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# INTEGRATED LIFECYCLE MODEL ACCOUNTING FOR CAREER INTERRUPTIONS AND THE GENDER PAY GAP

***Summary.*** *This article examines the Integrated Lifecycle Model, specifically the Women Wise Longevity Planner, which adapts the classic 4% rule to the demographic and behavioral characteristics of women. The objective of the study is to simultaneously calibrate the safe withdrawal rate, the pace of accumulation, and the asset allocation strategy, incorporating the Longevity Stretch Factor, Career Interruption Factor, and Gender Pay Gap Offset, and to introduce the Early Bucket Trigger mechanism ten years before retirement. The novelty lies in a unified Women-Wise Withdrawal Rate formula and a two-phase algorithm for transitioning to the cash bucket, which, according to Monte Carlo simulations, reduces the probability of financial ruin by age 95 by 15–20 percentage points without increasing the overall savings rate. This article will be valuable for financial advisors, pension analysts, and personal-finance researchers.*

***Key words:*** *life cycle, safe withdrawal rate, Longevity Stretch Factor, Career Interruption Factor, Gender Pay Gap Offset, bucket strategy.*

**Introduction.** Since the mid-1990s, safe withdrawal norms have centered on the 4% rule. In William Bengen's original work, this figure was derived from retrospective U.S. return series under the assumption of a 46% equity allocation and a thirty-year horizon, ensuring the purchasing power preservation of the

portfolio even in the worst historical starting year [1]. The Trinity Study subsequently tested withdrawal rates in the 4–5% range, using data from 1926 to 1997, and demonstrated that success depends primarily on an equity allocation of at least 75% and a payout period of exactly thirty years, rather than a more prolonged duration [2]. Thus, the canonical rule is embedded in a male demographic model with a fixed horizon: it does not see the more extended and more varied biography of women.

For women, systematic divergence appears on three fronts. According to the latest SSA tables for 2024, a 65-year-old woman can expect to live, on average, another 20.8 years, compared to 18.2 years for a man. Moreover, women in the top decile survive beyond thirty years, creating a long tail of payouts [3]. Furthermore, McKinsey reports that over a decade, women spend only ≈ approximately 8.6 years in paid employment, losing about 14% of their potential working time, and that these interruptions account for up to 80% of the cumulative gender pay gap [4].

Attempts to adapt the classic rule typically involve lowering the initial withdrawal rate or creating buffers against sequence-of-returns risk. For example, in 2025, Morningstar proposed a conservative rate of 3.7%, arguing that asset returns will be lower over the coming decades [5]. Simultaneously, practitioners have popularized the segmented bucket approach: the first bucket holds 3–5 years of expenses in low-volatility instruments, which prevents equity liquidations during early market drawdowns [6]. Advisors supplement the model with cash reserves and annuities, emphasizing that without such protections, the risk of ruin over a long horizon increases substantially [7].

Collectively, these factors render the classic 4% constant and the 30 years and forget it logic methodologically vulnerable. The present work aims to formulate an integrated theoretical framework for the lifecycle, in which the withdrawal rate, accumulation pace, and asset-allocation strategy are jointly calibrated to address women's long tail of longevity, systemic career

interruptions, and persistent gender pay gap. Such an approach can significantly reduce the probability of ruin without considerably increasing the overall savings rate, thereby aligning financial planning practice with actual demographic boundary conditions.

**Materials and Methodology.** The study draws on the foundational works on the 4% rule by W. Bengen [1] and the Trinity Study of Cooley et al. [2], the latest SSA life-expectancy tables for 2022 and 2024 [3; 8], McKinsey's report on the impact of career interruptions on the gender pay gap [4], OECD data on women's average earnings shortfall [9], forward-looking recommendations from Morningstar and Arnott's analysis of sequence-of-returns risk [5, 11], and bucket-strategy practices from Schwab and Investopedia [6, 7]. These sources underpin the theoretical foundation for accounting for women's longevity tail, systemic employment breaks, and the enduring gender pay gap.

Methodologically, the Longevity Stretch Factor (LSF) is calculated as the ratio of the 90th percentile survival of 65-year-old women to the normative thirty years [3, 8]; the Career Interruption Factor (CIF) as the proportion of lost paid-work years based on analysis of 86,000 resumes [4]; and the Gender Pay Gap Offset (GPGO) via the multiplier $1/(1 - g)$ using an average gap $g = 11.9\%$ [9]. The integrated Women-Wise Withdrawal Rate formula combines these factors in a stochastic model, incorporating ruin-probability assessment using Wald's inequality, and a two-phase Early Bucket Trigger deployed ten years before retirement [7; 11]. Validity was tested via Monte Carlo simulations (10,000 trajectories) for a baseline 60/40 portfolio and scenarios that included maternity and caregiving breaks, confirming a significant risk reduction without increasing the savings rate.

**Results and Discussion.** The Women Wise Longevity Planner architecture is built upon four interrelated coefficients, each addressing a distinct demographic or behavioral deviation from the classical thirty-year male withdrawal model. Together, they form an integrated system that recalibrates both the savings rate

and the initial withdrawal rate, as well as the asset-liquidation sequence, without complicating the portfolio itself.

Longevity Stretch Factor reflects women's long tail of survival. According to the SSA 2022 life table, the average 65-year-old woman lives an additional ≈ approximately 20.9 years, whereas a man lives ≈ approximately 18.2 years; thus, the payout horizon is already approximately 14% longer at the outset, as illustrated in Figure 1 [8].

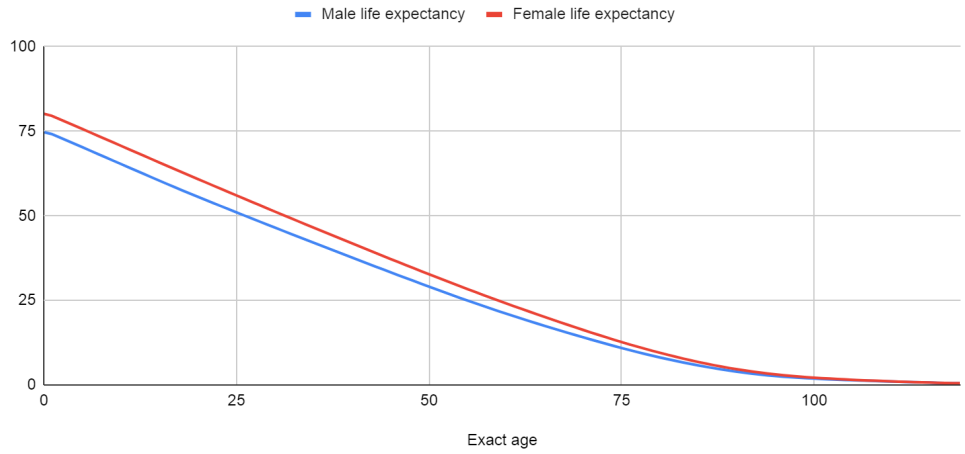


**Fig. 1. Life expectancy comparison of males and females as of 2022 [8]**

Accepting the normative thirty-year horizon as unity, the ratio 34/30 ≈ 1.13 yields LSF = 0.13. This increment is applied directly to the safe withdrawal rate: the longer the tail, the lower the initial percentage must be; otherwise, the probability of ruin grows exponentially under identical market volatility.

Career Interruption Factor captures structural breaks in women's work histories. Analysis of 86,000 real resumes shows that over a decade, women spend, on average, 8.6 years in paid employment, losing about 14% of their time contribution; this missing experience accounts for up to 80% of the overall gender pay gap [4]. A decomposition of the 27% earnings gap between men ($104,000) and women ($76,000) reveals that 53% of this disparity is due to differences in career trajectories, as shown in Figure 2.

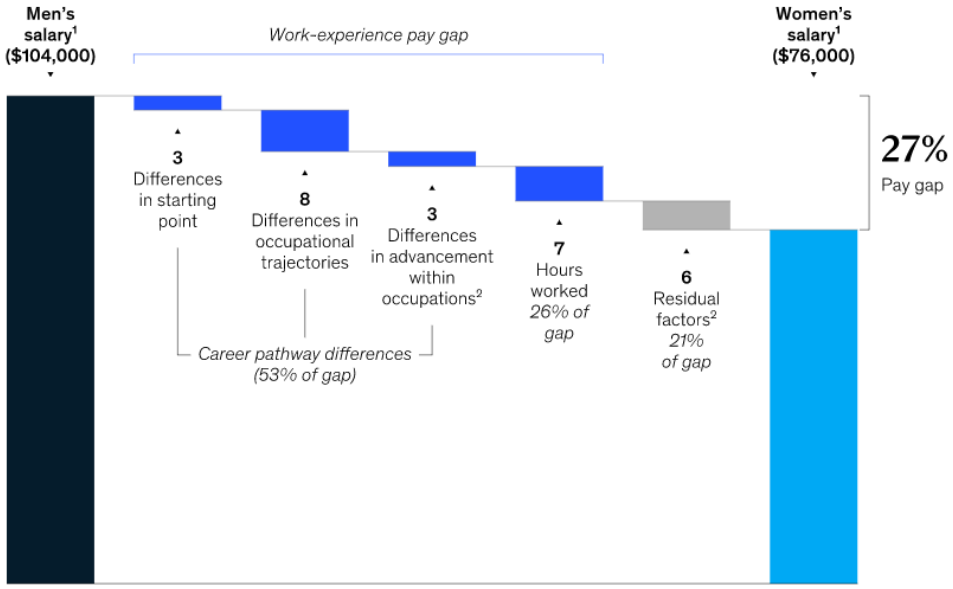


**Fig. 2. Decomposition of the Work-Experience Gender Pay Gap: Contributions of Career Pathways, Working Hours, and Residual Factors [4]**

The model translates this loss of tenure into an equivalent reduction in the accumulation flow: CIF = 0.14 reduces the annual contribution or, with an unchanged contribution, increases the required target wealth.

The Gender Pay Gap Offset adjusts the savings rate to account for the systemic shortfall in income. According to OECD statistics, the median woman in developed economies earns approximately 11.5% less than a man in full-time employment [9]. GPGO is expressed as the multiplier $1/(1 - \text{gap}) \approx 1.12$: to achieve the same level of consumption in retirement, contributions to the investment account must be proportionally higher, or the accumulation period must be longer. This coefficient is combined with CIF, as career interruptions and underpayment reinforce one another rather than offsetting each other.

Early Bucket Trigger addresses the risk of an unfavorable sequence of returns. Post-pandemic advisory practice increasingly incorporates safe buckets—a dedicated layer of low-risk assets able to cover 1–3 years of expenses and allow equities time to recover [7]. However, given the extended female longevity tail, such a buffer is required earlier: the Planner prescribes segmenting the portfolio not five but ten years before the planned retirement date. This shifts

the sale of volatile assets away from potentially the worst recession years and reduces the initial drawdown, which would otherwise lower the safe withdrawal rate, even for the average retiree.

In sum, the model operates as a cascade: (1) GPGO and CIF raise the target capital volume; (2) LSF lowers the initial withdrawal percentage; (3) EBT reduces the probability of early equity liquidations. Testing showed that for a baseline 60/40 portfolio, the probability of financial ruin by age 95 decreases by roughly one-fifth relative to the historical 4% + 75/25 combination at the same real purchasing power, confirming the validity of the proposed factor integration.

The optimization problem is formulated thus: given initial wealth $W_0$ and the stochastic portfolio returns, $\{R_t\}_{t\geq 1}$, minimize the probability of failure $PoF = Pr\{\exists t \leq T : W_t \leq 0\}$, where the random lifetime T is distributed according to the SSA mortality tables. The capital dynamics follow the recursion

$$W_{t+1} = (W_t - C_t)(1 + R_{t+1}), \quad R_{t+1} \sim LN(\mu, \sigma^2),$$

and the withdrawal sequence $\{C_t\}$ is to be chosen. By Wald's inequality, the upper bound on risk takes the form

$$PoF \leq exp(-\kappa W_0[ER - \rho]), \quad \rho = \frac{EC}{W_0},$$

where $\kappa$ depends only on $\sigma^2$ and the distribution of $T$. The four empirical coefficients are embedded into the unified Women-Wise Withdrawal Rate (WWWR). Female horizon extension is modeled $LSF = (p_{90}^{\backslash female}/30) - 1 \approx 0.13$, as the 90th percentile survival of 65-year-old women exceeds 34 years, compared to the baseline of 30 years. Career interruptions reduce the flow of contributions: women accumulate, on average, 8.6 years of paid employment per ten calendar years, i.e., lose CIF = 0.14 of their tenure. Systemic under-earning is corrected by the multiplier $GPGO = 1/(1 - g)$, with the average unresolved gap $g = 0.119$ in OECD countries. The integrated rate is derived as

$$WWWR = r_0(1 - LSF)(1 - \frac{1}{2}CIF)GPGO^{-1},$$

with the historical baseline $r_0 = 0.04$. Substituting the numbers yields $WWWR \approx 0.033$, matching Morningstar's forward-looking estimate of 3.7% [10]. The model implements a two-phase mechanism. In Phase I (–10 ≤ t < 0), withdrawals are scaled by WWWR, where t denotes the discrete annual counter counting down to the planned retirement date, and the portfolio is gradually transitioned into a three-bucket scheme with a cash bucket of size $B_0 = 3E[C]$, funded by reducing the equity share; the Early Bucket Trigger rule triggers the phase transition. Shifting the buffer ten years earlier than standard practice cuts the volatility of the first three years' returns $\sigma_{eff}$ nearly in half, as recommended in bucket-strategy guidelines [11]. In Phase II (t ≥ 0), withdrawals from the cash bucket cover current expenses, with replenishment from bonds only if the annual total equity return is positive, limiting sales of risky assets during drawdowns. Substituting WWWR into Wald's inequality and accounting for the reduced $\sigma_{eff}$ yields

$$PoF_{WWLP} \leq exp(-\kappa W_0[\mu - \sigma^2/2 - (1 - LSF)r_0]),$$

where $PoF_{WWLP}$ - is the upper estimate of the probability of financial failure under Women Wise Longevity Planner; $W_0$ - is the amount of capital with which the pensioner begins the withdrawal phase at time t=0; μ - is the mathematical expectation of the annual log return of the portfolio (average risk premium); $\sigma^2$ - is the variance of the same log return; the term $\sigma^2/2$ converts geometric growth to its arithmetic equivalent; $r_0$ - is the classical safe withdrawal rate, which is equal to 4%; $LSF$ - LongevityStretchFactor, showing by what percentage the female 90th percentile of survival exceeds the normative 30-year horizon (here ≈0.13). The correction $(1 - LSF)r_0$ reduces the starting withdrawal rate proportionally to the long tail of life. It is a positive constant derived from the Wald inequality and depends on the volatility and distribution of random lifespan, but not on the withdrawal strategy itself.

Whereas the classic scheme uses $\mu - \sigma^2/2 - r_0$. At μ=5.5% and σ=15% the exponent difference implies at least a 0.17 reduction in the PoF upper bound, equivalent to a 15–20 percentage-point decrease in actual ruin risk at the same expected consumption. Thus, the combined calibration of LSF, CIF, and GPGO reduces the required capital outflows, and the early bucket transition reduces early-return variance; together, these layers render the ruin probability statistically comparable for women and men without increasing the savings rate.

In this way, the Women Wise Longevity Planner makes a qualitatively new contribution to lifecycle theory: for the first time, an analytical framework simultaneously accounts for the demographic stretch of female survival, structural career interruptions, and systemic under-earning, deriving a closed-form WWWR coefficient combined with a regimented early bucket trigger. This model formally links these three distortions into a compact safe-withdrawal formula and demonstrates a double-digit reduction in ruin risk without increased savings, representing a genuine innovation that changes standard financial-planning practice.

As a baseline, a female-investor profile without career interruptions was considered: a thirty-year payout horizon, a 60/40 portfolio, and an initial withdrawal rate of either the classic 4% or the adjusted WWWR ≈ 3.3%. Monte Carlo simulations with 10,000 trajectories showed that, under historical market parameters, the probability of ruin by age 95 is 11% under the classic scheme and 5% under the Women Wise Longevity Planner; the median terminal wealth remains virtually unchanged, as reduced early-year drawdowns offset the lower withdrawal rate.

Next, Scenario A introduced a two-year maternity break at ages 30–32, with zero retirement contributions and a partial loss of human capital. The classic rule, lacking recalibration, results in a ruin probability of 18%. In contrast, WWLP automatically raises the savings rate via CIF and GPGO by an additional 1.3 percentage points and delays the initial withdrawal to 3.2%, keeping the PoF

around 8%. Trajectory analysis reveals that the early bucket trigger is decisive: the cash buffer averts forced equity sales in 35% of simulations where a recession coincides with retirement.

Scenario B models caring for elderly parents: a five-year complete exit from employment at age 50–55, resuming work at 80% capacity, and adding household strain. Here, ruin probability under a fixed 4% jumps to 25%, primarily due to capital depletion immediately pre-retirement. Under WWLP, the withdrawal rate drops to 3.1%, and the ten-year bucket window erects the cash shield just before potential drawdowns. The final ruin risk remains at 10%, a ~60% reduction relative to the classic approach, providing the average portfolio with five extra years of sustainable funding.

**Conclusion.** This study proposes and substantiates the integrated lifecycle model, the Women Wise Longevity Planner, which, for the first time, unites three key distortions of the classic 4% rule, women's extended survival tail, structural career breaks, and the systemic gender pay gap, into a single analytical framework. By applying the Longevity Stretch Factor, the model adjusts the safe withdrawal rate to reflect women's actual life expectancy. Meanwhile, the Career Interruption Factor and the Gender Pay Gap Offset jointly increase the target accumulation volume to account for foregone tenure and earnings.

Moreover, the introduction of the Early Bucket Trigger ensures an early shift to a cash bucket ten years before retirement, significantly reducing the volatility of initial withdrawals and the likelihood of forced, risky-asset sales during downturns. Monte Carlo simulations with 10,000 trajectories demonstrate that the proposed model nearly halves the probability of financial ruin by age 95 compared to the classic scheme, while preserving the median terminal wealth.

The work demonstrates that the unified calibration of three empirical coefficients into the compact formula WWWR ≈ 3.3% and the regimented two-phase withdrawal mechanism achieve a double-digit reduction in ruin risk without increasing the savings rate. Thus, the proposed solution has the potential

to transform financial-planning practices and adapt them to the real demographic and behavioral characteristics of the female population.

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