certain point, the pension becomes more attractive than the refund. A 25-year-old entrant reaches that point at age 52; at this age the pension would still be deferred to age 65, but exceeds in PV the value of the employee refunds. Beyond that point, the normal cost rate rises as the deferral to 65 becomes shorter. At age 55, she has reached 30 years of service, so she needs only defer the first draw to age 60: the series of benefit payments is extended forward by 5 years. That is why the normal cost rate to fund the benefit jumps at that point. It continues to

[10] There is a provision for “early retirement” under which the benefit is “reduced actuarially.” For our purposes, that means the normal cost of the benefit is the same as if the pension were deferred until normal retirement age.
[11] The assumed return was cut from 8.0 percent as of the 2016 valuation.

rise from age 55 to 60, as the deferral to age 60 grows shorter. Beyond age 60, there is no deferral: the first draw is immediate. Each year of further delayed retirement beyond 60 is a year of forgone pension payments. Thus, even though the pension payment continues to grow with additional years of service and higher FAS, the normal cost declines, due to the decreasing number of years the pension will be paid. Overall, the normal cost rate, varies from 3.7 percent to 9.3 percent.[12] Since 6.0 percent is paid by the member, the normal cost of the employer-provided benefit ranges from -2.3 percent to +3.3 percent for 25-year-old entrants.

Variation in Normal Cost Rates By Age of Entry and Age of Exit

The normal cost rate also varies with age of entry. In general, the normal cost rate can rise or fall with later entry under traditional FAS plans, and we can see this for KPERS 2.[13] Figure 2 depicts the range of normal cost rates for selected entry ages. Thus, for 30-year-old entrants, the normal cost rate is below that of 25-year-old entrants for exit ages 55 − 59, and is higher for exit ages beyond 60 (due to the different ages at which they reach 30 years of service). The highest normal cost rates of all those depicted are for 45-year-old entrants who exit at age 65. These (and other) late entrants expand the upper range of normal cost rates beyond the 25-year-old entrants' maximum of 9.3 percent up to a maximum of 12.4 percent.

The variation in normal cost rates, from 3.7 percent to 12.4 percent, generates a range of cross-subsidies. The overall normal cost rate is about 7.4 percent, by my rough estimate.[14]

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[12] I calculate the normal cost rate for the cohort of 25-year-old entrants to be 6.91 percent.

[13] Later entrants with the same exit age have shorter service, so their pension is lower, reducing B_{es}, but the stream of earnings is shorter, reducing W_{es}. Thus, the ratio, $n_{es} = B_{es}/W_{es}$, can rise or fall, over different ranges of s, discount rates, and benefit formulas. Another way of seeing the ambiguity is to note that for any given exit age, the normal cost rate varies with (i) the starting pension as a percent of FAS; and (ii) FAS relative to cumulative earnings. For older entrants, with shorter service, the starting pension is a lower percent of FAS, which reduces normal cost. But their FAS is higher relative to cumulative earnings (since it is a shorter stream), which raises normal cost.

[14] KPERS calculates the overall normal cost rate for school employees (all tiers) at 7.76 percent (net of death and disability payments and administrative expense).

Thus, the cross-subsidies range from about -3.7 percent to + 5.0 percent. These cross-subsidies are built into the funding plan. For those individuals below the dotted line in Figure 2, depicting the overall normal cost rate, the plan is counting on using some or all of the employer contributions – plus, for many (those below the dashed line), part of the assumed earnings on employee contributions – to help finance the benefits of others. The beneficiaries of the cross-subsidies (i.e. those whose benefits cost more than the uniform rate assessed for all teachers) are concentrated on those who exit at some age beyond 56 (depending on age of entry).[15]

Advocates of traditional FAS pension systems defend the apparent inequities as a rational human resource policy to reward longevity.[16] As we see in Figure 2, KPERS 2 does reward longevity for any given entry age, by awarding benefits at a higher annual rate, as the exit age rises from age 51 or so, up through ages 60 or 65. One may debate whether the extent of the reward (the steepness of the curves) is effective or goes beyond what is efficient for human resource goals.[17] But the variation across entry ages, for any given exit age (i.e. the vertical spread in Figure 2) often goes in the opposite direction: *shorter* tenures are rewarded. For example, a 65-year-old retiree who has served 40 years, after entering at 25, receives a pension that costs much less annually than one who has served only 20 years, after entering at 45. As we shall see, among other potentially attractive features, CB plans offer the opportunity for a more rational system of rewarding longevity.

[15] Rhee and Fornia (2016, 2017) and Rhee and Joyner (2019) argue that those individuals who would fall below the line comprise a very small portion of the active workforce, since, at any given time, most of these individuals would have already left. But as explained in Costrell and McGee, 2019 this results in "survivorship bias" toward the beneficiaries of the cross-subsidies. That is, the losses left behind by prior leavers are excluded, such that the cross-subsidies do not sum to zero. In other words, the funding math simply does not add up.
[16] See, for example, Rhee and Fornia (2016, 2017), Rhee and Joyner (2019) and Weingarten (2017).
[17] For a good summary of the research, see Koedel and Podgursky (2016), as well as recent papers by Ni and Podgursky (2016), McGee and Winters (2016), and Roth (2017).

I have previously calculated the normal cost rates for teachers in California, Massachusetts, and Arkansas.[18] The overall cost rate is lower under Kansas' FAS plan than these other states, although the employer-funded portion for Massachusetts is the lowest.[19] There are several factors in the KPERS formula that account for the lower cost of benefits, including a lower multiplier and a higher discount rate. One of the main reasons, however, appears to be the elimination of the COLA, a step taken by KPERS in 2012 in the face of serious under-funding (which later led to the adoption of the CB plan). The variation in the benefits is also generally lower under KPERS 2 than the other three plans, especially California and Massachusetts.[20] Thus, the inequities, although significant, were arguably less dramatic than some other plans, so there was less to gain on that score by moving to CB, and yet Kansas was the state to do so.

IV. INDIVIDUAL NORMAL COST RATES IN KANSAS' CASH BALANCE PLAN

As with other states, Kansas was moved to reform its plan under fiscal duress. By 2012, the year Kansas' CB plan was authorized, the funded ratio for school employees had dropped to 49 percent, and KPERS as a whole (including state employees and other local plans) was not doing much better. The state had already issued pension bonds netting $440 million for KPERS in 2004 (and would issue another $1.0 billion of pension bonds in 2015). A new Tier 2 had already been put in place for new hires as of 2009. For schools, the employer (i.e. district) contribution rate was actuarially determined to include 13.67 percent for the unfunded liability – over six times the employer normal cost as calculated at that time – but a statutory cap on

[18] See Figures A1 – A3 below, drawn from Costrell, 2018a, Costrell and Fuchsman, 2018, and Costrell, 2018c.
[19] The comparison with Figures A1 – A3 is not quite apples-to-apples, because the assumed rate of return is lower in these states (7.0 percent for CalSTRS and 7.5 percent for MTRS and ATRS). However, recalculating them with KPERS' 7.75 percent rate yields the same qualitative comparison.
[20] For example, the spread between the maximum and minimum normal cost rate for 25-year-old entrants is 5.6 percent under KPERS 2, vs. 13.0 percent for CalSTRS, 13.2 percent for ATRS, and 9.1 percent for MTRS.

employer contribution hikes deferred a quarter of these payments to the future. It was in this environment that the 2012 Legislature enacted benefit changes for existing Tiers 1 and 2 (notably including the elimination of COLAs for Tier 2,[21] as mentioned above, plus hikes in Tier 1 employee contributions), and created a new Tier 3 (KPERS 3), the CB plan effective for new hires as of January 1, 2015.

A CB plan is a defined benefit plan, in which each individual's benefit is directly tied to a retirement account balance, to be annuitized upon retirement.[22] That balance is equal to the cumulative value of employee contributions plus employer contribution credits (a bookkeeping entry called "retirement credits" in KPERS 3), together with accumulated interest credits. In an idealized plan, the employer contribution credit, with interest, *is* the employer-funded benefit, transparent to all. If the credit is uniform, so are the rewards – there are no cross-subsidies, as benefits accrue smoothly in tandem with contributions. For example, if Kansas were to have adopted a CB plan aimed at cost-neutrality and no cross-subsidies, such an idealized plan would be set with the retirement credit equal to the FAS plan's employer normal cost rate, interest credits equal to the assumed rate of return, and immediate vesting. As a result, the normal cost curves for all entry ages would collapse to the dotted line in Figure 2.

We turn now to the actual CB plan implemented under KPERS 3.[23] I first consider the contributions. The employee contribution is the same as in KPERS 2, 6.0 percent. The retirement credits rise with years of service, to reward longevity, and do so in a more rational, monotonically graduated fashion than typical FAS plans. Specifically, the retirement credits are 3.0 percent for years 0–4, 4.0 percent for years 5–11, 5.0 percent for years 12–23, and 6.0

[21] This was offset by an increase in the multiplier from 1.75 to 1.85 percent.
[22] There often includes a partial lump sum option, up to 30 percent in the case of KPERS 3.
[23] The plan as originally legislated in 2012 was modified in 2014 before implementation in 2015. I will consider the plan as implemented.

percent for years 24 and up. Thus, on the surface, it may appear that the CB plan is more costly to the employer than the FAS plan, since the retirement credit for all individuals exceeds KPERS 2's average employer normal cost, of about 1.4 percent. Of course, that is not the case (otherwise it would not have been adopted). There are several features that depress the CB plan's employer normal cost below the retirement credit rates.

The first such feature is vesting. As with FAS plans (and unlike many DC plans), vesting is not immediate: for KPERS 3, it is five years, the same as KPERS 1 and 2. An individual leaving before five years of service (absent an intention to return) withdraws one's own contributions with interest, but forfeits any benefit from the retirement credits that have accrued during that period. Thus, the individual normal cost curves that we shall see for KPERS' CB plan are qualitatively similar to those under the FAS plan (depicted in Figure 2) prior to vesting: neither of them include any cost for the employer.

The second feature that depresses the CB employer normal cost rate below the retirement credit rates of 3 – 6 percent is that the interest credit is below the assumed return, both before and after vesting. Specifically, the interest credit is 4.00 percent guaranteed, plus a dividend of three-quarters of the actual fund returns that exceed 6.00 percent over a five-year period.[24] This upside-risk-sharing provision leads KPERS to assume that the interest credit will average 6.25 percent.[25] Although to date this has proven to be a conservatively high cost assumption,[26] it still falls short of KPERS' assumed return of 7.75 percent. Thus, the fund assumes that part of the

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[24] The initial plan design, as enacted in 2012, provided a guaranteed interest credit of 5.25 percent, plus additional interest credits of 0 – 4 percent to be granted at the discretion of KPERS, based on actual returns and funding. The guaranteed interest credit was reduced to 4.00 percent and the formula-based dividends were introduced in 2014 legislation, prior to the 2015 implementation of KPERS 3.

[25] This was reduced from 6.50 percent in the 2016 valuation, when the assumed return was reduced from 8.00 to 7.75 percent.

[26] For the first three years of the plan, 2015 – 2017, the dividends were 0.0, 0.0, and 1.1 percent, so the interest credits came to only 4.0, 4.0, and 5.1 percent.

cost of funding the retirement credit will be covered by the cumulative difference between the interest credit and the return on the fund, up to the point of retirement.

The third factor that depresses the CB normal cost is the retirement eligibility requirement, since that determines the period during which the fund gains from the spread between the assumed return and the interest credit. The eligibility requirement for normal retirement is the same for KPERS 3 as for KPERS 2: age 65, after 5-year vesting, or age 60 with 30 years of service.[27] Thus, an individual leaving service after vesting, but before the eligibility age, defers the benefit until that age, and the interest-return spread continues to help cover the cost of the benefit until retirement.

The final factor is a rather important, but somewhat obscure provision.[28] This provision sets the interest rate embedded in the annuity, upon retirement, at 2.0 percentage points below the assumed return.[29] This means the present value of the annuity at retirement is less than the retirement account balance that is annuitized. My calculation is that the reduction is about 15 percent for retirement ages in the range of 60 – 65. This reduction does not appear to apply to the portion of the account balance which is claimed as a lump sum. KPERS assumes that all members of the CB plan take the full 30 percent lump sum allowed, so the reduction implied above is only assumed to apply to the 70 percent of the balance that is annuitized.

[27] As with KPERS 2 there is a provision for "early retirement" with reduced benefits, but, again, for our purposes, that means the normal cost of the benefit is the same as if the pension were deferred until normal retirement age. KPERS assumes such deferral for inactive vested members.

[28] It is not mentioned in the KPERS 3 benefit guide, but can be found in the most current (2017) valuation report. It seems to have last been mentioned in the 2013 valuation, released in 2014, where that year's legislation modifying the provision was reported. It is found in statute, subsection 74-49, 313(a).

[29] The initial legislation in 2012 set the annuity interest rate at 6.0 percent, which was 2.0 points below the assumed return at the time. The 2014 legislation tied it to whatever return is assumed.

Taking the benefit provisions given above and the actuarial assumptions reported in the valuation,[30] I estimate the individual normal cost rates for KPERS 3, depicted in Figure 3. Comparing with the FAS rates for KPERS 2, in Figure 2, I find that (1) although the spread is not eliminated, as in the idealized CB, it is very much reduced; and (2) the mean, around which the spread has been reduced, has itself shrunk, as one would expect given the circumstances of the plan's origin. The employer normal cost rate – which was already fairly minimal, so there was not much room to cut – seems to have been reduced by about half, to about 0.7 percent.

V. The Value of the Pension Guarantee Under KPERS' FAS and CB Plans

The preceding analyses are based on conventional actuarial practice of discounting by the assumed rate of return. However, as a long finance economics literature has unequivocally demonstrated (Novy-Marx and Rauh, 2009; Brown and Wilcox, 2009; Biggs, 2011) the value of a risk-free benefit is substantially understated when discounted by a rate that includes the risk premium embedded in the assumed return. More recently, Costrell, 2018b has shown how highly concentrated the distribution of the value of the pension guarantee is under FAS plans. This is done by examining the difference between individual normal cost rates evaluated at the assumed return and the risk-free rate. My analysis suggested that the concentration of individual values of the pension guarantee magnifies that of conventionally calculated normal cost rates.

[30] I make one modification in the assumptions. KPERS assumes that 100 percent of vested Tier 3 (CB) members leave their contribution with the system. By contrast, KPERS assumes that Tier 2 (FAS) members "take a refund if it is more valuable than the deferred annuity." I adopt this latter assumption for my Tier 3 estimates as well. This helps facilitate the comparison of the two systems, and also eliminates a discontinuous drop that would otherwise obtain for the CB normal cost rates upon vesting for young entrants. For most members, this assumption makes no difference, so the overall impact is a slight elevation in the estimated cost rates. It is also worth noting that for KPERS 2, the assumption is that members compare the refund with the value of the annuity "based on 7.75 percent interest," i.e. the assumed return without any reduction, unlike the annuitization rate in the CB benefit formula.

Thus, the value of the pension guarantee is much more concentrated under FAS plans, with their wide distribution of normal cost rates, than under CB plans with a narrower distribution.[31]

Figure 4 illustrates for Kansas' FAS plan. Each point represents the annualized value of the pension guarantee for individuals entering and exiting at the indicated ages. For example, individuals entering at age 25 and exiting at age 60 receive benefits that annually cost 9.3 percent, when discounted at 7.75 percent, as depicted in Figure 2, but 26.1 percent when discounted at 4.00 percent (not shown). The difference is 16.8 percent, the value of the pension guarantee depicted in Figure 4. As the whole diagram illustrates, the value of the pension guarantee is substantial and highly concentrated among teachers who stay beyond their mid-50s.

Figure 5 illustrates the value of the pension guarantee for Kansas' CB plan. It is estimated as the difference between the normal cost for the risk-free portion of the KPERS 3 benefit and the normal cost evaluated at the KPERS 3 assumptions, as depicted in Figure 2. Specifically, the risk-free portion is calculated using the guaranteed 4.00 percent interest credit, discounting at 4.00 percent, and also using an annuity rate of 4.00 percent (instead of the statutory 2.00 percent below the assumed return). For example, the same individual as above receives benefits that annually cost 7.1 percent when evaluated at KPERS 3 assumptions (depicted in Figure 3), but 10.9 percent (not shown) for the guaranteed portion as calculated above. The difference, 3.8 percent is the annualized value of that guarantee, depicted in Figure 5. Thus, the value of the CB pension guarantee is substantially reduced from that of the FAS guarantee, but much more evenly distributed.

Figure 5, together with Figure 3 also illustrates that the full value of the employer-provided CB benefit, including the value of the guarantee, is in fact fairly well aligned with the

[31] The illustration of this point in Costrell, 2018b with the case of Kansas' CB plan, while qualitatively accurate, is superseded quantitatively by this paper's analysis of KPERS 3.

stated employer credits, averaging 3 – 5 percent over one's career. For example, the full value of the employer-funded benefit for the individual discussed above, entering at age 25 and exiting at age 60, is 10.9 percent minus the 6.00 percent employee contribution, or 4.9 percent.

To summarize, the primary impact of moving from Kansas' FAS plan to the CB plan was arguably to reduce the unreported cost of risk to the plan, rather than the actuarially accounted employer normal cost (and the corresponding contribution), which was already so low there was little left to cut. Of course, on the other side of the coin, this also means the unreported benefits of the guarantee were cut overall – and substantially so for career teachers – but are more broadly distributed. The total employer-provided benefits for vested members fall in the range of 3 – 5 percent, including the value of guarantees not generally available in the private sector. Consequently, the total benefits may be comparable to those found in much of the private sector, but, unlike the private sector, these benefits largely take the form of unfunded guarantees.

VI. Conclusion

This paper builds on previous work (Costrell and McGee, 2019) on the redistribution of teacher pension benefits, as measured by the wide variation in individual normal cost rates by age of entry and exit, and the associated cross-subsidies embedded in the funding plan. As previously shown, these systems of cross-subsidies can be vast and/or idiosyncratic (e.g. CA, Costrell, 2018a; MA, Costrell and Fuchsman, 2018; and AR, Costrell, 2018c). I have argued that such cross-subsidies would vanish under an *idealized* cash balance (CB) plan: the individual normal cost rates would all be identical and equal to a common joint contribution rate if the interest rate equals the assumed rate of return. In this paper I have examined how the pattern of cross-subsidies *actually* changes under the first CB plan implemented for teachers, in Kansas.

I find that the cross-subsidies in Kansas' CB plan are much reduced, but not eliminated, from the FAS plan it replaced. Since the conversion to CB was no doubt prompted by Kansas' serious underfunding problem, one would expect that the overall level of employer-funded benefits would be reduced, but in fact there was already little left to cut. Thus, the spread of individual normal cost rates was shrunk around a lower mean, modestly raising benefits for vested short-termers (by virtue of a guaranteed 4 percent return on retirement accounts), while substantially cutting benefits for career teachers (among new hires only, of course).

In addition, I consider the distribution of the value of the risk borne by the employer. This is the value of the pension guarantee in defined benefit plans. It is quite substantial and highly concentrated in traditional, back-loaded FAS plans (Costrell, 2018b). This was also true for Kansas' FAS plan. It is much reduced, yet more broadly distributed in the CB plan that was adopted. This may form the strongest case for replacing FAS plans with CB. However, it remains the case that this benefit is off the books under current actuarial standards, and does not correspond to employer contributions.

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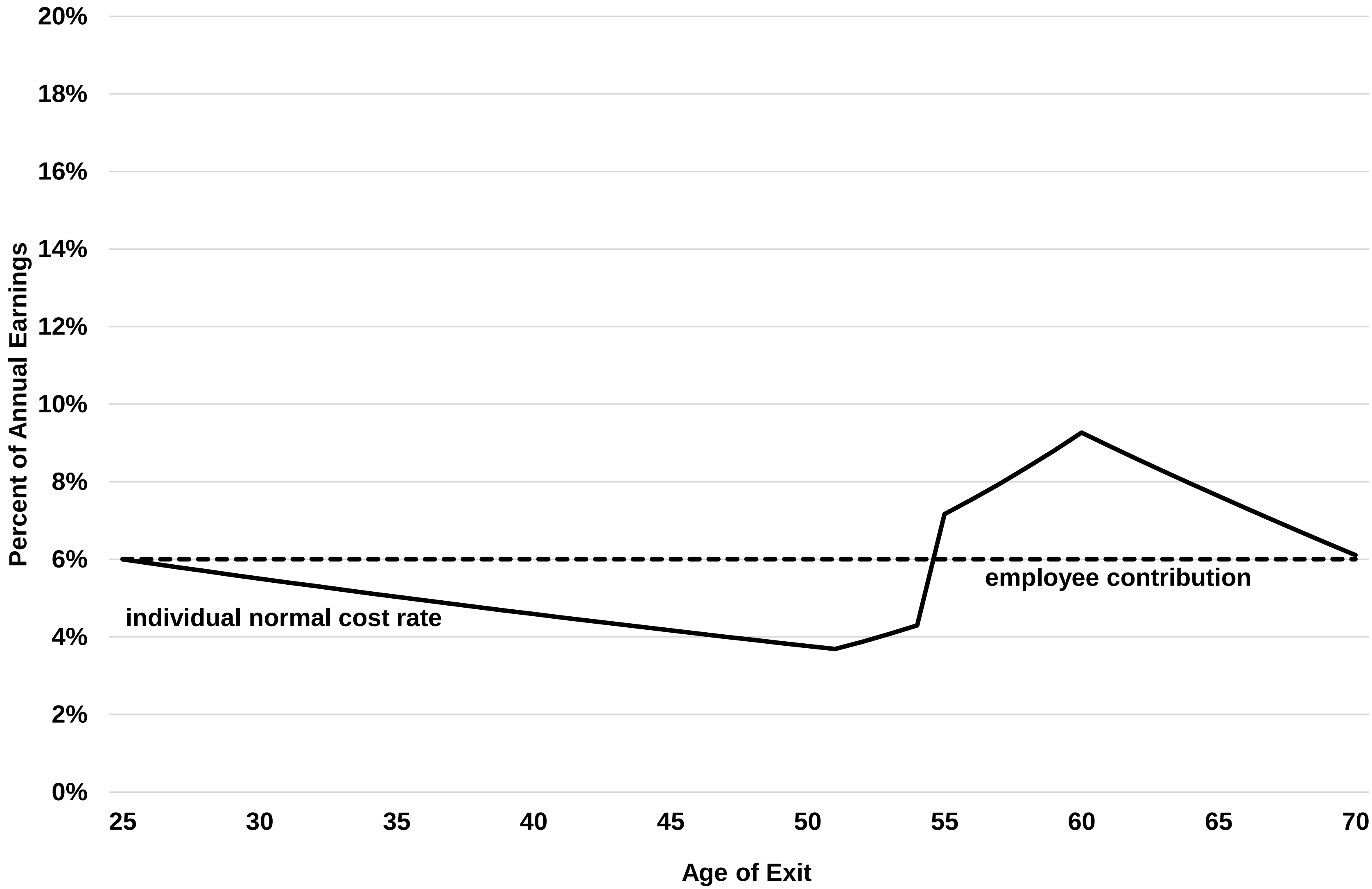
Figure 1. Normal Cost Rates, Kansas FAS Plan, by Age of Exit, Entry Age 25

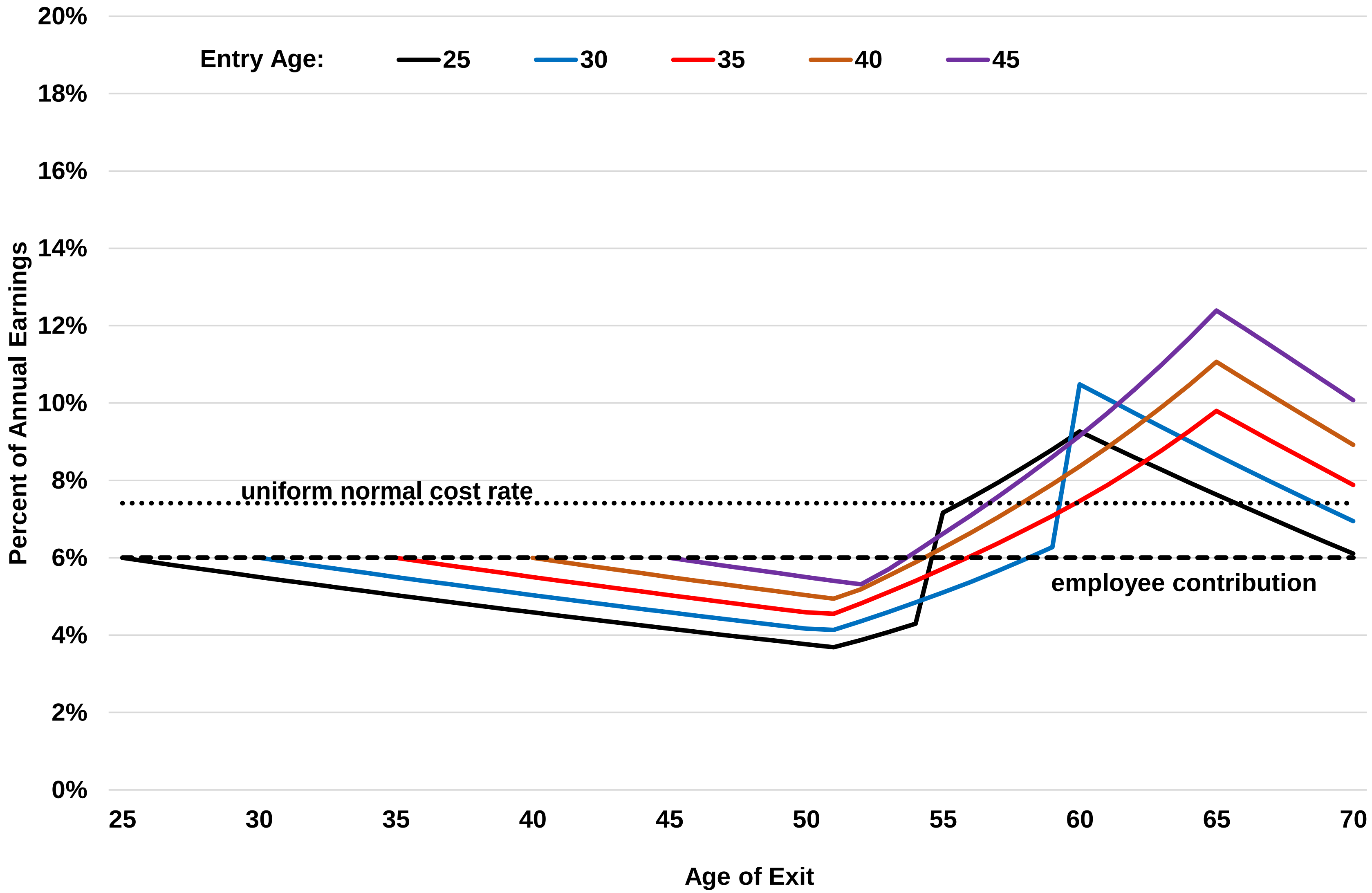
Estimated using 2017 KPERS 2 assumptions and benefit formula, r = 7.75%



The curves depict $n_{25,s}$, the annual contribution rate required to fund benefits of an individual entering at age *25* and exiting at age *s*.

Figure 2. Normal Cost Rates, Kansas FAS Plan, by Age of Entry and Exit

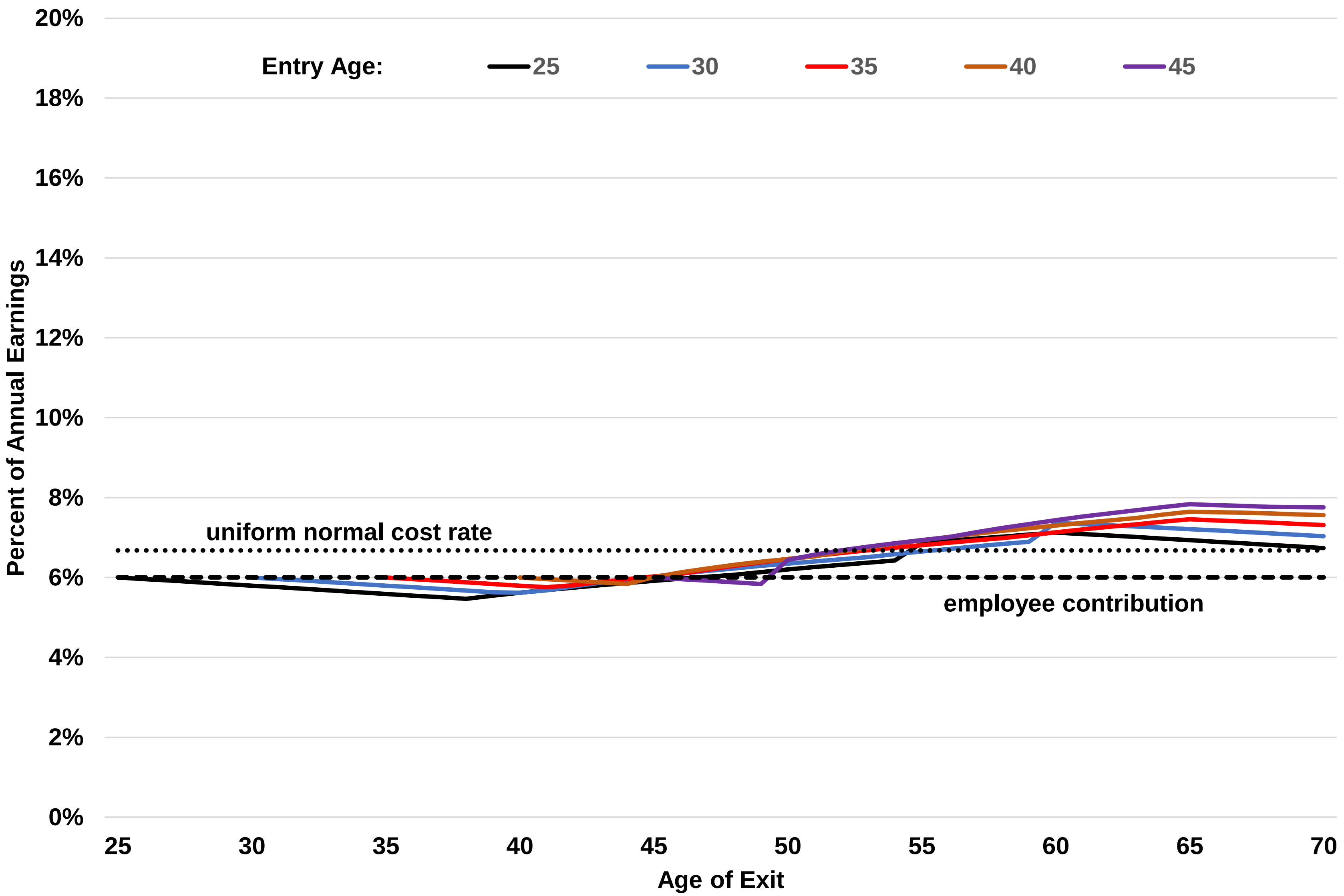
Estimated using 2017 KPERS 2 assumptions and benefit formula, r = 7.75%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual entering at age e and exiting at age s. Variation in cost by age of exit is shown along each curve; variation by age of entry is shown across curves.

Figure 3. Normal Cost Rates, Kansas CB Plan, by Age of Entry and Exit

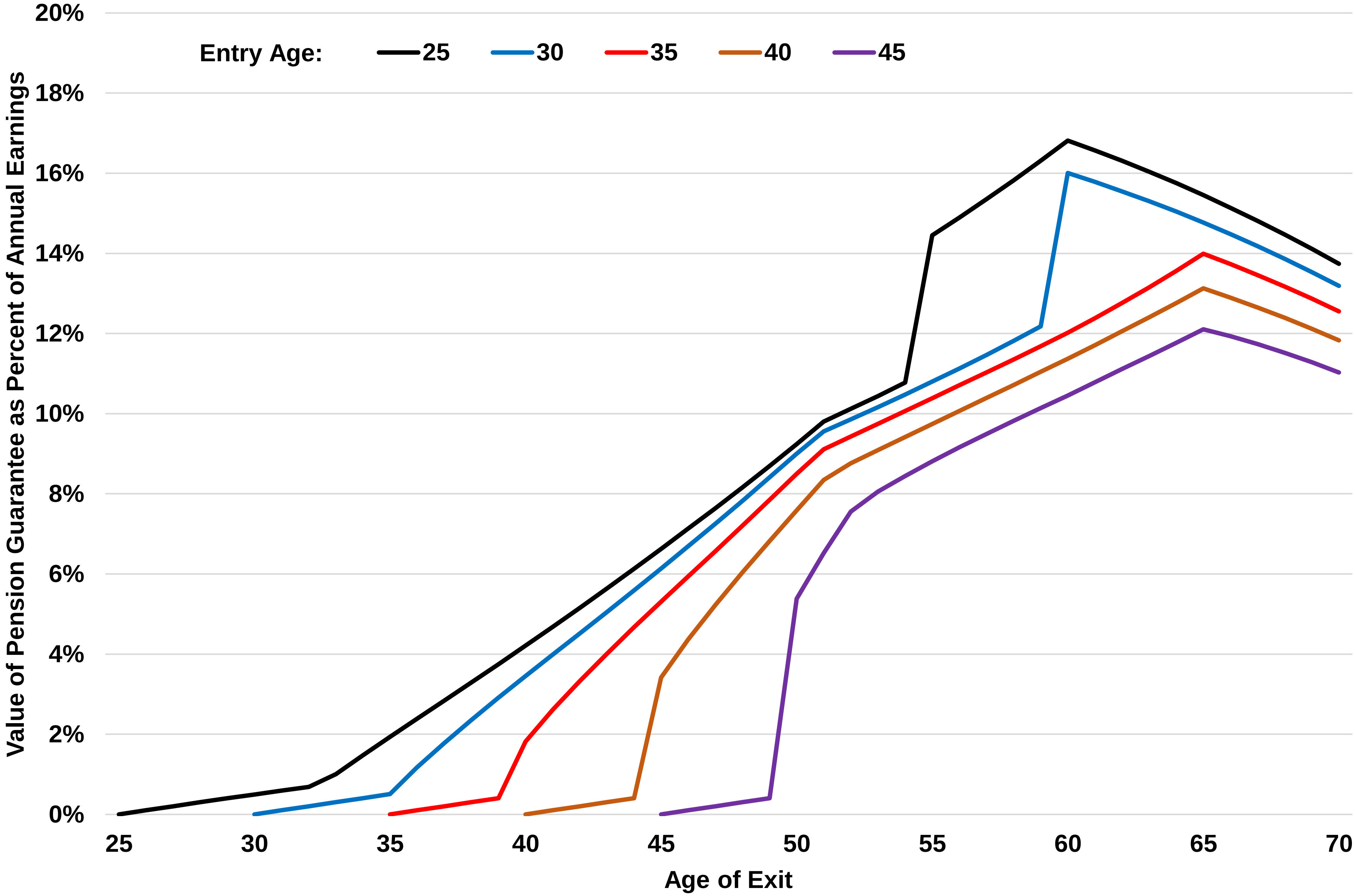
Estimated using 2017 KPERS 3 assumptions and benefit formula; r = 7.75%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual entering at age e and exiting at age s.

Figure 4. Value of Pension Guarantee, Kansas FAS Plan, by Age of Entry and Exit

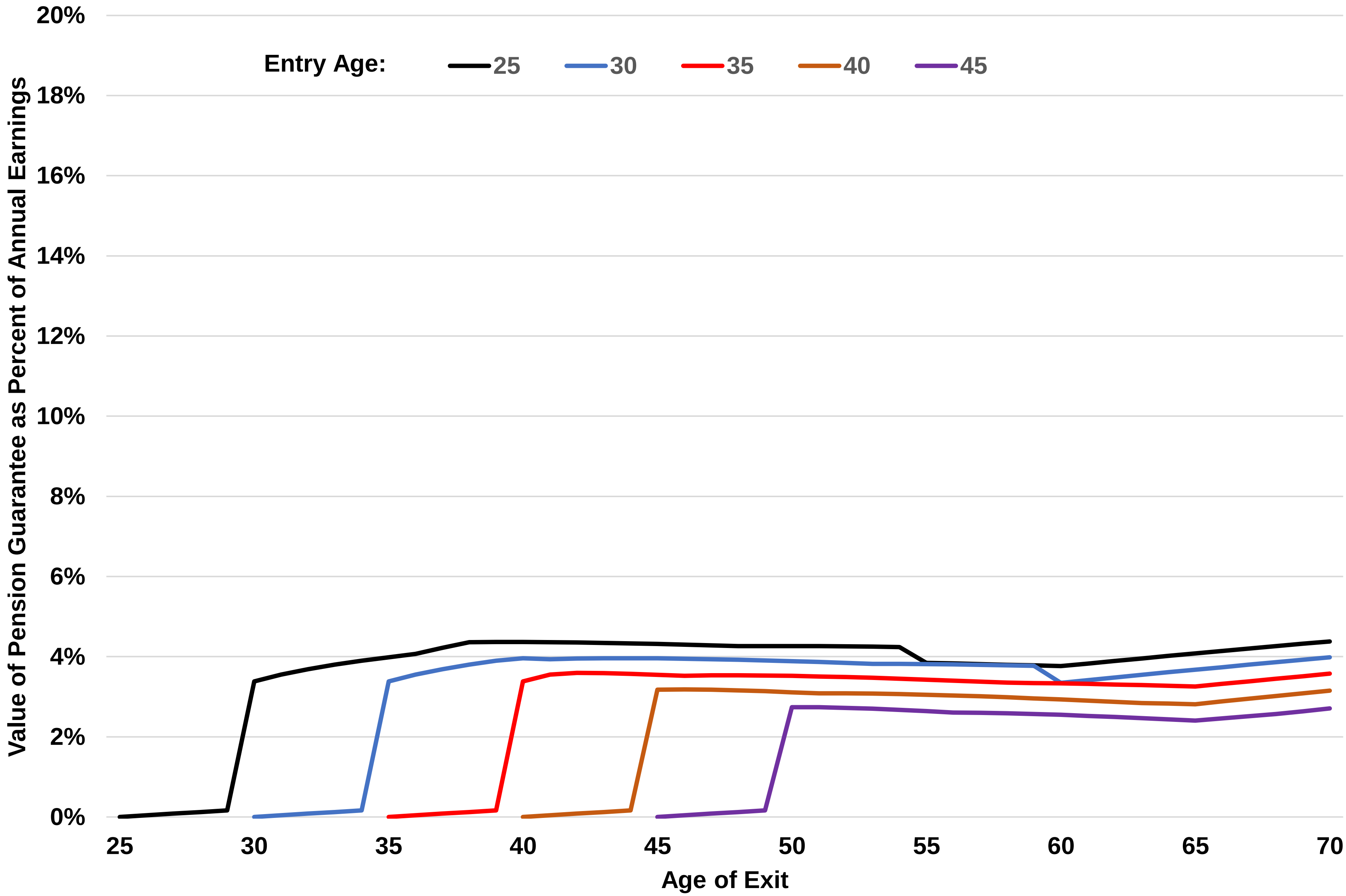
Difference between value of individual normal cost evaluated at 4.0% and 7.75% for KPERS-2 teachers



The curves depict the annualized market value of the pension guarantee for an individual entering at age e and exiting at age s.

Figure 5. Value of Pension Guarantee, Kansas CB Plan, by Age of Entry and Exit

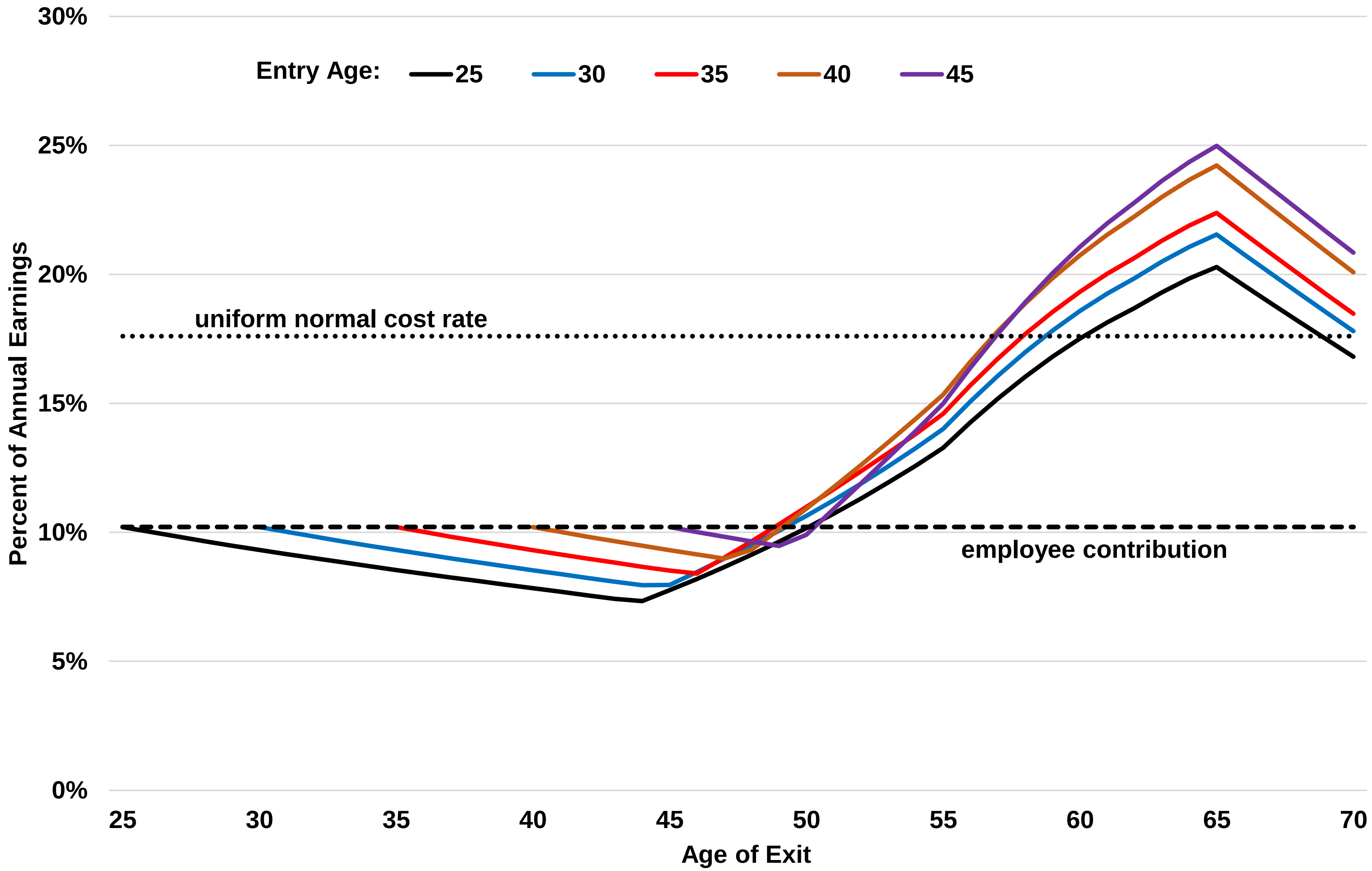
Difference between value of individual normal cost at discount = interest = annuity rate = 4.0% vs. KPERS 3 rates



The curves depict the annualized market value of the pension guarantee for an individual entering at age e and exiting at age s.

Figure A1. Normal Cost Rates, California, by Age of Entry and Exit

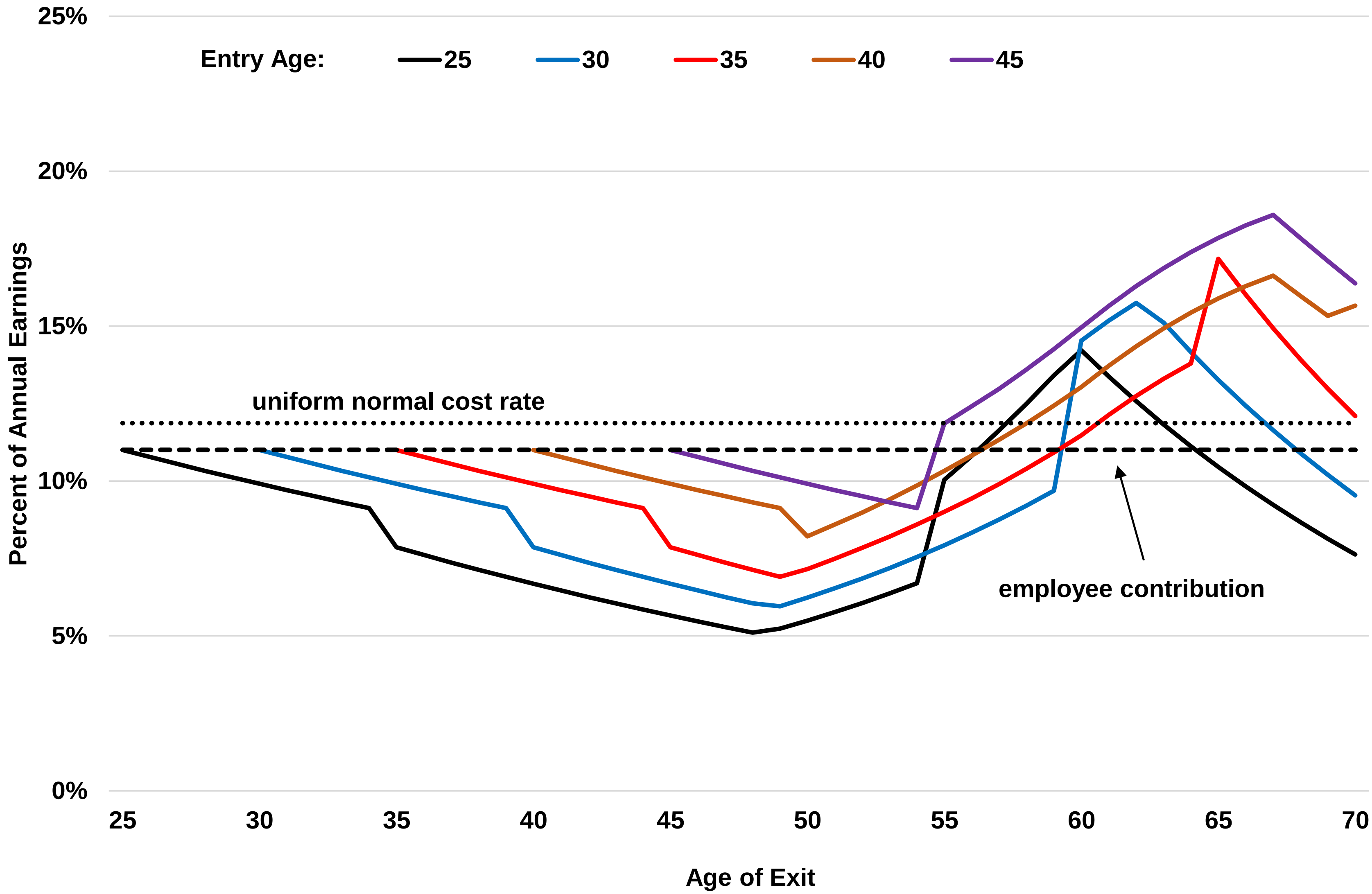
Estimated using 2016 CalSTRS assumptions and benefit formula for new hires, slightly modified; r = 7.0%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual entering at age *e* and exiting at age *s*. Variation in cost by age of exit is shown along each curve; variation by age of entry is shown across curves.

Figure A2. Normal Cost Rates, Massachusetts, by Age of Entry and Exit

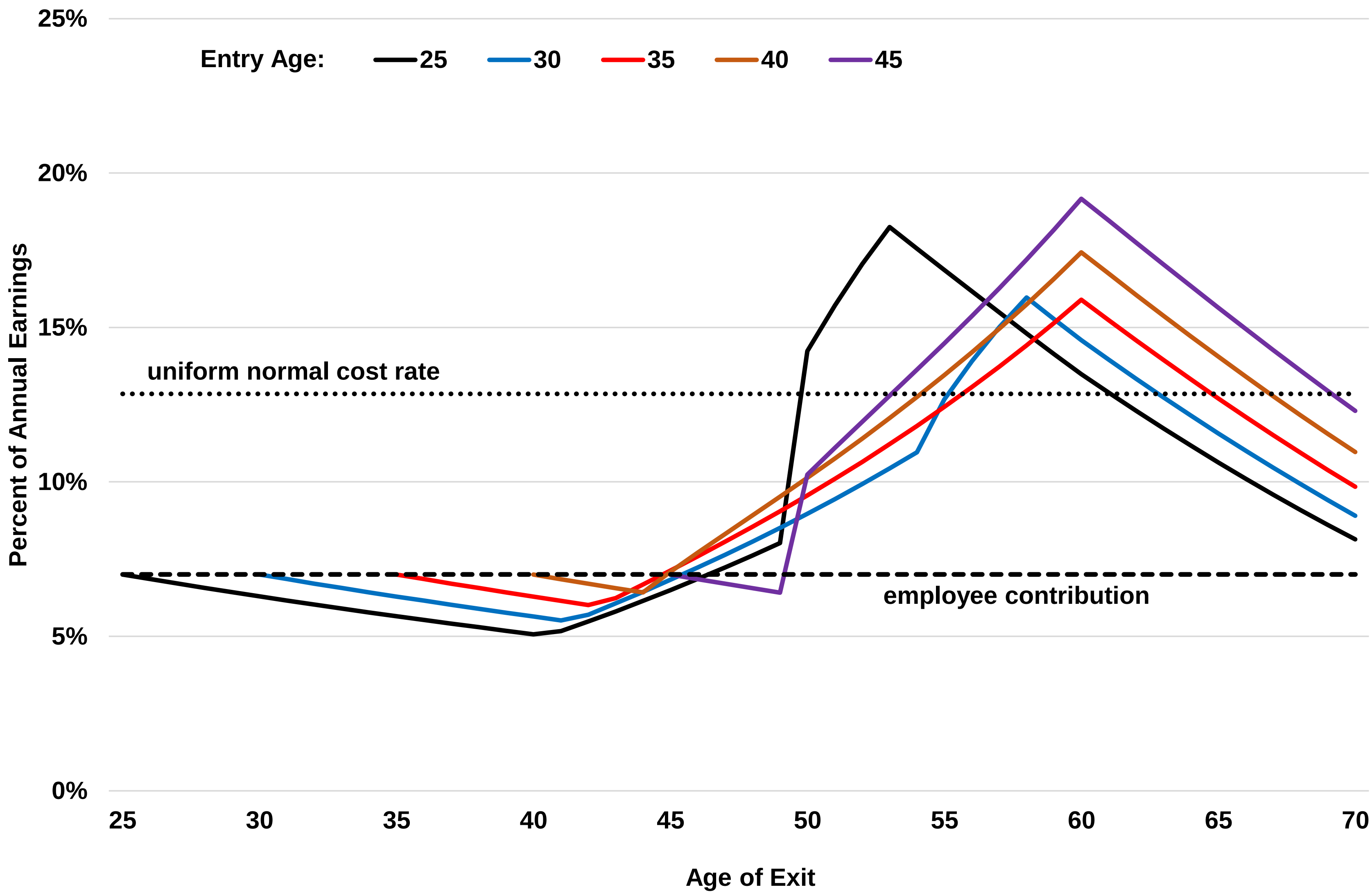
Estimated using 2016 MTRS assumptions and benefit formula for new hires; r = 7.5%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual entering at age e and exiting at age s. Variation in cost by age of exit is shown along each curve; variation by age of entry is shown across curves.

Figure A3. Normal Cost Rates, Arkansas, by Age of Entry and Exit

Estimated using 2017 ATRS assumptions and benefit formula for new hires, with FY23 contribution rate; r = 7.5%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual entering at age e and exiting at age s.
Variation in cost by age of exit is shown along each curve; variation by age of entry is shown across curves.