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Implicit Pension Taxes over the Life Cycle: Efficiency Costs and Tax Smoothing

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Abstract

This paper studies the efficiency cost of pay-as-you-go pension systems. The return on pension contributions – typically average income growth – is lower than the market return on capital. Because the gap between these returns compounds over the life cycle, early-career contributions have a higher implicit tax rate. I develop a sufficient-statistics framework in which the deadweight loss depends on the age profile of implicit tax rates. Deadweight loss is minimized when the implicit tax rate is constant, mirroring the logic of tax smoothing. I then propose an implementation within a notional defined contribution design: contributions are valorized at a higher, market-based rate of return, while a lower fraction of contributions is credited to notional accounts and the remainder treated as a pure tax. Finally, I apply my deadweight loss formula to OECD PAYGO pension systems. Under the assumed parameter values, the deadweight loss averages 19 percent. I find that only 0.2 percentage points is attributable to the uneven timing of implicit taxation.

Keywords: Pensions, social security, pay-as-you-go, implicit taxation, deadweight loss

JEL classification: H21, H55

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1 Introduction

Public pay-as-you-go pensions comprise an important share of an individual's lifetime income in most advanced economies. The design of such a system – in particular, how a worker's earnings history is mapped to a pension benefit level – therefore has a significant impact on labour supply incentives throughout working life. This paper studies how pension rules implicitly tax labour earnings at different ages.

The paper attempts to answer two questions: How large is the deadweight loss caused by the pension system? How can the pension system be designed to reduce that deadweight loss? In particular, the paper is concerned with the pension accrual and valorization rules that determine how much additional pension wealth is generated by a contribution at each age and therefore how much of that contribution functions as an implicit tax.

In overlapping-generations models, a pay-as-you-go pension promises contributors a return linked to the growth of the contribution base, which in steady state is governed by aggregate wage growth (Samuelson, 1958; Diamond, 1965; Aaron, 1966). As the market return on private saving has exceeded GDP growth over long periods in many countries (Piketty, 2014; Jordà et al., 2019), contributions to a pay-as-you-go scheme can deliver a lower internal rate of return than private capital accumulation. This wedge is an implicit tax embedded in the pension contribution which finances the transfer to the initial generation (Lindbeck & Persson, 2003).

I study how a worker's earnings history is mapped to a pension benefit level. The share of a pension contribution that constitutes an implicit tax varies systematically with age. Because the implicit return is tied to wage growth rather than the market return, it cumulates over the many years between early-career contributions and retirement. The same statutory contribution rate therefore implies a higher implicit tax share for young workers than for older workers.

The logic parallels the tax-smoothing argument in public finance. Since efficiency losses of taxation are convex in the tax rate, it is more efficient to smooth a given tax burden over time than to levy time-varying taxes. The literature on the optimal timing of distortionary taxation and public debt emphasizes keeping tax rates stable over time to minimize excess burden. Kifmann & Schindler (2001) apply this perspective directly to pay-as-you-go pensions, emphasizing “smoothing the implicit tax rate” across generations in response to demographic change. Fenge, Uebelmesser & Werding (2006) apply optimal-tax principles within the life cycle and show that the efficient profile is constant given an age-invariant elasticity and otherwise follows an inverse-elasticity rule.

There is a related theoretical literature that argues that income tax schedules should vary with age because earnings have different informational and behavioural significance at different stages of the life cycle. Kremer (2002), Blomquist & Micheletto (2008), Weinzierl (2011) and Bastani,

Blomquist & Micheletto (2013) generally favour lower marginal tax rates for younger workers, partly because early-career taxation distorts education and human-capital investment whose returns accrue over many years. In models with persistent earnings risk, the insurance motive further supports an upward-sloping age profile. For example, Farhi and Werning (2013) find that labour income tax rates rise substantially over the working life, while Heathcote, Storesletten & Violante (2019) obtain an increasing and concave profile for the average marginal tax rate, although optimal progressivity is U-shaped. Some models qualify this conclusion. Erosa & Gervais (2002) show that rising leisure with age can make declining labour taxes optimal, while models incorporating retirement responses suggest that lower taxes near retirement may sometimes be desirable. Nevertheless, the majority of papers support marginal tax rates that increase over most of the working life. The PAYGO pension systems studied in this paper tend to produce the opposite pattern: because younger workers must wait longer to receive the pension benefits generated by their contributions, the present value of those benefits is generally lower relative to the contributions paid. Mandatory pension contributions therefore impose a higher effective marginal tax rate on younger workers, reinforcing rather than mitigating the distortions that the age-dependent optimal-tax literature suggests should be lowest early in the working life.

The present paper employs a simple time-separable model with constant elasticity, in which implicit tax smoothing is optimal, and calculates the related efficiency gain. If the optimal marginal tax schedule is indeed increasing over the life cycle, the true welfare gains are larger than found in this paper.

Beyond efficiency, smoothing the implicit tax share over the life cycle has a fairness dimension. Current systems favour workers with high incomes late in life. A constant implicit-tax-share benchmark treats each euro of earnings symmetrically across the working life, strengthening horizontal equity between workers whose earnings differ in timing. Furthermore, it is well established that workers with lower lifetime incomes have a more frontloaded age-income profile (Guvenen et al., 2021). Implicit tax smoothing therefore on average redistributes to workers with lower lifetime incomes, improving vertical equity. The proposed reform consequently does not come with an efficiency-equity tradeoff, but improves both.

The theoretical contribution is to provide a transparent sufficient-statistics framework in which the deadweight loss of the pension contribution can be expressed as a function of (i) the age-specific implicit tax share and (ii) the elasticity of taxable labour income with respect to the net-of-tax rate. The paper makes the common assumptions that the elasticity is constant and that there are no income effects. The analysis builds on the idea that reduced-form elasticities can often summarize welfare effects of tax changes without full structural modelling, an approach surveyed by Saez, Slemrod & Giertz (2012) and Kleven (2021). Holding fixed the present-value amount of implicit revenue raised by the pension system, the deadweight loss is minimized when the implicit tax share is constant across working years.

The policy contribution is to show how implicit tax smoothing can be implemented in a typical

pension system. In most existing systems, the “interest” credited to contributors is linked to wage growth. The reform proposed here separates the pension contribution into two conceptually distinct parts: a saving component credited to a notional account that earns a return resembling the return to capital and a tax component that is not credited. By choosing a constant credited share, the system can preserve the same expected present-value transfer while smoothing the implicit tax share over the life cycle. Because the accounts remain notional, the government need not invest contributions in actual assets.

The empirical application applies the formula for the deadweight loss to OECD pension systems. It then compares how far existing pension systems deviate from the equal-implicit-tax-share benchmark along two dimensions captured by the model. The key institutional parameters are (i) the index used to revalue past earnings or notional account balances (the valorization rate) and (ii) the length of the earnings history entering the benefit calculation.

The quantitative results distinguish the overall efficiency cost of implicit pension taxation from the additional cost of imposing it unevenly across working life. Assuming a taxable income elasticity of 0.25 and a 6 percent discount rate, deadweight loss averages 19 percent of contributions, while equalizing the implicit tax share reduces it by 0.2 percentage points. Sensitivity analyses show a smaller deadweight loss if the elasticity or the discount rate is lowered, while the gain from reform is approximately unchanged. Thus, although pension formulas create pronounced differences in implicit tax rates across ages, most of the estimated efficiency cost arises from the financing burden itself and remains when that burden is smoothed. The proposed reform therefore offers a targeted improvement in efficiency and treats earnings more evenly across working life, without claiming to resolve the broader cost of financing an established PAYGO system.

The deadweight loss varies widely across countries, from 8 percent of contributions in Canada to 46 percent in Italy. The gains from reform likewise vary, with the largest estimated gains of 0.5 percentage points in France and Spain; these countries compute the reference wage from only the best 25 or 27 years and revalue past earnings with inflation. By contrast, systems that use full-career averaging and wage-based valorization generate a flatter age profile of implicit tax shares.

The comparison is not an overall ranking of national pension systems. It isolates accrual periods and indexation while abstracting from contribution ceilings, minimum pensions, survivor and disability insurance, taxation of benefits and heterogeneous mortality.

This paper shows that the deadweight loss of the pension system can be considerable, especially when implicit pension taxation is imposed on top of high income taxes. It is important to note that the existence of an implicit tax is not, by itself, an argument for a transition to full funding. A theoretical literature shows that legacy claims in an established pension system act like implicit public debt, so that moving to full funding replaces one burden with another (Browning, 1973; Sinn, 2000). Sundén (2002) points out that the ability to freely apportion taxes over the life cycle

is an argument in favour of a full funding reform that replaces implicit taxation with explicit taxes that can be made uniform across ages. This paper shows that the same effect can be achieved without having to make the transition to full funding.

2 Theoretical framework

This section sets up a partial-equilibrium model featuring a representative middle-income worker facing a stylized pension system. Labour income is denoted z and pension benefits (net of tax) b . Individual earnings grow at the rate h and economy-wide average income grows at the exogenous rate g . The individual can borrow and save at the rate r , interpreted as the risk-adjusted opportunity return on private saving. For tractability, the worker discounts consumption at the same rate, so that the discount factor is $\beta = 1/(1+r)$.¹ As a share of income, pension contributions are s and general taxes are τ . The individual works for W years and is retired for P years. Time is indexed by t or k (when referring to working life specifically).

2.1 Pension system

The earning of pensions is determined by the accrual rate α_k , which shows how much a dollar earned in year k raises the annual pension benefit. This is allowed to vary by year, but not by income. As a stylized representation of linear earnings-related formulae below relevant contribution ceilings, I assume

$$\alpha_k = \begin{cases} a(1+\kappa)^{W-k} & \text{if } k > W-M \\ 0 & \text{if } k \leq W-M, \end{cases} \quad (1)$$

where a is a parameter determining the level of pension accrual and κ is the valorization rate – the real rate of return credited to contributors. The last M years count towards the pension. This represents a best-years rule under the simplifying assumption that real income increases monotonically with age, implying that the best years are the last M years. The benefit level is then

$$b = \sum_{k=1}^W \alpha_k z_k = \sum_{k=W-M+1}^W a(1+\kappa)^{W-k} z_k.$$

In many pension systems, $\kappa = g$, the growth rate of average income. This describes notional defined contribution (NDC) systems such as Sweden's and approximates wage-indexed defined benefit formulae such as Social Security in the U.S. In many countries, $M = W$, i.e., the whole career matters for the pension, while in the U.S. $M = 35$.

It can be shown that the sustainable value of a given equal cohort sizes – the one where the

¹Otherwise there is a corner solution with all consumption in the first or last period.

pension system's budget constraint holds with equality – is given by

$$a = \begin{cases} \frac{sWg \left(1 - \frac{1+\kappa}{1+g}\right)}{[1-(1+g)^{-P}] \left[1 - \left(\frac{1+\kappa}{1+g}\right)^M\right]} & \text{if } \kappa \neq g \\ \frac{sWg}{[1-(1+g)^{-P}]M} & \text{if } \kappa = g. \end{cases}$$

In Sweden, $a = s / [(1 - (1 + g)^{-P})/g]$, i.e., the contribution rate divided by an annuity divisor. Since $\kappa = g$ and since $W = M$ in an NDC system, this equals the sustainable value. In a DB system with replacement rate ρ , we typically have $a = \rho/M$. In other systems, such as points-based ones, the accrual rate is set by fixing a at a certain percentage, typically around 2 percent.

Conversely, the sustainable contribution rate is given by

$$s = \begin{cases} \frac{a[1-(1+g)^{-P}] \left[1 - \left(\frac{1+\kappa}{1+g}\right)^M\right]}{Wg \left(1 - \frac{1+\kappa}{1+g}\right)} & \text{if } \kappa \neq g \\ \frac{a[1-(1+g)^{-P}]M}{Wg} & \text{if } \kappa = g. \end{cases} \quad (2)$$

Let the implicit tax share ϕ_k denote the share of the pension contribution associated with earnings in year k that does not generate pension benefits of equal present value (Beckmann, 2000). Equivalently, it is one minus the marginal money's worth ratio: the present value of the additional pension entitlement generated by an additional dollar of earnings, divided by the associated contribution. The implicit tax share varies by year:

$$\begin{aligned} \phi_k &\equiv 1 - \frac{\sum_{t=W+1}^{W+P} \beta^{t-k} \alpha_k}{s} = 1 - \alpha_k (1+r)^{k-W} \frac{1 - (1+r)^{-P}}{rs} \\ &= 1 - a \left(\frac{1+\kappa}{1+g}\right)^{W-k} \frac{1 - (1+r)^{-P}}{rs} \mathbf{1}[k > W - M]. \end{aligned} \quad (3)$$

Thus, $\phi_k = 0$ denotes actuarial fairness, while $\phi_k = 1$ denotes a pure tax. The total implicit tax imposed on the individual as a result of the pension system, denoted T , is the difference between discounted contributions and discounted benefits:

$$\begin{aligned} T &= \sum_{k=1}^W \beta^k s z_k - \sum_{t=W+1}^{W+P} \beta^t b = \sum_{k=1}^W \beta^k \phi_k s z_k = \\ &= \sum_{k=1}^W \beta^k \left(1 - a \left(\frac{1+\kappa}{1+g}\right)^{W-k} \frac{1 - (1+r)^{-P}}{rs} \mathbf{1}[k > W - M]\right) s z_k \end{aligned}$$

2.2 Individual behaviour

The model is concerned with the intensive margin of labour supply. The number of years in work and the retirement age are exogenous in order to focus the model on smoothing the effective marginal tax rate on labour income.

In each period, the individual maximizes an isoelastic and quasilinear utility function, supplying income with the elasticity ε . Denoting consumption by c , the per-period utility function is given by

$$u_t(c_t, z_t) = c_t - \frac{\hat{z}_t}{1 + \frac{1}{\varepsilon}} \left(\frac{z_t}{\hat{z}_t} \right)^{1 + \frac{1}{\varepsilon}} = c_t - \frac{\hat{z}_0(1+h)^t}{1 + \frac{1}{\varepsilon}} \left(\frac{z_t}{\hat{z}_0(1+h)^t} \right)^{1 + \frac{1}{\varepsilon}} = c_t - (\hat{z}_0(1+h)^t)^{-\frac{1}{\varepsilon}} \frac{z_t^{1 + \frac{1}{\varepsilon}}}{1 + \frac{1}{\varepsilon}},$$

where $\hat{z}$ denotes potential income – income if the tax rate were zero – which grows over the working life at the rate h .

The consumer maximizes lifetime utility

$$U = \sum_{t=1}^{W+P} \beta^t u_t$$

subject to the intertemporal budget constraint

$$\sum_{t=1}^{W+P} \beta^t c_t = \sum_{k=1}^W \beta^k (1-s-\tau) z_k + \sum_{t=W+1}^{W+P} \beta^t b = \sum_{k=1}^W \beta^k (1-\tau) z_k - T = \sum_{k=1}^W \beta^k (1-\phi_k s - \tau) z_k.$$

This shows that the implicit tax share is sufficient to capture the effect of the pension system on the individual's budget constraint, and therefore welfare and behaviour.

We can substitute the budget constraint into the expression for lifetime utility to obtain

$$U = \sum_{k=1}^W \beta^k (1-\phi_k s - \tau) z_k - \sum_{k=1}^W \beta^k \left(\hat{z}_0(1+h)^k \right)^{-\frac{1}{\varepsilon}} \frac{z_k^{1 + \frac{1}{\varepsilon}}}{1 + \frac{1}{\varepsilon}}.$$

Utility maximization yields the taxable income supply function

$$z_k = \hat{z}_0(1+h)^k (1-\phi_k s - \tau)^\varepsilon.$$

Indirect utility is then

$$V = \sum_{k=1}^W \beta^k \hat{z}_0(1+h)^k \frac{(1-\phi_k s - \tau)^{\varepsilon+1}}{\varepsilon+1}.$$

2.3 Deadweight loss

To calculate the deadweight loss imposed by the pension system through its distortion of labour supply, first find an expression for indirect utility under an actuarially fair (or no) pension system, i.e., $\phi_k = 0$:

$$V_0 = \sum_{k=1}^W \beta^k \hat{z}_0 (1+h)^k \frac{(1-\tau)^{\varepsilon+1}}{\varepsilon+1} = \sum_{k=1}^W \hat{z}_0 \left(\frac{1+h}{1+r} \right)^k \frac{(1-\tau)^{\varepsilon+1}}{\varepsilon+1} = \hat{z}_0 \frac{(1-\tau)^{\varepsilon+1}}{\varepsilon+1} \frac{1+h}{r-h} \left(1 - \left(\frac{1+h}{1+r} \right)^W \right)$$

The pension system also affects income tax revenue through labour supply effects. The effect of the pension system is obtained by multiplying the income tax rate with the difference between discounted taxable income under no or actuarially fair pension system ($\phi_k = 0$) and discounted taxable income under the current pension system:

$$\Delta IT = \sum_{k=1}^W \beta^k \tau \hat{z}_0 (1+h)^k [(1-\tau)^\varepsilon - (1-\phi_k s - \tau)^\varepsilon]$$

The deadweight loss (or excess burden) of the implicit pension tax is the reduction in money-metric utility and income tax revenue, over and above the amount of pension tax (T) paid:

$$\begin{aligned} DWL &= V_0 - V - T + \Delta IT = \\ &= \frac{\hat{z}_0}{1+\varepsilon} \sum_{k=1}^W \beta^k (1+h)^k [(1+\varepsilon\tau)(1-\tau)^\varepsilon - (1+\varepsilon(\phi_k s + \tau))(1-\phi_k s - \tau)^\varepsilon]. \quad (4) \end{aligned}$$

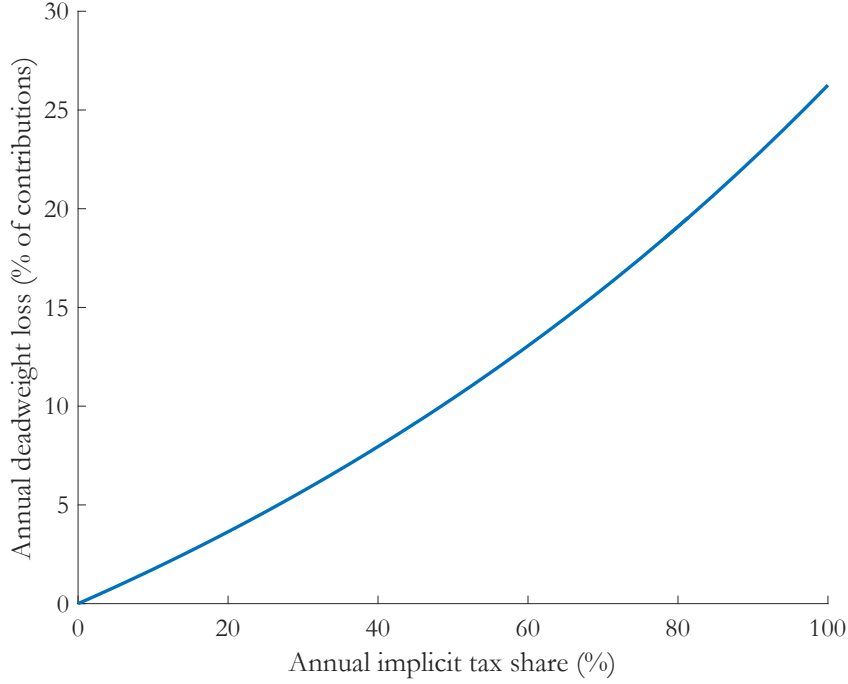
This formula is the first contribution of the paper. While the sum is not generally geometric and therefore cannot be expressed in closed form, it is straightforward to calculate. The deadweight loss is quadratic in the tax rate (Harberger, 1964) as a second-order approximation. Hence it increases roughly with the variance of the tax rates.

Figure 1 shows the deadweight loss for a specific year of working life. As expected, it is increasing with the implicit tax share. The relationship is convex, confirming that there are gains from tax smoothing, as shown below. However, the convexity is very slight with the given parameter values. Therefore the potential efficiency gains are also small.

2.4 Minimizing the deadweight loss

The design problem is to minimize deadweight loss while imposing a sufficiently large tax burden, in present value, to finance the inherited transfer:

$$\min_{\{\phi_k\}} DWL \text{ s.t. } T \geq \bar{T}.$$



Note: Shows the deadweight loss for a specific year of working life as a function of the implicit tax share (equation 3) for that year, i.e., the share of the contribution that does not generate pension benefits of equal present value. The curve is convex, albeit only slightly so, which demonstrates the potential gains from tax smoothing over the life cycle. Assumes a taxable income elasticity (ε) of 0.25, an income tax rate (τ) of 54% and a contribution rate (s) of 19%, a life-cycle potential-earnings growth rate (h) of 1% and a real discount rate (r) of 6%, all meant to capture typical OECD values.

Figure 1: Deadweight loss as a function of the implicit tax share

Since the deadweight loss and the pension tax both increase with the implicit tax share, the constraint will hold with equality. The Lagrangian is then

$$\mathcal{L} = \sum_{k=1}^W \beta^k \hat{z}_0 (1+h)^k \left[\frac{(1-\tau)^{\varepsilon+1}}{\varepsilon+1} - \frac{(1-\phi_k s - \tau)^{\varepsilon+1}}{\varepsilon+1} - s\phi_k (1-\phi_k s - \tau)^{\varepsilon} + \tau((1-\tau)^{\varepsilon} - (1-\phi_k s - \tau)^{\varepsilon}) \right] - \mu \left(\sum_{k=1}^W \beta^k \phi_k s \cdot \hat{z}_0 (1+h)^k (1-\phi_k s - \tau)^{\varepsilon} - \bar{T} \right)$$

with first order condition

$$\frac{\partial \mathcal{L}}{\partial \phi_k} = \beta^k \hat{z}_0 (1+h)^k s (1-\phi_k s - \tau)^{\varepsilon-1} \left[\varepsilon(s\phi_k + \tau) - \mu(1-\phi_k s - \tau - \varepsilon s\phi_k) \right] = 0$$

which implies

$$\phi_k^* = \frac{\mu - (\varepsilon + \mu)\tau}{s(\varepsilon + \mu + \mu\varepsilon)}.$$

Reflecting the logic of tax smoothing, the benchmark policy is to set the implicit tax share equal across all years of working life, as established by Fenge, Uebelmesser & Werding (2006). Under my pension system parameterization (equation 3), it follows that this is achieved by setting $\kappa = r$ – pension rights should accrue the same rate of interest as the worker’s risk-adjusted opportunity return – and $M = W$ – all years of working life should count towards the pension. The level parameter a is adjusted simultaneously so that the present-value revenue constraint continues to bind; changing M or κ without this adjustment would also change the level of implicit taxation. Within this class of models, equalization follows from time separability, quasilinearity and a common earnings-supply elasticity across working years.²

2.5 Limitations

The analysis isolates the labour-supply cost of allocating a given present value of implicit pension taxation across working ages. It is not a complete welfare evaluation of a pension system. Besides the age-invariant benchmark parameters relaxed above, the model abstracts from cross-age substitution, human-capital accumulation, endogenous retirement, liquidity constraints and imperfect perception of pension accrual. It also abstracts from heterogeneity in earnings histories, mortality, discount rates and welfare weights. The benchmark omits uncertainty and the insurance value of longevity, disability and survivor benefits, as well as general-equilibrium effects on wages, saving and capital accumulation. It also assumes that employer and employee contributions ultimately reduce the worker’s compensation one for one.

²To relax the age-invariance of the behavioural elasticity, suppose instead that taxable earnings in working year k have elasticity ε_k , while the contribution rate and general tax rate remain constant across ages. The interior first-order condition becomes

$$\varepsilon_k(s\phi_k + \tau) = \mu[1 - \tau - (1 + \varepsilon_k)s\phi_k],$$

which implies

$$\phi_k^* = \frac{\mu(1 - \tau) - \varepsilon_k\tau}{s[\varepsilon_k + \mu(1 + \varepsilon_k)]}. \quad (5)$$

For an interior solution, the implicit tax share is therefore lower at ages where taxable earnings are more elastic. The equal-share benchmark follows as the special case in which $\varepsilon_k = \varepsilon$ for every working year.

3 Implementing implicit tax smoothing

Implementing implicit tax smoothing amounts to redesigning pension finance so that the implicit tax share of the pension contribution is constant over the working life while the contributory component is treated as actuarially fair saving. In practice this requires two changes to pension formulas. First, accrued pension rights must be revalued in a way that does not systematically penalize early-career contributions relative to late-career contributions, which in this paper means setting the valorization rate equal to the rate of return on capital rather than wage growth or inflation. In order to satisfy the pension system’s budget constraint, the higher valorization must be taken back through a multiplicative conversion factor. This makes the legacy transfer explicit and smooths the implicit tax share across ages. Second, all years of working life should be considered in the pension benefit calculation.

This logic can be implemented within the main pension system families by applying the same decomposition in the institutional language of each system. In notional defined contribution systems – explained in detail below – it corresponds to crediting notional balances at a market-based rate and crediting only a constant fraction of contributions to the notional account, with the remainder collected as a uniform legacy charge that does not generate accrual. In traditional defined benefit systems, it corresponds to revaluing accrued earnings credits or service entitlements using a market-based factor and moving toward full-career earnings in benefit computation while generally lowering pension accrual to keep benefits unchanged on average. In points-based systems, it corresponds to revaluing point values using a market-based benchmark and specifying that only a constant fraction of contributions purchases points, with the residual treated as a pure tax. In each case, the reform can preserve expected financing and average benefit levels in present value while reducing the deadweight loss by eliminating the age variation in implicit tax shares that arises from non-market valorization and restricted earnings histories.

3.1 Current system design

Let us now examine how implicit tax smoothing can be implemented in a notional defined contribution system, specifically Sweden’s. In order to show that the concrete reform proposal achieves implicit tax smoothing without imposing additional risk on the pension system, I will begin by providing a richer description of the pension system than the stylized system described above, relaxing the assumptions of fixed retirement age and lifespan and constant income growth.

Let z_{it} denote pensionable labour income for individual i in year t . Contributions are a share s of income, so individual contributions are sz_{it} . Let I_t be the *income index*, which tracks average labour income. Let ω_i denote the individual’s year of birth. Longevity risk during working life is pooled within each cohort through the *inheritance gain factor* $\lambda_{\omega t}$. The notional account balance

evolves according to

$$K_{it} = K_{i,t-1} \frac{I_t}{I_{t-1}} \lambda_{\omega_i t} + sz_{it} = I_t \sum_{k \leq t} \frac{sz_{ik} \prod_{l=k+1}^t \lambda_{\omega_i l}}{I_k}.$$

Individuals retire in year q_i , which may vary across individuals. At retirement, the account balance is converted into an annuity by dividing by an annuity divisor

$$A_{\omega q} = \frac{1}{L_{\omega q}} \sum_{t=q}^{\infty} \frac{L_{\omega t}}{(1+f)^{t-q}},$$

where $L_{\omega t}$ is the share of cohort ω alive at time t and f is the advance rate, which works to front-load pension payments. During retirement, benefits are indexed with the income index net of the advance rate, so for $t \geq q_i$,

$$b_{it} = \frac{K_{iq_i}}{A_{\omega_i q_i}} \frac{I_t}{I_{q_i}} \frac{1}{(1+f)^{t-q_i}}.$$

For later use, define the cohort-specific composite credited return in year t as

$$R_{\omega t} \equiv \frac{I_t}{I_{t-1}} \lambda_{\omega t}.$$

Then the retirement balance can be written as

$$K_{iq_i} = \sum_{k \leq q_i} sz_{ik} \prod_{t=k+1}^{q_i} R_{\omega_i t}.$$

For $k \leq q_i \leq t$, the accrual rate is therefore

$$\alpha_{ikt} \equiv \frac{db_{it}}{dz_{ik}} = \frac{s}{A_{\omega_i q_i}} \left(\prod_{u=k+1}^{q_i} R_{\omega_i u} \right) \frac{I_t}{I_{q_i}} \frac{1}{(1+f)^{t-q_i}}.$$

3.2 Reform implementation

Now consider how an implicit tax smoothing reform can be implemented in this system. Let t^* denote the calendar year in which the reform is implemented. From t^* onwards, a bonus valorization is implemented, equal to roughly the difference between the return to capital and expected income growth. More precisely, the income-index factor is multiplied by a gross spread. Let r denote the risk-adjusted opportunity return, still assumed to be constant. The bonus valorization is defined multiplicatively by

$$1 + \delta \equiv \frac{1 + r}{1 + \mathbb{E}(g)}.$$

Before t^* , the baseline rules apply. Hence, from t^* onwards the composite credited return becomes $(1 + \delta)R_{\omega t} = (1 + r_t^*)\lambda_{\omega t}$. Here $1 + r_t^* \equiv (1 + \delta)I_t/I_{t-1}$ is the realized financial crediting rate.

If the expectation is correct, its expected value is $1 + r$, while the inheritance gain factor is unchanged.

The reformed balance $\tilde{K}_{it}$ therefore satisfies

$$\tilde{K}_{it} = \tilde{K}_{i,t-1} R_{\omega_i t} (1 + \delta)^{\mathbf{1}_{[t \geq t^*]}} + sz_{it},$$

and iterating forward yields

$$\tilde{K}_{it} = \sum_{k \leq t} sz_{ik} \prod_{u=k+1}^t \left[R_{\omega_i u} (1 + \delta)^{\mathbf{1}_{[u \geq t^*]}} \right].$$

Thus, a contribution paid in year k receives the additional spread only in crediting years from the implementation year onwards.

The reform then introduces a cohort- and retirement-year-specific *crediting factor* applied ex post when benefits are awarded. Let $\mathcal{C}_{\omega q}$ be the set of members of cohort ω who retire in year q . The factor is

$$\theta_{\omega q} \equiv \frac{K_{\omega q}^0}{\tilde{K}_{\omega q}} = \frac{\sum_{i \in \mathcal{C}_{\omega q}} \sum_{k \leq q} sz_{ik} \prod_{u=k+1}^q R_{\omega u}}{\sum_{i \in \mathcal{C}_{\omega q}} \sum_{k \leq q} sz_{ik} \prod_{u=k+1}^q \left[R_{\omega u} (1 + \delta)^{\mathbf{1}_{[u \geq t^*]}} \right]},$$

where $\tilde{K}_{\omega q}$ denotes realized aggregate balances for those in the cohort ω who retire in year q and $K_{\omega q}^0$ denotes counterfactual aggregate balance under current rules, i.e., no bonus valorization. Thus, $\theta_{\omega q}$ is the multiplicative take-back of the additional valorization.

Benefits under the reform are defined by replacing K_{iq_i} with $\theta_{\omega_i q_i} \tilde{K}_{iq_i}$ in the annuity formula:

$$\tilde{b}_{it} = \theta_{\omega_i q_i} \frac{\tilde{K}_{iq_i}}{A_{\omega_i q_i}} \frac{I_t}{I_{q_i}} \frac{1}{(1 + f)^{t - q_i}}, \quad t \geq q_i.$$

3.3 Effects of the reform

Let us first establish that the reform does not impose any additional financial burden of the pension system. By definition,

$$\sum_{i \in \mathcal{C}_{\omega q}} \theta_{\omega q} \tilde{K}_{iq} = \theta_{\omega q} \tilde{K}_{\omega q} = K_{\omega q}^0.$$

Thus aggregate benefits for the retirement cell are unchanged ex post. The ex-post factor θ absorbs all additional aggregate liability generated by the higher valorization: the identity above holds for every realization, not merely on average. Hence the proposal adds no aggregate financial risk to the PAYGO system relative to the old formula. The reform neither creates nor

removes the PAYGO system's existing exposure to contribution-base, longevity, retirement and post-retirement indexation shocks.

Now, let us show how the reform accomplishes implicit pension tax smoothing. Consider a contribution paid in a post-reform year k and hold its retirement year q_i fixed. Treating the cohort-wide factor $\theta_{\omega_i q_i}$ as given for the individual, the accrual expression above becomes

$$\tilde{\alpha}_{ikt} = \theta_{\omega_i q_i} \frac{s}{A_{\omega_i q_i}} \left[\prod_{u=k+1}^{q_i} (1 + \delta) R_{\omega_i u} \right] \frac{I_t}{I_{q_i}} \frac{1}{(1 + f)^{t - q_i}}.$$

If the expectation used to set δ is correct, its expected financial accumulation up to retirement is

$$\mathbb{E}_k \left[\prod_{u=k+1}^{q_i} (1 + \delta) \frac{I_u}{I_{u-1}} \right] = (1 + r)^{q_i - k}.$$

An earlier contribution accumulates for more years, but is also discounted over exactly the same additional years. Since $\beta = 1/(1 + r)$,

$$\beta^{q_i - k} \mathbb{E}_k \left[\prod_{u=k+1}^{q_i} (1 + \delta) \frac{I_u}{I_{u-1}} \right] = [\beta(1 + r)]^{q_i - k} = 1.$$

Thus the timing of the contribution has no effect on its expected discounted financial accumulation.

Inheritance gains do not change this conclusion. Under actuarially balanced cohort pooling,

$$\prod_{u=k+1}^{q_i} \lambda_{\omega_i u} = \frac{L_{\omega_i k}}{L_{\omega_i q_i}}.$$

The probability of surviving from year k to a benefit year t is $L_{\omega_i t}/L_{\omega_i k}$. Multiplying the two leaves $L_{\omega_i t}/L_{\omega_i q_i}$, which also does not depend on k .

Accordingly, the implicit tax share of the pension contribution (equation 3) under the reform is

$$\phi_k = 1 - \theta_{\omega_i q_i} \Psi_{\omega_i q_i} \tag{6}$$

where

$$\Psi_{\omega_i q_i} = \frac{1}{A_{\omega_i q_i}} \sum_{t=q_i}^{\infty} \beta^{t - q_i} \frac{L_{\omega_i t}}{L_{\omega_i q_i}} \mathbb{E}_{q_i} \left(\frac{I_t}{I_{q_i}} \right) \frac{1}{(1 + f)^{t - q_i}}$$

is a factor below one which reflects the fact that post-retirement indexation is not affected by the bonus. Both factors on the right-hand side of equation 6 are independent of k . Hence, if the expectation of income growth used to calibrate δ is correct, the reform makes the expected implicit tax share constant across post-reform contribution years. This is the condition for deadweight loss minimization under age-invariant elasticity established in section 2.4.

3.4 Numerical example

Consider a simple calibration with a 40-year working life and 21 years in retirement. Assume that earnings and contributions grow with the income index, whose expected annual growth is 1.5%, and that the reform applies throughout working life. Further, assume $r = 6\%$. The advance rate is set at the same value as in the Swedish system, $f = 1.6\%$. With fixed longevity there are no inheritance gains, so $\lambda_{\omega t} = 1$. The first contribution is credited for 39 years and the last for none.

The bonus valorization is given by $\delta = (1 + 6\%)/(1 + 1.5\%) - 1 \simeq 4.43\%$. At retirement, notional account balances are multiplied by the ex-post crediting factor

$$\theta = \frac{40}{\sum_{j=0}^{39} (1.06/1.015)^j} \simeq 38\%$$

which serves to keep the benefit level unchanged. The same numerical values give $\Psi \simeq 69\%$.³ This is the effect of below-discount-rate indexation after retirement. The benefit share of the pension contribution is given by the product $\theta\Psi \simeq 38\% \times 69\% \simeq 26\% \simeq 1 - \phi$. The implicit tax share is given by $\phi = 1 - \theta\Psi \simeq 74\%$. Thus, in this example, about 26% of each contribution represents pension saving and 74% represents implicit taxation.

³The annuity divisor is $A = \sum_{j=0}^{20} (1.016)^{-j} \simeq 18.00$ (unchanged by the reform). It is slightly lower than the number of expected years in retirement in order to front-load payments, which is clawed back via the advance rate, which lowers the annual indexation during retirement. We then have $\Psi = \sum_{j=0}^{20} [1.015/(1.06 \cdot 1.016)]^j / A$.

4 Country comparison

To illustrate the two design margins emphasized by the model, this section compares earnings-related pension formulae across OECD countries with PAYGO pension systems (see table 1). Countries that do not have such systems, notably the United Kingdom and Australia, are not included. Pension systems differ along many dimensions not represented here. The comparison comprises two parameters: the number of years that count towards the pension and the annual valorization rate. For systems using the best M years, the calculations impose the model’s monotonically rising earnings profile and therefore treat these as the last M years.

4.1 Calibration

The country-specific inputs are reported in table 1. Most countries do not have defined-contribution systems. For these countries, the contribution rate used in the table is calculated as the sustainable contribution rate under constant demographics (equation 2). This places contributions and benefits on a consistent basis across countries and isolates the implicit tax arising from the timing and valuation of pension rights. The calculation holds the number of contributors relative to pensioners constant; it therefore does not incorporate financing pressures caused by future demographic change. As the model imposes a linear accrual rule (equation 1), the results are a linear approximation for countries with non-linear accrual, such as the United States.

As for years in working life (W) and years in retirement (P), consistent data is hard to come by. OECD (2025) reports an average career duration of 40 years for men, which is the number I use. The average time after labour market exit is 21 years, which I use for P . These common values facilitate comparison but do not describe every country’s workforce or retirement pattern.

Behavioural responses are captured by the taxable income elasticity, for which Saez et al. (2012) suggest 0.25 as a reasonable midpoint of empirical estimates. I assume a common elasticity across countries for transparency and because the literature is not yet rich enough to provide clear evidence of cross-country differences (cf. Neisser, 2021). Higher and lower elasticities are reported in the sensitivity analysis.

Likewise, there is scant evidence on age variation in taxable income elasticities. For the current implicit tax profile to be optimal, the elasticity would have to be increasing exponentially with age in a very specific pattern. In contrast, Díaz-Caro & Onrubia (2018) – one of few papers looking at age heterogeneity – find decreasing elasticities by age in Spain. In all, in the absence of compelling evidence for age variation in tax responsiveness, I assume a constant elasticity over working life. The participation margin is important for older workers, but as this paper assumes an exogenous retirement age and considers the intensive margin only, this does not matter for present purposes.

I set the real discount rate (r) to 6 percent as a benchmark for the return individuals forgo when pension contributions displace private saving. Under standard portfolio choice assumptions and integrated global capital markets, investors should hold a diversified global market portfolio of risky assets (Sharpe, 1964). Broad, low-cost funds make a globally diversified portfolio feasible for individual savers. As an empirical benchmark for the return on such investment, Jordà et al. (2019, Table XII) report a GDP-weighted average annual real return on wealth of about 6 percent across 16 advanced economies, both over 1870–2015 and after 1980. Their measure includes equity, housing, bonds and bills, so I interpret it as a long-run average return to capital and hence a benchmark opportunity return. Results for lower discount rates are reported in the sensitivity analysis.

4.2 Results

Table 1 shows the deadweight loss as a percentage of pension contributions – similar to the average excess burden of a tax. It ranges from 8 percent in Canada to 46 percent in Italy, with an average of 19 percent. Thus pension systems can potentially cause significant efficiency losses. The cross-country variation in the efficiency loss is caused by the two pension system design parameters, the tax rate on labour income and the pension contribution rate as well as by past income growth, which is assumed to continue into the future and determine the wedge between pension system return and return to capital.

As shown above, the deadweight loss can be minimized by implementing implicit tax smoothing – full-career accrual with a credited return equal to the return to capital. No country currently does this. The closest cases along these two dimensions count all years and index by average income growth. The United States fares slightly worse than this as only the best 35 years are counted in Social Security. The largest departures along these dimensions are France and Spain, where only the best 25 or 27 years are included and the valorization rate is inflation.

The table also shows the reduction in the deadweight loss that could be achieved by smoothing implicit tax rates. The welfare gain is small: On average, countries could reduce the deadweight loss by 0.2 percentage points – from 19.1 to 18.9 percent of contributions. There is a potential welfare gain in every country but it varies considerably: from 0.01 percent of contributions in Lithuania to 0.5 percent in Spain and France. The estimates are also relatively high in Turkey (0.4 percent), Italy (0.3 percent) and Slovenia (0.3 percent). Spain and France, which calculate benefits using fewer than all 40 working years in the model, illustrate how uneven accrual across the career increases the gains from smoothing.

To see how a pension reform could potentially reduce the deadweight loss, consider the case of Sweden, which in 1999 implemented one of the most comprehensive pension reforms of any OECD country. Before the reform, the Swedish pension system was defined benefit, with only

the best 15 years being counted towards the pension. The valorization rate was inflation. The reform meant a transition to a defined-contribution system where all working years yield notional account credits and where the interest rate on the notional account is average income growth, as described in section 3.1. Holding the contribution rate, income growth and labour taxes constant at current Swedish levels, my model implies that the 1999 reform reduced Sweden’s deadweight loss by 1.2 percentage points.⁴ The remaining reform potential – implementing implicit tax smoothing by raising the notional account interest rate to the return on capital, as described in section 3.2 – corresponds to a deadweight loss reduction of just 0.1 percentage points. Thus Sweden has already exhausted most of its potential for efficiency-enhancing reform.

Figure 2 shows how the implicit tax share varies over the life cycle. Again, it is clear that France, along with Spain, constitutes the largest departure from the tax smoothing prescription. The implicit tax share profile also illustrates why the gains from tax smoothing are small: The reduction in implicit tax shares in early-career years, when it is highest under current systems, is quite small – from 90 to 80 percent in a typical OECD country under a 6 percent discount rate. In addition, the convexity of the deadweight loss is also small, as illustrated in figure 1.

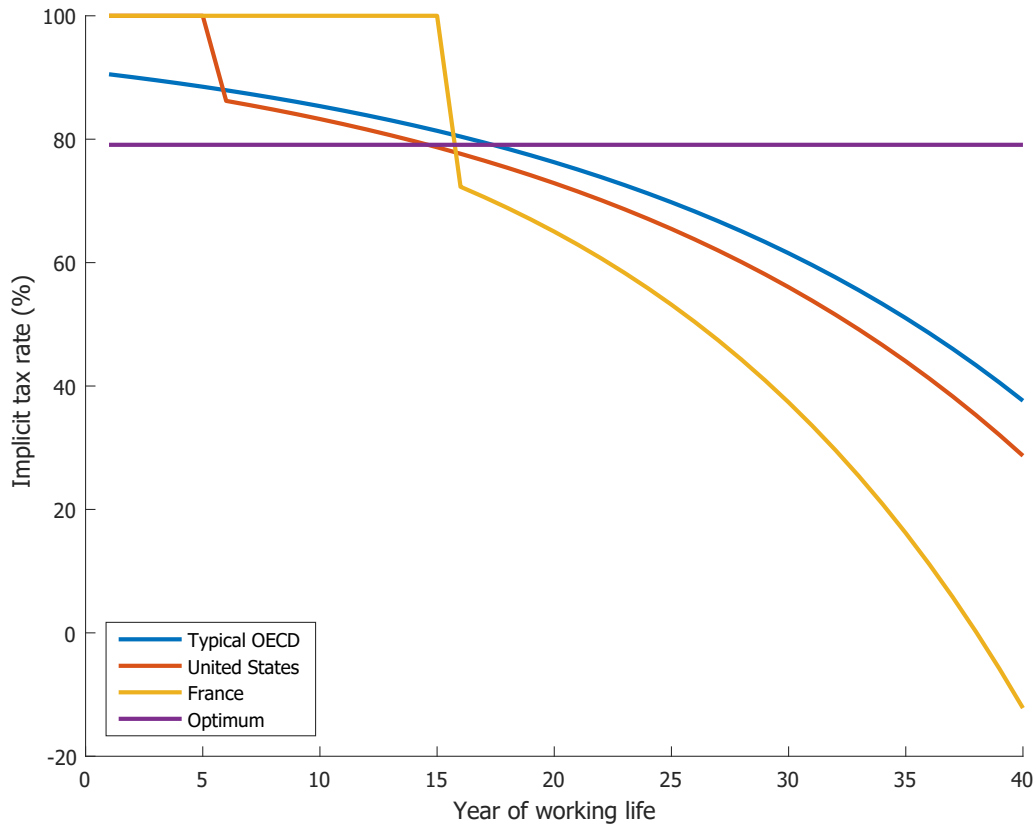
Figure 3 shows a two-dimensional diagram (heatmap) illustrating how the two parameters of interest affect the deadweight loss of the pension system, holding the contribution and income tax rate constant. Departure from the equal-tax-share benchmark results in a larger deadweight burden, for a given implicit tax. Both parameters matter, but it is clear that the number of years being considered is much more important than the valorization rate.

4.3 Sensitivity analysis

The quantitative results are calibrations rather than point estimates. A sensitivity analysis is provided in table 2.

The discount rate r is especially important because it determines the present value assigned to distant pension benefits. If earnings growth exceeds the discount rate, the implicit tax rate is negative as the pension system subsidizes labour supply; hence the deadweight loss of the pension system is also negative as it reduces the deadweight loss of the income tax. There is still a gain from implicit pension tax (or subsidy, in this case) smoothing, as a uniform subsidy is more efficient. Holding the elasticity at 0.25, the average deadweight loss is 12 percent of contributions under a discount rate of 4 percent, and only 0.3 percent of contributions under a discount rate of 2 percent – compared to 19 percent of contributions in the baseline case of 6 percent. Note that in the 2 percent case, the deadweight loss is negative in nine Eastern European countries with high wage growth, which explains why the average is close to zero.

⁴This concerns intensive margin responses only. The reform also affected extensive margin incentives and the incentives for working beyond the normal retirement age.

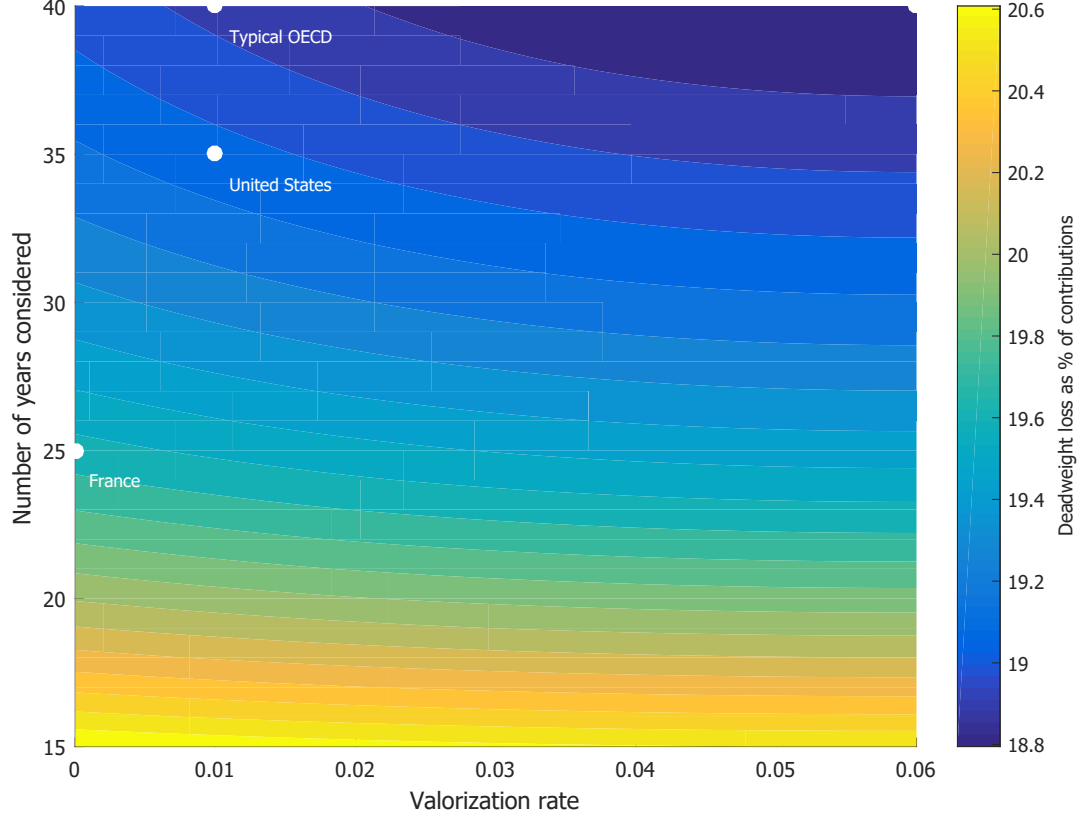


Note: The implicit tax share (equation 3) is the share of the contribution associated with earnings in a specific year that does not generate pension benefits of equal present value. A share of 0% indicates actuarial fairness, while a share of 100% indicates a pure tax. The profiles depicted here impose the same implicit tax in present value; only its distribution over working life differs due to different valorization rates and numbers of years that are considered (see table 1). The deadweight loss of the pension system is minimized when the tax is smoothed, i.e., the implicit tax share is the same for all years. The figure assumes a real wage growth rate of 1% and a real discount rate of 6%.

Figure 2: Annual implicit tax share by year of working life

The gain from reform remains around 0.2 percentage points, regardless of discount rate. Thus the discount rate mostly affects the level of implicit taxation and deadweight loss, not the variation over the lifecycle and the associated increase in the deadweight loss.

The earnings elasticity ε also affects the magnitude of deadweight loss and the gain from reform. Under the baseline discount rate of 6 percent, the deadweight loss increases to 39 percent of contributions if the elasticity is raised to 0.5, while it decreases to 8 percent of contributions if the elasticity is set to a low value of 0.1.



Note: Depicts the deadweight loss caused by the pension system (equation 4) as a function of the number of years considered in the pension calculation (M) and the real valorization rate applied to pension credits (κ). To enable comparison, the contribution rate is assumed at 19% and the income tax rate at 54% in all countries – both corresponding to the OECD average. The figures here therefore differ from table 1. Most countries index by real average income growth, g , assumed at 1%, and include all years, assumed to be 40, in the benefit calculation. The deadweight loss is minimized when the implicit tax share is smoothed over working life, which is achieved when all years are considered and when the valorization rate is the risk-adjusted opportunity return, r , assumed at 6% – i.e., upper right corner. The taxable income elasticity is assumed at 0.25.

Figure 3: Heatmap of pension system deadweight loss by valorization rate and years credited, with countries indicated

Table 1: Pension-system-induced deadweight loss in OECD countries with earnings-related PAYGO systems

Country	Years considered (M)	Real valorization rate (κ)	Real wage growth (g)	Sustainable contribution rate ^a	Effective labour tax rate	Deadweight loss ^f	of which avoidable ^g
Austria	All	g	0,8%	34%	66%	25%	0,2%
Belgium	All	0% ^b	0,8%	22%	71%	35%	0,3%
Canada	All	g	1,0%	16%	37%	8%	0,1%
Czechia	All	g	2,5%	12%	57%	17%	0,1%
Estonia	All	g	4,3%	4%	57%	12%	0,0%
Finland	All	80% g	0,8%	28%	66%	27%	0,2%
France	25	0% ^b	0,9%	13%	65%	32%	0,5%
Germany	All	g	0,9%	18%	57%	20%	0,1%
Hungary	All	g	2,3%	20%	59%	18%	0,1%
Italy	All	g	0,0% ^d	33% ^e	78%	46%	0,3%
Japan	All	g	0,0%	11%	44%	14%	0,0%
Korea	All	g	2,0%	8%	40%	10%	0,0%
Latvia	All	g	4,5% ^d	14% ^e	57%	9%	0,0%
Lithuania	All	g	4,8%	2%	59%	9%	0,0%
Luxembourg	All	g	1,3%	29%	68%	26%	0,2%
Norway	All	g	1,7%	18% ^e	61%	21%	0,1%
Poland	All	g	2,6% ^d	20% ^e	51%	12%	0,1%
Portugal	40	0.5% ^c	0,7%	44%	58%	16%	0,2%
Slovakia	All	95% g	2,9%	19%	56%	14%	0,1%
Slovenia	35	g	2,2%	16%	63%	22%	0,3%
Spain	27	0% ^b	0,4%	35%	57%	18%	0,5%
Sweden	All	g	1,4%	15% ^e	59%	23%	0,1%
Turkey	All	30% g	3,0%	21%	57%	14%	0,4%
United States	35	g	1,2%	20%	44%	10%	0,2%
<i>Average</i>			<i>1%</i>	<i>20%</i>	<i>54%</i>	<i>19%</i>	<i>0,2%</i>

Source: OECD (2025) and OECD statistics. The entries are stylized classifications of the main earnings-related public pension formula and refer to rules reported for 2024–25. Real wage growth is over 1990–2024 for most countries, with slightly shorter time spans in Eastern European countries.

a) Calculated so that the pension system’s budget constraint holds with equality under constant population, life expectancy and retirement age.

b) Inflation indexation only.

c) 25% of wage growth or 0.5%, whichever is lower.

d) The valorization rate is wage bill or nominal GDP growth. For data availability and consistency reasons, average wage growth is used instead. The numerical difference is small.

e) Actual contribution rate.

f) The deadweight loss is calculated from the other columns using equation 4 as follows. First, note that the tax and contribution rates reported in the table are different from the theoretical constructs in the main text as the effective labour tax rate reported here includes the pension contribution. In addition, consumption and payroll taxes must be accounted for, as payroll taxes are not part of the contribution base and consumption taxes reduce the purchasing power of pension benefits. Let s^{tab} and τ^{tab} denote the contribution rate and effective labour tax rate reported in the table. Let c be the effective consumption tax rate and p the average payroll tax rate; they are reported in appendix table 3 along with labour tax rates. The calculation uses $s = s^{\text{tab}}(1 - c)/(1 + p)$ and $\tau = \tau^{\text{tab}} - s$. The reported effective labour tax rate combines the OECD marginal labour tax wedge ℓ with consumption taxation according to $\tau^{\text{tab}} = \ell + (1 - \ell)c$. Pension accrual is converted to the same basis by multiplying a by $(1 - c)/(1 + p)$. These adjusted rates, together with the reported years considered, valorization rate, real wage growth and an assumed discount rate of 6 %, determine the annual implicit tax shares. The deadweight loss is then calculated using an elasticity of 0.25.

g) The reduction, in percentage points, of deadweight loss that would result from equalizing the implicit tax share over the life cycle by setting the valorization rate equal to the assumed opportunity return and including all working years in the benefit calculation.

Table 2: Deadweight loss by country, sensitivity analysis

	$\epsilon = 0.25$						$\epsilon = 0.1$						$\epsilon = 0.5$					
	$r = 2\%$		$r = 4\%$		$r = 2\%$		$r = 4\%$		$r = 6\%$		$r = 2\%$		$r = 4\%$		$r = 6\%$			
	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able	DWL	avoid- able
Austria	8%	0,1%	18%	0,2%	3%	0,0%	7%	0,1%	10%	0,1%	15%	0,2%	37%	0,4%	53%	0,4%		
Belgium	11%	0,3%	26%	0,4%	4%	0,1%	10%	0,2%	14%	0,1%	23%	0,4%	53%	0,6%	73%	0,5%		
Canada	2%	0,0%	6%	0,1%	1%	0,0%	2%	0,0%	3%	0,0%	5%	0,0%	12%	0,1%	17%	0,1%		
Czechia	-4%	0,0%	9%	0,0%	-2%	0,0%	4%	0,0%	7%	0,0%	-8%	0,0%	18%	0,1%	35%	0,1%		
Estonia	-24%	0,3%	-2%	0,0%	-10%	0,1%	-1%	0,0%	5%	0,0%	-48%	0,4%	-5%	0,0%	24%	0,0%		
Finland	8%	0,1%	19%	0,2%	3%	0,0%	8%	0,1%	11%	0,1%	17%	0,2%	40%	0,4%	56%	0,3%		
France	13%	2,0%	25%	1,0%	5%	0,9%	10%	0,4%	13%	0,2%	25%	3,3%	50%	1,7%	65%	0,8%		
Germany	6%	0,0%	15%	0,1%	3%	0,0%	6%	0,0%	8%	0,0%	13%	0,1%	31%	0,2%	42%	0,2%		
Hungary	-2%	0,0%	10%	0,1%	-1%	0,0%	4%	0,0%	7%	0,1%	-4%	0,0%	20%	0,1%	37%	0,2%		
Italy	20%	0,3%	36%	0,4%	8%	0,1%	14%	0,2%	18%	0,2%	42%	0,5%	75%	0,7%	98%	0,5%		
Japan	7%	0,0%	11%	0,1%	3%	0,0%	4%	0,0%	5%	0,0%	14%	0,1%	23%	0,1%	28%	0,1%		
Korea	0%	0,0%	6%	0,0%	0%	0,0%	2%	0,0%	4%	0,0%	0%	0,0%	12%	0,1%	20%	0,1%		
Latvia	-18%	0,9%	-4%	0,0%	-7%	0,4%	-1%	0,0%	3%	0,0%	-35%	1,5%	-7%	0,0%	17%	0,1%		
Lithuania	-34%	0,5%	-8%	0,0%	-14%	0,2%	-3%	0,0%	4%	0,0%	-68%	0,8%	-16%	0,0%	19%	0,0%		
Luxembourg	5%	0,0%	18%	0,2%	2%	0,0%	7%	0,1%	10%	0,1%	11%	0,1%	36%	0,4%	55%	0,4%		
Norway	2%	0,0%	14%	0,1%	1%	0,0%	5%	0,0%	8%	0,1%	5%	0,0%	28%	0,2%	43%	0,2%		
Poland	-2%	0,0%	6%	0,0%	-1%	0,0%	2%	0,0%	5%	0,0%	-5%	0,0%	12%	0,1%	24%	0,2%		
Portugal	5%	0,1%	11%	0,2%	2%	0,0%	4%	0,1%	6%	0,1%	10%	0,2%	23%	0,4%	33%	0,3%		
Slovakia	-5%	0,0%	6%	0,1%	-2%	0,0%	2%	0,0%	6%	0,1%	-10%	0,1%	12%	0,1%	29%	0,2%		
Slovenia	-1%	0,9%	13%	0,5%	0%	0,4%	5%	0,2%	9%	0,1%	-2%	1,4%	26%	0,9%	46%	0,5%		
Spain	9%	2,1%	14%	1,1%	3%	0,9%	6%	0,5%	7%	0,2%	17%	3,7%	29%	2,0%	37%	0,9%		
Sweden	4%	0,0%	15%	0,1%	2%	0,0%	6%	0,0%	9%	0,0%	8%	0,0%	31%	0,1%	46%	0,1%		
Turkey	-5%	0,1%	5%	0,4%	-2%	0,0%	2%	0,2%	5%	0,2%	-10%	0,2%	11%	0,7%	28%	0,7%		
United States	3%	0,5%	7%	0,3%	1%	0,2%	3%	0,1%	4%	0,1%	5%	0,9%	14%	0,5%	21%	0,3%		
Average	0,3%	0,3%	12%	0,2%	0,1%	0,2%	5%	0,1%	8%	0,1%	0,7%	0,6%	24%	0,4%	39%	0,3%		

Source: Own calculations.

Notes: The table shows the deadweight loss of the pension system as a percentage of pension contributions, along with the percentage point reduction in the deadweight loss that could be achieved by implicit tax smoothing. See the notes to table 1.

5 Conclusion

In a mature pay-as-you-go system, part of the pension contribution functions as a tax rather than saving, reflecting the gap between the worker's opportunity return and the return delivered by the pension formula through indexation and accrual rules. Because this return gap compounds over time, the implicit tax share of a contribution is higher early in the career than late in the career. Under a constant elasticity, the resulting age variation in implicit tax shares raises the efficiency cost of the system.

The theoretical analysis provides a sufficient-statistics mapping from pension design to deadweight loss. For a given present-value amount of implicit revenue raised by the pension system, deadweight loss is minimized by a constant implicit tax share when elasticities and other wedges are age-invariant. With age-varying elasticities, the efficient profile instead follows an inverse-elasticity rule.

The policy contribution is to show that the deadweight-loss-minimizing benchmark can be approximated within the institutional structure of notional defined contribution systems. The core idea is to separate contributions into a credited component that functions as saving from the individual's perspective and a non-credited component that functions as a pure tax. By crediting notional balances at a rate mimicking the return to capitals and applying a multiplicative conversion factor at retirement, the system can preserve the old formula's aggregate liability while smoothing the implicit tax share over the life cycle.

The illustrative cross-country comparison shows that common pension formula parameters generate substantial heterogeneity in the life-cycle pattern of implicit taxation. Systems that rely on short averaging windows for earnings histories and that revalue past earnings primarily with prices rather than wages create steep age gradients in implicit tax shares and therefore higher deadweight losses. By contrast, systems that use full-career averaging and revalue earnings with wage growth tend to produce flatter profiles, although they still depart from the equal-implicit-tax-share benchmark whenever the implicit return differs from the assumed opportunity return.

The quantitative analysis suggests that pension contributions impose a substantial efficiency cost, but that only a small part of this cost can be eliminated by smoothing implicit tax rates over working life. Under the benchmark assumptions, the estimated deadweight loss averages 19 percent of contributions across the countries studied. Equalizing the implicit tax share across ages reduces the average loss by 0.2 percentage points, with the largest estimated gains of 0.5 percentage points in France and Spain. The level of deadweight loss is sensitive to the assumed discount rate and earnings elasticity: at an elasticity of 0.25, lowering the discount rate from 6 to 4 percent reduces the average loss to 12 percent of contributions. The gain from a reform implementing tax smoothing remains small. Nevertheless, the reform is relatively straightforward

to implement: it changes how contributions are credited and benefits calculated, and does not require the state to accumulate financial assets. It may also be politically easier than reforms that cut aggregate benefits or raise contribution rates, since it preserves the present value of pension liabilities while changing how rights accrue across working life. The reform would improve horizontal equity by treating earnings more equally across ages and vertical equity because lower lifetime earners tend to receive more of their earnings early in their careers.

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A Tax rates

Table 3: OECD consumption and payroll tax rates

Country	Labour tax rate*	Consumption tax rate**	Payroll tax rate
Austria	58%	20%	28%
Belgium	65%	17%	27%
Canada	32%	7%	10%
Czechia	45%	21%	34%
Estonia	43%	25%	34%
Finland	56%	23%	20%
France	58%	17%	36%
Germany	49%	16%	21%
Hungary	41%	30%	13%
Italy	73%	18%	32%
Japan	38%	10%	16%
Korea	31%	13%	11%
Latvia	46%	21%	24%
Lithuania	50%	17%	2%
Luxembourg	57%	25%	14%
Norway	50%	21%	13%
Poland	38%	20%	16%
Portugal	48%	20%	24%
Slovakia	47%	17%	32%
Slovenia	51%	25%	17%
Spain	50%	15%	31%
Sweden	49%	21%	31%
Turkey	48%	17%	19%
United States	41%	5%	8%
<i>Average</i>	<i>44%</i>	<i>18%</i>	<i>17%</i>

* Including payroll but excluding consumption taxes.

** Expressed tax-inclusive.

Source: OECD, “Labour taxation – OECD member country tables”; Simon & Harding (2020).