

Beyond Beveridge and Bismarck: Revising the Typology of Pension Systems for the 21st Century

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Abstract

Pension systems are a major part of welfare states which have been under reform pressures across advanced economies. Established typologies of pension systems stress the difference between Bismarckian social insurance and Beveridgean basic security principles in their historical development. During the last decades, multiple reforms due to population ageing and fiscal challenges have cut back on public pensions, raised retirement ages and promoted pension privatization and financialization, reshaping the pension landscape. Reviewing major dimensions with key indicators of pension systems, our comparative cluster analysis studies the similarities and differences across 31 OECD countries. A typology of at least four clusters describes the main types of today's pension systems: Dominant Public, Hybrid Social Insurance, Mature Multi-pillar and Residual Public systems. While two common types derive from either the pure Bismarckian model or the Beveridgean basic security with hybrid private tiers, they no longer constitute the majority of cases. The Hybrid Social Insurance model goes beyond Bismarckian principles, whereas the Residual Public is still relatively rudimentary. Overall, past reforms towards multi-pillarization and financialization have altered pension systems, though these are far from converging, while ongoing reforms could be more impactful for future generations than current retirees.

Keywords: Pension systems, welfare state, institutions, typology, comparative analysis

1. Introduction

Old age, survivor, and disability pensions have been a major achievement of advanced welfare states but also became an object of major reforms in ageing societies. Pensions comprise about 18 percent of government expenditure (or 11 percent of GDP) across the Organisation for Economic Cooperation and Development (OECD, 2024), supporting already a quarter of the population in the European Union (EU). Pension systems have emerged in two major variants across Europe and advanced economies overseas: Bismarckian social insurance versus Beveridgean basic security model (Bonoli, 2003). The first old age and disability pensions of 1889 date to Bismarck's Germany, leading slowly to similar social insurance systems elsewhere (Palier, 2010). Following the Second World War, the Beveridge reforms in Britain inspired many European welfare states to provide basic pensions to all residents as social citizenship (Marshall, 1950). Reforms have often been only gradual, thus maintaining their historical legacy with few path-dependent structural transformations (Myles and Pierson, 2001; Korpi, 2001).

More generally, pensions are seen as an important part of welfare states, embedded in political economies that have structured state-market relations. Different models of welfare state regimes (Esping-Andersen, 1990) shaped the trajectories of advanced economies in Europe and overseas – universalist aspirations in the Nordic countries and Conservative status maintenance in Continental Europe, while market liberalism in Anglophone countries. With the transition to democracy in some Southern European countries in the 1980s and after the fall of communist regimes in the East in the 1990s, as well as the parallel economic development in East Asia, these new welfare states and their pension landscape have shown notable variations that go beyond established typologies. While pension systems are understood in the context of welfare state regimes, there is also a need to reflect on their own institutional setup and reform dynamics which is the aim of our comparative analysis.

Pension reforms have been on the agenda due to population ageing and fiscal limits to growth, changing the pension landscape more or less substantially across Europe but also in other regions. These reforms included the reversal of early retirement, retrenchment of

public pensions for current and future generations, the privatization of old-age income responsibility and the financialization of pensions via prefunded schemes. However, these overall shifts towards a multi-pillar structure have had divergent outcomes, partly due to path dependency and varying reform dynamics across countries. Considering changes over the last three decades, we seek to analyse the pension landscape in the 21st century, reviewing established pension typologies and mapping their changes due to ongoing reforms. Using available comparative data, we compare the pension architecture across advanced economies by studying similarities and differences in key system features by the 2020s. We contribute to the comparative literature by proposing a revised typology for today's pension systems, while also identifying their key dimensions subject to ongoing reform efforts.

We first provide an overview of established typologies, starting with the classification of pension systems along the Bismarck and Beveridge model divide, discussing their major institutional features. In addition, we review findings from comparative studies on pension systems that developed typologies with the help of indicators. We then delineate our major dimensions for our own empirical study. In the third section, we briefly describe our methodological approach, in particular the indicators and data used for comparative analysis. In section four, we discuss the findings of our cluster analysis of today's pension systems across 31 OECD countries based on the key indicators. We also review major changes since the 2000s across countries in their overall institutional configurations. The Conclusion then discusses to what degree there is less radical but much gradual change, indicating that there is less path departure than path-dependent changes toward multi-pillar systems, though from varying starting points and along different tracks.

2. Pension typologies and reform dynamics

As an analytical framework, comparative welfare state analysis has been shaped by a typological approach, most importantly capturing welfare states in a holistic view of their redistributive capacity (Esping-Andersen 1990). While such regime typologies have taken pension systems into account, their purpose is to capture overall societal goals and political forces shaping welfare states as well as the varying impact of redistributive policies on social inequalities. In addition to such a writ large vista, there have also been specific typologies,

most importantly juxtaposing two historical pathways of pension systems: the Bismarckian versus Beveridgean traditions (Bonoli and Palier, 2007; Ebbinghaus and Gronwald, 2011).

2.1. Early pension typologies

Historical studies have used the distinction between Bismarckian social insurance and Beveridge-type universalist social security to conceptualize fundamental differences in the pension architecture (Palier and Bonoli, 1995). Even though the Bismarckian reforms date back to the German Empire nearly 140 years ago, while the Beveridge reforms in Britain reshaped postwar welfare states, these traditions have had lasting impacts across modern welfare states. Even today, these two models combine different features that shape pension reforms in a gradual path-dependent way, like “elephants on the move” (Hinrichs, 2000). Nevertheless, following decades of reforms due to ageing societies and financial constraints, some observers also see notable path departure due to reconfigurations of key features in pension systems.

Bismarckian systems tend to be pay-as-you-go financed through social insurance contributions from workers and employers with a history of occupational fragmentation and stepwise inclusion of social groups. Following the principle of achievement-oriented status maintenance, benefits are earnings-related to maintain social status but therefore sensitive to contribution records during working life, allowing for less social redistribution. These dominant public pensions have also been found to crowd out private pillars (Korpi and Palme, 1998; Ebbinghaus and Gronwald, 2011). A fundamental transformation occurred as some public pension systems became stepwise all-inclusive and built-in minimum pension provision, coming closer to the basic protection against poverty of Beveridge systems.

Beveridge-type systems tend to be more state-funded basic pensions as a social citizenship right (Marshall 1950), providing all residents with a flat-rate benefit to reduce poverty risks in old age. However, a major consequence of the limited state intervention was the development of earnings-related supplementary pensions. While in some countries these were state second pensions, in others occupational and personal pensions (co-)emerged, some of which became mandatory or regulated by collective agreements (Ebbinghaus et al., 2011; Pavolini and Seeleib-Kaiser, 2018). Therefore, pension scholars differentiate between

Beveridge-plus with supplementary tiers and rather “lite” Beveridge versions of basic pensions (Hinrichs, 2000).

In addition, Korpi and Palme (1998) distinguish five ideal-types among old-age pension (and sick pay) insurance schemes: the targeted, voluntary state-subsidized, state corporatist, basic security and encompassing models. Korpi (2001) subsequently investigated their path-dependent development of 18 OECD countries until the 1990s, finding that five Continental countries plus Japan remained or became state corporatist, whereas Australia remained the only targeted, eight countries assumed basic security, and three Nordics became encompassing models; the latter three types resemble a means-tested, basic Beveridge-plus model, whereas the first group features the contributory Bismarckian social insurance.

Since the 1990s, the reforms towards a multi-pillar architecture have been introduced earlier in Beveridge-type systems, crowding in private supplementary pensions (Ebbinghaus and Gronwald, 2011). In contrast, much earlier occupational pensions co-evolved with basic pension systems in the United Kingdom (UK) and Ireland, while the Dutch and Swiss pension systems also saw occupational pensions filling the earnings-related supplementary function, becoming (quasi-)mandatory. In Anglophone overseas countries and residual welfare states in Asia, private funded pensions and personal savings became important means for retirement income.

With the fall of communism in the 1990s, many Central and Eastern European (CEE) countries introduced mandatory funded pensions on top of the public pillar (Müller, 1999), though there had been some rollbacks following the financial market crash of 2008 and subsequent Euro-crisis (Drahokoupil and Domonkos, 2012). In contrast, Bismarckian systems with contributory earnings-related public pensions tended to crowd out private pensions until more recent reforms. For instance, Germany introduced a voluntary prefunded Riester pension to fill gaps of public pension cutbacks, although its expansion has been slow despite subsidies for some groups (Ebbinghaus et al., 2011). Thus, historical institutionalist accounts suggest that changes should be largely path dependent and gradual, while some recent analyses of reforms see some “new pension mix” emerge (Natali, 2017).

2.2. Prior comparative analyses

Prior comparative studies help in understanding whether institutional differences are still relevant for pension systems. While the described Bismarck-Beveridge typology is based on historical and institutional analyses, there have been additional quantitative studies exploring pension systems, mirroring the cluster analysis of welfare state regimes (Arts and Gelissen, 2002). The comparative pension analyses, however, differ from Esping-Andersen's tripartite regimes (1990) by presuming the two main institutional models as basic institutional variation, while seeking to map their divergence towards a multi-pillar model following reforms. These comparative analyses rely largely on indicator-based reporting by international agencies (i.e., Eurostat, OECD), deriving pension typologies via explorative data analysis across Europe or also advanced economies overseas. A few comparative analyses have attempted to develop pension typologies in recent decades, which serve as background for our more updated analysis.

As part of an EU-funded project, Dutch scholars (Soede and Vrooman, 2008) proposed a pension typology by using 34 indicators on 25 EU member states plus Norway, the United States (US), Canada and Australia around the 2000s. Their principal component analysis found two main dimensions: the overall level of pension provision varying in generosity and the public-private mix, particularly whether a private mandatory pillar such as in the Netherlands coexisted. While they found liberal and corporatist clusters, in line with Beveridgean versus Bismarckian traditions, there were at least two further groupings: moderate public pensions and mandatory private schemes. A similar typology was developed by Marcinkiewicz and Chybalski (2019), which studied the public-private mix by comparing 30 OECD countries (yet excluding Asia). Their multivariate analyses found evidence for three pension models in the 2010s: pension systems with significant voluntary schemes (mainly anglophone countries), those with mandatory private schemes (Nordic, Dutch and Swiss funds, also some CEE countries and Australia), and mandatory public ones (mostly continental Bismarckian systems). These two studies describe Europe and Anglophone OECD countries, indicating between three and four distinct types prior to the financial market crash of 2008. However, their reliance on outdated data and the inclusion of non-pension indicators (i.e., economic outputs, population structures) renders their analyses divergent from our study.

Further comparative studies focus on different problem contexts, using pension and outcome indicators to map their differential impact. For example, Krpan et al. (2020) also use cluster analysis to describe changes over time from 1996 to 2016, focusing on 11 new EU member states in Central and Eastern Europe. Using pension system indicators, they assess their financial sustainability outcomes, also taking demographic and economic data into account. Ebbinghaus (2021) analyses poverty and social inequality in old age for European countries, classifying them into Bismarckian versus Beveridge-type pension systems, but finding that finer details matter to explain cross-national variation. Lee (2024) recently studied the relationship between public pension spending and old-age employment over time, detecting varying effects across the Bismarck- and Beveridge- models but also hybrid cases. These recent studies indicate the need to better classify pension systems, while it remains important to separate the typology of pension systems from their outcome, such as social inequality or financial sustainability.

2.3. Dimensions of pension systems

Building on this body of historical and comparative analyses, we seek to reassess and update a pension typology, reflecting recent reforms by combining multiple indicators to map pension systems today. Pensions provide income security during old age, sometimes also for (dependent) survivors or people with disabilities unable to work. In some countries, such pensions are all organized within one public system, whereas in others these benefits are more fragmented across different schemes, some of which are private.

The main goal of old-age pension policy has been twofold (see Table 1): maintaining the living standards earned during working life during retirement, versus poverty reduction in old age and when facing health-related incapacity or death of a partner. This main distinction reflects the Bismarckian emphasis on achievement-oriented status maintenance that reproduces inequalities during working life towards retirement, whereas the Beveridgean system guarantees basic provision for all to combat poverty in old age. We expect that this basic difference between *contributory* social insurance and *minimum* income security remains important for today's pension landscape.

The primary feature of pension architecture rests on its *pillars* (Ebbinghaus, 2011; Immergut and Anderson, 2007). Depending on the administrative responsibility and

governance mode, we distinguish three pillars: The first are public schemes, followed by the second pillar occupational pensions, either provided by employers or collectively bargained among social partners, and finally the third pillar, mainly (voluntary or mandatory) personal savings managed by financial institutions (banks, life insurers and investment funds). The main thrust of pension reforms has been a transformation from full reliance on public pensions to shifting responsibility towards private actors, known as the paradigm shift towards a multi-pillar architecture. Most influential are the Swiss three-pillar system, following a referendum in 1972, and the recommendations in the World Bank Report *Averting the Old Age Crisis* of 1994 (Leimgruber, 2012) that influenced CEE transition countries during the 1990s.

In addition to pillars, some scholars distinguish the multiple layers of pensions with respect to their income function, so-called *tiers* (Ebbinghaus, 2011). Hence, the first tier, providing the basic floor of the social safety net, includes means-tested social assistance or basic pension schemes (or income-tested top-up guarantees); followed by (quasi-) mandatory earnings-related contributory tiers, either defined benefit (DB) or defined contribution (DC) schemes; and finally, the third tier of voluntary top-up savings (or life insurance plans), dedicated to payout in retirement. While in most cases the first-tier function is fulfilled by the public pillar, the extent to which second-tier pensions are provided either mainly by public or private pillars characterizes the Bismarck versus Beveridge divide. The interaction between these tiers also shapes the income situation in old age, though work and other income sources may also be relevant (OECD, 2025a). At the base, means-tested social or universal basic pensions redistribute to mitigate poverty risks, while further tiers, either mandatory or voluntary schemes, reproduce inequalities from working life to old age (Ebbinghaus, 2021).

Place Table 1 about here

Another aspect is the *financing mode*, partly related to the governance structure of the public-private mix. Here, it is crucial whether public pensions are funded by the state through taxes or a contributory social insurance (with payments by employees and/or employers, sometimes with state subsidies). Contributory public pensions are usually funded as pay-as-

you-go schemes, combined with DB or notional defined contribution (NDC) payouts. However, there are also supplementary pensions that are (partially) pre-funded, either through private pension funds or guaranteed through sovereign funds. All these features have consequences for financial sustainability in ageing societies but also with respect to poverty and inequality in old age (Ebbinghaus, 2021). When the public pillar is predominantly tax-funded and serves mainly the first-tier function, the relative sizes of private pension expenditures and pension fund assets are expected to be enlarged, indicating significant public-private mixes and a large scope of pension fund capitalism.

Partly related to its governance and income tiers, *coverage* (or access) matters in pension systems. The key question is whether an income-related scheme is mandatory for all, collectively negotiated and organized by the social partners (quasi-mandatory), mandated on firms but with individual opt-out options (auto-enrolment), or merely voluntary for individuals to opt in with or without tax incentives or subsidies (Pavolini and Seeleib-Kaiser, 2018). These differences matter particularly among private schemes, ranging from full coverage in case of strong mandates to rather low, unequal take-up in case of voluntary schemes, with nudging rules, tax benefits or subsidies as possible in-between measures.

Finally, the governance and tier structures also tend to be reflected in the *scope* and *generosity* of the public pension system, which are often measured by the overall public pension expenditure and the replacement rates of contributory schemes respectively. Overall pension expenditures (and their public part) provide a measure of the economic resources used, though demographic ageing and the public-private mix also need to be considered. Replacement rates could be substantially different for those with average, low or high contributions, depending on the tier structure of public pensions. These could also differ for current or future retirees if reforms are incremental and ongoing. Given more generous pensions and other social benefits, early retirement has been common in Bismarckian social insurance systems, compared to Beveridgean basic security.

As the largest social expenditure programmes, pay-as-you-go public pensions have been at the centre of reforms towards multi-pillar systems and later retirement, as they are deemed to be financially unsustainable given increased old-age dependency in ageing societies. Indeed, ever more pensioners are paid directly from taxes and contributions by ever

fewer working people. As a hallmark of the intergenerational social contract, however, they have proven to be difficult to reform. In particular, the double payer problem (Myles and Pierson, 2001) is an obstacle to radical transition as today's working people would have to pay for the claims of current pensioners while also saving for their own retirement. Hence, path dependency scholars expected rather gradual change by stepwise adaptation than major paradigm shifts by big-bang reforms.

3. A Comparative Approach to Pension System Analysis

Given our aim of comparing and typologizing pension systems, we adopt a large-N cross-national analysis focusing mainly on high-income countries in the OECD. This approach has been widely employed in seminal studies of the welfare state (e.g., Arts and Gelissen, 2002; Esping-Andersen, 1990) as well as in domain-specific comparative policy research, including pensions. Compared to the small-N approach, which seeks in-depth case analysis, large-N comparative studies provide a bird's-eye view of institutional configurations and their cross-national variation, albeit with inherent selection problems (Ebbinghaus, 2005). A typological approach helps in understanding the main variation across cases, thus allowing us to cluster countries by similarities and differences along theoretically relevant key dimensions. Moreover, such an up-to-date typology of pension systems can then be used to explore their outcomes in further studies.

3.1. Main dimensions and their indicators

For our analysis, we select 31 OECD countries across Europe, North America and East Asia, for which comparable data on pension system indicators are available from our primary sources. These include the OECD Pensions at a Glance (PAG; OECD, 2025a), the OECD Pension Markets in Focus (PMF; OECD, 2025b), the OECD Social Expenditure database (SOCX; OECD, 2024) and the Social Insurance Entitlements Dataset provided by the Social Policy Indicators database (SIED, Nelson et al., 2025). While we rely on the most recent data (2024 or the closest available year) for our main empirical analysis, we also refer to pension architectures in the early 2000s based on country-specific policy descriptions (OECD, 2005) to analyse cross-national patterns of major pension reforms over the last two decades.

Table 2 presents the list of indicators used in our main analysis, their definitions and sources, as well as corresponding dimensions. These include: (1) income tier structure of the public pillar; (2) the public-private mix of pension systems; (3) generosity of public systems; and (4) early/late retirement. These dimensions build upon those of previous studies (outlined in Section 2.3), particularly those capturing primary features and reform arenas in response to demographic ageing and fiscal pressures across advanced economies (Hinrichs, 2021). The benefit type (i.e., DB, DC, flat-rate) and financing mode (i.e., pay-as-you-go or pre-funded) are not incorporated in our quantitative analysis for comparability issues of qualitative data but are discussed separately based on our institutional case knowledge.

As the first dimension, we consider the income tier structure of the first pillar, manifested in the redistributive structure and the degree of earnings-relatedness in public schemes. Redistributive structures are captured by the generosity of minimum and maximum public benefits, measured as a share of the average production worker's wage (APWW). The *minimum safety net* is embedded in either universal basic pensions or targeted old-age assistance benefits for retirees with zero contribution records but with full residency, while the *maximum pension* refers to the theoretical ceiling on public pension benefits.¹ The degree of earnings-relatedness is evaluated by using the *relative replacement rate* for *low-income workers* (half of average earnings) and for *high-income workers* (twice average earnings) expressed as a ratio to the replacement rate for average earnings. The benefit structure can be considered more Beveridgean when the former is higher, and more Bismarckian when the latter is higher, i.e. approaching one.

Place Table 2 about here

Second, we measure the degree of privatization in the public-private mix, reflecting the efforts to relieve fiscal pressures on public systems. Relevant are the financing mode and coverage of second-tier pensions, we use three indicators. The first is the share of current private spending in total pension expenditures (*private pension share*) to capture the

¹ In cases where the maximum benefit is not explicitly defined, we impute it as 2.5 times the average replacement rate for current retirees. Countries without a clearly defined legal maximum benefit in public pension schemes include Czechia, Estonia, Finland, Greece, Hungary, Italy, Latvia, Poland and Portugal.

dependency on non-public or funded pension sources. Second, we use the coverage rate of funded pension plans in the working-age population, this indicates whether occupational pillars are mandatory, quasi-mandatory (via collective agreements), auto-enrolment (with opt-out options) or voluntary, although in some countries mandatory funded schemes are managed by the state.² The *funded pension coverage* captures the pace of financialization even when the current private pension expenditure is yet low. Similarly, we use the scale of *private pension assets* (as a percentage of GDP), excluding public pension reserve funds, as a measure of ongoing financialization, making current and future retirement incomes dependent on financial market performance.

Third, we assess the overall generosity of public systems, using three indicators. The first is *public pension spending per older person*, given that major reforms since the 1990s have aimed at curbing public expenditure. Rather than using public expenditure on old-age pensions as a share of GDP – a widely used OECD indicator – we compute public spending per individual aged 65 or older as per capita share of GDP to adjust for cross-national differences in population structures and living standards simultaneously. We also use the *average replacement rate* to measure the generosity from a social entitlement perspective, modelled for *current* and *future retirees*. The former (obtained from SIED) captures a single person’s full pension benefit in a given year, assuming an APWW throughout their entire working life, normalized by annual APWW. For future retirees, we use OECD’s simulated replacement rate for average earnings, applying current accrual rules assuming labour market entry at age 22. We use gross replacement rates consistently for both measures since the OECD provides only gross measures for public pensions separated from mandatory private pensions.

Finally, we consider to what degree active ageing is promoted and later retirement has been achieved to capture major pension reform goals. We first use the *statutory retirement age*, which serves as a normative benchmark for retirement timing decisions. We also use the difference between the statutory retirement age and the effective labour market exit age to measure the remaining prevalence of *early retirement*. While we acknowledge that early exit from work is a product of multiple institutions beyond pension systems, including labour

² For instance, the Danish ATP pension, the Swedish premium pension and Latvia’s second-pillar pensions are pre-funded public schemes.

market institutions and disability benefits, it is more often supported by partial or reduced early pensions following the wave of welfare reforms (Hofäcker et al., 2016). Both indicators are based on men's retirement and exit ages in order to rule out gendered retirement patterns from our analysis, which are better explained by life-course regimes than pension systems *per se* (Madero-Cabib et al., 2023).

3.2. Analytical strategy

Using these twelve indicators across four key dimensions, we conduct hierarchical cluster analysis to derive a coherent typology of contemporary pension systems. All indicators are included as standardized values, while *private pension assets* are log-transformed before standardization to prevent outliers from driving the result. We first construct a (dis)similarity matrix that represents the distance between all pairs of observations based on Gower's distance metric. Hierarchical clustering is then performed using Ward's method, which minimizes total within-cluster variance based on the similarity matrix. We subsequently examine the cross-national variation in pension architectures, their recent reforms, and each of the twelve indicators, based on our proposed typology.

For a robustness check, we apply four different sets of weights to shrink the influence of interrelated indicators that capture similar concepts – i.e., relative replacement rates for *low-income* and *high-income* workers and public pension generosity for current retirees. We also use Euclidean distance instead of Gower's distance metric. We show that these alternative approaches produce results that are highly similar to the presented typology (see Supplementary Tables A1 and A2 and Supplementary Figures A1 to A5).

4. Results

4.1. Regimes of contemporary pension systems

Based on this hierarchical clustering, we propose a four-cluster typology to characterize the regimes of contemporary pension systems, which we label as Mature Multi-pillar, Residual Public, Hybrid Social Insurance and Dominant Public Systems (see Figure 1). Our proposed groupings slightly diverge from the “optimal” cutoff suggested by widely used cluster quality

metrics³ – we thereby seek to enhance the interpretability of the data-driven clusters by linking them to relevant theoretical concepts. The means of the twelve indicators for each regime are summarized in Table 3. We discuss the main features of the clusters in Figure 1 from right to left.

Place Figure 1 about here

Figure 1. Cluster dendrogram

Place Table 3 about here

The *Dominant Public* regime is a cluster combining Southern European countries with Austria, France and Luxembourg but also Finland. This regime remains largely a Bismarckian social insurance model despite major reform efforts: a single, encompassing public pillar still provides earnings-related benefits combined with pay-as-you-go financing. Private pension plans are thus mostly voluntary in this group – except in France and Finland – and their role remains relatively minor despite some reforms fostering private pension markets. These public schemes still offer relatively generous replacement rates even for high earners with high maximum pensions, and average public spending is higher than in all other regimes. Moreover, early exit from work remains dominant as both statutory and effective retirement ages are the lowest, with current exit from work still around 63 even after reforms.

The *Hybrid Social Insurance* cluster shares some similarity with the first one, representing a relatively heterogeneous group of three Western and six Eastern European countries. These are variants of the Bismarckian model but with more explicitly hybrid features today: public pensions are earnings-related but are less generous for middle- and high-earners, reflected in lower maximum pensions and higher relative replacement rates for low-income workers than in the pure Bismarckian group. Retirement incomes are thus supplemented through occupational pensions that are (quasi-) mandatory or voluntary with strong tax incentives.

³ The data-driven optimal result recommends a five-cluster solution, separating either Greece and Luxembourg from other Dominant Public systems or Iceland from other Mature Multi-pillar systems (see Supplementary Figure A6).

However, the relative sizes of private expenditures and assets remain modest as they are still accumulating. While public expenditures and replacement rates are smaller than in *Dominant Public* systems, their statutory and effective retirement ages are similar but slightly higher.

A third cluster includes *Residual Public Systems* in the Baltics (Estonia, Lithuania) and the two Asian countries (Japan, South Korea). While public systems in all four countries contain both contributory and non-contributory schemes, their benefits are the least generous for all income groups, resulting in the lowest levels of public pension spending. Other features that differentiate this group from the classic Beveridgean model include weak non-contributory safety nets and lower levels of financialization, although pension funds are growing at a rapid pace. As public systems are limited while private schemes are still immature in these countries, poverty rates are high and older workers tend to retire much later than the statutory age to supplement their insufficient pension (OECD, 2025a).

The fourth, *Mature Multi-pillar* regime is characterized by either a flat-rate or an earnings-related system with a low benefit ceiling in the main public scheme. This group largely overlaps with the Beveridgean multi-pillar systems, commonly associated with Anglophone countries but also Denmark, Iceland, the Netherlands and Switzerland. The Swedish system has also transformed into this type over the past three decades since its 1994 reform, departing from the former encompassing public system. Public pension expenditures and average generosity are relatively low in this cluster, but non-contributory basic or targeted safety nets are still generous. As these systems are oriented towards basic income provision and poverty alleviation, public pension entitlements are relatively generous for low-income retirees but decline sharply for middle- and high-earners who rely on private schemes. Distinctive is its high degree of financialization, as shown in huge private pension assets as well as high private pension shares which are still growing. Retirement age has been traditionally high (or substantially increased as in the Netherlands).

4.2. Distribution of pension system indicators across countries

Figures 2, 3 and 4 present the cross-country distributions of each variable used in the analysis, organized according to the analytical dimensions. Based on the twelve indicators, the four clusters overall represent distinct and internally coherent pension-system configurations, although some overlaps and within-cluster heterogeneity remain. Deviations

from major cross-regime patterns reflect distinct country-level features as well as the presence of outliers within broader institutional patterns.

Among the four indicators representing the income tier structure of the public pillar, the minimum safety net shows only limited regime differentiation (Figure 2A): Residual Public systems are located at the lower end, whereas the other three regimes overlap across the middle and upper ranges, while CEE countries in the Hybrid Social Insurance cluster show levels similar to those of Residual Public countries. By contrast, clearer cross-regime differences are seen for maximum public pensions (Figure 2B), with Dominant Public systems concentrated at the top, Hybrid Social Insurance systems in intermediate positions, and Mature Multi-pillar systems lower down. Countries in the Residual Public cluster are relatively more dispersed, while the US is a clear outlier among Mature Multi-pillar systems. A different configuration appears for relative replacement rates for low-income workers (Figure 2C): Mature Multi-pillar systems in general occupy the upper range (with the exception of Sweden, the US and Canada), Hybrid Social Insurance and Residual Public systems the middle range and Dominant Public systems the lower range. This ordering is largely reversed for high-income replacement rates (Figure 2D): Dominant Public and Hybrid Social Insurance systems dominate the upper range, Residual Public systems are scattered across intermediate positions, and Mature Multi-pillar systems cluster at the bottom, where Australia and Iceland form a distinct low-value subgroup.

Place Figure 2 about here

Figure 2. Indicators related to the income tier structure

Note: Maximum public pensions are imputed as 2.5 times the average replacement rate for countries without explicit benefit ceiling. Iceland is removed from Figure 2C due to its extreme outlier value.

Turning to the public-private mix dimension in Figure 3, the clearest cross-regime separation is observed for private pension assets (Figure 3D), where Mature Multi-pillar systems form a distinct upper cluster, while Dominant Public and Hybrid Social Insurance systems overlap at the lower end. A similar, though less pronounced, pattern emerges for the private pension share (Figure 3B), though Residual Public systems display here greater internal heterogeneity, splitting between highly privatized systems in Korea and Japan on the

one hand, and the Baltics with less mature private schemes on the other. For funded pension coverage (Figure 3C), Mature Multi-pillar systems again remain concentrated toward the upper range and Dominant Public systems toward the lower range, while Hybrid Social Insurance and Residual Public systems occupy intermediate positions. The latter are more dispersed, with the Baltics showing high levels of participation in funded schemes.

Largely coherent cross-regime patterns also emerge across the three indicators of public pension generosity (see Figures 3A, 4A and 4B): Dominant Public systems occupy the upper range, Hybrid Social Insurance systems generally the middle, and Mature Multi-pillar and Residual Public systems the lower range. However, this ordering is accompanied by substantial within-regime variation, particularly among Mature Multi-pillar countries. Across all three indicators, public pensions in Sweden and the US seem to be as generous as those in Hybrid Social Insurance systems, while the UK and Denmark exhibit high levels of public pension spending and current replacement rates. There is also considerable reshuffling in the cross-country rankings between current and future replacement rates, with Poland and the UK expected to face large declines in replacement rates relative to other countries.

Place Figure 3 about here

Figure 3. Public pension spending per older person (A) and indicators related to the public-private mix (B-D)

Finally, within the early/late retirement dimension, cross-regime differences are comparatively small. Statutory retirement ages place Mature Multi-pillar systems toward the upper end, but the remaining regimes overlap extensively. For early retirement, Residual Public systems are generally concentrated at the lowest, and mostly negative, values, with Lithuania as the main positive exception, while the other three regimes are broadly intermixed.

Place Figure 4 about here

Figure 4. Indicators related to the average generosity of public systems (A-B) and early/late retirement (C-D)

Note: The current and future replacement rates are on a different scale, as they are obtained from different data sources and normalized by different denominators (current APWW versus the average wave).

4.3. Pension architectures and recent dynamics

On top of the key indicators, we summarize in this section the overall design features of pension systems across countries (see Table 4 for an overview). These are relevant to the dimensions of pillars, tiers and the financing mode discussed in Section 2.3, including the institutional benefit types (DB, DC, NDC, Basic or Targeted) and regulatory frameworks (mandatory, quasi-mandatory or voluntary) of the public first pillar and occupational second pillar, which cannot be fully captured by quantitative indicators. Through this we can assess how our proposed regimes align with different architectures of pension systems and how their changes reflect recent reform dynamics. We therefore document major changes in these dimensions over the past 20 years, relying on prior qualitative policy descriptions across countries (OECD, 2005).

Place Table 4 about here

In the Mature Multi-pillar Regime, there are four subgroups of public schemes achieving basic security through different benefit structures: pure targeted (Australia, Iceland); (near-) universal basic (Denmark, the Netherlands, Ireland, UK); earnings-related DB with low benefit ceiling (US, Canada, Switzerland); and NDC with guaranteed top-up (Sweden). Sweden had been considered an encompassing model (Korpi and Palme, 1998), but its multi-pillarization has matured after three decades of the path-departing reform. Occupational schemes are either mandatory or quasi-mandatory in most European systems and in Australia, while the UK and Ireland recently introduced auto-enrolment. Private pensions remain voluntary but are important in North America, leading to upper-class concentrations and old-age inequality.

In Residual Public Systems, public DB pensions provide only modest replacement, supplemented by either basic or targeted safety nets. Estonia and Lithuania after the financial crisis have suspended or reversed earlier reforms that introduced mandatory funded

schemes, which now became optional. By contrast, Korea and Japan have been rapidly expanding their private pension markets to enhance retirement income security.

The Hybrid Social Insurance models contain several distinct trajectories. While public schemes still mostly combine DB with targeted safety nets, reflecting the Bismarckian tradition, Poland, Latvia and recently Norway consecutively introduced NDC with mandatory funded schemes, following the Swedish path. However, Poland as well as Hungary and Slovakia radically reversed their paths toward privatization since the Great Recession, re-nationalizing the funded schemes and making them voluntary (Naczyk and Domonkos, 2016). In others (Germany, Belgium, Czechia, Slovenia), occupational or other private schemes remain voluntary but are encouraged through tax incentives.

Finally in the Dominant Public systems, Italy (since the 1990s) and recently Greece have undertaken structural reforms to NDC systems, thereby reducing their thus far generous earnings-related benefits, whereas all other countries have maintained high DB replacement rates. Minimum safety nets are mostly attained through targeted old-age assistance, while occupational funded pensions also remain voluntary. Finland and France stand out as unique cases with mandatory occupational pensions, managed by the social partners, although their distinction from public schemes is less clear-cut.⁴

5. Conclusion

Our typology of pension systems based on hierarchical clustering accommodates multiple indicators relevant to the institutional public-private mix as well as the major reform domains to capture the complexity of contemporary pension designs. Our four-cluster typology extends the conventional Beveridgean versus Bismarckian dichotomy, as it also reflects the diversity of reform paths since the 1990s aimed at retrenchment and privatization. Following the wave of pension reforms, including structural shifts, only eight countries currently maintain the pure Bismarckian structure, whereas the mature multi-pillar model now includes

⁴ In Finland, while mandatory second-tier pensions are partially funded and decentralized in administration, a central organization (Finnish Centre for Pensions) coordinates their management based on common statutory principles (Kangas and Luna, 2011). The OECD therefore classifies the Finnish second tier as the public system (OECD, 2025a). In France, the mandatory Agirc-Arrco scheme runs on pay-as-you-go, defined-benefit principles, making a quasi-public system.

a more diverse mixture of systems. These are the classic Beveridgean basic security in Europe, the 'liberal' North American and Swiss three-pillar models, and the Swedish late-joiner. Moreover, two additional clusters now feature unique hybrid natures. The model of Hybrid Social Insurance keeps its public earnings-related system while allowing the private pillars to supplement retirement incomes for the upper- and middle-income retirees with some funded elements. The incomplete privatization in the Baltics brings them close to those in Residual Public systems in East Asia, characterized by limited minimum protection and less mature private pillars.

While our analysis captures the comparative dynamics of pension systems that have evolved since the early 2000s until recently, it remains uncertain whether future developments will reproduce the same typological patterns. In several countries, pension entitlements for current and future retirees already differ substantially, and private pension expenditures and assets tend to increase rapidly in hybrid systems. Whether Baltic states, including Estonia and Lithuania, will gradually diverge towards mature multi-pillar or hybrid insurance models could be of particular interest, given that their early reform efforts were partly reversed due to concerns arising from financial crises. Korea and Japan may also converge to the North American system if their private pension markets maintain the current pace of growth.

Although we considered the recent reform dynamics and documented them with the current pension architecture, our cluster analysis is based on cross-sectional data, indicating a snapshot of recent pension system features. Another limitation is that we did not consider detailed governance and regulatory structures for voluntary pension schemes, including tax incentives. We also had to exclude new OECD members in Latin America due to a lack of comparable data in several indicators.

Despite these caveats, the typology presented in this cluster analysis reaffirms the institutional perspective claiming that the tectonic of pension system architecture is only slowly and gradually altered. The main design principle established in the postwar period still matters for pension system differences today, and the basic divide between Bismarck and Beveridge remains important. Nevertheless, policy shifts towards controlling public expenditure, increasing retirement ages, fostering privatization and financialization have

altered the balance of pillars and tiers, though this has not led to an overall convergence towards one model. There are more hybrid cases and within-regime differences, but the main design choices still matter.

Future studies could extend our analysis to examine the link between pension models and distributional outcomes, including old-age poverty and income inequality as well as gender gaps in pension income and retirement ages. Such analyses would require a broader perspective beyond pension systems, as socio-economic differences in life-course employment patterns and earnings inequality during working lives also contribute to later-life inequality and poverty. Given previous findings (e.g. Ebbinghaus, 2021), the institutional public-private mix alone may not be the key determinant of overall redistribution. The generosity of minimum safety nets, as well as the collective organization and coverage of occupational pension schemes, often matter more in shaping distributive consequences than stylized architectures. Nevertheless, the four pension system types can be used as a basis for more fine-grained analyses in the future.

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Data Availability Statement

Data used in this study are secondary data, which are publicly available or to which the authors have authorized access for research purposes. The data and codes that support the findings of this study are available in Kun Lee's Pension Regime Project Repository (https://github.com/kunlee0910/pension_regimes). These data were derived from the following resources available in the public domain: OECD Social Expenditure Database (<https://www.oecd.org/en/data/datasets/social-expenditure-database-socx.html>), OECD Pensions at a Glance (https://www.oecd.org/en/publications/2025/11/pensions-at-a-glance-2025_76510fe4.html), OECD Pension Markets in Focus 2025 (https://www.oecd.org/en/publications/pension-markets-in-focus-2025_b095d0a0-en.html), Social Insurance Entitlements Dataset (<https://www.su.se/english/divisions/social-policy-indicators-database/data#h-Socialinsuranceentitlementsdatasetsied>).