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Cash Balance Equivalences

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Cash balance (CB) plans share similarities with both traditional defined benefit (DB) and defined contribution (DC) plans. For example, a cash balance plan with age-weighted accruals is quite similar to a career-average DB plan. Though similar to DC plans, CB plans typically promise a minimum rate of return, often called the interest credit, and can be converted into an annuity guaranteed by the plan. Before the term "cash balance plan" was coined, church plans were already using this type of design to protect their participants from investment risk in a DC plan and some multiemployer plans derived their benefits from accumulated contribution accounts. This paper discusses various types of pension plans and how they can be imitated by a cash balance plan. The paper will also illustrate the similarities between cash balance plans and the U.S. Social Security benefit formula.

The interest credit in a cash balance plan is similar to the indexation[1] that can occur in DB plans. The way a benefit might be indexed varies by plan design. In a career-average-pay plan, benefits are based on each year's pay without any indexation.[2] Final-pay plans index benefits by wage increases up to retirement or quit date if earlier. In CB plans, the indexation is provided by the interest credit, so the relative value of benefit dollars is more equalized by age. The use of interest credits in CB plans has also been referred to as indexation, although it may not be obvious at first. The indexation in CB plans is usually at a higher rate than either inflation or wage indexation. In addition, cash balance indexing is easier for employees to understand than the indexation that appears in other DB designs (such as Social Security). The following sections show how a CB plan can mimic various plan structures.

Final-Average Pay DB plans: A final-average pay DB plan has age-weighted accruals and is not as valuable to mobile employees who don't stay with one employer until retirement. This is because accruals normally are smaller for younger workers, and benefits are updated to current pay levels only as long as an employee works for the employer. The benefit eventually received at retirement is based on pay averages when the employee quits, which could be many years before retirement age, and thus small in relation to current pay levels.

CB Plan Pay Credit: An equivalent CB plan would have an annual pay credit equal to the present value of each year's pension accrual payable at the plan's normal retirement age (NRA). For example, let us assume that the DB plan we want to mimic has a benefit formula of:

1% x service x *final average* pay

Each year the equivalent CB plan would have a pay credit of 1 percent times the employee's *current average* pay times the present value of a deferred annuity payable at NRA. The present value of a deferred annuity currently ranges from around "1" for participants in their 20s to about "11" for participants near age 65. These present value (PV) factors depend on the interest rates and mortality tables used in the plan and can change each month, each quarter, or each year.[3] Thus, the equivalent plan would be an age-weighted CB plan with pay credits ranging from 1 percent to 11 percent of current average pay.

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[1] By indexation, we mean a calculation (or updating) that makes past amounts, such as prices and wages, more relevant to prices and wages at a later date, reflecting inflation, wage increases, or compounding of interest.

[2] Some would note that career average plans are indexed. If you assume that each year's accrual is based on current career average pay, then accruals are indexed in the future by increases in career average pay. In addition, career average plans often get updated (typically when inflation is high) to reflect new wage levels. In this case, one could say that wages are indexed up to the wage levels at the last update.

[3] If the final-pay DB plan pays lump sums, then the factors would use the 30-year Treasury rate and the 94GAM table projected to 2002. These are currently required for minimum lump sum calculations by IRC Sec. 417(3), unless the plan specifies a larger lump sum.

The equivalent pay credit percentages could change due to fluctuating interest rates. For example, if interest rates increased to 7 percent, then the pay credits would range from 0.6 percent up to 10 percent of average pay. These percentages are based on the prices of deferred annuities at an interest rate of 7 percent. Similarly, these PV factors would increase if interest rates decreased to, for example, 4 percent. In a final pay DB plan, the *employer* takes on the interest rate risk. In a CB plan with fixed pay credits, the *employee* takes on the risk associated with changes in interest rates, not the employer.

Interest Credit: Each year in a traditional final-pay DB plan, the employee's prior traditional accruals[4] grow with the increase in the employee's *average* pay, one less year of discounting, and one less year of mortality decrements. In addition, because interest rates may have increased or decreased, the lump sum will depreciate or appreciate just like a long bond with payments far in the future.[5] In other words, the equivalent interest credit (to mimic the traditional plan) would equal the increase in employee's *average* pay + interest + mortality[6] + appreciation/depreciation.[7] This shows the degree to which a final-average-pay plan is backloaded. The accruals grow by *both* interest *and* wage increases. A CB plan would probably not be allowed to do this "double-indexing" under the anti-backloading accrual rules, even though a final-pay plan avoids this problem.

Summarizing, for a traditional 1 percent of final pay DB plan, the equivalent CB plan would have:

Pay credit = 1% x current average pay x age-weighted PV factors ranging from 1 to 11
(varying thru time with interest rates)
Interest credit = Interest rate + increase in average pay + mortality + appreciation/depreciation
(zero after quit date)

Annuity Prices: When retirement is reached, an annuity is purchased. CB plan documents typically specify the use of the then current Sec. 417(e) rates. If the final-pay plan we are trying to mimic provides actuarial equivalent benefits at early and late retirement, no more formulas are needed. The annuity prices are actuarial. See Appendix A for plans with early retirement subsidies or plans with no actuarial increases for delayed retirement.

Career-Average Pay DB Plan: This DB plan is just a special case of the above example, where past service benefits are not increased for pay increases.[8] Thus, the increase in average pay is dropped from the formula for the interest credit, and the pay credit uses current pay, not current average pay. The formulas for the equivalent CB plan are:

Pay credit = 1% x current pay x age-weighted PV factors ranging from 1 to 11
Interest credit = Interest rate + mortality + appreciation/depreciation

Inflation-Indexed Career-Average DB Plan: In this plan, employees get their benefits indexed to retirement, whether they continue working to retirement or not. That means the pay-credit formula changes by giving employees credit in the year they work for all the indexation to retirement. This increases the value of the pay credits for younger employees the most, and it is the same as reducing the amount of age weighting. For example, in the plans above, the age weighting was determined using Sec. 417(e) Treasury rates. If the DB plan we want to mimic has indexation using inflation rates, then the equivalent CB age weighting would be based on what economists call the real rate of return (the Treasury rate minus the inflation rate). That is, it would be something like the 5 percent

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[4] By "prior" accruals we are referring to the value of benefits associated with prior service.
[5] This is the whipsaw term that makes lump sums go up and down. It can be confusing in CB plans.
[6] In actuarial notation, the accounts lost by the q_x percent who die, get spread to the remaining p_x employees, which means that the account grows by $1 + q_x / p_x = 1 / p_x$.
[7] Appreciation/depreciation is the change in a bond value due to decreases/increases in interest rates.
[8] However, see footnote 1. You could use the same two formulas and just substitute "career-average-pay" for "final-average-pay."

nominal Treasury rate minus a 3 percent inflation rate equaling 2 percent. Using 2 percent to determine age weighting gets more age neutral present value factors that range from four for workers in their 20s to 11 for workers near age 65.[9] If pensions were indexed to inflation after retirement (e.g., government plans and Social Security), then the range would be more like 6 to 15.

Because the indexing is already in each year's pay credit, the "increase in average pay" item is dropped from the interest credit, so the formulas to mimic an *inflation*-indexed career average plan are as follows:

Pay credit = 1% x pay x age weighted PV factors ranging from 4 to 11
Interest credit = Interest rate + mortality + appreciation/depreciation[10]

Wage-Indexed Career-Average DB Plan: This is the same as the inflation-indexed DB plan, except that wages are indexed by the average increase in wages until retirement, instead of inflation. In this case, the interest rate for determining the PV factors is calculated using the Treasury rate minus the wage index rate, which is usually close to 0 percent (i.e., the wage index rate is probably higher than the inflation rate and close to the Treasury rate). Thus, the age-weighted formula is even flatter. For example, if we assume that over time, wages go up about the same as the Treasury rates, then the age weighting formula would range from 10 percent to 11 percent.[11] As in the prior section, if pensions are indexed after retirement, the PV factors range from 14 to 15. So, to mimic a 1 percent *wage*-indexed career-average DB plan, the equivalent CB formulas would be:

Pay credit = 1% x pay x age weighted PV factors ranging from 10 to 11
Interest credit = Interest rate + mortality + appreciation/depreciation[12]

Simple Cash Balance Plan: The prior section demonstrates that a CB plan with a pay credit of 10 percent of pay is quite similar to a wage-indexed career-average DB plan. Of course, this would be more expensive than a regular career-average or final-pay DB plan, because it gives more to younger, mobile employees by indexing their pay.

In order to keep total costs the same as a typical final-pay DB plan, the equivalent CB plan could have pay credits of, for example, 5 percent of pay, but then the CB plan would be more generous to younger mobile employees and less generous to older long service employees. A simple cash balance plan also simplifies the formula by eliminating the tiny mortality increase in the interest credit. To keep the lump sum always increasing, for ease of communication and employee appreciation, the appreciation/depreciation term in the formula for interest credit is also dropped. This would happen in a more steady economy where interest rates and wages do not change so much. Therefore, the formulas would be as follows:

Pay credit = 5% x pay
Interest credit = Interest rate

Because the pay credit does not increase or decrease as bond rates fluctuate, the interest credit does not include appreciation/depreciation. However, the annuity price does fluctuate with interest rates

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[9] This would provide both younger and older employees, assuming the same pay credit with the same purchasing power at age 65. While younger employees would get a larger nominal annuity benefit, they would not get the "real" growth that would occur with a full "interest rate" indexation.

[10] Where appreciation/depreciation is similar to that of an inflation-indexed Treasury bond (i.e., TIPS).

[11] These PV factors (for deferred annuities) were determined using a 0% interest rate. The only reason the factor is not fixed at 11 is because some younger people won't reach their NRA to get a pension. If they do, they will get their account balances increased each year by the mortality factor, which is still in the interest credit. It reflects the money placed into their accounts from those that die.

[12] Where appreciation is a function of the change in the interest rate, minus the wage index.

(e.g., annuity prices increase when interest rates decrease), so a worker will be subject to interest rate risks at retirement. This could be resolved if plans could always use the same interest rate (6 percent) to determine the annuity, but some suggest this could subject the employer to whipsaw litigation. If the plan did not pay lump sums, there would be no problem. However, if lump sums are available, then using a fixed interest rate at all times could create arbitrage concerns. When interest rates are significantly higher than 6 percent, participants should take the plan's lump sum and buy an annuity outside the pension plan. When interest rates are lower than 6 percent, they should take the plan's annuity, which would be a good deal using 6 percent. The employer would be subsidizing the pension in those years and contributing too much in years when the participants take lump sums. [13]

Because most CB plans (like other private-sector plans) do not have post-retirement indexation of the pension, retirees are subject to inflation risk. Of course, the employer could provide an inflation-adjusted pension, but it would start out at a much smaller amount, so most retirees would probably not elect it. While it would eliminate their inflation risk, it appears that most employees would not take the necessary steps to avoid such work, evidenced by very few people purchasing inflation-indexed annuities when they were available recently. The only insurance company offering them withdrew the product.

Social Security: Social Security is a wage-indexed career average plan, in which pensions increase with inflation after retirement. The age-weighting factors in the equivalent CB plan would be based on projecting pay to age 60 using average national wages and CPI for the last three years before age 65, and then discounting back at a bond rate. This means the age weighting factors in the equivalent CB plan would range from around 12 at younger ages to 15 at NRA.

In Social Security, there are three replacement rates used. Covered workers at low wage rates get 90 percent of their 35-year average wage replaced. The other two (marginal) replacement rates are 32 percent and 15 percent. Let us determine the equivalent pay credit for the middle replacement rate. Each year the employee's wage is indexed and then divided by 35 to get a 35-year average wage. If we take the 32 percent and divide it by 35 years and multiply it by 13.5 percent, a typical age-weighted PV factor for a plan with inflation-indexing after retirement, we get 12.4 percent, which also happens to be Social Security's contribution rate. This indicates that the employer and employee contributions to Social Security are close to paying for the benefits using the middle replacement rate of 32 percent. Because the 90 percent replacement rate is three times better, in effect, the government subsidizes lower-income workers by providing them a 200 percent matching contribution, until the first bend-point is reached. The 15 percent replacement rate, then, is equivalent to a negative 50 percent match. That is, the employer's contribution above the second bend-point goes to other workers, not to their higher paid workers.

After 35 years of full-time work, for example, a worker's average wage does not normally increase much, so in effect most of the worker's (and the employer's) contribution helps someone else. For example, if a worker's wages in his 36th year are 10 percent larger than the smallest indexed wage in an earlier year, then in effect, the worker's pay credit is 10 percent of the worker's contribution or about 1 percent of the worker's pay. In fact, if wages at these older ages are less than any of the indexed wages in the worker's 35-year wage average, the new wages may not improve the worker's Social Security benefit at all.[14]

[13] The example shown is based on differences in market interest rates. The law also creates similar arbitrage possibilities. For example, the requirement that pension plans use gender-neutral factors, which IRAs don't need, can also give an incentive for male participants (or those with worse than average health) to take lump-sum options, and then buy annuities from an insurance company, which is allowed to reflect gender and health status.

[14] This could suggest two alternative policy changes for Social Security. The payroll tax could be reduced after 35 years of full-time work, or more years could be included in the average wage. In order to do that, one might want to allow drop out years for childcare.

Two other Social Security provisions affect the formulas: (1) Workers with spouses who do not have a wage-paying job get 50 percent more on top for their spouse's benefit, and (2) Social Security has made their early and late retirement factors quite actuarial, so the formula can be simplified by avoiding reference to these factors. Thus, the equivalent cash balance formulas for Social Security are as follows:

Pay credit = Employer + Employee total contribution (12.4%) up to 35th year of covered work
= 1% after 35th year of covered work (remainder of payroll tax helps others)
Govt. match = 200% up to 1st bend-point (for low income workers & those with few covered years)
+ 50% match to workers with non-wage-earning spouses
(Govt. takes employer contribution above the 2nd bend-point to pay for matches[15])
Interest credit = Interest rate + mortality + appreciation/depreciation[16]

Simple Pay Equity Plan (PEP): A PEP plan is a cash balance plan in which the interest credits equal the employee's pay increase rate. How the interest credit is defined after the employee quits varies among PEPs. In most cases, the employee takes a lump sum, so it is not needed. However, if an employee doesn't take the lump sum, some plans provide that the interest credit will equal an average interest rate. Other plans fix the interest rate after the employee quits. Thus, the equivalent cash balance formulas are:

Pay Credit = PEP pay credit
Interest Credit = Employee's pay increase rate that year (while working)
= Interest rate after employee quits

Simple DC Plan: A cash balance plan can even mimic any DC plan by setting the interest credit in the plan document to the rate of return in the selected mutual fund or investment index. The plan would then be subject to the DB minimum funding rules, and the assets would not have to equal the sum of the account balances. The employer might put floors and ceilings on the interest credit, if so desired.

Summary

Cash balance plan designs can mimic other plans. Accrual rules and recent court cases, however, suggest that they may violate the law even where demonstrated to be actuarially equivalent to qualified plan structures in general use. It is important that these equivalences be better understood and appreciated to provide for plan structures that may better meet the needs of a mobile workforce and the employers who provide deferred income to assist them in meeting financial security. It is hoped that the laws can be clarified and synchronized so that these more flexible, simpler, and more easily understood plan structures can evolve to benefit both employers and employees.

[15] In effect, a negative 50 percent match above the 2nd bend-point.
[16] Where appreciation/depreciation is a function of the difference between the interest rate and wage index.

Appendix A: Plans with Non-Actuarial Factors for Early and Late Retirement

Early Retirement: If the DB plan we are trying to mimic subsidizes early retirement benefits (for example, the plan's early retirement factor (ERF) at age 55 equals 100 percent), then, in effect, the actuarially equivalent benefit (plan's ERF / actuarial ERF) is multiplied by a number larger than one. For example, at age 55, the plan's early retirement factor could be 100 percent, while an actuarial early retirement factor would be more like 50 percent. Thus, the ratio equals the number two,[17] which means the value of the pension could be twice the value of the account.[18]

Late Retirement: If the DB plan we are trying to mimic does not provide actuarial increases for late retirement, and the plan's late retirement factor (LRF) could be one, this is the same as multiplying the pension purchased from the account balance (plan's LRF / actuarial LRF) by a number less than one.[19]

Pension = (plan RF / actuarial RF) x actuarially priced pension purchased by account

Note that if the plan's retirement factors are actuarial, this formula just becomes:

Pension = actuarially priced pension purchased by account

[17] This is equivalent to subsidizing the annuity purchase price by multiplying it by the reciprocal (actuarial ERF / plan ERF). In this example, the annuity price at age 55 is cut in half.

[18] Since this ratio decreases to a value of one at normal retirement date (NRD), it is possible that these workers may lose value, even though the new benefit is based on a larger pay average, and even if they get another year's accrual.

[19] Under traditional DB plans, the value of a worker's benefit can decrease thru time after the NRD. This is sometimes referred to as a permissible suspension of benefits. By retiring one year later, the employee loses one year of benefit payments. If the employee is expected to live 15 more years, then he has lost 1/15 (or 6.67 percent) of his benefits (plus interest and mortality). Meanwhile he picks up another year of service. If he has 10 years of service, that increases his benefit by 1/10th or 10 percent (plus a salary increase) which is more than what he lost. Thus, he has a net gain. However, if he had 30 years of service, he only increases his benefit by 1/30 (plus a salary increase), which is less than what he lost by delaying retirement. If the plan provides an actuarial increase, then he doesn't lose benefit value on these prior accruals, and his gain is the full accrual for the past year of work. The same principles apply for early retirement. Other factors can change this analysis, such as back-loading and larger accruals in later years due to integration's leveraging affect on higher salaries prevalent at older ages, benefit or service maximums, supplements, and pro forma joint and survivor (J&S) factors, which can be subsidized (or not) at certain age groupings.