INTERNATIONAL MONETARY FUND

European and Fiscal Affairs Departments

# Pension Reforms in Europe

## How Far Have We Come and Gone?

*Prepared by Armand Fouejieu, Alvar Kangur, Samuel Romero Martinez, and Mauricio Soto*

DP/2021/016

European and Fiscal Affairs Departments

# Pension Reforms in Europe
## How Far Have We Come and Gone?

Prepared by Armand Fouejieu, Alvar Kangur,
Samuel Romero Martinez, and Mauricio Soto

INTERNATIONAL MONETARY FUND

**Cataloging-in-Publication Data**
**IMF Library**

Names: Fouejieu A., Armand. | Kangur, Alvar. | Romero Martinez, Samuel. | Soto, Mauricio. | International Monetary Fund. European Department, issuing body. | International Monetary Fund. Fiscal Affairs Department, issuing body. | International Monetary Fund, publisher.
Title: Pension reforms in Europe : how far have we come and gone? / prepared by Armand Fouejieu, Alvar Kangur, Samuel Romero Martinez, and Mauricio Soto.
Other titles: International Monetary Fund. European Department (Series). | International Monetary Fund. Fiscal Affairs Department (Series).
Description: Washington, DC : International Monetary Fund, 2021. | Departmental paper series. | Includes bibliographical references.
Identifiers: ISBN 9781513593920 (paper)
Subjects: LCSH: Pensions—Europe.
Classification: LCC HD7105.45.E85 F68 2021



Publication orders may be placed online, by fax, or through the mail:
International Monetary Fund, Publication Services
P.O. Box 92780, Washington, DC 20090, U.S.A.
Tel. (202) 623-7430 Fax: (202) 623-7201
E-mail: publications@imf.org
www.imfbookstore.org
www.elibrary.imf.org

# Contents

**Figures**

## Tables

# Acknowledgments

This paper was prepared by an IMF staff team consisting of Armand Fouejieu, Alvar Kangur, Samuel Romero Martinez (all EUR), and Mauricio Soto (FAD/COM), under the general guidance of Jörg Decressin (EUR) and David Coady (FAD). Samuel Romero Martinez provided superb research and modelling assistance, and Kelly MacKinnon provided excellent production assistance.

The paper has benefited from constructive comments from many IMF staff and from the Office of the Executive Directors. The authors are indebted to Csaba Feher, Boele Bonthuis, and Carlos Mulas Granados for their invaluable advice and contributions to the paper as well as to Lucy Liu and Niki Kalavrezou for their contributions to country-specific simulations. We remain grateful to the participants in seminars and meetings at the IMF for their insightful comments. The paper also benefited immensely from the external review by Heinz Rudolph from the World Bank.

This paper uses data from the Eurosystem Household Finance and Consumption Survey.

# Glossary

| | |
|---|---|
| AR | Ageing Report |
| AROP | At Risk of Poverty |
| AROPE | At Risk of Poverty or Social Exclusion |
| AWG | Working Group on Ageing Populations and Sustainability |
| DB | Defined Benefit |
| DC | Defined Contributions |
| EC | European Commission |
| EP | European Parliament |
| ERR | Economic Replacement Rate |
| EU | European Union |
| GDP | Gross Domestic Product |
| GFC | Global Financial Crisis |
| IMF | International Monetary Fund |
| IRR | Internal Rate of Return |
| NDC | Notional Defined Contributions |
| NPV | Net Present Value |
| OECD | Organisation for Economic Co-operation and Development |
| PAYG | Pay-as-you-go |
| PM | Proportionality Measure |
| SPC | Social Protection Committee |
| UN | United Nations |

# Executive Summary

In the past few decades, a myriad of reforms in Europe have had a significant impact on the way and extent to which public pensions provide retirement income. This departmental paper takes stock of where European pension systems stand and assesses their key characteristics. We present a novel measure of the balance between lifetime benefits and contributions—the Proportionality Measure—to examine pension systems' long-term sustainability, fairness, and intergenerational equity.

The results presented in this paper suggest that in most countries additional efforts are needed to ensure the long-term sustainability of pension systems. Reforms enacted in recent decades raised retirement ages, streamlined benefit entitlements, and flattened the profile of pension spending projections. Still, in many countries, pension spending and deficits are projected to increase and remain at high levels for decades to come, fueled by rising old-age dependency. Older generations—that is, current retirees—receive lifetime benefits that exceed their lifetime contributions more than twofold. Reforms legislated in the decade following the GFC reduced the lifetime benefit-contribution ratio to nearly 1.5 for younger generations, going halfway toward long-term sustainability. However, subsequent and more recent reforms and reversals have partly eroded these gains and, as of 2021, the lifetime benefit-contribution ratio stands at about 1.7 for younger generations. This leaves most pension systems dependent on substantial state transfers for generations that crowd out other productive spending, including resources needed for greener and more inclusive economic transformation.

Reforms have widened intergenerational divides, posing risks for broad support to pension systems in the future. To improve sustainability, reforms in most countries have more closely aligned contributions and benefits for younger cohorts who will not be treated as favorably as older ones. Compared to current retirees, future generations will access public pensions later in life and receive relatively lower benefits. Such differences in treatment across generations might disincentivize younger generations to participate in pensions systems and heighten risks for reform reversals, ultimately adding pressure on long-term sustainability.

Tackling the risks ahead requires frontloaded reforms to ensure sustainability and fairness across generations. Our results suggest that addressing existing imbalances would ideally require a more equitable burden-sharing across generations. In addition to tackling sustainability concerns, pension systems should minimize labor market distortions insofar as trade-offs with adequacy are less acute. Reforms that appeal to shared principles of equity along with enhanced financial literacy can be socially and politically more palatable. Measures to encourage later retirement and instruments to complement public schemes can support pension adequacy.

The COVID-19 crisis may place higher demands on future pension reforms. The crisis has contributed to another wave of increase in public debt, although cushioned by lower interest rates. The costs of the crisis have been largely shouldered by younger generations, including in the form of scarring and human capital losses. Governments will therefore need to strengthen the resilience of economies—and social security systems in particular—to future shocks. All in all, the crisis will strengthen calls for ensuring fair, equitable, and sustainable pension systems in the post-COVID-19 world.

# Chapter 1 Introduction and Motivation

The past three decades have witnessed extraordinary reform efforts to contain pension spending outlays. With increasing life expectancy and low fertility, old-age dependency rates have been creeping up and pension spending in Europe has been gradually rising through 2010s. Countries have responded, and responded with vigor. A myriad of reforms, mostly enacted in the aftermath of the global financial crisis (GFC), have improved the long-term sustainability—as captured by the Proportionality Measure, defined as the balance between lifetime benefits and contributions—and—with some mixed success—the design of pension systems. In balancing macro-fiscal and political constraints, reforms have been mostly gradual, thus delaying adjustments well into the future.

In recent years, reform efforts have lost momentum, and several countries have reversed earlier measures. The low interest rate environment reduces the cost of public debt and may make public finances to look more sustainable and generational disparities less stark. Against this background, and despite adverse demographics, political pressures to unroll previous reforms have been building up well before the COVID-19 crisis. This raises questions: have the reforms been sufficient to put the pension systems on sustainable grounds? If so, have reforms been fair and equitable, and will these reforms be sustained? If not, how far are we and what lies ahead?

As the COVID-19 crisis sharply transforms economic conditions, reviewing the role of social protection systems becomes critical. Rising public debt—including that associated with pension system deficits, reform reversals, and long-term scaring—affect the sustainability of pension systems and public finances. These conditions will also induce wider generational imbalances as the crisis has affected disproportionately the youth and working aged. The changing economic environment requires clear diagnosis of the sustainability of pensions under the current policies and places higher demands on rethinking the design and mix of pension and welfare systems.

This paper assesses the sustainability, fairness, and intergenerational equity of pension systems in Europe. We document pension reforms in Europe over the past three decades along with recent episodes of reversals—as ultimately encapsulated in 2021 Ageing Report (EC 2021) projections—and discuss their key macro-fiscal implications. To formalize the consequences of reforms on sustainability, fairness, and equity, we examine pension systems in a framework that compares contributions and benefits over the lifetime of different cohorts. Such framework starkly reveals how the assessment of pension systems depends on their debt, deficits, and the interest rate–growth environment or "*r* – *g*."

Past reforms have been insufficient to restore sustainability. Before the GFC, the pension systems in Europe provided lifetime benefits that, in present value terms, doubled lifetime contributions on average—a recipe for unsustainability. Reforms enacted over nearly a decade, leaning against the GFC and the European debt crisis and population aging, were expected to gradually reduce lifetime benefits to just above 1.5 times contributions as of 2018 (in net present value [NPV] terms) for cohorts retiring in 2040s and beyond; reaching nearly halfway toward sustainability. Still, pressures to reverse reforms in late 2010s eroded some of these gains, and lifetime benefit-to-contribution ratio for the younger generations stands at 1.7 as of 2021. In the long-term, pension spending would remain at unprecedentedly high levels—the number of countries in our sample with pension spending of more than 10 percent of GDP goes from 9 out of 27 in 2000 to 18 out of 28 in 2050—and pension systems in most European countries are not sustainable.

The gradual approach to many reforms carries implementation risks. Phased-in reforms can deepen intergenerational divides for decades, protecting the elderly and weighing on the youth, and shift into the future the political costs related to their implementation. Reform reversals have been evident in several countries already before the COVID-19 pandemic. In emerging Europe, reversals have typically aimed at addressing short-term deficits at the expense of future pension adequacy, in some cases worsening long-term sustainability. In advanced Europe, reversals have partly rolled back retirement age extensions and increased pensions to current retirees, shifting the implementation farther in the future (for example Greece, Italy, and Spain).

Maintaining pension benefits that are not affordable can constrain room for policy maneuver and lead to efficiency losses. Reforms that fail to address imbalances between pension contributions and benefits expose countries to shocks and risks associated with financing these gaps, and can put pressure on sovereign yields, especially in countries with high debt. Furthermore, high pension spending can constrain policy space, especially in deep recessions with unfavorable financing conditions, crowd out other productive spending, and erode long-term potential growth. Room to increase pension contribution rates, which are already on average 22 percent of wages in statutory terms, to finance existing imbalances is limited. While employment rates tend to be negatively associated with labor taxes (that include pension contribution rates), the employment impact of pension contributions depends on the extent to which these are perceived as valuable as savings. Increases in contributions should be accompanied with strengthening their links with benefits: stronger actuarial contribution-benefit links in earnings-related systems can mitigate otherwise discouraging impact of contributions on labor supply and labor-leisure choices and even encourage participation and employment.

The paper further discusses broader implications for pension system design. Even pension systems that are sustainable and equitable across generations can introduce important distortions. For example, individuals with low earnings might find it beneficial to contribute the minimum number of years required to qualify for a minimum pension when its value does not depend on the years of contribution. Pension design matters also on political economy grounds. Long phase-in periods can deepen intergenerational divides, posing risks to their future implementation. Reforms that appeal to shared principles, ensure equity across generations, and address distortions in the systems could foster greater political acceptability.

The paper is organized as follows. Chapter 2 clarifies key definitions and concepts and presents a quantitative framework for assessing sustainability, actuarial fairness, and intergenerational equity. Chapter 3 describes key pension reforms enacted over the past three decades, followed by a quantitative assessment of sustainability and fairness across European countries in Chapter 4. Chapter 5 discusses key aspects of incentives, adequacy, and affordability and presents political economy considerations of reforms. Chapter 6 outlines policy implications and recommendations.

Chapter

# 2 Sustainable, Fair, and Equitable Pension Systems

## Definitions and Principles

The impact of pension system on public finances and labor market incentives depends on the system as a whole, not only on particular features of its components. This chapter discusses the following principles and their interrelations that are useful in describing and diagnosing pension systems: (1) long-term sustainability; (2) actuarial fairness; (3) intergenerational equity; (4) incentive compatibility; (5) affordability, and (6) adequacy.

- *Sustainability.* This paper assesses the sustainability of pension systems by their ability to ensure that pension benefits are funded by pension contributions without requiring additional transfers.[1] More formally, a measure of *long-term sustainability* therefore requires that the present value of contributions *at least* equals the present value of benefits.[2]
- *Actuarial fairness*. A system that provides benefits that fully compensate individuals for their lifetime contributions is actuarially fair (Queisser and Whitehouse 2006). We assess actuarial fairness at the cohort level—

[1]In some countries, pension systems might be explicitly financed by revenue sources other than pension contributions. For example, in Norway, pension contributions are considered part of general revenue (that is, not directly linked to the financing of pensions). Moreover, the state pension fund (SPF) is also intended to finance government non-pension spending; see Pension Fiche for Norway in EC (2021).

[2]This is akin to sustainability of fiscal policies formally defined as set of policies under which, over an infinite horizon, the present value of primary deficits to GDP is equal to the negative of the current level of public debt to GDP (see Blanchard and others 1990). In a similar fashion, a pension system that is actuarially fair at the Aaron (1966)-Samuelson (1958) rate of return would ensure that debt-to-GDP ratio does not increase in the long term. As with infinite horizon government budget constraint, dynamic (in)efficiency conditions extend also to the pension system, that is, when the interest rate is lower than the rate of economic growth, a pension system might be able to sustain a lower present value of contributions relative to benefits (by running a Ponzi game).

whether the aggregate contributions paid by a cohort during the working life are compensated by the aggregate benefits received by the same cohort in retirement. This concept is closely linked to sustainability: if, for every generation, the present value of lifetime contributions equals the present value of lifetime benefits, it must be the case that the present value of all system contributions equal the present value of all system benefits. However, a pension system that is sustainable on aggregate does not ensure actuarial fairness for cohorts (for example, if there is redistribution across generations) or individuals (for example, if there is redistribution within generations).[3]

- *Intergenerational equity.* A pension system achieves intergenerational equity if the balance between the present value of contributions and benefits does not change across generations. A system can be equitable across generations without being sustainable or actuarially fair, for example if all individuals of all generations receive benefits that are systematically larger than their contributions. Conversely, a system could be sustainable without being equitable across generations, for example if what one generation receives in benefits in excess of contributions is offset by providing benefits lower than contributions for another generation. An actuarially fair pension system does not entail any redistribution across generations and is thus intergenerationally equitable.
- *Incentive compatibility.* The incentives for individuals to participate in and contribute to a pension system are strongly influenced by its *design*. Systems where lifetime benefits exceed contributions—that are "more than" actuarially fair—should exert stronger incentives for participation. Conversely, when additional contributions are not compensated by equivalent additional benefits (in present value)—that is, *actuarial neutrality* is not ensured—pension systems discourage contributions. In addition, pension contributions could be viewed not as deferred earnings but as distortive taxes. This could happen when pension design does not link benefits well to contributions but also because of *market failures*. People can be myopic or imperfectly informed, giving more weight to current contributions than future benefits. Distributional features common in pension systems normally create distortions.
- *Affordability.* In countries with a vulnerable fiscal position or limited access to finance, pension system deficits could lead to unsustainable debt dynamics, elevated sovereign risk premia, and potentially crowd out productive private spending (normally investment). High public pension outlays are thus not without economic costs. Since higher consumption of retirees

[3]A system that would ensure actuarial fairness for individuals or cohorts—although hard to achieve in practice—would remain sustainable in the long term in face of demographic shifts, although it can exhibit imbalances during the demographic transitions.

comes out of current national income, it leads to lower consumption and/or less savings somewhere in the economy, which similarly means less investment and likely lower national income in the future (Barr and Diamond 2008). The fiscal adjustment that ultimately is needed can be procyclical and is harder to achieve by other means if the pension spending forms a large share of government outlays. Adjusting other government spending or increasing contributions may similarly weigh on growth as this may also crowd out other productive public spending (for example, health, investment) or increase distortive taxes. In other words, even when a pension system is sustainable, it might be expensive, and ultimately *unaffordable,* to the extent it limits the scope to respond to short-term shocks and potentially depletes resources that could be used in other productive activities.

- *Adequacy.* Too-low public pension spending might not be *adequate* in that it might lead to considerable deterioration in living standards after retirement, potentially leaving a high share of elderly with retirement income that is not enough to lift them above the poverty level. Chen and others (2018) document that since the financial crisis, the risk of elderly poverty declined steeply while that of the working-age population and particularly of the young (18–24 years old) increased. Pension systems in Europe along with other sources of income (investment income, imputed income from home ownership) shield the elderly well from poverty. Existing pockets of elderly poverty are more effectively addressed with tools outside the contributory pension systems.

We assess how pension systems in Europe correspond to these principles in a unified present value framework with a focus on its macro-fiscal interlinkages. While a generalized framework is useful for fixing the ideas, one has to be mindful of its nuances that can complicate the assessment of the pension system's compatibility with the aforementioned principles under common parameterization. For example, while sustainability, actuarial fairness and neutrality are all present value concepts, sustainability is closer in spirit to an *infinite* horizon macroeconomic budget constraint while fairness and neutrality describe how the system is perceived by individuals or cohorts over their *finite* lifetimes. Different time perspectives can create a wedge between these concepts, for example, in case of adverse demographic trends or if the time preference of individuals differs from the internal rate of return (IRR) of the aggregate system.[4] Different discount rates can also imply that present-value equivalence of the system does not necessarily remove labor market disincen-

[4]The rate of time preference of individuals might be approximately equal to (or based on some studies even exceed) the market rate of interest which is usually larger than the sustainable rate of return for an aggregate system (Börsch-Supan 2006). Moreover, subjective discount rates might be important in forming perceptions of pension system fairness, which might also reflect the overall credibility of governments (Brown, Ivković, and Weisbenner 2010).

tives for individuals (Börsch-Supan 2006). And further, due to incomplete markets or imperfect information, pension systems can face deviations from the first-best environment in which case actuarial benefits may not minimize distortions (Barr and Diamond 2008, 2010). All these considerations imply that pension systems need to balance multiple objectives and that a good policy design that should still seek to avoid distortions and strive to adhere to the aforementioned principles, should do so with appropriate tools.

## Assessing Sustainability, Fairness, and Intergenerational Equity

We propose a novel application of the Proportionality Measure (PM) to quantitatively assess the sustainability, fairness, and intergenerational equity of pension systems across countries.[5] Actuarial fairness implies that the present value ratio (that is, the ratio of the present value of benefits to the present value of contributions) is equal to 1:

$$\frac{\sum_{a=a_R}^{a=a_D} P_a \left(\frac{1}{1+r}\right)^{a-a_w}}{\sum_{a=a_w}^{a=a_{R-1}} C_a \left(\frac{1}{1+r}\right)^{a-a_w}} = 1 \tag{1}$$

in which $C$ is pension contributions, $P$ is paid-out pension benefits, $r$ is a discount rate, and $a$ is age. The age is further segmented into age at the entrance into working life ($a_W$), age at retirement ($a_R$) and age at end of pension period ($a_D$). Defining the benefit ($q_a$) and contribution ($\tau_a$) rates as ratios of benefits and contributions to nominal GDP ($Y$), respectively, and assuming a constant GDP growth ($g$), equation (1) can be rewritten as:

$$\frac{\sum_{a=a_R}^{a_D} q_a\, Y_a \left(\frac{1}{1+r}\right)^{a-a_w}}{\sum_{a=a_w}^{a_{R-1}} \tau_a\, Y_a \left(\frac{1}{1+r}\right)^{a-a_w}} = \frac{\sum_{a=a_R}^{a_D} q_a\, Y_{a_w} (1+g)^{a-a_w} \left(\frac{1}{1+r}\right)^{a-a_w}}{\sum_{a=a_w}^{a_{R-1}} \tau_a\, Y_{a_w} (1+g)^{a-a_w} \left(\frac{1}{1+r}\right)^{a-a_w}}$$

$$= \frac{\sum_{a=a_R}^{a_D} q_a \left(\frac{1+g}{1+r}\right)^{a-a_w}}{\sum_{a=a_w}^{a_{R-1}} \tau_a \left(\frac{1+g}{1+r}\right)^{a-a_w}} = 1 \tag{2}$$

Setting $r = g$, equation (2) boils down to a proportionality measure (PM):

[5]This concept is inspired by Knell (2005a, b) who defines a proportionality index as the ratio of the sum of contribution rates to the sum of benefit rates and showed that in the demographic steady state the proportionality index is consistent with the balanced budget condition of the pension system.

$$PM = \frac{\sum_{a=a_R}^{a_D} q_a}{\sum_{a=a_w}^{a_{R-1}} \tau_a} \tag{3}$$

For each cohort, the PM is calculated as the ratio of (undiscounted) sum of pension benefits to the sum of contributions, both in percentage of GDP. The PM is thus a gauge of *actuarial fairness* of a pension system. It calculates the ratio of lifetime benefits and contributions under the assumption that the discount rate ($r$) is equal to the return that each cohort gets on their pension contributions that in turn is set equal to the GDP growth ($g$)—a close approximation to a "pure" pay-as-you-go (PAYG) return of a growth rate of the contribution base (see Chapter 4).

The PM links the assessments of *fairness* and *sustainability* of a pension system. According to the Aaron-Samuelson condition (Aaron 1966, Samuelson 1958), in a pure PAYG pension system the fiscally sustainable rate of return is equal to the sum of the growth rates of labor productivity and labor input (that is, the growth rate of the tax base, which equals the growth of GDP in steady state). Thus, when $r=g$ in a pure PAYG system, PM=1 indicates an actuarially fair system for a cohort. A PM persistently above unity is a sign of pension schemes requiring persistent intergenerational transfers.[6] Further, it is desirable to distinguish between the "actuarial balance" of the overall pension system and actuarially fair benefits for the cohort. If the pension system is actuarially fair—or PM=1—for all cohorts, it is also sustainable on aggregate. At the same time, at the aggregate level, the pension system can be affected by demographic shifts and for some time signal PM higher than 1 (or per-period "actuarial deficits") even if it is actuarially fair for the cohorts retiring during the same time period.

The PM is also a measure of intergenerational equity. There is a close connection between the PM and the equity theory (Adams 1963, Knell 2005b), whereby a distributional rule would be regarded as fair across individuals if the ratio of inputs to outcomes is identical for all. In that spirit, a pension scheme that yields a constant PM across cohorts would ensure *intergenerational equity*.

The PM needs to be complemented by other measures to fully assess incentive compatibility, affordability, and adequacy of pension systems. A pension system might be sustainable, fair, and equitable, and still provide poor incentives to participate (for example, achieving a PM of 1 by raising contributions excessively) or result in inadequate outcomes (for example, achieving a PM of 1 by lowering benefits excessively). Alternatively, a system might be unsus-

[6]Should the real interest and growth rates differ, the PM benchmarks for actuarial fairness and sustainability would differ from unity. The appropriate PM benchmarks in this case are discussed in the fourth section of this chapter.

tainable from contributions but still affordable (for example, a country could finance a PM greater than 1 with permanent transfers for non-contributory benefits without threatening solvency or crowding out other productive spending). Thus, it is important to complement the PM with other measures to put pension schemes in the specific country context—we discuss these issues in Chapter 5.

## The Choice of a Discount Rate

A key parameter in any actuarial calculation is the choice of a discount rate ($r$)—the rate at which contributions and benefits would be valued, also representing the rate of return on alternative investments. Several options are possible depending on the objective, including riskless interest rate, market rate of return, and the rate of time preference of individuals who make their retirement decisions. A discount rate relevant in the context of public pension systems is the yield on long-term government bonds—the rate at which governments can borrow, reflecting the riskiness of government long-term promises such as pensions (Queisser and Whitehouse 2006)[7] that is often used in the official assessments of sustainability of pension systems (OECD 2020, US Social Security Board of Trustees 2020, CBO 2019). For cross-country comparisons EC (2020) and Eurostat, European Central Bank (2011) suggest using a basket of European government bond yields to discount pension liabilities to address the interdependence between pension policy and bond yields at the country level and to obtain a single risk-free interest rate.

A discount rate at which the sum of discounted values of lifetime contributions and benefits are equal—that is, the interest rate at which equation (1) holds—is the *internal rate of return* (IRR). Accordingly, a flow of contributions and benefits would be *actuarially fair* if the discount rate corresponds to the IRR. Following (3), a pay-as-you-go pension system without intergenerational redistribution would then have a PM equal to 1. An IRR > $r$ (equivalent to a PM > 1) would describe a pension scheme where the relative contribution burden during the working life is more than compensated by the payments at retirement. Conversely, with IRR < $r$ (equivalent to a PM < 1) lifetime contributions would exceed lifetime benefits.

An assessment of sustainability also requires a benchmark for the discount rate. In a pure PAYG pension system (where pension spending is adjusted

[7]Setting the discount rate equal to GDP growth as per Aaron-Samuelson condition is tantamount to saying that governments (and individuals) are indifferent between receiving a given share of GDP today or anytime in the future. A fiscally sustainable rate of return from the point of view of public finances can differ from a "fair" return for an individual who could earn a risk-adjusted rate of return (for example, risk-free rate plus an equity premium).

every year to equal pension contributions under a constant contribution rate), a fiscally *sustainable* rate of return on contributions is equal to the rate of growth of the contribution base (Aaron 1966, Samuelson 1958). Such system would always be able to pay benefits with collected pension contributions and is thus sustainable. In practice, as discussed in Box 1, PAYG pension systems are rarely pure and choosing an appropriate benchmark for a discount rate to assess sustainability can be more complex. In our framework a sustainable benchmark for a discount rate is GDP growth as also reflected in equations (2) and (3). A PM=1 would indicate exactly sustainable pension system.

## What PM Level Is Actuarially Fair and Sustainable?

In this present value framework, conditions for fairness and sustainability are determined by the interplay of *r*, *g*, and *IRR*. The degree of actuarial fairness depends on the distance between the discount rate (yield on long-term government bonds) and the IRR of a pension system. The ability of the system to cover actuarial per-period balances depends on the relationship between the IRR and the growth rate of the economy (that is the IRR of a pure PAYG system). Further, the macro-fiscal sustainability of the system depends on the relationship between the discount rate and the growth rate of the economy, or r-g.

The benchmark level of PM consistent with actuarial fairness and sustainability depends crucially on *r–g*. In deriving (3) we conveniently assumed that *r=g* that in line with the above conditions implies that a PM=1 is actuarially fair. It is also sustainable since the present value of contributions and benefits—that define *primary* pension system balances net of interest payments on pension system liabilities—would stabilize debt at its initial level. *However, the actuarially fair and sustainable benchmarks for PM diverge when r≠g.*

- The actuarially fair PM is proportional to r–g. The *actuarially fair* PM is greater than 1 when r>g. Other things equal, higher interest rates or lower economic growth will lower the PDV of future benefits by more than the PDV of contributions. Thus, benefit rates can be raised, or contributions lowered (relative to when r=g), resulting in a PM>1 while still maintaining the balance between the present value of benefits and contributions. Conversely, when r<g, an actuarially fair benchmark for the PM would be lower than one. Numerical simulations on actuarially fair PM benchmarks for different values of r–g and lengths of contribution and benefit periods are provided in Box 2.

**Table 1. Sustainable Proportionality Measure Depending on Interest Rate – Growth Rate Differential and Debt Level**

| | Debt level | | | | | |
|---|---|---|---|---|---|---|
| **r-g** | **0** | **25** | **50** | **75** | **100** | **150** |
| –2 | 1.00 | 1.06 | 1.12 | 1.18 | 1.24 | 1.35 |
| –1 | 1.00 | 1.03 | 1.06 | 1.09 | 1.12 | 1.18 |
| 0 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1 | 1.00 | 0.97 | 0.94 | 0.91 | 0.88 | 0.82 |
| 2 | 1.00 | 0.94 | 0.88 | 0.82 | 0.76 | 0.65 |

Source: IMF staff calculations.
Note: The table presents benchmark sustainable proportionality measure depending on interest rate and growth differential and the level of public debt in steady state, assuming steady state contributions equal to 8.5 percent of GDP.

- The sustainable PM—for most pension systems in Europe—is inversely related to r–g (Table 1). Actuarial fairness at the cohort level does not necessarily ensure a systemwide sustainability when interest and growth rates differ (Box 3). When r=g, economic growth is exactly sufficient to offset interest payments and, assuming zero primary balances, an actuarially fair pension system with PM=1 will also stabilize debt as a share of GDP. When r>g, to stabilize or reduce debt requires the present discounted value of benefits to be *lower* than the present discounted value of contributions. This implies that—on average across cohorts—a sustainable PM is lower than 1. Clearly, while lower initial debt or higher primary balances tend to make the system more sustainable and thus increase the PM values required to stabilize debt (possibly above unity), most pension systems in Europe have run primary deficits and accumulated high pension system debt. Conversely, when r<g, a pension system can afford to provide more than actuarially fair benefits in order to stabilize debt. In sum, with r>g, the sustainability condition is more binding than actuarial fairness (pursuing fairness does not ensure sustainability), generally requiring a PM<1, while with r=g or r<g, actuarial fairness will help to stabilize or reduce debt. Table 1 provides PM benchmark values for sustainability depending on r-g and initial level of debt.

What is the appropriate *r–g* for sustainability analyses? Recent research stresses that, with considerable variation across time, over the past two centuries negative *r–g* has occurred more frequently (Mauro and Zhou 2020). Table 2 shows mean and median *r–g* for advanced economies for different time periods. More recently since euro inception, *r–g* has come closer to zero for advanced economies on average. Consistent with this, and given the uncertainty surrounding the evolution of *r-g* in the long-term, this paper maintains an overall Europe-wide PM benchmark at 1.0 to assess fairness and sustainability. Still, long periods of *r* diverging from *g* can substantively change both assessments. Wide differences in *r–g* are evident across coun-

**Table 2. Interest Rate – Growth Rate Differential in Selected Advanced Economies, 1950–2016**

| | 1950–1979 | | 1980–1999 | | 2000–2016 | | 1950–2016 | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| Australia | –4.4 | −3.9 | 2.2 | 1.9 | −1.0 | −1.0 | −1.6 | −1.5 |
| Belgium | –1.4 | −1.2 | 3.2 | 3.8 | 0.4 | 0.4 | 0.4 | 0.5 |
| Canada | –3.4 | −2.7 | 3.1 | 2.9 | −0.4 | −0.8 | −0.7 | −0.8 |
| Denmark | –1.7 | −1.5 | 3.4 | 3.8 | 0.3 | −0.1 | 0.2 | 0.6 |
| Finland | –2.0 | −1.3 | 1.7 | 0.2 | 0.4 | −0.3 | −0.3 | −0.4 |
| France | −4.0 | −4.0 | 2.6 | 3.0 | 0.8 | 0.3 | −0.8 | −0.2 |
| Germany | −2.3 | −2.0 | 1.9 | 2.6 | 0.8 | −0.2 | −0.3 | −0.3 |
| Italy | −4.3 | −3.5 | 2.0 | 2.3 | 2.0 | 0.8 | −1.0 | −0.7 |
| Japan | −6.9 | −6.8 | 0.8 | 0.5 | 1.6 | 1.1 | −2.8 | −1.1 |
| Netherlands | −4.1 | −3.8 | 2.2 | 2.7 | 0.2 | 0.0 | −1.2 | −1.2 |
| Norway | −4.4 | −4.2 | 1.7 | 1.8 | −1.9 | −2.9 | −1.9 | −2.4 |
| Portugal | −5.1 | −3.2 | −0.8 | −1.8 | 2.5 | 0.0 | −1.9 | −1.7 |
| Spain | −9.6 | −10.0 | 1.1 | 1.3 | 0.4 | −2.1 | −4.0 | −2.9 |
| Sweden | −3.2 | −2.9 | 2.0 | 2.1 | −0.2 | −0.3 | −0.9 | −1.0 |
| Switzerland | −3.2 | −3.2 | 0.2 | 0.2 | −0.5 | −1.2 | −1.6 | −1.9 |
| UK | −2.1 | −2.2 | 1.1 | 1.6 | −0.2 | −0.8 | −0.7 | −0.8 |
| USA | −2.6 | −3.0 | 1.8 | 1.4 | −0.3 | −0.9 | −0.7 | −0.8 |
| | | | | | | | | |
| ALL | −3.8 | −3.3 | 1.8 | 1.9 | 0.3 | −0.2 | −1.2 | −0.9 |

Sources: Jordà and others (2019); and IMF staff calculations.

tries, several of which have had positive *r–g* since 1980. Interest rate–growth differentials were notably elevated in the last decade since the GFC for several high-debt countries, including Italy, Portugal, and Spain, while at the same time *r–g* has been negative, for example, for Germany and most Nordic countries. The sustainability conditions discussed in Box 3 stress particular importance of cases where initial debt and pension system deficits are high, and *r–g* is persistently positive. The first two conditions are relevant for Europe: pension system deficit in Europe currently stands at about 2.5 percent on average (see Chapter 5) and by our calculations, pension system deficits accumulated since 1980s (or earliest available year) are of the same order than general government debt for an average European country. In these circumstances, sustainability constraints dictate using a sustainable PM benchmark below unity (Table 1) that is more constraining than actuarially fair PM benchmark. For example, Italy has had a positive *r–g* at about 2 since 1980 that for a debt at about 150 percent of GDP (and zero primary pension deficits) requires a PM benchmark of about 0.56–0.65. For many northern countries *r–g* has come down to the vicinity of zero where sustainable steady-state benchmarks center around 1.

## Data Sources and Key Concepts

Operationalizing the framework proposed in this paper requires time-series of contributions and benefits observed over a lifetime of generations. The calculations combine aggregate historical data with the Working Group on Ageing Populations and Sustainability (AWG) projections on pension benefits and contributions, assigned to cohorts based on population structure, employment, and earnings profiles, yielding an unbalanced three-dimensional database spanning from 1950 to 2100 across cohorts, countries, and different vintages of pension projections. Technical aspects and explanations on constructing the database are provided in the Annex 1. Few related studies similarly concerned with the effects of gradual pension reforms on future cohorts calculate the IRRs relying on pension model simulations, differentiated for different family types (Wilke 2005).

- *Data sources*. Our key data source for long-term pension projections is the AWG Ageing Report, augmented with historical data taken from Eurostat and the OECD. Demographical data and projections are taken from the UN population projections.
- *Vintages.* The data is separated into three vintages defined by the 2009, 2018, and 2021 AWG projection rounds as documented in EC (2009, 2018a, 2021). This isolates the impact of reforms and subsequent reversals between the three vintages, covering the GFC, the European sovereign debt crisis, and its aftermath—a decade that witnessed the most frequent and extensive reforms.
- *Cohorts*. The key to assessing the intergenerational equity as well as sustainability simultaneously is to break the data down into cohorts. Cohorts are defined by their birth year, and the lengths of their working and pension lives are determined by the calculated effective retirement age. Pension expenditures at any given year are assigned to cohorts based on the size of each respective cohort in the total number of pensioners. Earnings and contributions are assigned to cohorts based on their respective shares in total employment and are distributed over their working lives based on an age-earnings profile and actual contribution data.
- *Pension contributions and Intergenerational transfers.* Actuarial calculations by cohorts are meaningful only when the actual contributions paid by any specific cohort can be matched with their expected benefits. We therefore exclude from calculations any state transfers and other third-party revenues—denoted as "state contributions" in the AWG Ageing Report definitions—other than contributions paid by employees and employers used to finance the pension system. Such state transfers are by definition a financing from general taxation that are not linked to pension rights and in

most part constitute intergenerational transfers from current working-age population to current retirees; the very concept that our framework is set to explore.

- *Pension benefits.* We rely on a broad AWG concept covering all public pension benefits, including some non-contributory benefits to the elderly, such as non-earnings related social assistance provided to elderly who do not fulfil the minimum contribution requirements for old-age pensions (EC 2017).[8] While the scale and eligibility for non-contributory pensions is a design choice in the form of social assistance, in substance it provides retirement benefits to the elderly and is therefore a choice that deeply interlinks with contributory system. Conceptually, accounting for these benefits is important for cross-country comparability of the PM for sustainability assessments. For example, in countries where replacement rates are projected to fall (for example, Sweden) or eligibility conditions are projected to tighten (for example, Poland), spending on non-contributory minimum pensions can increase substantially. Ignoring this projected increase in social assistance spending would make pension systems to look more sustainable than warranted. In addition, non-contributory benefits also shape the incentives of individuals in their labor market decisions (see Chapter 5), especially as even beneficiaries of social pensions are likely to pay some contributions over their lifetimes, whereby social assistance pension can be viewed as a return on these contributions. In practice, such non-contributory minimum pension benefits included in the AWG (EC 2021) definition of pension spending are small in most countries to make any material difference to the calculations of the PM (that is, non-contributory minimum pensions in 2019 amounted to 0.2 percent of GDP in France, 0.3 percent of GDP in Italy and 0.1 percent of GDP in Greece).[9]
- *Robustness tests.* Sensitivity tests on retirement ages, age-spending and age-income distributions indicate a high degree of robustness of baseline results (see Annex 1 for technical discussion).

[8]The AWG definition includes social assistance benefits to retirees if equivalent to non-earnings-related minimum pension and any supplements that are granted for an indefinite period based on certain criteria but not linked to remuneration but excludes housing subsidies. Some country-specific studies exclude non-contributory benefits along with state transfers (see Wilke 2005).

[9]The exceptions are Denmark (5.7 percent of GDP) and Norway (2.6 percent of GDP), which have large non-contributory components. Also, AWG coverage of pension spending is generally already lower than that of the Eurostat, excluding some categorical or other short-term benefits for specific conditions or purposes paid to the elderly.

### Box 1. What Is the Appropriate Discount Rate to Assess Sustainability?

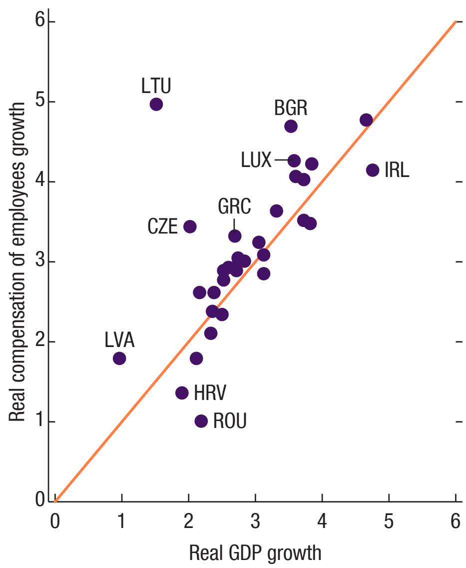
Determining which discount rate to use to assess sustainability of pension systems depends on the nature of pension systems and their financing mix. Sustainability as defined in the beginning of Chapter 2 implies that the pension systems' (long-term) internal rate of return (IRR) is equal to the implicit rate of return on contributions or pension wealth. The implicit return for this equality to hold—defining a sustainable benchmark for the discount rate—is the rate of return that the system itself would naturally yield, thus depending on the general design and financing of the system. In a pure fully funded defined contributions (DC) system, the theoretical benchmark for sustainability is the market rate of return on accumulated assets (Börsch-Supan 2006). In pension systems that are PAYG financed the benchmark for sustainable discount rate depends on the underlying growth rate of the contribution base. For tax-funded pension components, the underlying sustainable benchmark for a discount rate depends on the growth of the tax base.

The growth rate of the wage bill is an appropriate discount rate for assessing sustainability of pure PAYG earnings-related pension systems. In its strictest form, sustainability requires that benefits equal contributions at each point in time. To maintain this balance, in line with the Aaron-Samuelson condition the rate of return on PAYG contributions should be equal to the growth rate of the contribution base (the wage bill for earnings-related pensions). The latter is also the notional interest rate typically chosen for notional defined contribution (NDC) pension systems. This makes the growth rate of the wage bill (absent large changes in contribution rates, floors, and ceiling) an appropriate benchmark for financial balance—systems that provide internal rates of return on contributions higher than the growth rate of the wage bill would generate deficits. Therefore, for pure earnings-related PAYG systems, in deriving the PM in equations 2 and 3 benefits and contributions can be expressed as ratios to the contribution base (see Knell 2005b).

In practice, the pension systems are rarely pure earnings-related PAYG schemes, making the choice of a benchmark discount rate less clear-cut. Every country in Europe has an old-age safety net, generally financed from taxes and included in pension spending figures. Many European countries also have basic and minimum pension components that are similarly often fully or partially tax financed. Based on the 2021 Ageing Report currently only Latvia would be able to cover its pension spending from contributions throughout 2070 while at the other extreme Denmark is financing its universal public pensions from general taxes on PAYG basis (EC 2021). In several European countries including France, Germany, and Greece, financing of pensions in no small part depends on earmarked taxes or surcharges. In the case of tax-financed pension components, a tax base, or if difficult to determine, a rate at which governments can move money over time, would provide a more appropriate benchmark. Therefore, for most countries in

**Box 1. What Is the Appropriate Discount Rate to Assess Sustainability *(continued)***

**Box Figure 1.1. Real Growth of Compensation of Employees and GDP, 1960–2020**




Sources: AMECO; OECD; and IMF staff calculations.
Note: For Latvia, Romania, and Slovenia data starts in 1990, and for Bulgaria, Estonia, Croatia, Hungary, Malta, and Slovakia data starts in 2000.

Europe a benchmark rate relevant for measuring a sustainable discount rate depends on a combination of growth rates of relevant contribution and tax bases. The wide variation in the PAYG financing mix indicates that, in practice, no single pure benchmark for a sustainable discount rate—for example, the Aaron-Samuelson condition—is either exact or fully comparable across countries.

This paper uses GDP growth as an approximation to sustainable discount rate in deriving and interpreting the PM. GDP combines different macroeconomic tax bases that in the steady state, once the transitional dynamics has played out, should grow at a common rate. The choice whether to set the discount rate equal to a growth rate of GDP or wage bill can affect the PM if these growth rates persistently differ from each other. The evidence suggests that over the past 25–60 years, growth rates of GDP and compensation of employees have been very close in most European countries (Box Figure 1.1), suggesting that they are broadly equivalent as benchmark rates for sustainability. For several countries, however, deviations between GDP and wage growth are sufficiently large to affect the PM. This might reflect shorter data availability and still-maturing[1] pension systems (for example, Czech Republic, Lithuania, Romania). Among countries with more developed pension systems, differences between GDP and wage bill growth rates over the past 60 years are smaller and noticeable only in Greece and Ireland. However, the Greek pension system relies heavily on general taxes—contributions cover only about 40 percent of pension spending—that significantly reduces the relevance of wage bill growth as a benchmark for sustainability. Ireland provides flat-rate public pensions in which overall macro-fiscal sustainability assumes greater importance than actuarial concepts.

[1]We use the terms "mature" and "maturing" to reflect the development level of pension systems. European countries with maturing pension systems had gone through fundamental pension reforms in 1990s as countries liberalized their economies. Under their current pension structures the balance of lifetime benefits and contributions for older cohorts still reflects initial restructuring or legacy costs, inflating PMs well above their steady-state levels.

**Box 1. What Is the Appropriate Discount Rate to Assess Sustainability *(continued)***

Using GDP growth as a discount rate allows the assessment of the sustainability of pension systems at the macro level as part of the general government budget constraint. As pension contributions in Europe finance on average about 70 percent of pension spending (see Chapter 5), pension systems require substantial transfers from general taxes and therefore put a burden on governments that might have to borrow to finance their activities. The condition relevant for macro-fiscal sustainability is the macroeconomic dynamic efficiency condition or "$r - g$"—the gap between the rate at which government can borrow and GDP growth—that governs public debt dynamics. With long-term government bond rates as a discount rate ($r$) and GDP growth as a sustainable benchmark ($g$) for a discount rate, the PM allows to assess governments' ability to finance deficits of pension systems. At a point where $r = g$, our PM metric delivers a value of 1 when pension systems are exactly sustainable from general governments' perspective. Box 3 shows the sensitivity of the PM benchmark value for sustainability to the interest rate-growth differential.

### Box 2. An Actuarially Fair Benchmark for the Proportionality Measure

The difference between the long-term interest rate and GDP growth—"*r–g*"— affects the level of PM that is consistent with actuarial fairness. Other things equal, the higher *r–g* the higher the PM value consistent with actuarial fairness. Consider the case where a cohort contributes a constant share of GDP each year (*C*) throughout the work life and receives a constant share of GDP (*B*) in benefits during retirement. In this case, the PM can be expressed as:

$$\frac{B\,\Sigma_{a_R}^{a_D}\left(\frac{1}{1+r-g}\right)^{a-a_w}}{C\,\Sigma_{a_w}^{a_{R-1}}\left(\frac{1}{1+r-g}\right)^{a-a_w}} \leqslant PM$$

When $r=g$, this expression is simply a ratio of annual benefits to GDP times years in retirement (*BR*) to annual contributions to GDP times years contributing (*CW*). When $r>g$, the sum in the numerator declines proportionally more than the sum in the denominator when discounted to the initial period because of the *compounding effect* (the first period in the sum of the numerator is one period after the sum in the denominator ends) and the PM required to balance the numerator and denominator would be greater than 1. Correspondingly, when $r<g$ the actuarially fair PM would be less than 1.

To illustrate potential variation in the PM to *r–g*, assume a cohort participates in a pure PAYG system with a contributory period of 30 years and a retirement period of 15 years. When *r–g* is equal to zero, the PM is equal to 1 (Box Table 2.1). As *r–g* increases, the benchmark for actuarial fairness increases (when yields are higher than GDP growth, individuals are indifferent between a share of GDP today and a share of GDP in the future compounded by *r–g*). For a range of *r–g* between –2 and +2 percentage points, the corresponding reference value for an actuarially fair PM is between 0.65 and 1.56.

**Box Table 2.1. Actuarially Fair Proportionality Measure Depending on Interest Rate – Growth Rate Differential**

| | B = 2*C | | B = 3*C | |
|---|---|---|---|---|
| **r-g** | **30/15** | **40/20** | **30/10** | **39/13** |
| −2 | 0.65 | 0.56 | 0.68 | 0.61 |
| −1 | 0.80 | 0.75 | 0.82 | 0.78 |
| **0** | **1.00** | **1.00** | **1.00** | **1.00** |
| 1 | 1.25 | 1.35 | 1.22 | 1.30 |
| 2 | 1.56 | 1.83 | 1.49 | 1.69 |

Source: IMF staff calculations.
Note: The table presents benchmark actuarially fair proportionality measures depending on interest rate and growth differential, the relative level of benefits (B) and contributions (C), and the relative lengths of working and pension lives.

### Box 3. Sustainability and the Proportionality Measure

A pension system is *sustainable* when on aggregate (for all individuals or past and future cohorts) the usual intertemporal budget constraint is satisfied:

$$\sum_{t=1}^{\infty} \left(\frac{1+r_t}{1+g_t}\right)^{-t} (C_t - B_t) \geq D_0$$

This budget constraint states that the present discounted value (PDV) of contributions and benefits—or "primary balances"—must be sufficiently large to offset the initial debt of the pension system (all variables expressed as a ratio of GDP). In contrast to actuarial fairness, the definition of sustainability: (1) considers contributions and benefits of overlapping cohorts, (2) takes into account the initial level of debt of the pension system and associated interest payments, and (3) is assessed over an infinite time horizon.

When interest and growth rates differ, actuarial fairness does not necessarily imply sustainability. The following three general cases can be identified assuming a positive initial level of debt:

- When r=g, a pension system that is actuarially fair will stabilize debt. In this case, economic growth is exactly sufficient to offset interest payments and actuarial fairness for all cohorts will also keep the systemwide debt stable at its initial level (in percent of GDP). Requiring debt to converge to zero would require higher contributions relative to benefits in present value.
- When r>g, a pension system that provides *less* than actuarially fair benefits will stabilize debt. In this case, to satisfy the budget constraint, the contemporaneous balances of the pension system must offset part of the interest on initial debt. This requires—for cohorts or individuals on average—a PDV of benefits that is lower than a PDV of contributions.
- When r<g, a pension system can offer *more* than actuarially fair benefits and still stabilize debt. In this case, an infinite horizon budget constraint will raise the possibility of a Ponzi game, whereby the government can lower the debt-to-GDP ratio by rolling over debt. Thus, a pension system can provide higher benefits than contributions in present value while still stabilizing debt. Consequently, providing actuarially fair benefits will result in declining debt-to-GDP ratio.

The appropriate benchmark for the *PM* for sustainability analysis thus depends on r–g, the size of the initial debt and the PDV of primary balances. Assume for simplicity that a pension system has positive initial debt (for example, legacy cost) and runs primary balances. When r=g, a PM=1 ensures both actuarial fairness and stabilizes debt. Should *r* rise to exceed *g*, two opposing forces are at play: (1) the compounding effect discounts distant benefits more than contributions, implying that maintaining actuarial fairness requires higher benefits (lower contributions) and thus an *actuarially fair* PM>1 (Box 2); and (2) growth is not sufficient to offset interest payments on

**Box 3. Sustainability and the Proportionality Measure *(continued)***

initial debt, requiring lower benefits or higher contributions over time and on average across cohorts (compared to a case when $r=g$) and thus a *sustainable* $PM<1$. Conversely, when r declines ($r<g$), a $PM<1$ is actuarially fair and will also ensure sustainability, while the possibility of a Ponzi game could allow for a *more* than actuarially fair benefits to stabilize debt. Obviously, lower initial debt and/or higher primary balances tend to make the system more sustainable, thus increasing the sustainable PM benchmark values and vice versa. However, near all contributory public pension systems in Europe are likely to have a positive initial debt and run primary deficits, requiring a sustainable $PM<1$ when $r>g$.

Chapter

# 3 Recent Public Pension Reforms

The past three decades have witnessed growing need to adjust pension systems. In this period predominantly pay-as-you-go (PAYG) pension systems first introduced in most Western countries in Europe after the turn of the 20th century matured and reached near full coverage. Along with aging populations expenditure pressures mounted—the estimated public pension spending to GDP ratio (AWG definition) increased from about 8½ percent in 1980 to 11¼ percent today in countries with more mature pension systems and reached 12.1 percent in the euro area—making pension benefits the largest public spending outlay. With this, the impact of pension systems on macro-fiscal policy choices and outcomes, but also on household behavior as well as political decision, became increasingly evident, making pension reforms one of the most complex and intensely contemplated public policy choices.

In many countries the decades preceding the GFC were dominated by discussions on pension system design, though with limited success in containing spending growth. Policymakers were predominantly concerned with (1) the relationship between contributions and benefits, and financial incentives to retire (IMF 2012); (2) the extent of redistribution within the pension system (IMF 2011, Clements, Eich, and Gupta 2014); and (3) the complimentary role of private pensions or multipillar pension systems (Holzmann 2002). With structural or parametric reforms, policymakers attempted to simultaneously alter the incentive structure and—through longer careers or complementary policies—contain the spending growth. Nevertheless, at the eve of the GFC, pension spending in Europe was expected to increase on average by 2½ percent of GDP between 2007 and 2060, exceeding 13 percent of GDP in 15 countries and reaching as high as 24 percent in 2 countries (EC 2009).

Europe emerged with predominantly earnings-related public pension schemes aiming to link contributions and benefits. The principal idea is to treat contributions as deferred earnings and not taxes. In similar vein, *notional defined contribution* (NDC) schemes were put in practice designed to mimic funded defined contribution plans with more direct link between contributions and benefits. Also, reforms to Germany's point scheme as well as Austria's 2005 reform were more grounded in the actuarial considerations compared to their earlier pension schemes. In contrast, Denmark, Ireland, the Netherlands, and the United Kingdom offer mostly flat-rate public pensions, while only Denmark is financing pensions fully through general (consumption) taxes.[1] Such model gives up on the difficult task of convincing individuals that their contributions to the pension system are pure savings, and instead aims toward greater redistribution and equality while financing pension benefits through arguably less distortive instruments. *Privately funded* pensions also gained more prominence in an effort to build up private pension income to enhance adequacy of pensions, particularly in emerging Europe where public pension schemes offer lower replacement rates.

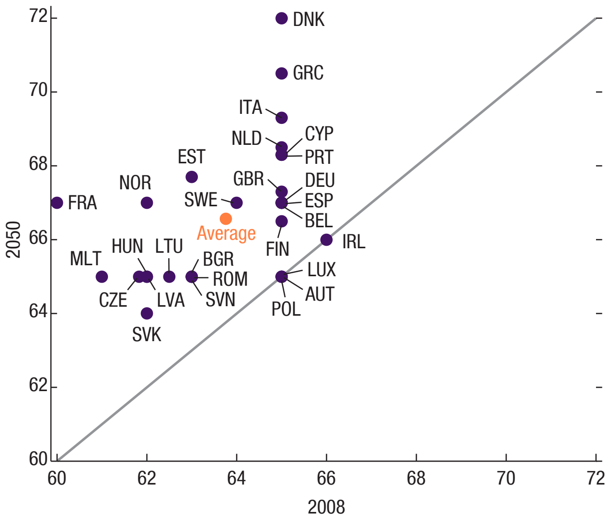
Low fertility and demographic projections on increasing life expectancy continued to warn policymakers about long-term sustainability of pension systems. Still, the reform efforts were accelerated not by the warnings of demographers, but by the GFC and the European debt crisis that made the strains in public pension systems painfully evident. At these crisis times the reform events in terms of the number of main pension measures taken increased threefold compared to earlier two decades, sometimes concentrating on short-term measures to enhance sustainability and affordability (Carone and others 2016). More structural or systemic reforms altering the "deeper" parameters were often implemented gradually.

The GFC, European debt crisis and their aftermath also brought out the political fragilities associated with such long-lasting reforms. Many countries either temporarily or permanently reduced contributions to private pension schemes and redirected these to finance public pensions. Others started to roll back past reforms as economies recovered. This chapter documents key measures taken over the past three decades, reform implications, as well as some of the best practices.[2]

[1]While in these countries' public pension benefits are generally not earnings related, in Ireland and the United Kingdom they are related to an individual's career length (and therefore still contributory).

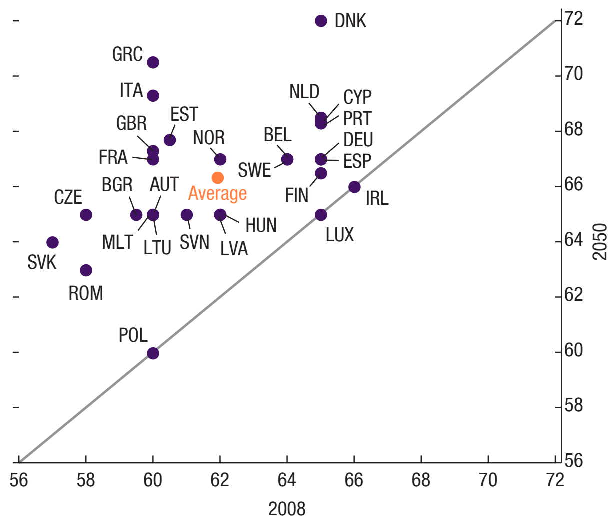
[2]This chapter relies on experiences from the IMF country work, systematic documentation of pension reform measures by the OECD (2005, 2007, 2009a, 2011a, 2013, 2015, 2017, 2019) as well as by the EC Ageing Working Group as summarized by Carone and others (2016).

**Figure 1. Statutory Retirement Age, Male**
*(Years)*




Sources: 2009, 2018, and 2021 Ageing Report; and IMF staff calculations.

**Figure 2. Statutory Retirement Age, Female**
*(Years)*




Sources: 2009, 2018, and 2021 Ageing Report; and IMF staff calculations.

## Key Reform Directions

### Eligibility

Tightening pension eligibility facilitates sustainability by increasing contributory periods and lowering benefit periods and raises potential output by expanding the labor force. Increasing early and normal *retirement ages* as well as *required contributory years* for full benefits have been the most common measures adopted in Europe. This has been accompanied by tightening early retirement options for some special regimes (Belgium, Greece, the Netherlands) or increasing compulsory retirement ages (France, United Kingdom). Most countries have increased retirement ages of women more steeply to harmonize them with those of men. As a result, statutory retirement ages in the EU are set to increase from 64 for male and 62 for women in 2008 to about 66½ in 2050 (Figures 1 and 2) and about 67 in 2070. Still, a substantial gap exists between the statutory and effective retirement ages, which is expected to widen in the future. EC (2021) predicts that, for a one-year increase in the statutory retirement age for men (by 2030), the availability of alternative pathways to retirement would lead to an increase in the effective retirement age by about 0.7 years. While increases in required contributory history to qualify for a full pension have been observed along with population aging, care must be taken not to exacerbate elderly poverty as not all individuals can extend their working lives.

A similarly powerful way to support both sustainability and labor supply is to alter financial incentives through the design of benefit provisions.[3] Several countries have closed or disincentivized *pathways to early retirement* through other social programs such as unemployment or disability benefits (Belgium, Finland). *Actuarial corrections*—penalties (bonuses) to retire before (after) the normal pension age—are an effective tool to incentivize longer working lives and have been introduced or strengthened (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, United Kingdom). For OECD countries Queisser and Whitehouse (2006) estimate the actuarially neutral factors at normal retirement age to fall in the 6–9 percent range while more recent results by OECD (2017) suggest somewhat lower range of 4–7½ percent with 5½ mean for a larger sample of countries.[4] Reform efforts have removed financial disincentives in most countries to defer pensions and work longer, though in several countries benefits at normal retirement age do not reach actuarial neutrality and incentives to retire at earlier ages still exist. *Restricting eligibility for different components of the benefit structure (for example, until normal retirement age) or linking it to contributory history* is similarly an effective way to strengthen incentives to contribute and has been used, for example, in Belgium.

### Benefit Formula

Reductions in nominal benefits are often politically hard to implement and involve tradeoffs between sustainability, incentives, and adequacy. Discretionary or ad hoc benefit cuts were sometimes implemented during the crises as part of fiscal adjustment programs. Elimination of seasonal bonuses such as 13th and 14th monthly payments (Greece, Hungary, Portugal) or consolidation of parallel funds (Greece) are the most common measures. However, ad hoc reductions without any regard to benefit design can dilute benefit-contribution links. Parametric measures that address existing distortions or systemwide reforms have often proved to be more successful and durable approach to curtail benefit outlays.

One of the key parametric reform directions over the past decades was to extend the period over which *pensionable earnings* are calculated. These reforms were in most countries implemented well before the GFC, for example, in Austria, Finland, France, the Netherlands (in occupational pension

[3]See Gruber and Wise (1998).

[4]Queisser and Whitehouse (2006) and OECD (2017) define actuarial neutrality as a marginal change in the benefit entitlement conditions, requiring that the present value of accrued pension benefits does not change from working an additional year (that is, benefits increase only by the additional entitlement earned). The definition of actuarial neutrality can differ across literature in its treatment of employer and employee contributions.

plans), Poland, Portugal, and Slovak Republic, while Greece and Norway followed since the GFC. Restricting pensionable earnings to few recent or best-performing years, as was often the practice, dilutes the link between current earnings and future benefits, disincentivizing work earlier in the career and normally leading to excess pension payments (compared to full-career earnings base), and can benefit more high earners who tend to have steeper earnings profiles (Barr and Diamond 2008, 2010).

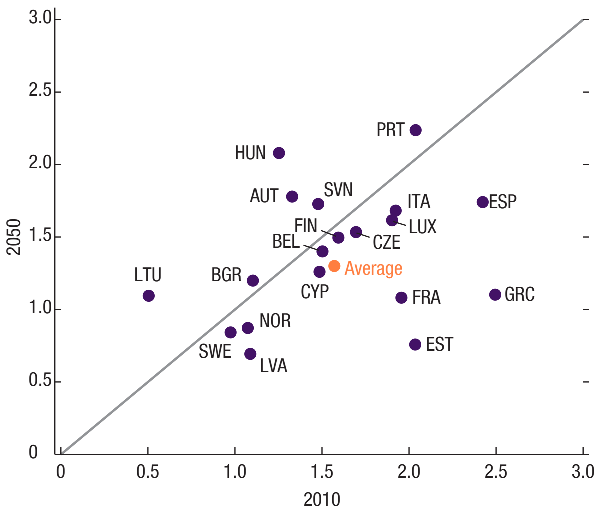
Another option used during the GFC and its aftermath was to temporarily freeze pensions (Czech Republic, Finland, Greece, Portugal, Slovenia) or restrict *indexation* or *valorization* rules. Many countries in Europe have moved from indexing pensions to wages to full or partial indexation to prices, or from valorizing past earnings based on changes in living standards (for example, wages) toward a mix of wage-price valorization. While both options support sustainability, valorization below nominal wage growth penalizes early career years and, other things equal, can contribute to disincentives and unfairness. Indexing below inflation erodes purchasing power and thus adequacy of pensions in payment. In both cases, it is preferable to address any financial shortfalls explicitly in the pension system rather than to rely on inflation to erode imbalances (Barr and Diamond 2008, 2010).

In a defined benefit system, one structural way to contain benefits is to *reduce accrual rates.*[5] This option has been used, for example, in Austria, Greece, Italy, Norway, Turkey. An equivalent way is to reduce the point values in a point-system or increase the annuity factors in the NDC system (Italy). Overall, the *effective* average accrual rates—reflecting also the impact of other measures—have been estimated to fall from 1.6 percent in 2008 to 1.3 in 2050 (Figure 3).

While reducing benefit levels many countries have opted to protect lower-income retirees to safeguard pension adequacy. Such distributional objectives have been achieved predominantly by increasing or introducing basic or minimum pension allowances (Germany, Greece, Luxembourg, Poland, Slovak Republic, Slovenia, Spain, Sweden, Turkey, United Kingdom) or expanding social safety nets outside the pension system (Italy), while

[5]Although rare in practice, the accrual rates can be used not only to control for the generosity but also for the progressivity of the pension system. Greece has allowed for a progressive profile of marginal accrual rates over a working career to provide incentives for longer contributory periods that partly offsets disincentive effects arising from high flat basic pension. However, progressive profiles of accrual rates are uncommon since they tend to benefit wealthier individuals with longer careers (low earners can start their careers earlier though tend to have more gaps in their career, face lower incentives to contribute and exit the labor market earlier) and can distort contribution-benefit links. In contrast, accrual rates in Portugal vary by reference earnings brackets, accruing pension benefits at higher rate for individuals at lower earnings brackets and thus directly supporting progressivity. In the Czech Republic, instead of varying accrual rates, progressivity in pension benefits is achieved by lowering the share of pensionable earning for higher earnings brackets.

**Figure 3. Average Accrual Rates**
*(Percent of new earnings-related pensions)*




Sources: 2009, 2018, and 2021 Ageing Report; and IMF staff calculations.

some countries have provided benefits through other social assistance programs (for example, housing, health, utilities) targeted to retirees (Ireland, Sweden, Turkey). Few countries abolished basic pensions (Poland). However, it is not possible to change the income distribution without causing some distortions, including disincentives to contribute (Barr and Diamond 2008). Attention should therefore be given to the benefit design. In this vein, for example, Germany and Portugal adjusted the earnings or asset test to make work more attractive. Some countries have offered one-off benefits to retirees (Greece, Poland) that, however, have not always been well targeted or have been distributed to all retirees.

## Financing

Revenue measures have been used less frequently since in many countries income and payroll taxes are already high. Particularly at the time of GFC several countries were looking for measures to support labor demand. Stimulus packages at that time included reductions in employer social security (not necessarily pension) contributions to support labor demand that were often temporary and/or targeted to new hirers, disadvantaged groups (for example, youth, long-term unemployed) or low-wage earners (OECD 2009b).

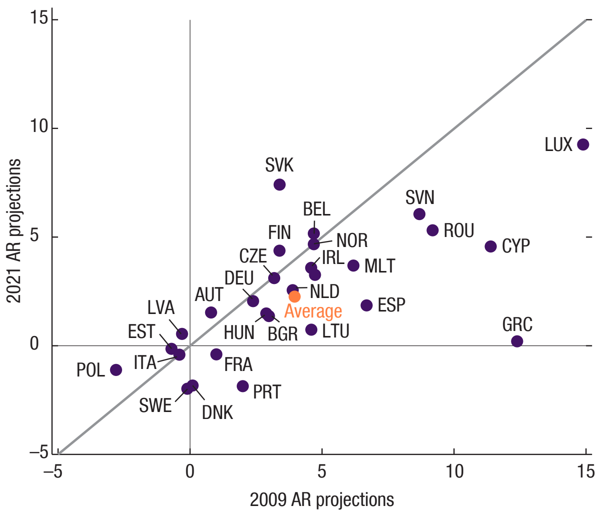
Countries whose labor costs were not too elevated or who at times experienced financing constraints increased, sometimes temporarily, social contribution rates or introduced temporary levies (Finland, France, Greece, Iceland, Ireland, Italy, Luxembourg, Portugal, Switzerland, United Kingdom), while others have reduced pension contributions (Germany, Hungary, Lithuania, Sweden). On balance, the estimated pension contribution burden in advanced economies has remained broadly constant since 1990s. Often reforms had the additional objectives to harmonize contribution rates and bases across categories of workers (Greece), or to change the financing mix by reducing or reallocating the contribution burden away from employers for efficiency gains (Finland, Lithuania in 2019). Some countries increased ceilings on earnings subject to contributions (Slovak Republic), reduced social security tax exemptions (Belgium) or other tax expenditures related to pension income (France, Germany, Ireland, Israel, the Netherlands, Sweden). Yet others have reduced the tax burden on pension income (United Kingdom). Pension income in several countries still enjoys preferential treatment while there is little justification to taxing pension income differently from other labor income (IMF 2012). In addition to pension contributions, many countries either earmark tax revenues or have set up reserve funds to finance current or projected future increases in pension liabilities.

### Automatic Adjustments

The objective of *automatic adjustment mechanisms* is to enhance financial stability by linking the "deep parameters" of the pension system to sources of imbalances (such as demographic trends). In the simplest and most popular form, the adjustment mechanisms link retirement ages or sometimes minimum contributory periods to life expectancy. Such *sustainability factors* dating back to 1995 in Italy (through notional annuity calculation) and introduced in Denmark and France (for a minimum contribution period) among early reformers gained in popularity in the aftermath of the GFC, have since been legislated in Estonia, Finland, Greece, the Netherlands, Portugal and announced in Belgium. Importantly, early pathway out of the labor market can be retained when minimum years of contributions for full pension are not adjusted in line with the retirement age (for example, Greece). Instead, other countries including Finland, Norway, Poland, Portugal, and Spain (currently suspended until 2023) link pension benefits to expected changes in demographics. Similar adjustment is inherent in the NDC systems where higher life expectancy reduces benefits by increasing the annuity factor (Italy, Latvia, Poland, Sweden). Few sustainability factors introduce intergenerational equity considerations. For example, sustainability factor in the German pension system allocates a share $\alpha$ in the change in pensioner dependency ratio to lowering the relative pension level and a share $1-\alpha$ to raising the contribution rate (Knell 2005b, 2010).

More elaborate *automatic balancing mechanisms* that respond to wider range of shocks are still underused. By altering the indexation or contribution rules these mechanisms automatically steer the pension system toward financial balance. The important difference with the sustainability factors is that instead of adjusting benefits in response to changes in a single parameter, the automatic balancing mechanisms are guided by considerations of a system-wide financial balance and thus respond to a wider range of shocks. In this fashion, the Swedish automatic balancing mechanism introduced as early as 1998 links indexation of pensions as well as the notional pension capital to a net present value (NPV) ratio of systemwide assets and liabilities. The Pension Revalorization Index (IRP) in Spain established in 2013 but consequently suspended in 2018 adjusts pensions in payment according to the

**Figure 4. Change in Pension Spending, 2007–60**
*(Percentage points of GDP)*




Sources: 2009 and 2021 Ageing Report; and IMF staff calculations.

financial balance of pensions and the social security system. The readjustment mechanism in Luxembourg foresees a partial or zero indexation to real wages when the pension system is in deficit.[6]

## Reform Outcomes

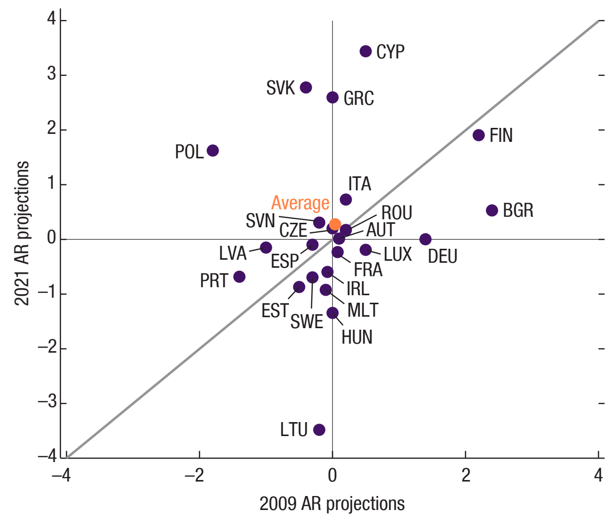
Enacted reforms deliver very gradual adjustments, dampening the secular increase in pension benefits in the long term and implying gradually declining economic replacement rates as populations get older. Nevertheless, the benefits on average reach very high levels and at any point will not be covered by pension contributions.

- *Pension spending*. Pension spending as a share of GDP has been on a rising trend as systems have matured and populations got older. Even with reform efforts running up to the GFC, pension spending in Europe was projected to increase in excess of 40 percent between 2010 and 2060. Reforms enacted since the GFC shaved off nearly half of the increase in pension spending projected in the 2009 Ageing Report (Figure 4) and are expected to broadly stabilize pension spending in the long-term that—given the projected near-doubling of old-age dependency in several countries—is a remarkable achievement. Still, pension spending as a share of GDP is expected to increase until about 2040, when pressures from population aging will start to abate. The long-term adjustment has been larger in countries with mature pension systems where pension spending projections for 2060 between the 2021 and 2009 Ageing Report vintages decline by nearly 2 percent of GDP, compared to about ¾ percent of GDP in the countries with currently maturing pension systems.

[6]In addition to sustainability factors and automatic balancing mechanism, pension laws may foresee conditional rules or mandate institutionalized reviews. For example, in Luxembourg the sustainability of pension system is reviewed every 10 years with interim assessments after 5 years. At the beginning of each 10-year period the contribution rate is reset with the objective of maintaining the pension reserve level above its legal threshold of 1.5 times the annual expenditures (IMF 2019). In Estonia the government has a legal obligation to analyze the financial and social sustainability of a pension system in every five years subject to public scrutiny though without strict mandate to propose legislative changes. In Greece, parametric adjustments should ensure that long-term increase in pension spending would not exceed 2.5 percentage points of GDP over the level of spending in 2009.

- *Pension contributions.* On average, pension contributions projections have changed little since the GFC and any adjustments have been less systematic (Figure 5). Few changes that were forecasted in the 2009 Ageing Report have retained the same magnitude and direction (that is, few countries are on the 45 degree line). Large changes occurred after the GFC, notably in few countries more strongly affected by the crises. Concentration of changes in contribution revenue around zero in 2021 Ageing Report vintage indicates that measures affecting contributions (for example, to support labor demand and reduce tax wedge on labor during the crises) have been small (especially compared to variation in pension spending) or largely temporary. The balance of adjustments in spending and contributions is illustrative of the limitations that countries with large pension systems and/or high labor taxes face in raising revenue from contributions.

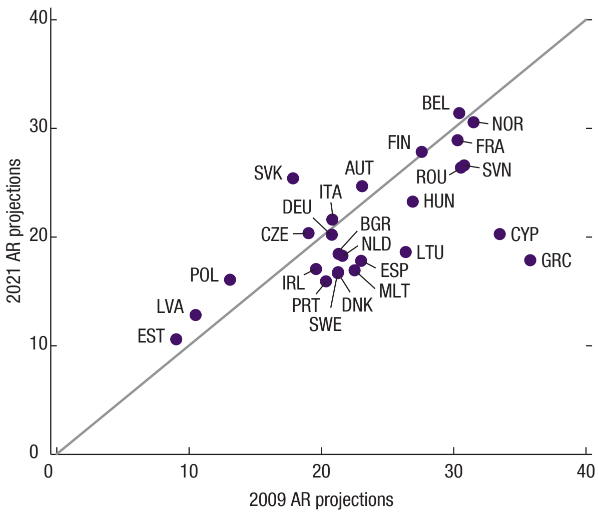
**Figure 5. Change in Pension Contributions, 2007–60**
*(Percentage points of GDP)*




Sources: 2009 and 2021 Ageing Report; and IMF staff calculations.

- *Economic replacement rates.* Compared to the 2009 Ageing Report, the economic replacement rates (ERR)—defined as pension spending per old-age population over GDP per working-age population—in the 2018 Ageing Report vintage have a higher starting point (around the year 2010) and decline by about 3 percentage points in the long term (Figure 6). The adjustment is larger in countries with mature—and larger—pension systems, while in one-third of the countries the ERR has increased. Beyond the scale of reforms, diverging replacement rates for current and future retirees indicate wider generational disparities. The reform impact on ERRs is only gradual, reflecting that reform design in most part protects (grandfathers) the elderly, bearing mostly on younger generations. Put differently, younger generations will have to work longer and save more for retirement to achieve replacement rates similar to current retirees (Soto 2017).

**Figure 6. Economic Replacement Rate, 2060**
*(Percent)*




Sources: 2009 and 2021 Ageing Report; and IMF staff calculations.

Chapter

# 4 How Far Have We Come and Gone?

This chapter assesses the sustainability and fairness aspects of pension systems and illustrates the impact of recent reforms on different cohorts. The observed reform outcomes as outlined in the previous chapter raise important policy questions. How far have we come? Have reforms been sufficient to ensure sustainability? How large are intergenerational divides? To answer these questions we provide an assessment of long-term sustainability and fairness properties of the pension systems in Europe as they stand today based on 2021 Ageing Report (EC 2021) and show how these assessments have changed vis-à-vis 2009 and 2018 Ageing Report vintages (EC 2009, 2018a) that best capture pre-GFC conditions and subsequent reforms, respectively. The analysis is done calculating the PMs for cohorts born between 1930 and 2000, that is, covering individuals who turn age 65 between 1995 and 2065. We find the PMs for the current elderly around or above 2—signaling concerns over sustainability—and document differences across countries and over time and generations. Post-GFC reform efforts delivered notable gains, initially nearly halving the gap between actual and sustainable PMs for younger cohorts, reducing the PM to slightly higher than 1.5 (as of 2018 Ageing Report vintage). However, subsequent reforms and reversals have eroded part of these gains, contributing to an increase in the PM for younger cohorts to about 1.7 in the recent 2021 Ageing Report projections.

## Sustainability and Fairness of Current Pension Schemes

We use the most recent 2021 Ageing Report projections to assess properties of sustainability and fairness. The 2021 Ageing Report (EC 2021) includes actual data up to 2019 and projections thereafter. The data allow us to construct a PM—which requires a history of pension contributions and benefits from age 22 until death—for cohorts born from 1930 (including those who reached age 65 in 1995) to 2000 (who will reach age 65 in 2065); see

Annex 2 for detailed results. Due to historical data limitations on lifetime contribution and benefit profiles, the PM for older cohorts can be calculated only for a smaller group of countries with more mature pension systems.

For nearly all countries in Europe the proportionality measure is well above unity. Based on the 2021 Ageing Report, for early cohorts who retired around the GFC and the European debt crisis, the PM ranges from 1.4 in Norway and Spain to about 4.5 in Greece, averaging at around 2.0 for countries for whom sufficiently long contribution and benefit history can be constructed (Table 3). Thus, pension systems, as they stand, provide current retirees with lifetime benefits that are two times higher than their lifetime contributions. Even for younger generations, and more characteristic of the pension system's steady state, the PMs hover around 1.7 on average. Such levels of PM imply that most pension systems are unsustainable on their own contributions and require substantial transfers to maintain financial balance. Only three countries—Estonia, Latvia, and Portugal—could consider their pension systems as sustainable and actuarially fair in the long term: in these countries, for younger cohorts the lifetime contributions broadly balance lifetime benefits (see Annex 2).

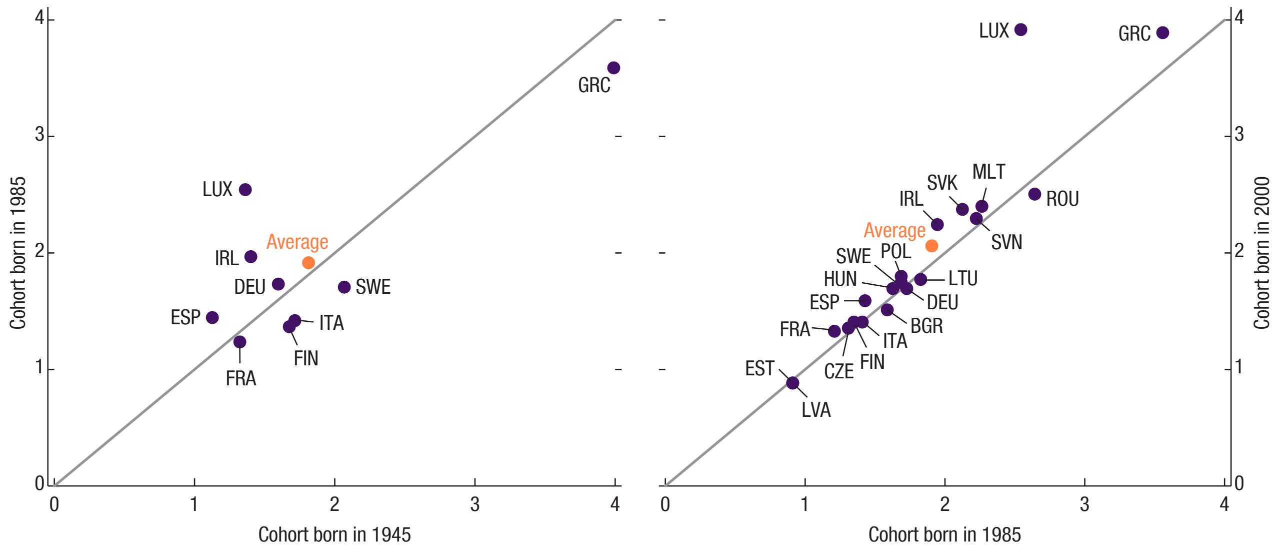
Individual country sustainability assessments require particular attention to cases where persistently positive r–g is combined with high debt or that run high pension system deficits. The paper uses a global Europe-wide benchmark of 1 in determining pension system sustainability. It is worth reminding that in case r–g is persistently positive due to country-specific circumstances, pension systems in these countries must run surpluses to stabilize or reduce debt, requiring PM less than 1 (Box 3). This becomes particularly important at high levels of debt, in which case fiscal sustainability dictates PM benchmarks that are notably below unity (Table 1). In the past, these conditions seem to have prevailed in some countries that have also run high pension system deficits. Overall, since most countries in Europe have run pension system deficits for decades (Chapter 5), reducing current and implicit debt would thus require PMs below 1 over the long term.

The pattern of PMs over time—declining from high initial levels for older cohorts—indicates that pension systems favor early generations. The patterns in PMs across cohorts are consistent with the reform efforts documented in Chapter 3. Some of the early reformers including Finland, Norway, and Sweden were able to notably reduce their PMs for cohorts born in 1930s and 1940s who retired pre-GFC. Pension reforms in Italy deliver sustained gains over a longer horizon due to long transition periods. Impact of early reformers generally vanishes for cohorts born in late 1960s when the PMs broadly stabilize. In Greece and Portugal, reform gains become evident for cohorts born around 1955 who retire after the GFC and European debt crisis. At

**Table 3. Proportionality Measure by Birth Year of Cohorts**
Ageing Report, 2021

| | 1930 | 1935 | 1940 | 1945 | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 1940–1950 | 1950–2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 1.99 | 2.19 | 2.08 | 1.98 | 1.93 | 2.09 | 1.84 | 1.76 | 1.68 | 1.72 | 1.84 | 1.71 | 1.72 | 1.71 | 1.73 | −0.15 | −0.20 |
| DEU | 1.99 | 1.91 | 1.76 | 1.50 | 1.63 | 1.68 | 1.77 | 1.75 | 1.81 | 2.03 | 2.04 | 2.03 | 2.01 | 1.99 | 1.95 | −0.13 | 0.32 |
| ESP | 1.43 | 1.35 | 1.36 | 1.38 | 1.38 | 1.35 | 1.25 | 1.15 | 1.15 | 1.14 | 1.11 | 1.18 | 1.25 | 1.21 | 1.25 | 0.02 | −0.12 |
| FIN | . | . | 1.92 | 1.80 | 1.74 | 1.43 | 1.44 | 1.46 | 1.37 | 1.51 | 1.44 | 1.47 | 1.51 | 1.53 | 1.56 | −0.17 | −0.19 |
| FRA | . | . | 1.64 | 1.55 | 1.44 | 1.51 | 1.59 | 2.00 | 2.10 | 1.96 | 1.99 | 1.82 | 1.69 | 1.74 | 1.69 | −0.21 | 0.25 |
| GRC | 3.62 | 4.01 | 4.21 | 4.54 | 4.47 | 3.34 | 2.59 | 2.22 | 1.88 | 1.76 | 1.68 | 1.60 | 1.61 | 1.58 | 1.60 | 0.26 | −2.87 |
| IRL | 2.41 | 2.38 | 2.25 | 2.23 | 2.21 | 2.05 | 1.97 | 2.12 | 2.24 | 2.15 | 2.25 | 2.38 | 2.78 | 2.97 | 3.11 | −0.03 | 0.90 |
| ITA | 2.00 | 2.09 | 2.12 | 2.08 | 1.83 | 1.61 | 1.58 | 1.53 | 1.46 | 1.38 | 1.40 | 1.40 | 1.33 | 1.35 | 1.37 | −0.29 | −0.46 |
| LUX | 1.91 | 1.72 | 1.83 | 2.04 | 1.84 | 1.70 | 1.86 | 1.87 | 1.85 | 2.13 | 2.23 | 2.54 | 2.79 | 3.02 | 3.27 | 0.01 | 1.43 |
| NLD | 1.71 | 1.53 | 1.48 | 1.50 | 1.44 | 1.57 | 1.52 | 1.59 | 1.72 | 1.82 | 1.89 | 1.94 | 1.99 | 1.92 | 1.96 | −0.04 | 0.51 |
| NOR | 2.10 | 1.77 | 1.50 | 1.36 | 1.28 | 1.19 | 1.23 | 1.16 | 1.21 | 1.25 | 1.29 | 1.24 | 1.29 | 1.26 | 1.35 | −0.22 | 0.07 |
| PRT | 1.73 | 2.15 | 2.22 | 2.16 | 2.00 | 1.67 | 1.43 | 1.31 | 1.29 | 1.15 | 1.04 | 1.04 | 1.04 | 1.06 | 1.08 | −0.23 | −0.92 |
| SWE | 3.43 | 2.71 | 2.17 | 1.83 | 1.47 | 1.29 | 1.35 | 1.36 | 1.37 | 1.35 | 1.48 | 1.49 | 1.50 | 1.42 | 1.55 | −0.70 | 0.08 |
| Average | 2.21 | 2.16 | 2.04 | 2.00 | 1.90 | 1.73 | 1.65 | 1.64 | 1.62 | 1.64 | 1.67 | 1.68 | 1.73 | 1.75 | 1.80 | −0.14 | −0.09 |
| Median | 1.99 | 2.09 | 1.92 | 1.83 | 1.74 | 1.61 | 1.58 | 1.59 | 1.68 | 1.72 | 1.68 | 1.60 | 1.61 | 1.58 | 1.60 | −0.17 | −0.14 |

**Figure 7. 2009 Ageing Report: Proportionality Measure Across Cohorts**



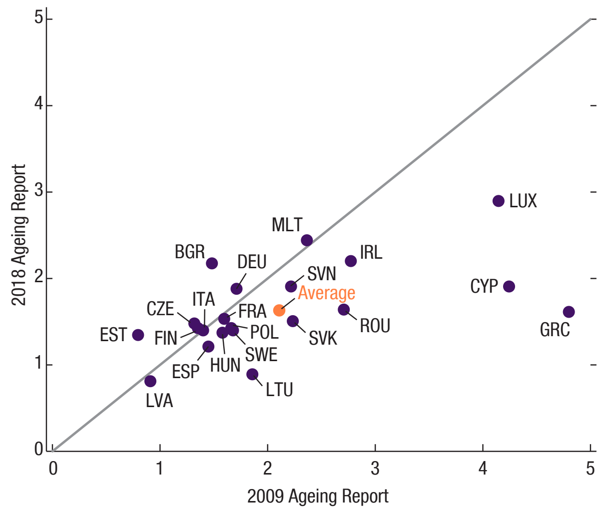

Sources: 2009 Ageing Report; Eurostat; and IMF staff calculations.

European level, these gains are offset by few countries, most notably Ireland and Luxembourg, where the PMs increase for younger cohorts.

## Impact of Reforms since the GFC

Before the GFC, pension systems treated generations broadly equally in most countries though on the account of providing excessive returns on contributions to all generations. For Europe overall, the PMs before the GFC—calculated based on 2009 Ageing Report projections unvarnished by the GFC and European debt crisis—remained broadly stable around 2 on average across most cohorts (Figure 7). For current retirees, this is consistent with PMs based on 2021 Ageing Report, although for younger cohorts in the 2009 Ageing Report the PMs increase in few countries with limited or no reform efforts (Greece, Luxembourg), indicating that, pre-GFC, these pension systems were not designed to cope with population aging. The pension systems, as they stood before the GFC, treated generations broadly fairly, even favoring younger cohorts in some countries, though on the account of providing all generations with unsustainable lifetime benefits that exceeded contributions broadly twofold. The relative stability of PMs preceding the crises and subsequent reforms makes the 2009 Ageing Report vintage an informative benchmark.

**Figure 8. Proportionality Measure for Younger Cohorts**
*(Cohort born in 1990)*



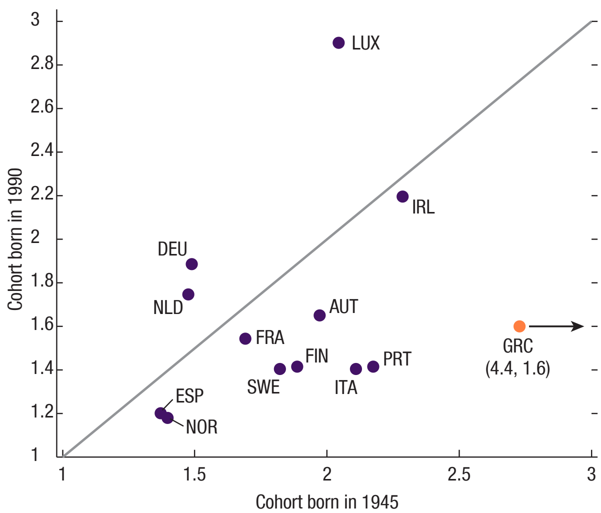

Sources: 2009, 2018, and 2021 Ageing Report; Eurostat; and IMF staff calculations.

Nearly a decade of reforms enacted since the GFC brought Europe halfway toward achieving sustainability. We capture the impact of reforms following the GFC by comparing the PMs from 2009 and 2018 Ageing Report vintages; beyond 2018 the overall reform momentum not only stopped but, in several cases, reversed.[1] Figure 8 compares PMs for 1990 birth cohorts (retiring when pension systems have reached their post-reform steady states) for the 2018 and 2009 AR vintages (EC 2009, 2018a); see Annex 2 for detailed results. The PMs decline substantially for younger cohorts across these vintages. To a large part, this is due to reforms in countries hit the hardest by the GFC and European debt crises, including Cyprus and Greece, though a general shift toward sustainability is evident: compared to the 2009 AR vintage, the PMs declined in two-thirds of countries. Also, the cross-country variation in PMs (measured by standard deviation) for younger cohorts declined by half with long-term convergence in the mean and median PMs toward 1.6 and 1.5, respectively. Consequently, even though the reform efforts were impressive, as of 2018 pension systems in Europe had reached only halfway toward achieving sustainability.

Reforms generally favored the current elderly over the current youth, demonstrating the divides that pension systems can draw between generations. Figure 9 compares PMs for cohorts born in 1945 (current retirees) and 1990 (current young working age) for the 2018 Ageing Report vintage. Only in few countries, including Germany and the Netherlands, the PM is projected to increase over time, suggesting that pension systems tend to somewhat favor younger generations. In most countries, the PM for younger cohorts declined substantially relative to the generations who retired around the

[1]Different Ageing Report vintages not only incorporate new reforms, but also capture changes in demographic and macroeconomic assumptions, better modeling, and coverage etc. Therefore, although a PM can be more robust to certain changes in underlying assumptions, not all changes in the PMs across Ageing Report vintages can be attributed to reforms.

**Figure 9. Proportionality Measure across Cohorts**
*(2018 Ageing Reoprt)*




Sources: 2018 Ageing Report; Eurostat; and IMF staff calculations.

GFC and European debt crisis. This is evident for both countries that undertook major reforms in the aftermath of the GFC (for example, Greece, Portugal) as well as the early reformers (for example, Italy, Sweden). This suggests that reforms that were implemented at that time fully protected the older generations—for whom the PMs remained at levels comparable to those in the 2009 Ageing Report—at the expense of the young.

Some reform strategies promoted greater equity across generations. An accelerated reform was initially adopted in Greece where the benefit formula introduced by the 2016 reform applied to both future and—with 2017 amendment—to current retirees in full without prorating. Such recalibration of pensions in payment would have substantially lowered the PM for cohorts born in 1950 and earlier but was subsequently reversed (see the next section). Another example of an accelerated reform was the introduction of an NDC public pension scheme in Latvia in 1996. The reform covered entire working-age population from age 15, converted pension rights acquired under the old scheme into NDC capital as of the reform date after which all newly retired were subject to new rules (Palmer and others 2006). While the reform treated all new retirees broadly equitably, it was not extended to existing retirees.

## Reforms and Reversals

All in all, the results demonstrate that while for younger cohorts reforms initially reduced the PMs to around 1.5, reducing the gap with respect to sustainable PMs by nearly a half compared to pre-GFC as well as to the older generations, subsequent reforms and reversals have eroded some of these gains. Many of these reform reversals are encapsulated in the recent 2021 Ageing Report and have benefited the youth. In the 2021 Ageing Report vintage, for the younger generations the PMs average around 1.7, indicating that the distance toward sustainable PM benchmarks[2] has declined by about

[2]The 2021 Ageing Report documents that a large share of an increase in projected pension spending in 2019–70 between the 2021 and 2018 Ageing Report vintages—where the latter includes post-2018 reform updates for some countries, that is not the case in our exposition—are due to changes in macroeconomic and demographic assumptions.

one-third when compared to the 2009 Ageing Report benchmark as well as to the older generations. Consequently, in most countries in Europe, pension systems provide returns that notably exceed their sustainable benchmarks (Box 4) and thus remain financially unsustainable.

Most recently, reforms that contribute to higher PM have dominated the landscape. Recent years—preceding the COVID-19 crisis—have witnessed not only a slowdown in reform efforts but also several reversals that undo previously legislated reforms or introduce new measures that weaken sustainability and fairness of pension systems. In advanced Europe, reversals generally concern rollbacks of earlier increases in retirement ages and suspensions of sustainability factors. In emerging Europe, mandatory DC pension systems have taken most of the fire.

- *Retirement ages.* Several countries partly reversed earlier increases in retirement ages by capping the increases in retirement ages (Czech Republic), temporarily postponing the scheduled increases (Italy, the Netherlands), reversing already implemented (Poland) or planned retirement age increases through a new reform (Italy), or abolishing some early retirement penalties (Italy). Germany and Portugal allowed earlier retirement for the insured with long contributory history.
- *Pension benefits.* Greece reversed the 2016–17 reforms that were set to align benefit formula of existing retirees with those of new retirees; reversed parametric spending reductions (by reinstating 70 percent entitlement of the deceased's pension instead of reformed 50 percent) and age limitations of survivor's pensions; following 2019 court ruling on 2019 reforms increased accrual rates for insured with longer contributory periods and partially reversed supplementary pension reductions; and provided an Easter bonus for retirees in 2019. Similarly, Hungary reintroduced a 13th and Italy a loosely targeted 14th pension payment and provided temporary cash benefits to elderly workers.
- *Private pension and reserved funds*. Several emerging market economies, as part of crisis response measures, reversed earlier reforms that established privately managed mandatory DC pension funds. Hungary closed mandatory private DC funds and transferred almost all assets to the state as most members returned to the public scheme system. Ireland transferred the National Pension Reserve Fund to the state, used largely to recapitalize banks. Baltic states and Poland either temporarily or permanently transferred some of the contributions from the DC accounts to the state pension pillar. More recently, Estonia allowed for optional dismantling of privately managed DC plans returning the assets to the individual account holders.

- *Automatic adjustment mechanisms.* Italy cancelled the automatic adjustment of retirement ages to life expectancy for 2019–20 while similar reforms were subsequently cancelled in the Slovak Republic and softened in the Netherlands.[3] Spain postponed the introduction of the sustainability factor that linked initial pension benefits to life expectancy while temporarily suspending the automatic adjustment mechanism that indexed pensions to the financial balance of pension and social security system.
- *Pension contributions.* In 2019 Lithuania changed the financing mix by shifting financing from employer pension contributions toward the state budget (personal income taxes). Hungary reduced social contributions from 27 to 15.5 percent in four steps between 2017–20. Greece reduced pension contributions for the self-employed and provided a temporary subsidy on employers' pension contributions for youth.

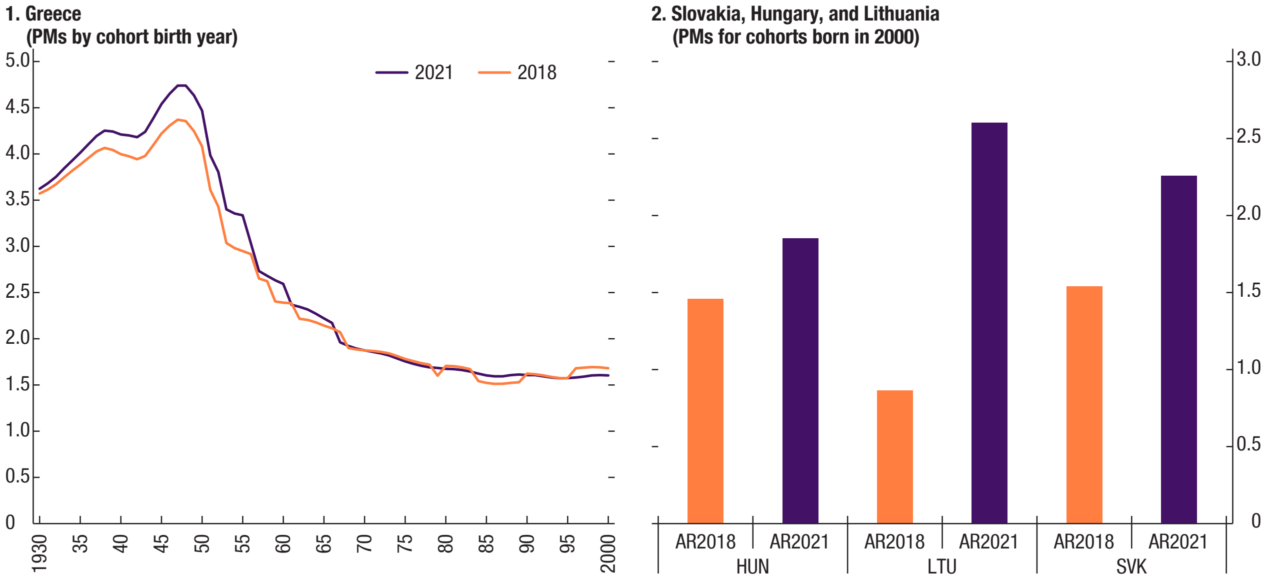
We illustrate the impact of recent reforms and reform reversals for selected countries. Since the timing of these reforms and reversals falls largely in between the 2018 and 2021 Ageing Report vintages, we do so by comparing the PMs between these two vintages for selected countries (Figure 10).

- *Reversing reforms affecting the current elderly.* In Greece, reform reversals mostly affect current retirees: the largest measure reversed was the planned recalibration of pensions of existing retirees in the order of 1 percent of GDP. The reversals imply a contained outward shift in the PM for current and early cohorts of new retirees. Permanent long-term increase in pension spending in the 2021 Ageing Report compared to the 2018 vintage in excess of 1 percent of GDP is offset by projected higher pension contributions without affecting the PM for younger generations.
- *Benefit readjustments and automatic adjustment mechanism.* Cancellation of automatic adjustment of retirement ages to life expectancy in Slovakia is the largest contributor to an increase in the long-term PM by nearly ¾ points along with improved modelling coverage, worse macroeconomic assumptions, freezing the minimum pension and other policy-related and methodological changes.[4] The impact of cancelling the automatic adjust-

[3]While postponing the automatic adjustment of retirement age to life expectancy, the 2019 pension reform in the Netherlands enacted an eight-month increase of retirement age for one additional year of life expectancy (instead of a one-to-one adjustment as originally planned).

[4]Similarly, the sustainability and fairness properties of the Spanish pension system would be strongly affected if the automatic adjustment mechanism (IRP) is permanently removed. Since this mechanism takes the form of lower indexation of paid out pensions, the effect of its permanent removal is cumulative for each cohort, benefits mostly future generations and raising the long-term PM by about half index points. At the time of this writing, the Government of Spain has been preparing a draft law in line with some of the principles and recommendations set forth in the 2020 update of the Toledo Pact. To that effect, on July 1, 2021, a tripartite social agreement was signed, envisaging to abolish the IRP and replace it by pension indexation to CPI. The draft law further aims to (1) move the non-contributory social benefits to the state budget; (2) introduce mea-

**Figure 10. Recent Reforms and Reversals**




Sources: 2018 and 2021 Ageing Report; and IMF Staff calculations.

ment mechanism on the PM across cohorts is gradual as the measures feed into lifetime spending and contribution profiles. Increase in the PM for Hungary is affected by permanent reintroduction of the 13th pension as well as residual reduction in the contribution rates.

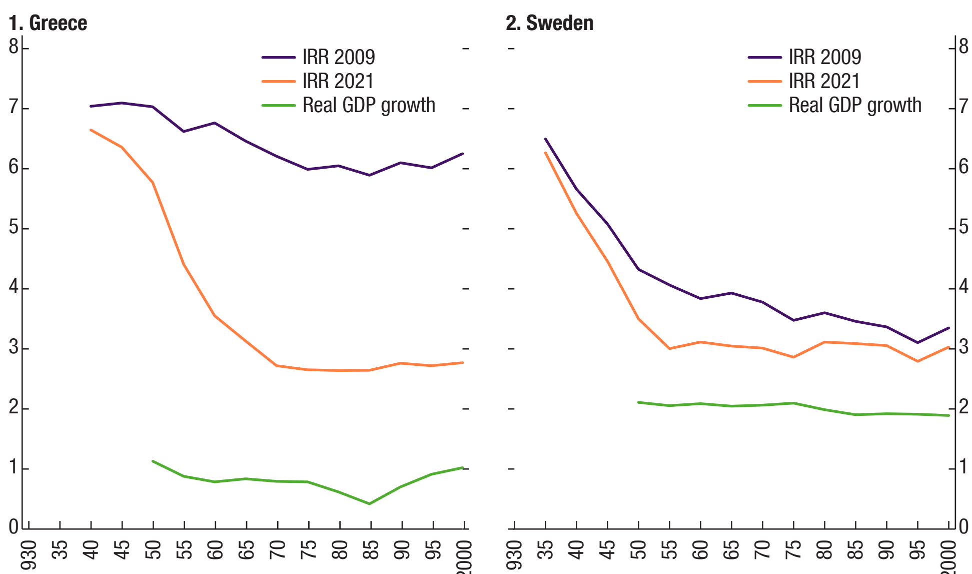
- *Changes in financing mix.* In 2019, Lithuania introduced changes on the financing of the pension system with the aim to shift the financing of the first pillar from contributions to the state budget, accompanied by changes in personal income taxes to ensure revenue neutrality. The reform eliminated nearly all of the employer social contributions (28.9 percent of wages, of which 22.7 percent of wages was earmarked for pensions) and raised wages by 1.289 to keep gross wages constant. To offset the revenue loss, the reform raised employee contributions to 8.72 percent of the new wage and the reminder was to be financed by personal income taxes. Also, the reform of the second pillar led to an upward revision in public pension spending projections (EC 2021).

sures to bring the effective retirement age closer to the legal retirement age; and (3) replace the sustainability factor currently set for implementation in 2023 with an intergenerational equity mechanism yet to be specified.

### Box 4. Internal Rates of Return of Pension Systems

Real internal rates of return provide a consistent assessment of sustainability across countries and the AR vintages. The ability of pension systems to cover actuarial balances and ultimately ensure sustainability depends on the distance between the IRR and system's sustainable benchmark for the discount rate that we proxy with GDP growth rate (see Box Figure 4.1). The IRRs derived from equation (1) under the same assumptions on retirement ages and life expectancy as used for the PMs are reported in Annex 3. In the 2009 AR vintage, for cohorts born in 1950, the IRRs ranged from 3.4 percent in Germany to 7 percent in Greece, exceeding the average real GDP growth by about 1.8 and 6 percentage points, respectively. At steady state (for younger birth cohorts born from 1980 onward) Estonia and Latvia have the lowest IRRs (less than 1 percent) below their long-term GDP growth rates. Although the IRRs based on the 2021 AR vintage are generally lower for younger cohorts compared to the IRRs based on the 2009 AR, they still remain notably above their *country-specific* GDP growth rates. This confirms that despite the positive impact of reforms over the past decade or so, in most European countries more efforts are needed to ensure sustainability of pension schemes.

**Box Figure 4.1. Real Internal Rates of Return and Real GDP Growth by Cohort Birth Year**
*(Percent)*




Sources: 2009 and 2021 Ageing Report; Eurostat; and IMF staff calculations.
Note: Real internal rates of return by cohort birth year. Real GDP growth rates for the same cohorts are averages calculated from the year of entrance into working life to the end of pension period.

Chapter

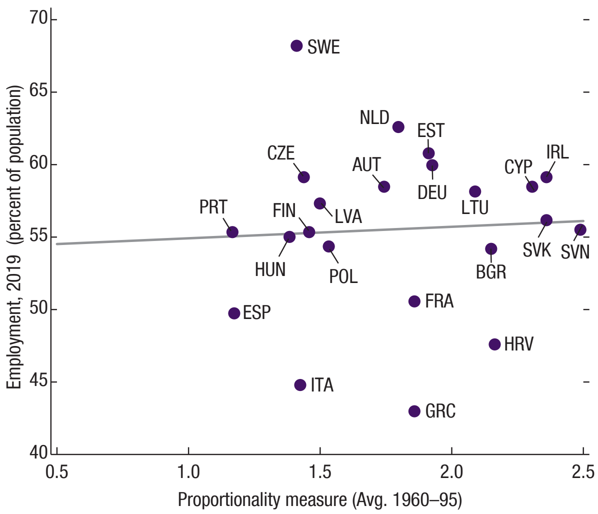
# 5 Incentives, Adequacy, and Affordability

The PM is an indicator of sustainability and fairness of pension systems on aggregate. What lies beneath, however, is a complex world of rules and parameters that might create important imbalances or inequities within generations not directly observable from a single aggregate metric. This particularly concerns principles of incentive compatibility, adequacy, and affordability, the assessment of which requires a more detailed understanding of pension system design. In this chapter we review some of these key policy rules and parameters, with a focus on (1) design issues that can affect marginal decisions to contribute and work; (2) the potentially distortive way in which pension systems are typically financed; (3) the ability of pension systems to mitigate poverty risks; (4) macro-fiscal consequences of excessive public pension spending; and (5) political-economy considerations of reforms.

## Beyond the PM—Design Matters!

Even pension systems that offer a relatively high contributions-to-benefits balance can introduce important distortions. The high IRRs that public pension systems in Europe provide could themselves incentivize people to contribute to pension schemes and participate in labor market. Still, in the analysis of this paper, the PM is not evidently linked with outcomes of labor markets (Figure 11). Beyond a myriad of factors that can affect employment, rates of return on contributions can mask important disincentives to participate, leading to variations in employment even for countries with similar PM values. For example, pension systems with PM equal to one can provide very high and/or flat (marginal) returns at low years of service and low or negative (marginal) returns at high years of service, thus distorting incentives to contribute at points where an additional contribution provides returns that are below the alternatives (deviation from actuarial neutrality). The PM is thus a

**Figure 11. Employment and Proportionality Measure**




Sources: 2021 Ageing Report; International Labour Organization; and IMF staff calculations.

good barometer of pension systems at the macroeconomic level, providing a quick assessment of fiscal sustainability, the returns of the pension systems for cohorts, and equity across generations. But how exactly system delivers along these three dimensions while trying to accomplish other policy objectives—the design of the system—is also important for efficiency and equity outcomes.

From an individual's perspective, an important question is the impact that marginal contributions can have on lifetime benefits. If the present value of the change in lifetime benefits is lower than the additional contribution, individuals have incentives at the margin to avoid these contributions, either by exiting the labor force or engaging in informal employment. In pensions systems, each component of the benefit formula can affect the link between contributions and benefits (accrual rates, the calculation of the reference earnings measure for pensions and its valorization, pension indexation).[1] Below we discuss critical decisions that can have a large effect on the link between contributions and benefits at the margin, such as the benefit adjustments around the time of retirement, kinks introduced by discrete eligibility components (years of contributions), and interactions with other social programs.

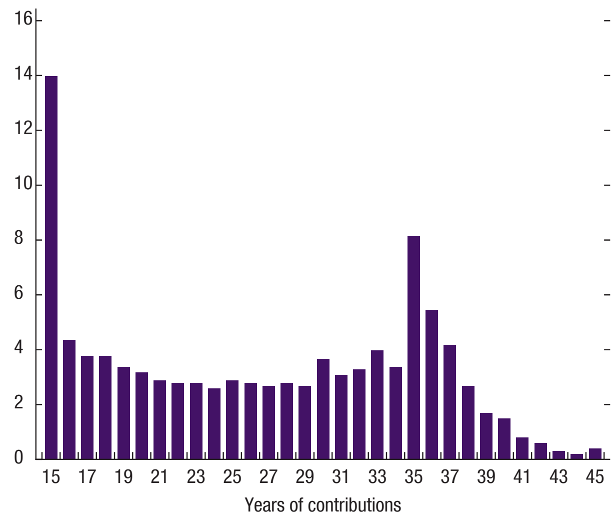
- *Actuarial adjustments and retirement decisions*. Retirement systems generally provide flexibility on when to claim benefits, usually applying an "actuarial adjustment" that modifies benefits depending on the age at which they are claimed (that is, lowering benefits when claimed earlier to account for the additional number of years over which they would be received or conversely providing bonuses when delaying claiming).[2] Evidence indicates that too small adjustments drive individuals to claim early (Gruber and Wise 1999, 2004; Blondal and Scarpetta 1999; Börsch-Supan 2000). Even today, many European countries—including Belgium, Bulgaria, Italy (DB scheme), Luxembourg, Malta, and Romania—provide adjustments that,

[1]Most pension systems in the OECD use an earnings measure based on lifetime earnings valorized by wages (OECD 2017).

[2]Retirement decisions are influenced by factors other than financial incentives in pension systems, including health factors, fixed cost associated with employment, collective bargaining provisions, and mandatory retirement rules that still exist in many OECD countries (OECD 2017).

especially for men, are less than what is required for actuarial neutrality (Freudenberg, Laub, and Sutor 2018; Börsch-Supan 2013; Andrle and others 2018). In the other extreme, penalties well above what is required for actuarial neutrality (as in Portugal or Spain) can push many to delay claiming benefits but could leave those who have to exit the labor market earlier with inadequate pensions.

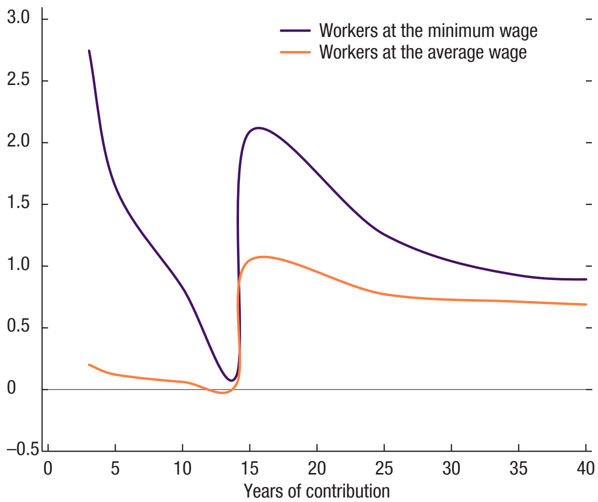
**Figure 12. Greece: Retirement by Years of Insurance, 2015**
*(Percent)*




Sources: IDIKA; and IMF staff calculations.
Note: The distribution refers to retirees receiving old-age pensions and covers all main pension funds.

- *Minimum pensions and years of contributions*. To address equity concerns, pension systems often include progressive benefit components. For example, several European countries (including Belgium, Greece, Latvia, Italy, Spain, and Sweden) provide a minimum pension for individuals who meet certain conditions, including a minimum number of years of contributions (Holzmann and others 2020, EP 2007). For low earners, the presence of a minimum pension introduces incentives not to contribute beyond the minimum required years, as these individuals are unlikely to receive benefits above the minimum based on their own contribution records, even under a full career. In countries with such design, the literature has found bunching at the minimum years of contributions for low earners, but not for high earners. For example, in Greece before the 2016–17 reforms the insured with low earnings had a strong incentive to retire having contributed for only 15 years (Figure 12). At this point the combination of minimum and targeted pensions ensured that a minimum wage earner, having contributed for 15 years, became eligible for an old-age pension that in nominal terms was similar to the average pension received by a retiree who worked and contributed for 31 years (IMF 2017). In Spain, the minimum pension introduces incentives for low earners to retire early (Jiménez-Martín 2014). In Chile, low earners bunch at the 20 years of contribution mark corresponding to the minimum contributory period to access a minimum pension (Wong 2016).

**Figure 13. Ratio of Lifetime Social Cash Transfers to Lifetime Social Insurance Contributions in Montenegro**
*(Percent)*




Source: IMF staff calculations.
Note: The illustration assumes that throughout their working lives one type of worker earns the minimum wage, and the other earns the average wage. Both workers are assumed to receive old-age pensions according to current law. Life expectancy at the claiming age is assumed to be 20 years. Unemployment insurance is assumed to be used for one year for those with 15–25 years of contributions and two years for those with more than 25 years of contributions. Workers are assumed to have two children over their lifetime, with contributory benefits available only to those with more than 15 years of contributions. Minimum wage workers are assumed to receive 10 years of minimum of pensions if they do not reach 15 years of social insurance contributions. The analysis excludes survivor or disability benefits, both of which would raise the value of contributions.

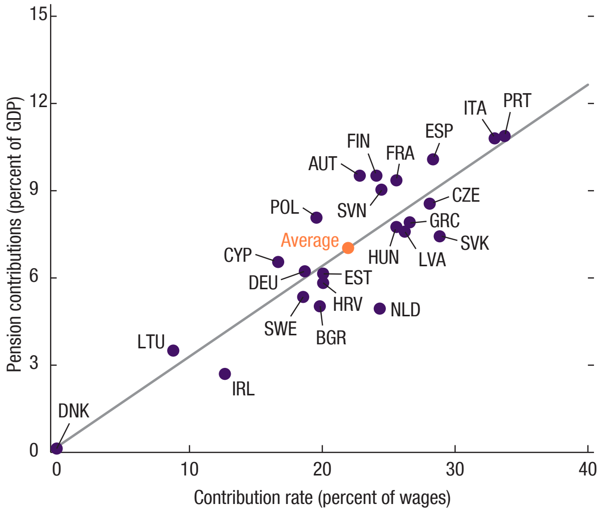
- *Interactions with other social programs*. In Europe, pension systems are usually part of a wider social safety and insurance network, including other social transfers to alleviate poverty (such as basic income programs) and other insurance programs (unemployment and health care) that can often provide pathways to early retirement. Decisions to work or retire are ultimately shaped by the manner the individual programs interact with each other. Consider the case in Montenegro, where the social assistance and insurance system includes means-tested support to assist the poor, pensions and unemployment insurance, and parental leave benefits. Over the lifetime of a worker, the ratio of lifetime social benefits (contributory and non-contributory) to lifetime social insurance contributions depends on the number of years of contributions and the earnings level, with higher returns for those with fewer years of contributions and lower earnings (Figure 13). For low earners, there are incentives to avoid contributions, if possible, or at least limit these contributions to no more than 15 years—the point at which workers become eligible for minimum pensions. In contrast, higher earners likely see value in complying with social contributions but might face incentives to underreport earnings.

## Are Social Contributions Distortive?

Public pensions are typically financed by dedicated taxes on labor. In Europe, the average payroll tax rate earmarked for pensions is 22 percent and the average collection is 7 percent of GDP in revenue—about 0.32 percentage points of GDP per point of payroll tax (Figure 14). These contributions cover on average 70 percent of pension spending, the rest being largely financed by general revenue sources (Figure 15).

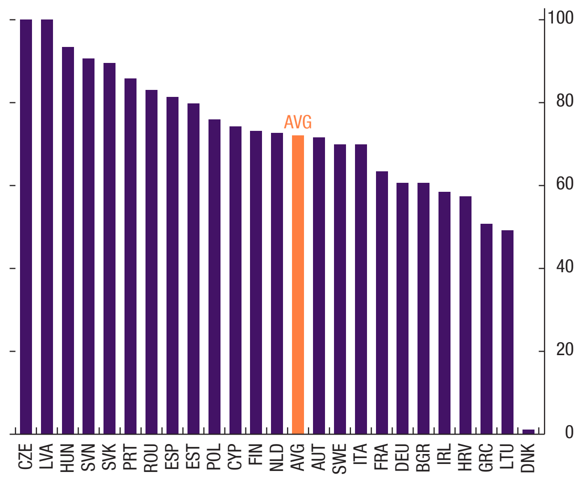
Taxes on labor, including dedicated contributions, can affect labor market outcomes. Taxes on earnings from employment, including personal income taxes and social insurance contributions, affect employment by driving a wedge between labor cost and the take-home wage received by employ-

**Figure 14. Pension Contributions, 2019**




Sources: 2021 Ageing Report; US Social Security Administration (2018); and IMF staff calculations.

**Figure 15. Share of Contributions in Pension Financing, 2019**
*(Percent of pension spending)*




Sources: 2021 Ageing Report; and IMF staff calculations.

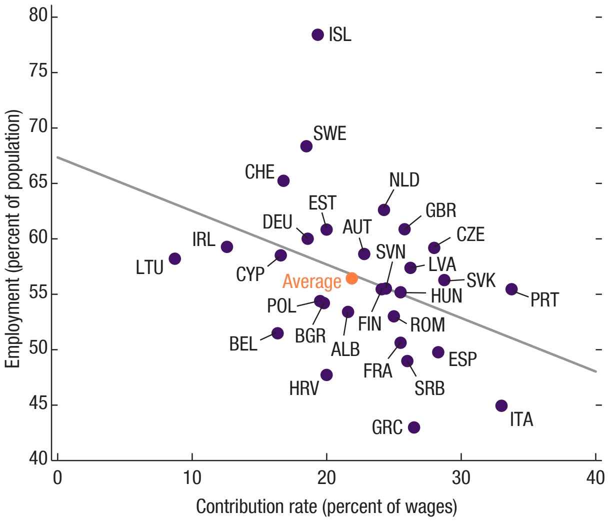
ees.[3] This can affect labor demand to the extent to which taxes push labor costs above market clearing levels, and supply through the perceived effect of taxes on net pay. Cross-country analyses in OECD countries generally find a significant negative impact of the tax wedge on employment (Nickell 2003, Bassanini and Duval 2006, Dolenc and Laporšek 2015, Zimčík 2017, Velasquez and Vtyurina 2019). Overall, empirical findings from macro and micro studies suggest that a 10 percentage points change in the after-tax wage can raise employment by 2–5 percent (IMF 2012). This is consistent with observed negative association between employment rates and pension contributions in Europe (Figure 16). While macro studies tend to find large wage elasticities of labor supply, evidence from micro studies point to lower elasticates and can be more mixed. Most of the response seems to be driven by individuals with higher sensitivity at the extensive margin (participation), including low-income workers, women, single parents, second earners, and older workers, with more mixed results for prime-aged men (Disney 2004; OECD 2011b; IMF 2012; OECD-IMF 2015).[4]

An important consideration is the extent to which pension contributions are perceived as taxes or savings. In most European pension systems, benefits

[3]OECD (2020) defines the tax wedge as the sum of personal income tax, employee and employer social security contributions, and any payroll taxes less cash transfers expressed as a percentage of labor costs. In this definition pension contributions are equivalent to taxes although their economic impact can be different.

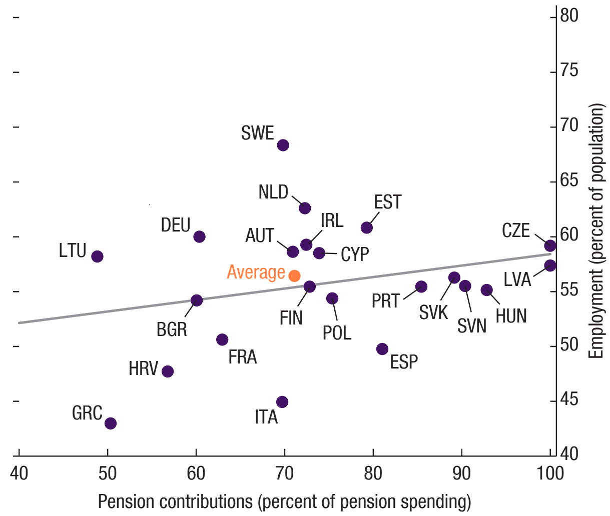
[4]In addition, EC (2017b) finds a negative but statistically insignificant relationship between undeclared work and the tax rate on labor.

**Figure 16. Employment Rates and Pension Contribution Rates, 2019**




Sources: 2021 Ageing Report; International Labour Organization; US Social Security Administration (2018); and IMF staff calculations.

**Figure 17. Employment Rates and Share of Contributions in Pension Financing, 2019**

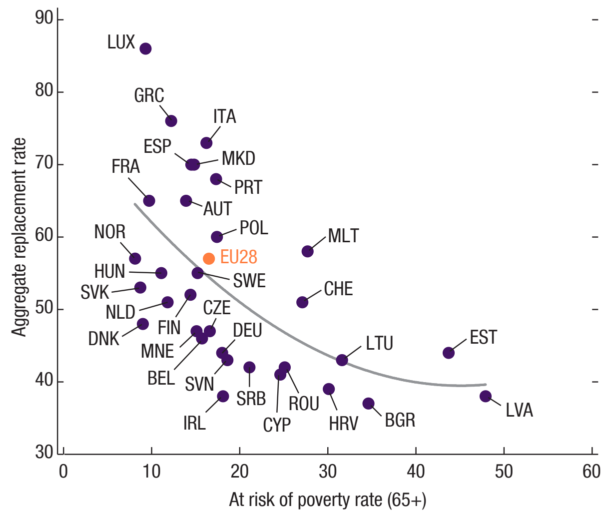



Sources: 2021 Ageing Report; International Labour Organization; US Social Security Administration (2018); and IMF staff calculations.

are determined by lifetime contributions. Individuals with higher annual contributions and longer contributory periods generally receive higher pensions. The extent to which individuals value this link between contributions and benefits—the degree to which contributions are perceived as valuable as take-home wages and savings in the form of entitlement to benefits in the future—can offset labor market distortions arising from the tax wedge. This depends on the design of pension systems—whether the PM is attractive enough for a cohort—and cognitive biases such as myopia.

Stronger actuarial links between pension contributions and benefits can remove the distortionary effects of pension contributions. Disney (2004), for example, finds that the PAYG *equilibrium* contributions have—as expected—an adverse negative impact on economic activity rates of women but not those of men (indicating that not all categories are sensitive to changes in equilibrium pension contributions). He further shows that the negative impact on female participation is entirely driven by the tax or "redistributive" component of pension financing while the savings or "actuarial" component has the opposite effect. A metric that can proxy the savings component is a contemporaneous share of pension contributions in pension spending that in actual data is positively though weakly correlated with employment (Figure 17). In predominantly earnings-related systems making the contribution-benefit link stronger can mitigate the otherwise negative impact of overall pension contributions on labor supply and—especially if such contributions should yield a high return—the "savings" component in contribution-based system can encourage participation (IMF 2012).

**Figure 18. Replacement and Elderly Poverty Rates, 2019**
*(Percent)*




Source: Eurostat.

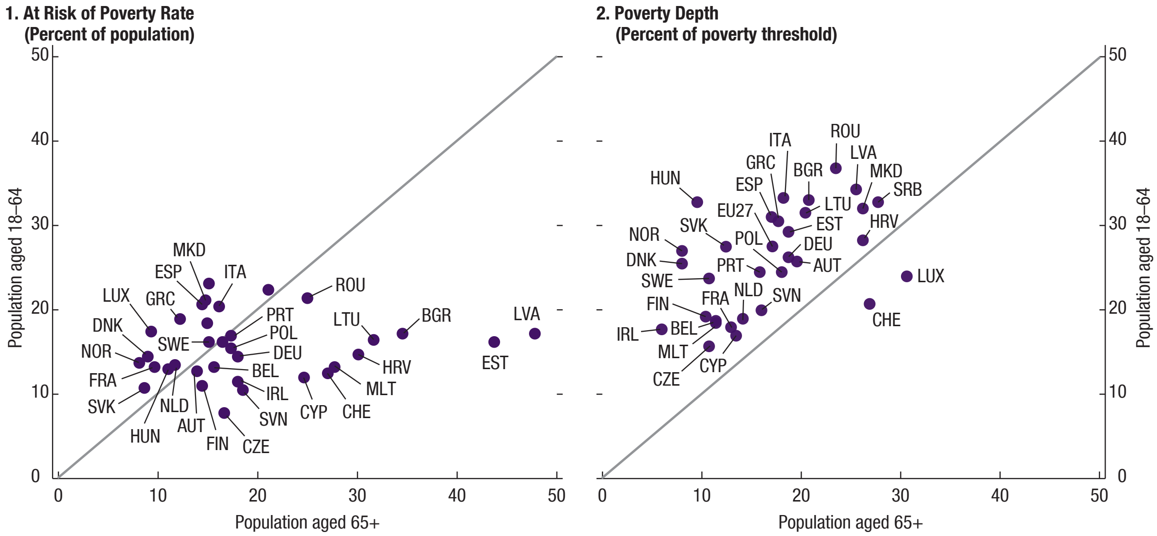
## Pension Adequacy

In Europe, public pensions constitute the bulk of the income of the elderly. The adequacy of a pension system can be measured by its ability to ensure income maintenance after retirement and mitigate risks of poverty among retirees. With old-age pension accounting for about 72 (85 including survivors' pensions) percent of single-person retirees' total income in the EU on average (EC 2018b), public pension benefits play a key role in determining living standards of the elderly in member states.

Reforms necessary to ensure sustainability must be mindful of balancing adequacy of benefits and incentive-compatibility of the pension system. The generosity of pension systems (measured by replacement rates) is inversely linked with poverty risks at retirement (Figure 18).[5] Since past reforms have focused on addressing sustainability concerns of pensions, expected gradual reduction of replacement rates over the coming decades is likely to weigh on adequacy going forward. To counterbalance this impact, many countries have adopted complementary measures to prevent elderly poverty and increase income maintenance. These included expanding basic or minimum pension allowances or providing benefits to retirees outside the pension system (see Chapter 3). However, reducing overall replacement rates while increasing the protection at the lower tail of the benefit distribution necessarily implies

[5]Risk of poverty is defined by the EC as the risk and depth of income poverty and severe material deprivation. The At Risk Poverty (AROP) rate is defined as the share of the people with an equivalized disposable income below the risk-of-poverty threshold (set at 60 percent of national median equivalized income, after social transfers). AROP measures low income, which does not necessarily imply low wealth or standard of living.

**Figure 19. At Risk of Poverty Rate and Poverty Depth, 2019**




Source: Eurostat.

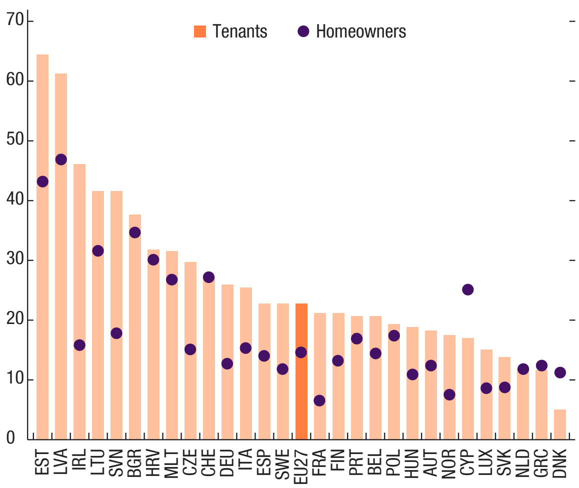
flattening of pensionable earnings—benefits profile.[6] The higher the protection the larger are the efficiency distortions, potentially leading to perverse incentives (see previous section). This calls for a careful balancing act between efficiency and equity objectives of the pension system.

In Europe, the incidence of poverty among elderly shows important disparities, and over the past decade has generally been lower on average when compared to the working-age population.

- In advanced European economies with mature pension systems the risk of poverty tends to be lower among the elderly when compared to the working-age population, while the opposite prevails in most countries with less mature or generous systems. Nevertheless, the poverty depth—the relative gap between the median equivalized income of people at risk of poverty and the income defining the poverty line—of elderly remains on average well below that of the working-age population throughout nearly all of Europe (Figure 19).
- Other sources of income available to retirees contribute to improve income maintenance, beyond pension benefits—these sources of income are mainly income from work (as employees or self-employed) and private pensions,

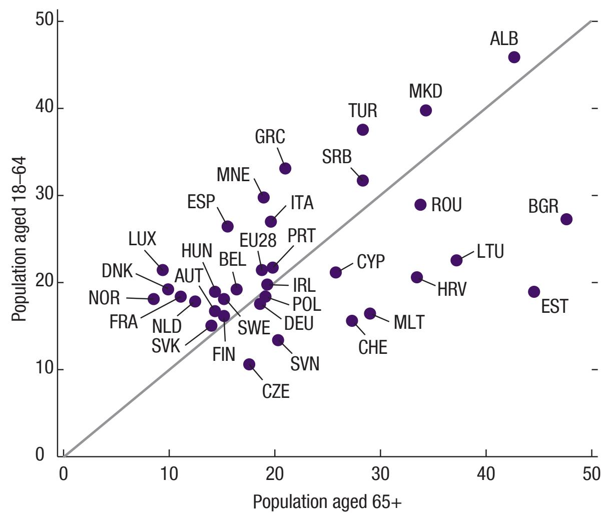
[6]Assuming an actuarially fair pension system (or PM equal to one) on aggregate over the income distribution, high minimum or basic pension benefits leading to PM greater than one at lower incomes implies a PM less than one at higher incomes. Such system has flatter overall earnings—benefits profile that is normally associated with weaker incentives to contribute.

**Figure 20. At Risk of Poverty by Tenure, 2019 Population Aged 65+**
*(Percent)*




Source: Eurostat.

**Figure 21. People At Risk of Poverty or Social Exclusion, 2019**
*(Percent of population)*




Source: Eurostat.

but also from assets (imputed income from home ownership and investment income such as rental, dividends, interests, profits).[7] On average, the elderly are more likely to be homeowners compared to younger people. In OECD, in 2011 on average 77 percent of heads of households aged 55 and older were homeowners compared to 60 percent among those younger than 45 (OECD 2013). Data for European countries further suggests that the risk of poverty among elderly is lower for those who own their home relative to those who rent (Figure 20), a gap that increased dramatically over the past 10 years. OECD (2013) shows that taking into account imputed rent as an unearned income of households significantly reduces the risk of poverty for retirees.

- In the majority of European countries, the risk of poverty and social exclusion[8] (AROPE)—as opposed to AROP—is therefore much more prevalent among the working-age population when compared to the elderly (Figure 21). The former are historically more likely to experience severe material deprivation, reflecting lower asset holdings and less secure income sources. The AROPE gap between the working-age population and the elderly is especially high in advanced economies, reaching nearly 4.5 per-

[7]The shares of such additional sources of income vary depending on households' characteristics (for example, work income account for about 4 percent of total income for a single retiree person, while it represents almost 16 percent of income in a household consisting of a couple with at least one member aged 65 and older).

[8]The indicator of people At Risk of Poverty or Social Exclusion (AROPE) tracks people not only at risk of poverty, but also severely materially and socially deprived or living in a household with a very low work intensity. It is the main indicator for monitoring the EU 2030 targets on poverty and social exclusion.

centage points in 2019 for the euro area or countries with more mature pension systems.

In general, in earnings-related pension systems aiming for strong links between contributions and benefits, it would be preferable to provide income support outside the contributory public pension systems. While current retirees are generally well protected, replacement and benefit[9] rates in public pension systems (see Chapter 3) are set to decline in decades to come. The EC 2018 Pension Adequacy Report projects that pension systems will be on average less adequate in 2056 compared to what was observed in 2016. Occurrences of low public pensions most prominently reflect lack of employment income, short careers, or informal work, highlighting the first-order importance of policies to reduce structural unemployment and incentivize formal participation. Within the pension system, preference should be given to ensuring incentives are in place—particularly at the lower-income levels—to lengthen formal work careers and increasing retirement ages to increase pension income at retirement. While enhancing efficiency and employment, making adequacy contingent on longer career might not be sufficient in all occupations. Countries with proportionality measures below 1, implying that cohorts receive lifetime benefits below their lifetime contributions may afford to increase pension expenditures while improving incentives and adequacy, provided that long-term sustainability is ensured. If sustainability of pension systems remains a concern, policymakers should aim to use tools outside the contributory pension systems to address poverty concerns and provide better opportunities for the youth. Attention should therefore be given to income maintenance policies to complement public pension income, protection against poverty at younger ages, and investment in education and training. Governments could explore measures to encourage workers to save through private pension schemes which would help to complement public pension benefits as well as diversify income sources (Carone and others 2016).[10]

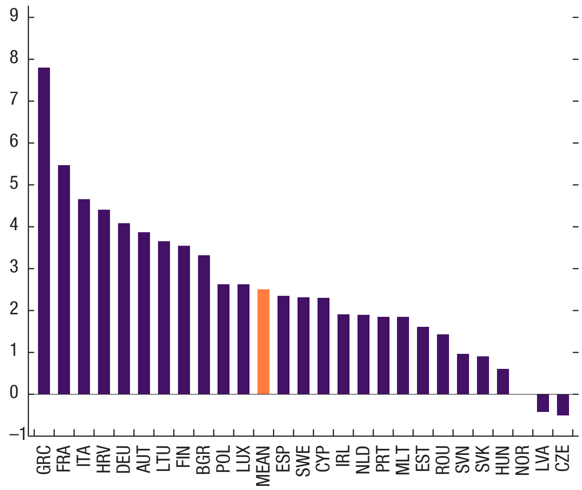
## Financing High Pension Spending and Short-Term Imbalances

Public pension spending and deficits remain at historical highs. The average pension system deficit in Europe is currently about 2½ percent of GDP (Figure 22) after peaking at about 3 percent of GDP in the aftermath of European sovereign debt crisis—double of pension system deficits before the

[9]The benefit ratio is calculated as the ratio of total public pension spending divided by the number of retirees, to the average wage in the economy. A decline in the benefit ratio, all other things equal, would reflect reduced generosity of the pension system with respect to wages. The ratio therefore captures (on an aggregate basis) the concepts of income maintenance and consumption smoothing.

[10]Private pensions schemes, however, might be costly to participants and provide limited risk-diversification, highlighting the importance of strong regulation to accompany private pension schemes (Égert 2012).

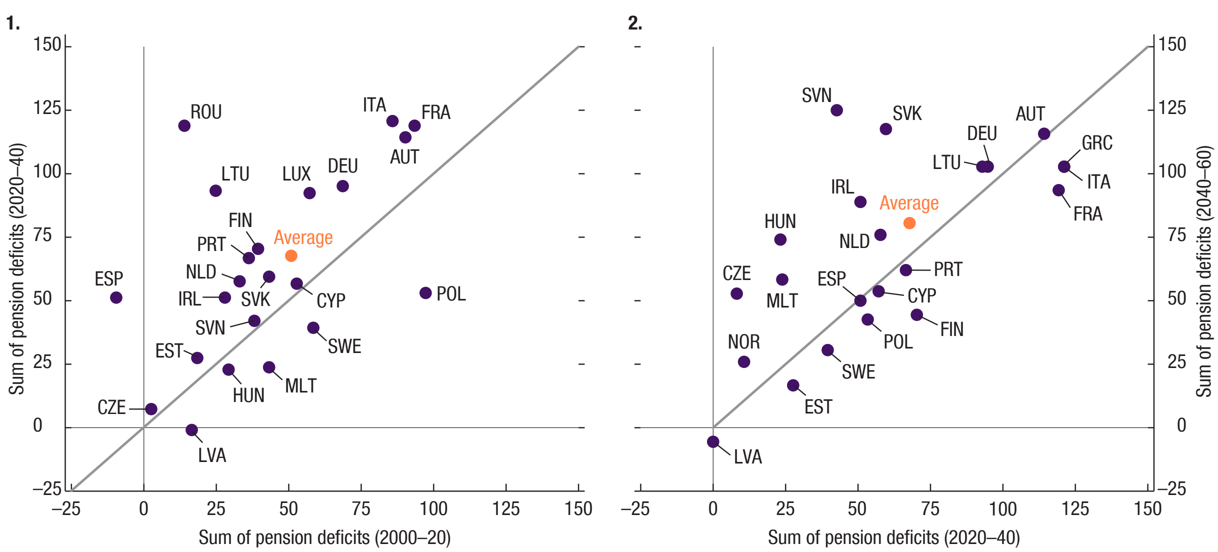
**Figure 22. Deficits of the Public Pension Systems, 2019**
*(Percent of GDP)*




Sources: 2021 Ageing Report; and IMF staff calculations.
Note: State transfer is defined as a difference between pension spending and actual employer and employee pension contributions as defined in the Ageing Report, excluding third-party revenues and non-contributory state transfers.

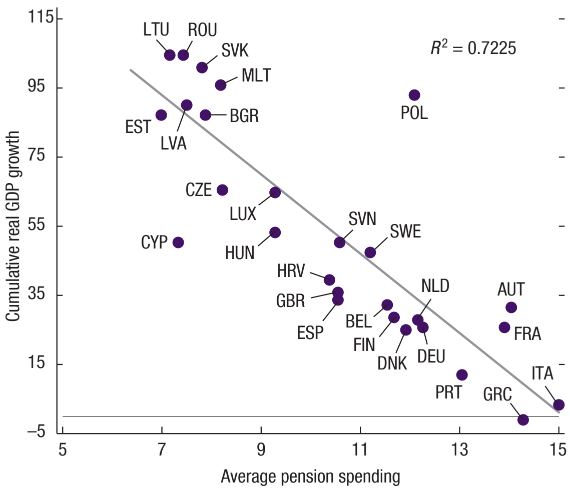
GFC. This compares to a primary general government deficit of about ½ percent of GDP that countries in our sample have run on average over the past two decades and before the COVID-19 pandemic. According to the latest projections by the AWG, pension reforms have succeeded in containing the *average* level of pension spending around or above 12 percent of GDP in Europe between now and 2070. This is a notable improvement relative to pre-GFC projections. Nevertheless, pension spending will remain at historically high levels—average pension spending was 9 percent of GDP in 2000—and, despite measures taken since GFC and the European debt crisis, pension spending will slowly continue increasing in several countries. The number of countries with pension spending over 10 percent of GDP is projected to increase from 9 out of 27 in 2000 to 18 out of 28 in 2050. In parallel, also the deficits of the pension systems will continue increasing. For Europe overall, cumulative pension deficits since 1980s (or the earliest year when the data are available)

**Figure 23. Cumulative Deficits of the Public Pension Systems**
*(Percent of GDP)*




Sources: IMF staff calculations.

**Figure 24. Cumulative Real GDP Growth and Pension Spending, 2000–18**
*(Percent of GDP)*



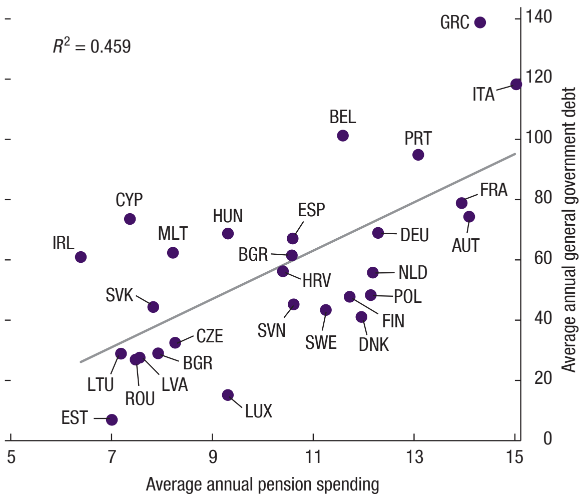

Sources: Eurostat; and IMF staff calculations.

are on the same order of magnitude as gross sovereign debt (before the COVID-19 crisis). Within the next 20 years pension system deficits increase mostly in countries with mature pension systems, while after 2040s spending pressures are stronger in currently maturing systems (Figure 23). The Europe-wide annual deficit will stabilize at about 4 percent of GDP by 2050s, making the pension systems increasingly larger drag on public finances in decades to come.

Can countries afford in the next decades sustained levels of pension deficits and spending? If history offers any guidance, in Europe over the past nearly two decades the countries that spent higher shares of their national incomes on pensions tended to experience lower real growth rates (Figure 24). The pension systems can weigh on economic performance in many ways. The benefit design and financing discussed previously closely interact with employment incentives. Pension spending may also displace other productive spending, contribute to fiscal vulnerabilities and limit the scope to respond to shocks. While several countries have improved long-term sustainability of their pension systems, they might not be able to afford still high levels of pension spending projected for the next few decades. It is therefore vital to avoid adverse feedback loops between pension system, fiscal policy, and economic performance from building up.

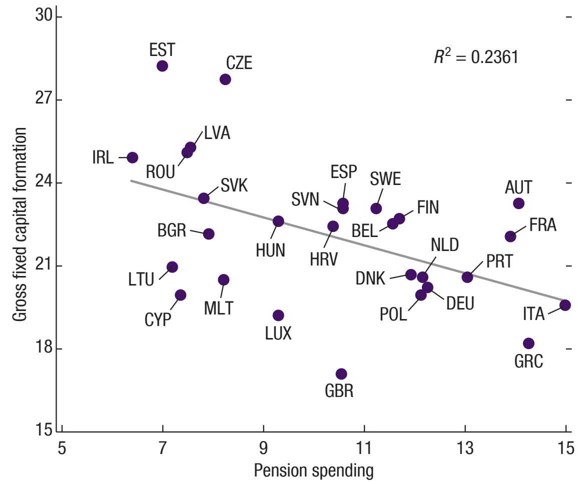
Countries with relatively high pension spending seem to be more vulnerable, in that they tend to have higher deficits and debt (Figure 25). Reforms that fail to address imbalances between pension contributions and benefits in the short term expose countries to risks associated with financing these gaps—at times of recessions and unfavorable financing conditions, high and persistent deficits can limit policy space, put pressure on sovereign yields and crowd out other spending. The disruptive impact of these vulnerabilities was evident in the GFC when countries that spent the highest share in pension entitlements also faced high yields on sovereign bonds (Börsch-Supan 2013). These imbalances can also lead to reforms that favor the short-term adjustment needs at the cost of long-term structural enhancements. For example, in Greece the crisis led to several progressive ad hoc pension cuts in 2011–12 that were not rooted in a system-wide reform and flattened the earnings-benefits curve.

**Figure 25. General Government Debt and Pension Spending, 2000–18**
*(Percent of GDP)*




Sources: Eurostat; and IMF staff calculations.

**Figure 26. Aggregate Gross Fixed Capital Formation and Pension Spending, 2000–18**
*(Percent of GDP)*



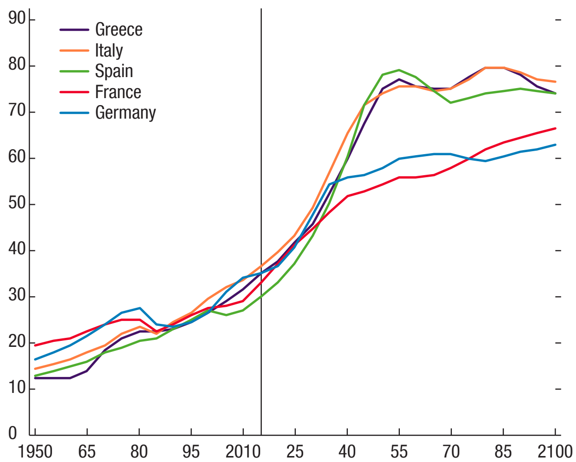

Source: Eurostat.

Several countries in emerging Europe were not able to sustain the persistent pension deficits associated with the deviation of contributions toward privately funded pensions, leading in some cases to reversals of earlier reforms. In this vein, in 2011, Hungary closed the mandatory private scheme introduced in 1998 (Szikra 2018).[11]

Crowding out other productive spending can lead to erosion of long-term potential output. The conventional wisdom holds that government—including pension—deficits can crowd out both public and private investment, thus lowering national income and living standards for future generations (Ball, Elmendorf, and Mankiw 1998). Since euro inception when the average *r–g* in advanced economies has been close to zero (see Table 2), pension spending has been negatively associated with gross fixed capital formation (Figure 26). This may point to some crowding out effect or broader problems in economies that feed back in investment, GDP, and pension spending—countries that require adjustments in their pension systems are also countries that face multiple challenges, requiring structural-fiscal reforms beyond the pension system to enhance the sustainability of overall fiscal policies. Alternatively, without reforms, to finance such levels of pension spending by other means than issuing debt would necessitate lower productive public non-pension spending or relatively high levels of labor taxation that again weigh on long-term growth. Further, large-scale pension systems espe-

[11]In 2010 Hungary eliminated the obligatory participation in the private scheme and made it possible for participants to return to public pension scheme.

**Figure 27. Elderly Relative to Working-Age Population**
*(Population aged 65+ as a ratio to population aged 20–64)*




Source: UN Population Projections (medium variant).

cially in Mediterranean countries are often accompanied by small social protection and assistance schemes. Such structure contributes to intergenerational unfairness but can also lock a country in a high debt environment by creating implicit future debt and lowering the ability to sustain adjustment programs due to lack of adequate unemployment insurance and social assistance programs for working-age population (Börsch-Supan 2013).

## Political Economy Considerations

Pension systems are put to the test by changing political economy forces that often create pressures to reverse reforms. Carrying thorough pension reforms that impose large burden on households and span over generations requires strong political ownership. This is a tall order: as populations get older—old-age dependency rates are projected to almost double in several countries (Figure 27)—pressures from a median voter to roll back on reforms are likely to intensify (Galasso 2006). By 2040 the median age of a population is projected to reach 52 years for men and 55 years for women; an increase by 19 years compared to early 1990s (Carone and others 2016). This increases the pressure for intergenerational transfers from working-age population (for example, in the form of higher taxes) to retirees (in the form of pensions or other social services).

Since reforms weigh heavily on future retirees, and thus today's young, pressures to reverse reforms are likely to mount over time. The risks for reform reversals are likely to be stronger in countries where resulting pension systems are not perceived to treat generations fairly (implying declines in the proportionality measure). Deeper intergenerational inequities can contribute to polarization in political preferences and political fragmentation. In such environments political executives can often find hard to control spending, agree on political direction or change status quo (Crivelli and others 2016), and thus actually implement necessary reforms. With gradual or phased-in reforms that protect current retirees or selected categories of population, delays in reform implementation or reversals are easier to occur. With such strategies the political costs are perceived to be largely imposed on future governments that can be tempted to renege on such inherited burden (Kohli and Arza 2011).

The empirical evidence on the political consequences of pension reforms is scarce—a testimony to the immense difficulties and complexities in carrying out such reforms. It is often expected that cutbacks in pensions are associated with broader popular dislike (Kohli and Arza 2011) and can therefore have political costs to the incumbent government. Empirical investigation of this claim is notoriously difficult. It not only requires objective political economy indicators and defining what constitutes a substantiated reform event, but also is riddled with identification difficulties as reform intensity is highest at the times of crises, reform incident can be endogenous the re-election prospects and impact contingent on several factors.

Enfranchising younger cohorts can offset the political economy forces of aging voters and increase the political acceptability and durability of reforms. The literature generally predicts that intergenerational redistribution responds to shifts in political power across generations (see, for example, Tabellini 1991). In this vein, Song and others (2012) present a theory whereby the presence of younger voters induces fiscal discipline and low debt accumulation. Bertocchi and others (2020) identify the impact of greater political engagement among the young on fiscal outcomes in the United States. They find that a 1 percent increase in young voter turnout increases the allocation of public resources toward higher education—the type of public spending most preferred by the young—by 0.77 percent. This literature therefore suggests that increasing political participation of the young, for example by allowing preregistration for young voters or lowering the voting age, could advance policies that improve the opportunities of younger generations and arguably could help to make pension reforms more durable.

Financial literacy and political and fiscal institutions can contain electoral costs and facilitate reform implementation. In an innovative study, Fornero and Lo Prete (2019) find no robust evidence of a relationship between pension reforms and re-election prospects in advanced economies.[12] They find though that this relationship is contingent on the level of basic economic and financial knowledge: while on average in their sample the frequency of pension reforms do not affect re-election probabilities, pension reforms can have electoral costs in societies where economic and financial literacy is very low and conversely reforms can provide political benefits if the economic and

[12]Related literature investigates electoral consequences of fiscal adjustment programs. Alesina, Carloni, and Lecce (2013) find no evidence that governments that carry out large fiscal adjustments suffer negative effects on their election prospects. On the contrary, they find that fiscally loose or irresponsible governments tend to lose elections more often. Similarly, Brender and Drazen (2008) show that voters are more likely to punish rather than reward persistent budget deficits over the executive's time in the office, especially in developed economics. Alesina, Favero, and Giavazzi (2019) find that while tax-based fiscal adjustments can have electoral consequences, expenditure-based do not.

financial literacy is very high.[13] Further, the impact of pension reforms as well as education on re-election probabilities become insignificant when using broader indicators of human capital instead of financial literacy. The aforementioned results suggest that promoting financial literacy in schools and educational programs for adults can enhance durability of reforms. Similarly, some elements of political and fiscal institutions can have beneficial implications. For example, Verbič and Spruk (2019), in a sample of high-income countries over the period 1970–2013, find that countries with certain elements of executive constraints, political competition, and inter-jurisdictional fiscal federalism have been significantly more likely to reform mandatory PAYG or occupational pension systems or initiate supplementary reforms to, inter alia, strengthen regulation and risk management, stimulate private pension savings and facilitate transition from unfunded to funded schemes.

Ultimately voters tend to reward good policies based on shared principles. More importantly, good reform design, once again, matters. Reforms that strengthen links between contributions and benefits appeal to shared principles of equity and fairness and can thus be easier to maintain, whereas categorical or redistributive retrenchments create more evident winners and losers, lacking broader societal backing (Kohli and Arza 2011). These authors observe that welfare cuts are more easily accepted if the burden-sharing is perceived as fair. In this sense the reforms that give due attention to the systemwide properties of sustainability and fairness should be preferred to ad hoc measures. Such comprehensive reforms based on broad societal dialogue and backing can enhance reform durability over several legislatures though are also more difficult and take time to build. For this, policymakers and the public need a shared understanding of the size, scope, and nature of the underlying problems (US GAO 2008). Experience also suggests that dedicated commissions tasked with developing reform proposals can facilitate broader coalition building and reform implementation by taking sensitive issues out of the political process and alleviate political risk. Further, the gradual reform strategies involve strong trade-offs that might not be conducive to reform durability. While long phase-in periods give households time to adapt, they also delay budgetary savings, create divides between generations, may lower credibility of reforms, and create implementation risks (Kohli and Arza 2011).

[13]While in the basic econometric specification in Fornero and Lo Prete (2019) pension reform frequency is not a significant determinant of re-election probability (see also the working paper version), the partial negative coefficient can be identified when controlling for the reform interaction with financial literacy. Since the interaction term has a positive coefficient, the impact of pension reform depends on sample values of the two variables. At the sample mean values of pension reform and financial literacy variables, the positive interaction term (more than) offsets the negative partial effect of the pension reform frequency on re-election probabilities. Thus, on average (around sample means) pension reform does not affect re-lection probabilities. It can have political costs if pension reform frequency is very high or financial literacy very low. Conversely, pension reforms can affect re-election probabilities positively if reform frequency is very low or financial literacy very high. Instrumental variable results to deal with endogeneity of reforms to election probabilities confirm the results.

CHAPTER

# 6 Policy Implications

While European countries have improved the long-term sustainability of their pension systems, many countries are not out of the woods yet. European economies have introduced several pension reforms that will fundamentally change the way and extent to which public pension schemes provide retirement income. Younger generations have to contribute more, work longer, or receive a lower share of their wages in pensions relative to current retirees.

In several countries more decisive reforms are needed to ensure fiscal sustainability and affordability of pension systems. In present value terms, we find a significant gap between benefit entitlements and contributions that will have to be financed through general revenue, competing with other productive spending. Furthermore, pension spending and deficits that reached historical highs in the aftermath of the GFC and European debt crises—especially in countries with high debt—are projected to increase further in the next few decades until the old-age dependency rates peak. Annual pension system deficits that currently stand at about 2½ percent of GDP in Europe are projected to increase to 4 percent of GDP in the next three decades. Therefore, this is not a time to stall the reform momentum: the authorities would need to diligently implement further reforms and ensure a robust fiscal position. This is even more important for countries with high pension spending that tend to be also those who have grown less and need to service relatively high government debt. Not only are these economies more susceptible to shocks given limited room for policy maneuver, but large pension outlays can crowd out other spending, both public and private, and weigh on growth.

Bridging intergenerational divides is more important than ever. Pension replacement rates in Europe over the past decade have been higher than projected before the GFC, while current AWG projections indicate lower replacement rates in the long term (in 2050–60) than projected a decade ago. Intergenerational divides between generations are therefore, yet again, expected to widen. Countries have generally chosen a gradual approach to pension reforms, whereby younger generations will get a *lower* balance between pension contributions and benefits than older generations or current retirees—the authors estimate that the initial impact of reforms was to reduce the average PM from above 2 for the elderly today to nearly 1.5 for those who are in their 20s today, only to revert to about 1.7 supported by reform reversals. While gradual reform strategy can facilitate a smooth transition, delays in implementation and persistent intergenerational gaps can heighten risks for reversals once the impact of reforms becomes evident—younger generations might perceive it unfair having to finance pension deficits of older generations while accumulating lower pension rights for themselves. To address this divide, a resolute implementation of pension reforms should be accompanied by increasing the opportunities for the youth. This could include structural reforms for more dynamic labor market conditions (Banerji and others 2014), greater protection against poverty risks at younger ages, investment in education and training, and reforms to other non-pension benefits, including unemployment insurance (Chen and others 2018). Moreover, countries would need to introduce measures to enable individuals to work longer and instruments to complement public pensions.

Addressing these imbalances ideally requires burden-sharing by both current and future retirees. Even if the legislated reforms would be implemented, they come at a cost of intergenerational divides for decades to come. In several countries the "legacies" of pension systems have ballooned the spending on the current elderly whose lifetime benefits exceed lifetime contributions on average twofold. An example of intergenerational burden-sharing could be the 2016–17 pension reforms in Greece that introduced a new pension benefit formula for the future retirees and aimed—albeit with a long phase-in period—at recalibrating pensions for current retirees. Burden-sharing by current retirees is the more important the higher current pension outlays or public debt to shield against future shocks and release resources for other productive and targeted activities.

Careful balancing is required among sustainability, efficiency-enhancing pension design, and adequacy of benefits. The design of benefit programs has a powerful impact on incentive compatibility as well as sustainability of the pension system. At the same time, well-known trade-offs can exist, in particular between redistributive policies and efficiency considerations. Labor market distortions should be minimized where this trade-off is less acute, for example, by setting actuarial adjustments for early retirement at actuarially neutral levels. Where social, basic, or minimum pensions are in place to provide poverty alleviation, care should be taken in how these interlink with earnings-related pensions or other support to elderly to smooth participation tax rates and avoid bunching effects at low years of contributions. Such improvements in design strengthen actuarial links between pension benefits and contributions that can further mitigate the adverse economic impact of overall pension contributions on labor supply or encourage participation through higher "savings" component. To enhance adequacy, reforms that foster labor force participation and higher productivity growth are the key since elderly poverty often reflects lack of employment income, short careers, or informal work. Income support could be provided outside the pension system to address specific poverty gaps, allowing to preserve links between contributions and benefits in earnings-related pension systems. Developing private pension schemes along with strengthened regulation and consumer protection and encouraging workers to save would support retirement incomes as well as diversify income sources.

Reform design to favor shared principles and financial literacy can effectively alleviate pressures to reverse reforms. While in practice pension reforms are hard and reducing benefits in payment is often perceived as politically costly, effective reform strategies can make reforms socially more acceptable and durable. Also, here the design matters—reforms that appeal to shared principles of equity and fairness—for example, by strengthening links between contributions and benefits—and lead to fairer burden-sharing can be socially more acceptable. This suggests that systemwide reforms based on broad societal dialogue and shared understanding of the objectives, although more difficult and requiring time to build, can enhance reform durability over several legislatures. Available empirical evidence further suggests that electoral impact of pension reforms is contingent on the level of basic economic and financial knowledge: pension reforms can have electoral costs in societies where economic and financial literacy is very low and conversely can provide political benefits if the economic and financial literacy is very high.

# Annex 1. Data Sources and Technical Assumptions

The following are the data sources, key definitions and technical assumptions:

- *Projection vintages* follow the 2009, 2018, and 2021 versions of the Ageing Report (EC 2009, 2018a, 2021).
- *Population data*—both historical and forecasts—is taken from the UN population database (medium variant).
- *Number of pensioners* for 2007 – (2060) 2070 are taken from the respective Ageing Report vintages and extended backward until 2005 with growth rates of number of retirees from Eurostat.
- *Workers* are defined as the part of the population aged 22 to the calculated effective retirement age. Everyone above the calculated retirement age is considered a pensioner.
- *An effective retirement age* is calculated by distributing the number of pensioners for each year to the population of that year starting from age 100 until all pensioners have been accounted for. This retirement age is extended backwards with growth rates of statutory retirement ages from the OECD for 1950–2005 and kept constant for (2060) 2070–2100. The model's sensitivity was tested to the labor market exit age as reported in the respective vintage of the Ageing Report, supplemented with the historic data taken from the OECD, yielding very similar results.[1]

[1]While a change in the retirement age will adjust the lengths of working and retirement lives, it will not alter the annual contributions and benefits that we take as given from the Ageing Report vintages and will have very little impact on lifetime contributions and benefits of cohorts. For example, higher retirement age generally implies longer years of contributions and more cohorts at any given year, but also lower annual contributions per cohort per year with little effect on a sum of contribution rates for each cohort over their lifetimes. Similarly, higher retirement age would imply both lower years over which benefits are received as well as higher benefits per cohort per year, leaving the lifetime sum of benefit rates for each cohort broadly unchanged.

- *Pension contributions* for 2007 – (2060) 2070 follow the respective Ageing Report vintages while netting out any state transfers and third-party contributions as defined in the 2018 and 2021 Ageing Report vintages. These pension contributions are extended backward with growth rates of total social contributions from the OECD for 1965–2016. Where OECD data was not available, pension contributions are assumed constant as a share of GDP prior to 1970 and after (2060) 2070 until 2100.
- *Pension expenditures* for 2007 – (2060) 2070 follow the respective Ageing Report vintages. These are extended backward with growth rates of actual pension spending data from Eurostat for 1990–2007 and from the OECD for 1980–90, and forward for (2060) 2070–2100 with growth rates of old-age dependency ratio.
- *Cohorts* are defined by their birth year.
- *Distribution of pension contributions* to different cohorts for a given year are assigned based on an interaction term between the size of the respective cohort in total workers and country-specific age-income profiles over the working life of a worker. The latter are derived from the Eurosystem Household Finance and Consumption Survey microdata (wave 3) and are kept constant before the age of 20 and after the age of 67 when smaller sample size can give rise to a selection bias. Cohort pension contributions and cohort pension expenditures are calculated by adding all contributions and expenditures over the lifetime of a cohort (22–100).
- *Distributions of pension expenditures* to different cohorts for a given year are assigned based on the size of the respective cohort in the total number of pensioners that underlies reported baseline results. As a robustness test, pension expenditures were further distributed based on a notional age profile, constructed by dividing spending after retirement by a cohort-specific index of compounded real GDP growth rates. By distributing pension spending from older to younger retirees this adjustment allows for declining spending profile as retirees get older since pensions in payment in most countries are indexed with less than nominal wage growth. The resulting PM values show minimal changes for mature pension systems and for all European countries covered decline toward zero in the long term.[2]
- *Linear interpolation* is applied to data between 5-year forecasts of the Ageing Report.
- *The proportionality measure* for a given cohort is calculated by dividing lifetime cohort benefits received by lifetime cohort pension contributions paid.

[2]The age distribution of pension spending remains relatively stable over time and across cohorts. Since the total annual pension spending in our model is constant, given by the Ageing Report vintages, the impact on the PM is minimal for mature pension systems and noticeable only for less mature pension systems at their transition period. For mature pension systems the historical impact (for older cohorts) is on average less than 0.15 index points. For all countries the impact declines in the long term, averaging at about 0.05 for younger cohorts.

# Annex 2. Data and Calculated Proportionality Measures

**Annex Table 2.1. Pension Expenditures based on Ageing Report 2021**
(Percent of GDP)

| | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | . | . | 12.6 | 13.5 | 13.9 | 13.5 | 15.1 | 15.1 | 14.7 | 14.6 | 14.3 | 14.0 | 14.4 | 15.0 |
| BGR | . | . | . | . | 9.9 | 8.4 | 8.5 | 8.6 | 9.3 | 9.8 | 9.7 | 9.8 | 10.5 | 10.4 |
| CYP | . | . | . | 5.6 | 7.2 | 9.0 | 10.0 | 10.2 | 10.1 | 10.7 | 10.9 | 10.9 | 11.1 | 11.3 |
| CZE | . | . | 6.5 | 8.0 | 8.6 | 8.1 | 8.8 | 9.8 | 11.4 | 11.8 | 10.9 | 11.1 | 11.5 | 11.5 |
| DEU | . | 10.9 | 10.0 | 10.9 | 10.6 | 10.4 | 11.5 | 12.0 | 12.2 | 12.5 | 12.4 | 12.2 | 12.6 | 13.1 |
| ESP | . | 6.3 | 8.0 | 8.8 | 10.1 | 12.4 | 12.3 | 12.8 | 13.0 | 11.7 | 10.3 | 10.6 | 10.9 | 10.9 |
| EST | . | . | . | 6.5 | 9.0 | 7.6 | 6.9 | 6.5 | 6.1 | 5.8 | 5.4 | 5.8 | 6.1 | 6.0 |
| FIN | . | 7.4 | 9.7 | 9.8 | 12.1 | 13.1 | 13.7 | 12.8 | 12.7 | 13.5 | 14.4 | 15.1 | 15.9 | 16.5 |
| FRA | . | 10.6 | 11.9 | 12.6 | 14.3 | 14.9 | 15.6 | 15.2 | 14.3 | 13.4 | 12.6 | 13.4 | 14.0 | 14.7 |
| GRC | . | 5.1 | 9.4 | 10.4 | 14.6 | 15.5 | 13.8 | 14.0 | 13.6 | 12.0 | 11.9 | 12.5 | 12.2 | 12.0 |
| HRV | . | . | . | . | 10.7 | 10.3 | 11.0 | 10.4 | 9.9 | 9.7 | 9.5 | 9.9 | 10.0 | 10.0 |
| HUN | . | . | . | 9.1 | 12.0 | 8.4 | 8.3 | 9.7 | 11.2 | 11.9 | 12.4 | 12.4 | 12.9 | 13.1 |
| IRL | . | 4.1 | 3.9 | 3.7 | 6.8 | 4.7 | 5.9 | 6.9 | 7.5 | 7.5 | 7.6 | 8.6 | 9.0 | 9.2 |
| ITA | . | 8.9 | 11.8 | 13.8 | 15.0 | 15.5 | 17.3 | 17.8 | 16.2 | 14.1 | 13.6 | 13.7 | 13.8 | 14.1 |
| LTU | . | . | . | 8.1 | 8.5 | 7.2 | 7.9 | 8.4 | 8.2 | 8.1 | 7.5 | 7.4 | 8.0 | 8.2 |
| LUX | . | 11.4 | 10.3 | 9.4 | 8.8 | 9.4 | 11.4 | 13.0 | 14.8 | 16.7 | 18.0 | 18.6 | 20.0 | 21.5 |
| LVA | . | . | . | 10.4 | 9.8 | 7.1 | 6.9 | 6.6 | 6.3 | 6.2 | 5.9 | 6.1 | 6.5 | 6.5 |
| MLT | . | . | . | 6.4 | 10.2 | 7.1 | 6.6 | 6.6 | 8.1 | 10.1 | 10.9 | 10.3 | 10.1 | 10.8 |
| NLD | . | 8.6 | 9.0 | 6.7 | 6.8 | 6.9 | 8.1 | 9.1 | 8.9 | 8.9 | 9.1 | 9.4 | 9.8 | 10.2 |
| NOR | . | . | 9.8 | 8.8 | 8.1 | 11.1 | 12.3 | 12.6 | 12.7 | 13.2 | 13.6 | 14.1 | 15.0 | 15.9 |
| POL | . | . | 6.1 | 12.7 | 11.6 | 10.8 | 11.0 | 10.5 | 10.7 | 10.8 | 10.5 | 10.7 | 10.8 | 10.4 |
| PRT | . | 4.4 | 5.8 | 9.3 | 12.7 | 12.8 | 14.2 | 14.4 | 12.6 | 10.5 | 9.5 | 9.8 | 9.7 | 9.7 |
| ROU | . | . | . | 6.4 | 9.5 | 8.9 | 12.9 | 14.2 | 14.8 | 13.6 | 11.9 | 12.6 | 12.8 | 12.8 |
| SVK | . | . | . | 7.1 | 8.3 | 8.6 | 10.2 | 11.6 | 13.4 | 14.5 | 14.2 | 13.9 | 14.7 | 14.8 |
| SVN | . | . | . | 11.1 | 11.4 | 10.0 | 10.8 | 13.6 | 15.7 | 16.1 | 16.0 | 16.2 | 16.9 | 16.9 |
| SWE | . | 9.2 | 10.1 | 9.4 | 8.4 | 7.7 | 7.4 | 7.0 | 7.0 | 7.4 | 7.5 | 7.9 | 8.5 | 8.9 |

Sources: Ageing Report vintages; Eurostat; and OECD.

## Annex Table 2.2. Pension Contributions based on Ageing Report 2021
(Percent of GDP)

| | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 5.6 | 7.8 | 8.5 | 9.5 | 8.4 | 9.4 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| BGR | . | . | . | . | 4.2 | 5.0 | 5.0 | 5.3 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |
| CYP | . | . | . | 4.0 | 5.6 | 6.6 | 7.1 | 7.7 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 | 7.6 |
| CZE | . | . | . | 7.7 | 8.4 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| DEU | 5.3 | 7.0 | 7.3 | 7.9 | 7.4 | 6.3 | 6.6 | 7.0 | 7.0 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| ESP | 5.6 | 10.4 | 10.9 | 11.1 | 10.9 | 10.0 | 9.9 | 10.1 | 10.2 | 10.6 | 10.8 | 10.8 | 10.8 | 10.8 |
| EST | . | . | . | 6.9 | 7.6 | 6.0 | 5.5 | 5.3 | 5.3 | 5.2 | 5.3 | 5.3 | 5.3 | 5.3 |
| FIN | 2.5 | 7.5 | 10.0 | 9.3 | 9.9 | 9.5 | 10.0 | 10.2 | 10.6 | 11.2 | 12.0 | 12.0 | 12.0 | 12.0 |
| FRA | 7.4 | 10.2 | 11.0 | 9.8 | 8.5 | 9.3 | 9.4 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 |
| GRC | 3.2 | 3.8 | 4.3 | 5.0 | 6.3 | 7.9 | 8.2 | 8.2 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 | 8.1 |
| HRV | . | . | . | . | 6.1 | 5.8 | 6.1 | 6.1 | 6.1 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| HUN | . | . | . | 8.3 | 8.6 | 7.7 | 7.5 | 7.4 | 7.3 | 7.3 | 7.4 | 7.4 | 7.4 | 7.4 |
| IRL | 1.6 | 3.0 | 3.2 | 3.2 | 4.4 | 3.3 | 3.3 | 2.9 | 2.8 | 2.9 | 2.8 | 2.8 | 2.8 | 2.8 |
| ITA | 9.0 | 10.5 | 11.5 | 10.0 | 11.0 | 10.8 | 11.0 | 11.0 | 11.1 | 11.1 | 11.0 | 11.0 | 11.0 | 11.0 |
| LTU | . | . | . | 6.3 | 6.7 | 3.4 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 | 3.1 |
| LUX | 4.0 | 6.0 | 5.7 | 5.7 | 5.8 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |
| LVA | . | . | . | 8.2 | 6.4 | 7.5 | 6.9 | 6.7 | 6.6 | 6.6 | 6.7 | 6.7 | 6.7 | 6.7 |
| MLT | . | . | . | 6.4 | 5.9 | 5.3 | 5.6 | 5.4 | 5.2 | 5.0 | 4.6 | 4.6 | 4.6 | 4.6 |
| NLD | 4.6 | 6.0 | 5.9 | 5.7 | 5.2 | 4.9 | 5.1 | 5.2 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| NOR | 4.5 | 7.3 | 8.7 | 8.7 | 11.5 | 11.6 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 | 11.5 |
| POL | . | . | . | 7.6 | 5.8 | 8.0 | 8.3 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| PRT | 5.1 | 7.8 | 8.7 | 9.5 | 10.9 | 10.9 | 10.6 | 9.9 | 9.4 | 9.2 | 9.2 | 9.2 | 9.2 | 9.2 |
| ROU | . | . | . | 10.7 | 7.1 | 6.7 | 6.8 | 6.6 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| SVK | . | . | . | 5.2 | 4.9 | 7.4 | 7.0 | 7.2 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 | 7.4 |
| SVN | . | . | . | 9.1 | 9.2 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| SWE | 2.4 | 5.8 | 6.2 | 6.3 | 5.9 | 5.4 | 5.4 | 5.5 | 5.6 | 5.6 | 5.7 | 5.7 | 5.7 | 5.7 |

Sources: Ageing Report vintages; Eurostat; and OECD.

## Annex Table 2.3. Old-age Dependency Ratio based on Ageing Report 2021
(Percent)

| | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 22.7 | 23.5 | 21.8 | 22.6 | 26.3 | 29.9 | 40.5 | 50.6 | 54.8 | 59.0 | 58.3 | 57.1 | 58.8 | 61.1 |
| BGR | 14.3 | 18.0 | 19.8 | 24.5 | 26.8 | 33.4 | 37.0 | 42.5 | 50.5 | 53.1 | 45.8 | 46.6 | 49.6 | 49.4 |
| CYP | 17.1 | 14.2 | 15.3 | 15.2 | 16.4 | 20.7 | 26.9 | 33.0 | 43.4 | 52.9 | 55.8 | 56.1 | 57.0 | 58.1 |
| CZE | 18.2 | 21.5 | 19.2 | 19.7 | 21.9 | 31.7 | 36.1 | 43.4 | 54.6 | 57.8 | 51.0 | 51.8 | 54.0 | 53.9 |
| DEU | 21.6 | 23.9 | 21.5 | 23.7 | 31.3 | 35.3 | 47.7 | 55.8 | 58.6 | 61.6 | 61.6 | 60.6 | 62.5 | 64.8 |
| ESP | 15.4 | 17.5 | 20.0 | 24.3 | 25.2 | 31.0 | 41.4 | 57.2 | 69.5 | 65.7 | 61.4 | 63.8 | 65.0 | 65.1 |
| EST | 17.8 | 19.0 | 17.6 | 22.3 | 26.0 | 32.3 | 37.9 | 42.2 | 48.2 | 54.3 | 47.5 | 50.3 | 53.1 | 52.7 |
| FIN | 13.8 | 17.7 | 19.9 | 22.3 | 25.8 | 36.9 | 43.3 | 43.7 | 45.7 | 48.6 | 49.5 | 52.2 | 54.7 | 56.7 |
| FRA | 20.6 | 21.8 | 21.2 | 24.7 | 26.4 | 34.1 | 40.5 | 45.6 | 46.3 | 46.2 | 48.2 | 51.2 | 53.7 | 56.2 |
| GRC | 17.4 | 20.5 | 20.4 | 24.9 | 28.7 | 35.0 | 41.3 | 53.5 | 66.0 | 67.4 | 65.7 | 69.2 | 67.7 | 66.1 |
| HRV | 13.9 | 17.2 | 16.9 | 23.2 | 26.2 | 32.4 | 39.7 | 45.1 | 52.6 | 56.6 | 58.4 | 60.9 | 61.5 | 61.5 |
| HUN | 17.1 | 21.1 | 20.4 | 22.3 | 24.4 | 30.4 | 32.9 | 37.9 | 47.0 | 51.3 | 49.0 | 49.2 | 51.0 | 52.1 |
| IRL | 18.9 | 18.0 | 18.0 | 15.5 | 16.4 | 23.4 | 29.2 | 37.0 | 45.6 | 43.9 | 43.9 | 49.7 | 52.2 | 53.4 |
| ITA | 17.3 | 20.6 | 21.5 | 26.7 | 31.2 | 38.3 | 48.6 | 63.1 | 67.6 | 65.4 | 63.4 | 64.0 | 64.5 | 65.9 |
| LTU | 16.2 | 17.4 | 16.3 | 20.9 | 25.8 | 29.3 | 36.0 | 39.0 | 37.8 | 43.2 | 41.3 | 40.8 | 43.8 | 45.2 |
| LUX | 19.3 | 20.2 | 19.3 | 21.0 | 20.5 | 21.8 | 28.3 | 34.9 | 38.7 | 40.9 | 42.8 | 44.4 | 47.8 | 51.3 |
| LVA | 18.1 | 19.5 | 17.8 | 22.4 | 27.2 | 31.3 | 36.7 | 39.4 | 42.5 | 48.6 | 42.5 | 43.5 | 46.4 | 46.6 |
| MLT | 13.7 | 14.0 | 15.2 | 17.2 | 23.7 | 32.5 | 39.9 | 44.7 | 52.0 | 59.6 | 64.5 | 61.0 | 59.7 | 63.8 |
| NLD | 16.2 | 17.3 | 18.4 | 20.0 | 23.2 | 31.8 | 41.9 | 49.0 | 47.9 | 48.7 | 51.2 | 52.7 | 54.6 | 57.3 |
| NOR | 20.5 | 23.3 | 25.2 | 23.4 | 22.7 | 26.8 | 32.2 | 37.9 | 39.8 | 43.2 | 44.4 | 46.2 | 49.1 | 51.9 |
| POL | 12.7 | 15.3 | 15.6 | 17.9 | 18.9 | 28.2 | 36.3 | 41.0 | 55.8 | 67.2 | 64.2 | 65.6 | 66.0 | 63.6 |
| PRT | 15.7 | 18.3 | 20.7 | 24.0 | 28.3 | 35.5 | 44.7 | 57.2 | 66.4 | 65.9 | 67.4 | 69.5 | 68.7 | 68.6 |
| ROU | 12.9 | 16.2 | 15.8 | 20.1 | 23.2 | 30.0 | 33.6 | 44.4 | 51.8 | 51.3 | 50.2 | 53.3 | 53.8 | 53.9 |
| SVK | 14.3 | 16.6 | 16.1 | 16.5 | 17.1 | 24.2 | 31.6 | 37.2 | 49.5 | 57.2 | 52.4 | 51.5 | 54.3 | 54.5 |
| SVN | 14.9 | 17.4 | 15.5 | 20.1 | 24.0 | 32.6 | 42.7 | 51.3 | 61.2 | 60.9 | 54.1 | 55.0 | 57.4 | 57.3 |
| SWE | 20.9 | 25.4 | 27.7 | 26.8 | 27.9 | 33.8 | 37.0 | 40.2 | 40.5 | 44.2 | 42.7 | 45.0 | 48.3 | 50.7 |

Source: United Nations.

## Annex Table 2.4. Calculated Retirement Age based on Ageing Report 2021

(Years)

| | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 56.1 | 56.1 | 56.1 | 56.1 | 55.8 | 58.4 | 59.4 | 58.8 | 59.5 | 59.7 | 59.5 | 59.5 | 59.5 | 59.5 |
| BGR | . | . | . | . | 56.8 | 58.4 | 60.1 | 62.2 | 63.4 | 63.2 | 62.7 | 62.7 | 62.7 | 62.7 |
| CYP | . | . | . | . | 62.4 | 63.5 | 63.9 | 62.6 | 61.2 | 60.9 | 63.5 | 63.5 | 63.5 | 63.5 |
| CZE | 56.7 | 54.3 | 55.3 | 55.3 | 57.1 | 59.1 | 60.7 | 62.2 | 61.9 | 61.2 | 61.6 | 61.6 | 61.6 | 61.6 |
| DEU | 60.9 | 60.9 | 60.9 | 60.9 | 60.5 | 60.7 | 61.5 | 60.2 | 60.8 | 60.4 | 60.1 | 60.1 | 60.1 | 60.1 |
| ESP | 63.4 | 63.4 | 63.4 | 63.4 | 63.6 | 63.7 | 65.3 | 65.3 | 64.3 | 62.7 | 63.2 | 63.2 | 63.2 | 63.2 |
| EST | . | . | . | . | 55.3 | 56.6 | 57.7 | 59.5 | 61.9 | 62.0 | 62.5 | 62.5 | 62.5 | 62.5 |
| FIN | 58.3 | 58.3 | 58.3 | 58.3 | 59.5 | 60.3 | 61.0 | 61.3 | 61.4 | 61.6 | 61.9 | 61.9 | 61.9 | 61.9 |
| FRA | 63.4 | 63.4 | 58.5 | 58.5 | 58.4 | 52.4 | 52.0 | 51.1 | 50.9 | 51.8 | 51.8 | 51.8 | 51.8 | 51.8 |
| GRC | 60.2 | 60.2 | 60.2 | 60.2 | 60.9 | 64.1 | 65.8 | 66.1 | 66.3 | 66.7 | 66.0 | 66.0 | 66.0 | 66.0 |
| HRV | . | . | . | . | 57.0 | 58.5 | 59.6 | 61.2 | 62.4 | 62.9 | 63.1 | 63.1 | 63.1 | 63.1 |
| HUN | 53.8 | 53.8 | 53.8 | 53.8 | 55.8 | 59.6 | 60.0 | 61.1 | 60.7 | 60.2 | 60.7 | 60.7 | 60.7 | 60.7 |
| IRL | 62.9 | 62.9 | 58.4 | 58.4 | 58.6 | 59.2 | 59.6 | 60.2 | 59.6 | 59.4 | 60.8 | 60.8 | 60.8 | 60.8 |
| ITA | 59.5 | 59.5 | 56.9 | 56.9 | 60.5 | 63.9 | 65.5 | 66.9 | 67.8 | 68.3 | 69.0 | 69.0 | 69.0 | 69.0 |
| LTU | . | . | . | . | 54.3 | 57.1 | 58.2 | 58.2 | 59.9 | 59.5 | 59.1 | 59.1 | 59.1 | 59.1 |
| LUX | 55.9 | 55.9 | 55.9 | 51.6 | 50.7 | 50.1 | 44.6 | 38.6 | 33.2 | 30.1 | 26.9 | 26.9 | 26.9 | 26.9 |
| LVA | . | . | . | . | 57.6 | 59.1 | 60.2 | 60.9 | 62.1 | 60.4 | 61.6 | 61.6 | 61.6 | 61.6 |
| MLT | . | . | . | . | 63.1 | 65.5 | 66.4 | 65.6 | 65.2 | 65.4 | 65.1 | 65.1 | 65.1 | 65.1 |
| NLD | 59.6 | 59.6 | 59.6 | 59.6 | 60.5 | 62.3 | 63.3 | 63.0 | 63.5 | 64.3 | 64.6 | 64.6 | 64.6 | 64.6 |
| NOR | 62.6 | 62.6 | 59.9 | 59.9 | 59.7 | 58.4 | 57.0 | 55.0 | 54.0 | 51.5 | 52.1 | 52.1 | 52.1 | 52.1 |
| POL | 51.5 | 51.5 | 53.6 | 53.6 | 56.0 | 60.1 | 59.9 | 60.8 | 61.1 | 60.7 | 61.2 | 61.2 | 61.2 | 61.2 |
| PRT | 58.0 | 58.0 | 56.7 | 56.7 | 59.4 | 62.2 | 63.8 | 64.6 | 65.5 | 65.3 | 65.6 | 65.6 | 65.6 | 65.6 |
| ROU | . | . | . | . | 56.0 | 59.2 | 59.2 | 59.4 | 60.2 | 61.1 | 62.4 | 62.4 | 62.4 | 62.4 |
| SVK | 56.8 | 54.4 | 55.4 | 55.4 | 56.3 | 58.3 | 57.9 | 59.3 | 59.4 | 58.7 | 59.3 | 59.3 | 59.3 | 59.3 |
| SVN | . | . | . | . | 56.7 | 58.2 | 59.1 | 59.1 | 58.4 | 57.2 | 58.4 | 58.4 | 58.4 | 58.4 |
| SWE | 61.8 | 61.8 | 59.9 | 59.9 | 60.3 | 59.7 | 60.0 | 58.9 | 59.0 | 57.2 | 58.0 | 58.0 | 58.0 | 58.0 |

Source: IMF staff calculations.

Note: See Annex 1 for definitions.

## Annex Table 2.5. Proportionality Measure based on Ageing Report 2021

(By cohort birth year)

| | 1930 | 1935 | 1940 | 1945 | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 1.99 | 2.19 | 2.08 | 1.98 | 1.93 | 2.09 | 1.84 | 1.76 | 1.68 | 1.72 | 1.84 | 1.71 | 1.72 | 1.71 | 1.73 |
| BGR | . | . | . | . | . | . | . | . | . | . | . | 1.85 | 1.86 | 1.89 | 2.04 |
| CYP | . | . | . | . | . | . | . | . | . | . | . | 1.72 | 1.71 | 1.81 | 1.82 |
| CZE | . | . | . | . | . | . | . | . | . | 1.32 | 1.28 | 1.35 | 1.46 | 1.46 | 1.47 |
| DEU | 1.99 | 1.91 | 1.76 | 1.50 | 1.63 | 1.68 | 1.77 | 1.75 | 1.81 | 2.03 | 2.04 | 2.03 | 2.01 | 1.99 | 1.95 |
| ESP | 1.43 | 1.35 | 1.36 | 1.38 | 1.38 | 1.35 | 1.25 | 1.15 | 1.15 | 1.14 | 1.11 | 1.18 | 1.25 | 1.21 | 1.25 |
| EST | . | . | . | . | . | . | . | . | . | . | . | 1.10 | 1.02 | 1.05 | 1.16 |
| FIN | . | . | 1.92 | 1.80 | 1.74 | 1.43 | 1.44 | 1.46 | 1.37 | 1.51 | 1.44 | 1.47 | 1.51 | 1.53 | 1.56 |
| FRA | . | . | 1.64 | 1.55 | 1.44 | 1.51 | 1.59 | 2.00 | 2.10 | 1.96 | 1.99 | 1.82 | 1.69 | 1.74 | 1.69 |
| GRC | 3.62 | 4.01 | 4.21 | 4.54 | 4.47 | 3.34 | 2.59 | 2.22 | 1.88 | 1.76 | 1.68 | 1.60 | 1.61 | 1.58 | 1.60 |
| HRV | . | . | . | . | . | . | . | . | . | . | . | . | 1.67 | 1.70 | 1.61 |
| HUN | . | . | . | . | . | . | . | . | 1.17 | 1.29 | 1.32 | 1.55 | 1.66 | 1.78 | 1.85 |
| IRL | 2.41 | 2.38 | 2.25 | 2.23 | 2.21 | 2.05 | 1.97 | 2.12 | 2.24 | 2.15 | 2.25 | 2.38 | 2.78 | 2.97 | 3.11 |
| ITA | 2.00 | 2.09 | 2.12 | 2.08 | 1.83 | 1.61 | 1.58 | 1.53 | 1.46 | 1.38 | 1.40 | 1.40 | 1.33 | 1.35 | 1.37 |
| LTU | . | . | . | . | . | . | . | . | . | . | . | 1.98 | 2.21 | 2.33 | 2.60 |
| LUX | 1.91 | 1.72 | 1.83 | 2.04 | 1.84 | 1.70 | 1.86 | 1.87 | 1.85 | 2.13 | 2.23 | 2.54 | 2.79 | 3.02 | 3.27 |
| LVA | . | . | . | . | . | . | . | . | . | . | . | 0.93 | 0.88 | 0.88 | 1.06 |
| MLT | . | . | . | . | . | . | . | . | . | . | . | 1.91 | 2.03 | 2.09 | 2.15 |
| NLD | 1.71 | 1.53 | 1.48 | 1.50 | 1.44 | 1.57 | 1.52 | 1.59 | 1.72 | 1.82 | 1.89 | 1.94 | 1.99 | 1.92 | 1.96 |
| NOR | 2.10 | 1.77 | 1.50 | 1.36 | 1.28 | 1.19 | 1.23 | 1.16 | 1.21 | 1.25 | 1.29 | 1.24 | 1.29 | 1.26 | 1.35 |
| POL | . | . | . | . | . | . | . | . | 1.57 | 1.46 | 1.45 | 1.35 | 1.34 | 1.41 | 1.41 |
| PRT | 1.73 | 2.15 | 2.22 | 2.16 | 2.00 | 1.67 | 1.43 | 1.31 | 1.29 | 1.15 | 1.04 | 1.04 | 1.04 | 1.06 | 1.08 |
| ROU | . | . | . | . | . | . | . | . | . | . | . | 2.35 | 2.17 | 2.21 | 2.04 |
| SVK | . | . | . | . | . | . | . | . | . | 2.19 | 2.07 | 2.09 | 2.08 | 2.09 | 2.26 |
| SVN | . | . | . | . | . | . | . | . | . | . | . | 1.80 | 1.93 | 1.96 | 2.07 |
| SWE | 3.43 | 2.71 | 2.17 | 1.83 | 1.47 | 1.29 | 1.35 | 1.36 | 1.37 | 1.35 | 1.48 | 1.49 | 1.50 | 1.42 | 1.55 |

Source: IMF staff calculations.

## Annex Table 2.6. Proportionality Measure based on Ageing Report 2018

(By cohort birth year)

| | 1930 | 1935 | 1940 | 1945 | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | 1.99 | 2.19 | 2.08 | 1.97 | 1.92 | 2.08 | 1.82 | 1.72 | 1.64 | 1.66 | 1.78 | 1.76 | 1.65 | 1.65 | 1.57 |
| BGR | . | . | . | . | . | . | . | . | . | . | . | 2.31 | 2.17 | 2.22 | 2.41 |
| CYP | . | . | . | . | . | . | . | . | . | . | . | 1.89 | 1.92 | 1.80 | 1.74 |
| CZE | . | . | . | . | . | . | . | . | . | 1.28 | 1.36 | 1.45 | 1.49 | 1.51 | 1.64 |
| DEU | 1.99 | 1.91 | 1.75 | 1.49 | 1.61 | 1.66 | 1.75 | 1.84 | 1.76 | 1.96 | 1.95 | 1.92 | 1.88 | 1.85 | 1.80 |
| ESP | 1.43 | 1.34 | 1.35 | 1.37 | 1.38 | 1.36 | 1.26 | 1.26 | 1.24 | 1.22 | 1.17 | 1.15 | 1.21 | 1.18 | 1.18 |
| EST | . | . | . | . | . | . | . | . | . | . | . | 1.36 | 1.35 | 1.39 | 1.52 |
| FIN | . | . | 1.97 | 1.89 | 1.85 | 1.56 | 1.59 | 1.50 | 1.49 | 1.50 | 1.40 | 1.40 | 1.42 | 1.35 | 1.37 |
| FRA | . | . | 1.73 | 1.69 | 1.62 | 1.75 | 1.91 | 1.78 | 1.79 | 1.65 | 1.62 | 1.57 | 1.54 | 1.53 | 1.53 |
| GRC | 3.57 | 3.88 | 4.00 | 4.22 | 4.08 | 2.95 | 2.39 | 2.14 | 1.87 | 1.78 | 1.71 | 1.52 | 1.62 | 1.58 | 1.68 |
| HRV | . | . | . | . | . | . | . | . | . | . | . | . | 1.23 | 1.34 | 1.28 |
| HUN | . | . | . | . | . | . | . | . | 1.08 | 1.22 | 1.21 | 1.30 | 1.36 | 1.42 | 1.46 |
| IRL | 2.42 | 2.40 | 2.29 | 2.29 | 2.29 | 2.15 | 2.09 | 2.08 | 2.17 | 2.05 | 2.07 | 2.11 | 2.20 | 2.38 | 2.53 |
| ITA | 2.00 | 2.09 | 2.13 | 2.11 | 1.87 | 1.66 | 1.65 | 1.61 | 1.57 | 1.49 | 1.50 | 1.40 | 1.41 | 1.42 | 1.35 |
| LTU | . | . | . | . | . | . | . | . | . | . | . | 0.96 | 0.90 | 0.87 | 0.86 |
| LUX | 1.91 | 1.72 | 1.83 | 2.05 | 1.86 | 1.75 | 1.95 | 2.02 | 2.08 | 2.14 | 2.42 | 2.65 | 2.90 | 2.89 | 2.90 |
| LVA | . | . | . | . | . | . | . | . | . | . | . | 0.89 | 0.81 | 0.78 | 0.91 |
| MLT | . | . | . | . | . | . | . | . | . | . | . | 2.30 | 2.44 | 2.51 | 2.54 |
| NLD | 1.71 | 1.53 | 1.46 | 1.47 | 1.40 | 1.50 | 1.52 | 1.58 | 1.61 | 1.70 | 1.77 | 1.70 | 1.74 | 1.69 | 1.63 |
| NOR | 2.10 | 1.78 | 1.52 | 1.40 | 1.33 | 1.25 | 1.24 | 1.20 | 1.19 | 1.18 | 1.17 | 1.17 | 1.18 | 1.28 | 1.30 |
| POL | . | . | . | . | . | . | . | . | 1.63 | 1.53 | 1.54 | 1.43 | 1.42 | 1.39 | 1.38 |
| PRT | 1.73 | 2.15 | 2.23 | 2.17 | 2.01 | 1.69 | 1.56 | 1.46 | 1.39 | 1.32 | 1.36 | 1.40 | 1.42 | 1.41 | 1.38 |
| ROU | . | . | . | . | . | . | . | . | . | . | . | 1.68 | 1.65 | 1.87 | 1.88 |
| SVK | . | . | . | . | . | . | . | . | . | 1.53 | 1.49 | 1.46 | 1.52 | 1.49 | 1.54 |
| SVN | . | . | . | . | . | . | . | . | . | . | . | 1.90 | 1.91 | 2.04 | 2.02 |
| SWE | 3.43 | 2.71 | 2.16 | 1.82 | 1.46 | 1.27 | 1.23 | 1.31 | 1.23 | 1.28 | 1.31 | 1.40 | 1.40 | 1.40 | 1.52 |

Source: IMF staff calculations.

## Annex Table 2.7. Proportionality Measure based on Ageing Report 2009

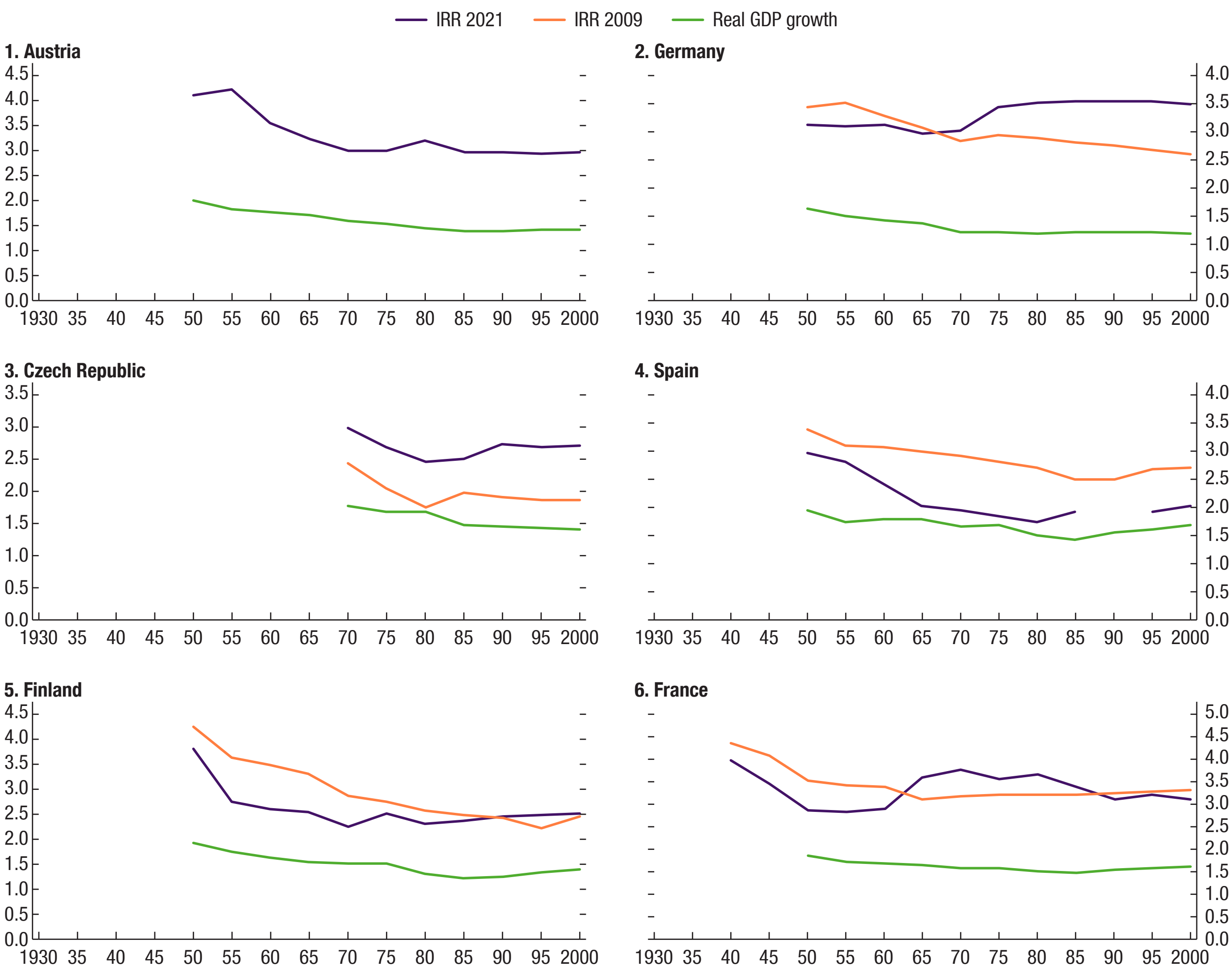
(By cohort birth year)

| | 1930 | 1935 | 1940 | 1945 | 1950 | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUT | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| BGR | . | . | . | . | . | . | . | . | . | . | . | 1.58 | 1.48 | 1.50 | 1.48 |
| CYP | . | . | . | . | . | . | . | . | . | . | . | 3.88 | 4.24 | 4.18 | 4.46 |
| CZE | . | . | . | . | . | . | . | . | . | 1.17 | 1.16 | 1.31 | 1.33 | 1.33 | 1.33 |
| DEU | 2.02 | 1.97 | 1.84 | 1.61 | 1.68 | 1.79 | 1.77 | 1.73 | 1.66 | 1.73 | 1.74 | 1.72 | 1.71 | 1.70 | 1.68 |
| ESP | 1.33 | 1.20 | 1.15 | 1.13 | 1.14 | 1.11 | 1.18 | 1.27 | 1.36 | 1.44 | 1.49 | 1.44 | 1.46 | 1.56 | 1.56 |
| EST | . | . | . | . | . | . | . | . | . | . | . | 0.91 | 0.79 | 0.73 | 0.87 |
| FIN | . | . | 1.81 | 1.69 | 1.63 | 1.47 | 1.50 | 1.51 | 1.39 | 1.40 | 1.37 | 1.35 | 1.35 | 1.27 | 1.38 |
| FRA | . | . | 1.74 | 1.71 | 1.52 | 1.54 | 1.55 | 1.47 | 1.51 | 1.54 | 1.56 | 1.57 | 1.60 | 1.63 | 1.66 |
| GRC | 3.28 | 3.48 | 3.58 | 3.87 | 3.93 | 3.64 | 3.90 | 3.83 | 3.87 | 3.97 | 4.34 | 4.37 | 4.81 | 4.75 | 5.10 |
| HRV | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| HUN | . | . | . | . | . | . | . | . | 1.57 | 1.66 | 1.53 | 1.63 | 1.59 | 1.63 | 1.67 |
| IRL | 2.21 | 2.11 | 1.93 | 1.87 | 1.83 | 1.91 | 2.09 | 2.15 | 2.33 | 2.31 | 2.44 | 2.60 | 2.77 | 3.05 | 2.94 |
| ITA | 1.90 | 1.92 | 1.86 | 1.73 | 1.51 | 1.36 | 1.39 | 1.44 | 1.49 | 1.52 | 1.42 | 1.41 | 1.40 | 1.39 | 1.39 |
| LTU | . | . | . | . | . | . | . | . | . | . | . | 1.84 | 1.86 | 1.69 | 1.74 |
| LUX | 1.90 | 1.71 | 1.83 | 2.06 | 1.89 | 1.80 | 2.01 | 2.29 | 2.33 | 2.51 | 2.96 | 3.81 | 4.15 | 4.95 | 5.85 |
| LVA | . | . | . | . | . | . | . | . | . | . | . | 0.92 | 0.91 | 0.89 | 0.85 |
| MLT | . | . | . | . | . | . | . | . | . | . | . | 2.28 | 2.37 | 2.31 | 2.39 |
| NLD | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| NOR | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| POL | . | . | . | . | . | . | . | . | 1.52 | 1.64 | 1.67 | 1.69 | 1.67 | 1.73 | 1.77 |
| PRT | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| ROU | . | . | . | . | . | . | . | . | . | . | . | 2.64 | 2.72 | 2.50 | 2.49 |
| SVK | . | . | . | . | . | . | . | . | . | 2.07 | 2.12 | 2.13 | 2.23 | 2.15 | 2.36 |
| SVN | . | . | . | . | . | . | . | . | . | . | . | 2.24 | 2.22 | 2.20 | 2.29 |
| SWE | 3.54 | 2.86 | 2.36 | 2.07 | 1.73 | 1.66 | 1.61 | 1.71 | 1.70 | 1.62 | 1.73 | 1.70 | 1.68 | 1.58 | 1.72 |

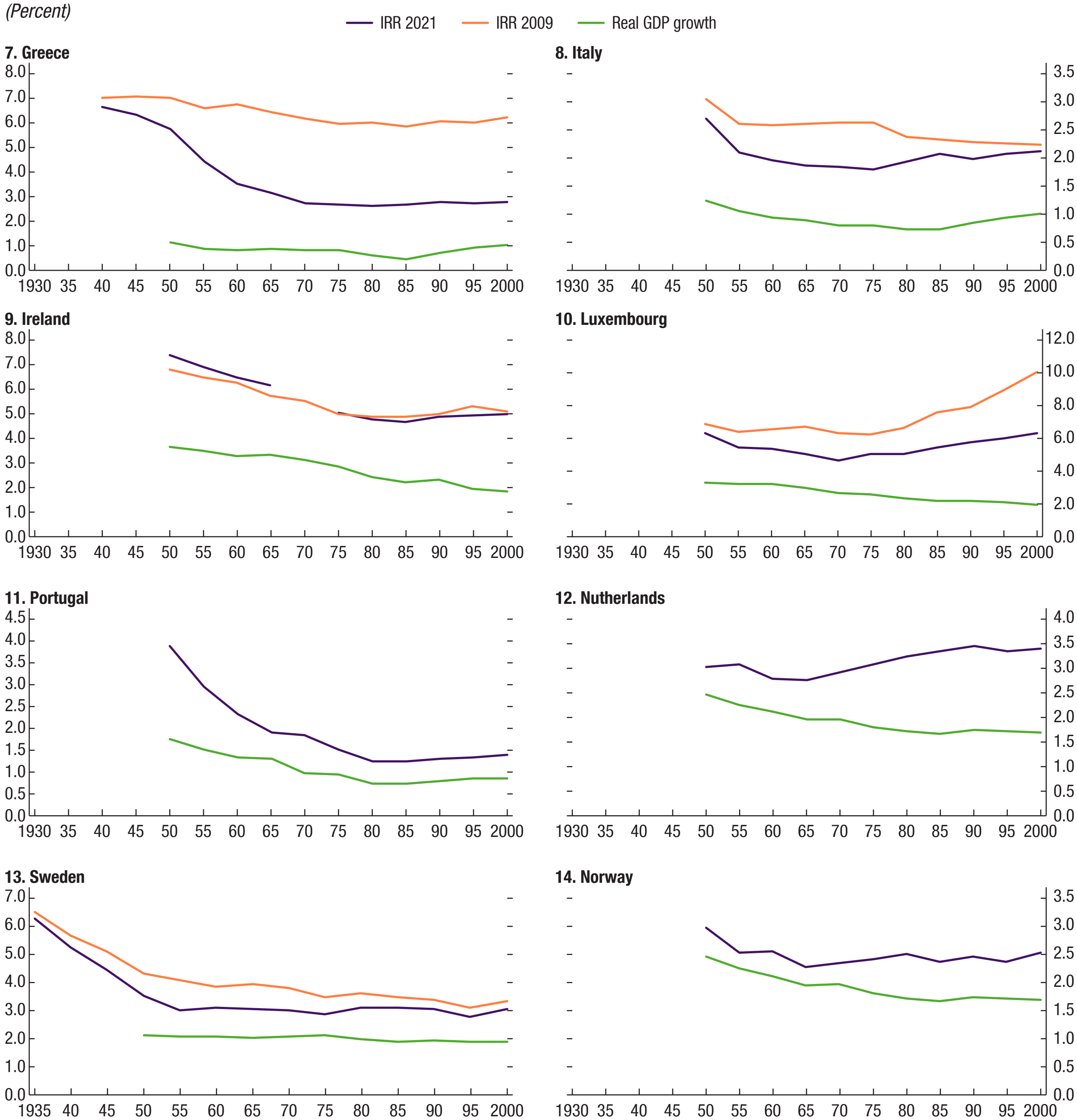
Source: IMF staff calculations.

# Annex 3. Internal Rates of Return

**Annex Figure 3.1. Real Internal Rates of Return and Real GDP Growth by Cohort Birth Year**
*(Percent)*



**Annex Figure 3.1. Real Internal Rates of Return and Real GDP Growth by Cohort Birth Year (continued)**
*(Percent)*




Sources: 2009, 2018, and 2021 Ageing Report; Eurostat; and IMF staff calculations.
Note: Real internal rates of return by cohort birth year. Real GDP growth rates for the same cohorts are averages calculated from the year of entrance into working life to the end of pension period.

## Annex Table 3.1. Real Internal Rates of Return based on Ageing Reports 2009, 2018, 2021
(Percent)

| | 2009 | | | | | | 2018 | | | | | | 2021 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 | 1950 | 1960 | 1970 | 1980 | 1990 | 2000 |
| AUT | | | | | | | 4.15 | 3.61 | 3.08 | 3.28 | 2.93 | 2.63 | 4.13 | 3.56 | 2.99 | 3.22 | 2.97 | 2.97 |
| BGR | | | | | 2.31 | 2.11 | | | | | 3.70 | 3.93 | | | | | 3.24 | 3.50 |
| CYP | | | | | 7.22 | 7.09 | | | | | 3.57 | 3.14 | | | | | 3.68 | 3.71 |
| CZE | | | 2.43 | 1.75 | 1.91 | 1.87 | | | 2.49 | 2.34 | 2.55 | 2.85 | | | 2.98 | 2.44 | 2.72 | 2.71 |
| DEU | 3.43 | 3.29 | 2.85 | 2.90 | 2.75 | 2.60 | 3.10 | 3.11 | 2.95 | 3.31 | 3.19 | 3.03 | 3.12 | 3.14 | 3.02 | 3.52 | 3.55 | 3.50 |
| ESP | 3.37 | 3.06 | 2.90 | 2.71 | 2.48 | 2.69 | 2.73 | 2.08 | 1.89 | 1.82 | 2.16 | 2.27 | 2.96 | 2.42 | 1.93 | 1.73 | 2.05 | 2.01 |
| EST | | | | | 0.38 | 0.59 | | | | | 2.21 | 2.49 | | | | | 1.67 | 1.91 |
| FIN | 4.26 | 3.49 | 2.87 | 2.58 | 2.43 | 2.45 | 3.86 | 2.73 | 2.40 | 2.29 | 2.46 | 2.38 | 3.80 | 2.61 | 2.25 | 2.32 | 2.45 | 2.52 |
| FRA | 3.51 | 3.38 | 3.17 | 3.21 | 3.23 | 3.33 | 3.22 | 3.51 | 3.26 | 3.07 | 3.02 | 3.00 | 2.85 | 2.89 | 3.77 | 3.65 | 3.12 | 3.10 |
| GRC | 7.03 | 6.76 | 6.20 | 6.05 | 6.10 | 6.25 | 5.42 | 2.96 | 2.25 | 2.21 | 2.39 | 2.63 | 5.77 | 3.55 | 2.72 | 2.64 | 2.77 | 2.77 |
| HRV | | | | | | | | | | | 1.92 | 1.93 | | | | | 2.66 | 2.46 |
| HUN | | | | 2.92 | 2.63 | 2.60 | | | | 2.19 | 2.42 | 2.54 | | | | 2.78 | 3.27 | 3.40 |
| IRL | 6.79 | 6.26 | 5.50 | 4.89 | 5.00 | 5.11 | 7.29 | 6.19 | 5.21 | 4.33 | 4.21 | 4.62 | 7.39 | 6.45 | 5.75 | 4.77 | 4.90 | 4.96 |
| ITA | 3.06 | 2.59 | 2.64 | 2.37 | 2.28 | 2.25 | 2.69 | 1.94 | 1.80 | 1.92 | 1.98 | 1.91 | 2.71 | 1.97 | 1.83 | 1.94 | 1.99 | 2.12 |
| LTU | | | | | 2.72 | 2.15 | | | | | 0.64 | 0.69 | | | | | 3.55 | 3.89 |
| LUX | 6.87 | 6.53 | 6.29 | 6.63 | 7.91 | 10.08 | 6.44 | 5.77 | 5.50 | 5.58 | 5.91 | 5.54 | 6.31 | 5.37 | 4.65 | 5.04 | 5.75 | 6.28 |
| LVA | | | | | 0.45 | 0.27 | | | | | 0.78 | 1.03 | | | | | 0.60 | 1.11 |
| MLT | | | | | 3.65 | 3.49 | | | | | 4.53 | 4.31 | | | | | 3.99 | 3.76 |
| NLD | | | | | | | 2.89 | 2.80 | 2.79 | 3.15 | 3.19 | 2.95 | 3.02 | 2.79 | 2.91 | 3.23 | 3.45 | 3.39 |
| NOR | | | | | | | 3.15 | 2.64 | 2.38 | 2.25 | 2.22 | 2.44 | 2.97 | 2.56 | 2.35 | 2.51 | 2.47 | 2.53 |
| POL | | | 3.48 | 2.80 | 2.18 | 2.13 | | | 3.83 | 2.90 | 2.16 | 1.91 | | | 4.09 | 3.00 | 2.16 | 2.06 |
| PRT | | | | | | | 3.76 | 2.37 | 1.84 | 1.75 | 1.92 | 1.81 | 3.88 | 2.32 | 1.85 | 1.24 | 1.30 | 1.40 |
| ROU | | | | | 4.14 | 3.43 | | | | | 3.07 | 3.34 | | | | | 4.06 | 3.48 |
| SVK | | | | 3.77 | 3.19 | 3.07 | | | | 3.21 | 2.86 | 2.73 | | | | 3.93 | 3.59 | 3.74 |
| SVN | | | | | 3.41 | 3.46 | | | | | 3.41 | 3.55 | | | | | 3.45 | 3.51 |
| SWE | 4.33 | 3.84 | 3.78 | 3.60 | 3.37 | 3.35 | 3.49 | 2.86 | 2.69 | 2.82 | 2.93 | 3.11 | 3.52 | 3.11 | 3.01 | 3.11 | 3.05 | 3.03 |

Source: IMF staff calculations.

# References


Aaron, Henry. 1966. "The Social Insurance Paradox." *Canadian Journal of Economics and Political Science* 32 (3): 371–74.

Adams, J. Stacy. 1963. "Towards an Understanding of Inequity." *The Journal of Abnormal and Social Psychology* 67 (5): 422–36.

Alesina, Alberto F., Dorian Carloni, and Giampaolo Lecce. 2013. "The Electoral Consequences of Large Fiscal Adjustments." In *Fiscal Policy after the Financial Crisis*, edited by Alberto Alesina and Francesco Giavazzi, 531–70. Cambridge, MA: National Bureau of Economic Research.

Alesina, Alberto, Carlo Favero, and Francesco Giavazzi. 2019. *Austerity: When It Works and When It Doesn't*. Princeton, NJ: Princeton University Press.

Andrle, Michal, Shafik Hebous, Alvar Kangur, and Mehdi Raissi. 2018. "Italy: Toward a Growth-Friendly Fiscal Reform." IMF Working Paper 18/59, International Monetary Fund, Washington, DC.

Ball, Laurence, Douglas W. Elmendorf, and N. Gregory Mankiw. 1998. "The Deficit Gamble." *Journal of Money, Credit and Banking* 30 (4): 699–720.

Banerji, Angana, Sergejs Saksonovs, Huidan Lin, and Rodolpe Blavy. 2014. "Youth Unemployment in Advanced Economies in Europe; Searching for Solutions." IMF Staff Discussion Note 14/11, International Monetary Fund, Washington, DC.

Barr, Nicholas, and Peter Diamond. 2008. *Reforming Pensions: Principles and Policy Choices*. Oxford: Oxford University Press.

Barr, Nicholas, and Peter Diamond. 2010. *Pension Reform: A Short Guide*. Oxford: Oxford University Press.

Bassanini, Andrea, and Romain Duval. 2006. "Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions." OECD Economics Department Working Paper 486, OECD Publishing, Paris.

Batog, Cristina, Ernesto Crivelli, Anna Ilyina, Zoltan Jakab, Jaewoo Lee, Anvar Musayev, Iva Petrova, Alasdair Scott, Anna Shabunina, Andreas Tudyka, Xin Cindy Xu, and Ruifeng Zhang. 2019. "Demographic Headwinds in Central and Eastern Europe." IMF Department Paper 19/12, International Monetary Fund, Washington, DC.

Bertocchi, Graziella, Arcangelo Dimico, Francesco Lancia, and Alessa Russo. 2020. "Youth Enfranchisement, Political Responsiveness, and Education Expenditure: Evidence from the US." *American Economic Journal: Economic Policy* 12 (3): 76–106.

Blanchard, Olivier J., Jean-Claude Chouraqui, Robert Hagemann, and Nicola Sartor. 1990. "The Sustainability of Fiscal Policy: New Answers to an Old Question." *OECD Economic Studies* 15: 7–36.

Blondal, Sveinbjörn and Stefano Scarpetta. 1999. "The Retirement Decision in OECD Countries." OECD Economics Department Working Papers No. 202.

Brender, Adi, and Allan Drazen. 2008. "How Do Budget Deficits and Economic Growth Affect Reelection Prospects? Evidence from a Large Panel of Countries." *American Economic Review* 98 (5): 2203–20.

Brown, Jeffrey R., Zoran Ivković, and Scott Weisbenner. 2010. "Political Risk and Discount Rates: Evidence from the Croatian Pension System." NBER Working Paper 10–07, National Bureau of Economic Research, Cambridge, MA.

Börsch-Supan, Axel. 2000. "Incentive Effects of Social Security on Labor Force Participation: Evidence in Germany and Across Europe." *Journal of Public Economics*, 78: 25–49.

Börsch-Supan, Axel. 2006. "What Are NDC Systems? What Do They Bring to Reform Strategies?" In *Pension Reform: Issues and Prospects for Non-Financial Defined Contribution Schemes*, edited by Robert Holzmann and Edward Palmer, 35–55. Washington, DC: The World Bank.

Börsch-Supan, Axel. 2013. "Entitlement Reforms in Europe: Policy Mixes in the Current Pension Reform Process." In *Fiscal Policy after the Financial Crisis*, edited by Alberto Alesina and Francesco Giavazzi, 405–35. Cambridge, MA: National Bureau of Economic Research.

Carone, Giuseppe, Per Eckefeldt, Luigi Giamboni, Veli Laine, and Stéphanie Pamies Sumner. 2016. "Pension Reforms in the EU since the Early 2000's: Achievements and Challenges Ahead." European Economy Discussion Paper 42, European Commission, Brussels.

Chen, Tingyun, Jean-Jacques Hallaert, Alexander Pitt, Haonan Qu, Maximilien Queyranne, Alaina Rhee, Anna Shabunina, Jérôme Vandenbussche, and Irene Yackovlev. 2018. "Inequality and Poverty across Generations in the European Union." IMF Staff Discussion Note 18/01, International Monetary Fund, Washington, DC.

Clements, Benedict J., Frank Eich, and Sanjeev Gupta. 2014. *Equitable and Sustainable Pensions: Challenges and Experience*. Washington, DC: International Monetary Fund.

Congressional Budget Office. 2019. "CBO's Long-Term Social Security Projections: Changes Since 2018 and Comparisons with the Social Security Trustees' Projections." https://www.cbo.gov/publication/55914.

Crivelli, Ernesto, Sanjeev Gupta, Carlos Mulas-Granados and Carolina Correa-Caro. 2016. "Fragmented Politics and Public Debt." IMF Working Paper 16/190, International Monetary Fund, Washington, DC.

Disney, Richard. 2004. "Are Contributions to Public Pension Programmes a Tax on Employment?" *Economic Policy* 19 (39): 267–311.

Dolenc, Primož, and Suzana Laporšek. 2012. "Labour Taxation and its Impact on Employment Growth." *Managing Global Transitions* 10 (3): 301–18.

European Commission. 2009. "The 2009 Ageing Report: Economic and Budgetary Projections for the EU-27 Member States (2008–2060)." European Economy 2, European Commission, Brussels.

European Commission. 2017a. "An Evaluation of the Scale of Undeclared Work in the European Union and Its Structural Determinants: Estimates using the Labour Input Method." European Commission, Brussels.

European Commission. 2017b. "The 2018 Ageing Report: Underlying Assumptions & Projection Methodologies." European Economy Institutional Paper 65, European Commission, Brussels.

European Commission. 2018a. "The 2018 Ageing Report: Economic and Budgetary Projections for the 28 EU Member States (2016–2070)." European Economy Institutional Paper 79, European Commission, Brussels.

European Commission. 2018b. "The 2018 Pension Adequacy Report: Current and Future Income Adequacy in Old Age in the EU." Volume I. Publication Office of the European Union, Luxembourg.

European Commission. 2020. "Quarterly Report on the Euro Area." Institutional Paper 135, European Commission, Brussels.

European Commission. 2021. "The 2021 Ageing Report: Economic and Budgetary Projections for the EU Member States (2019–2070)." European Economy Institutional Paper 148, European Commission, Brussels.

Égert, Balázs. 2012. "The Impact of Changes in Second Pension Pillars on Public Finances in Central and Eastern Europe." OECD Economics Department Working Paper 942, Organisation for Economic Co-operation and Development, Paris.

European Parliament. 2007. "The Role of Minimum Income for Social Inclusion in the European Union." Policy Department Economic and Scientific Policy, European Parliament, Brussels.

Eurostat and European Central Bank. 2011. "Technical Compilation Guide for Pension Data in National Accounts," Eurostat Methodologies and Working Papers, Luxembourg.

Fornero, Elsa, and Anna Lo Prete. 2019. "Voting in the Aftermath of a Pension Reform: The Role of Financial Literacy." *Journal of Pension Economics & Finance* 18 (1): 1–30.

Freudenberg, Christoph, Natalie Laub, and Tim Sutor. 2018. "Pension Decrement Rates across Europe – Are They Too Low?" *The Journal of the Economics of Aging* 12: 35–45.

Galasso, Vincenzo. 2006. *The Political Future of Social Security in Aging Societies*. Cambridge, MA: MIT Press.

Gruber, Jonathan, and David Wise. 1998, "Social Security and Retirement: An International Comparison." *The American Economic Review* 88 (2): 158–63.

Gruber, Jonathan, and David Wise. 2004. *Social Security Programs and Retirement around the World.* Chicago, IL: University of Chicago Press.

Holzmann, Robert, Edward Palmer, Robert Palacios, and Stefano Sacchi. 2020. *Progress and Challenges of Nonfinancial Defined Contribution Pension Schemes: Volume 1. Addressing Marginalization, Polarization, and the Labor Market*. Washington, DC: World Bank.

Holzmann, Robert. 2002. "The World Bank Approach to Pension Reform." *International Social Security Review* 53 (1): 11–34.

International Monetary Fund (IMF). 2011, "The Challenge of Public Pension Reform in Advanced and Emerging Economies." IMF Policy Paper, Washington, DC.

International Monetary Fund (IMF). 2012. "Fiscal Policy and Employment in Advanced and Emerging Economies." IMF Policy Paper, Washington, DC.

International Monetary Fund (IMF). 2017. "Reforming the Greek Pension System." IMF Country Report 17/41, Washington, DC.

International Monetary Fund (IMF). 2019. "The Pension System in Luxembourg." IMF Country Report 19/131, Washington, DC.

Jiménez-Martín, Sergi. 2014. "The Incentive Effects of Minimum Pensions: Extended Version." Working Paper 2014–04, FEDEA.

Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick, and Alan M. Taylor. 2019. "The Rate of Return on Everything, 1870–2015." *The Quarterly Journal of Economics* 134 (3): 1225–98.

Knell, Markus. 2005a. "Demographic Fluctuations, Sustainability Factors and Intergenerational Fairness – An Assessment of Austria's New Pension System." ONB Monetary Policy & The Economy Q1/05, Oesterreichische Nationalbank, Vienna, Austria.

Knell, Markus. 2005b. "On the Design of Sustainable and Fair PAYG Pension Systems When Cohort Sizes Change." ONB Working Paper 95, Oesterreichische Nationalbank, Vienna, Austria.

Knell, Markus. 2010. "How Automatic Adjustment Factors Affect the Internal Rate of Return of PAYG Pension Systems." *Journal of Pension Economics and Finance* 9 (1): 1–23.

Kohli, Martin, and Camila Arza. 2011. "The Political Economy of Pension Reform in Europe." In *Handbook of Aging and the Social Sciences*, edited by R. H. Binstock and L. K. George, seventh edition, 251–64. San Diego, CA: Academic Press.

Lindbeck, Assar, and Mats Persson. 2003. "The Gains from Pension Reform." *Journal of Economic Literature* XLI: 74–112.

Mauro, Paolo, and Jing Zhou. 2020. "r-g<0: Can We Sleep More Soundly?" IMF Working Paper 20/52, International Monetary Fund, Washington, DC.

Nickell, Stephen. 2003. "Employment and Taxes." CESifo Working Paper 1109, Center for Economic Studies and ifo Institute, Munich.

Organisation for Economic Co-operation and Development. 2005. "Pensions at a Glance 2005: Public Policies Across OECD Countries." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2007. "Pensions at a Glance 2007: Public Policies Across OECD Countries." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2009a. "Pensions at a Glance 2009: Retirement-income Systems in OECD Countries." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2009b, "The Jobs Crisis: What Are the Implications for Employment and Social Policy?" In *OECD Employment Outlook 2009: Tackling the Jobs Crisis*, 17–115. Paris: OECD Publishing.

Organisation for Economic Co-operation and Development. 2011a, "Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2011b. "Taxation and Employment." *OECD Tax Policy Studies* 21.

Organisation for Economic Co-operation and Development. 2013. "Pensions at a Glance 2013: OECD and G20 Indicators." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2015. "Pensions at a Glance 2015: OECD and G20 Indicators." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2017. "Pensions at a Glance 2017: OECD and G20 Indicators." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2019. "Pensions at a Glance 2019: OECD and G20 Indicators." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. 2020. "Guidelines for the OECD Table on Social Insurance Pension Schemes (Table 2900)." OECD Publishing, Paris.

Organisation for Economic Co-operation and Development and International Monetary Fund. 2015. "Fiscal Policy and Growth: Why, What and How?" OECD Publishing, Paris.

Palmer, Edward, Sandra Stabina, Ingemar Svensson, and Inta Vanovska. 2006. "NDC Strategy in Latvia: Implementation and Prospects for the Future." In *Pension Reform: Issues and Prospects for Non-Financial Defined Contribution Schemes*, edited by Robert Holzmann and Edward Palmer, 397–424.

Queisser, Monika, and Edward Whitehouse. 2006. "Neutral or Fair? Actuarial Concepts and Pension-system Design." OECD Social, Employment and Migration Working Paper 40, Organisation for Economic Co-operation and Development, Paris.

Samuelson, Paul A. 1958. "An Exact Consumption-Loan Model of Interest With or Without the Social Contrivance of Money." *Journal of Political Economy* 6: 467–82.

Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti. 2012. "Rotten Parents and Disciplined Children: A Politico-Economic Theory of Public Expenditure and Debt." *Econometrica* 80 (6): 2785–803.

Soto, Mauricio. 2017. "Pension Shock." *Finance & Development* 54 (2): 14–15.

Szikra, Dorottya. 2018. "Reversing Privatization and Re-Nationalizing Pensions in Hungary." ESS Working Paper 66, International Labor Organization, Geneva.

Tabellini, Guido. 1991. "The Politics of Intergenerational Redistribution." *Journal of Political Economy* 99 (2): 335–57.

US Government Accountability Office. 2008. "Entitlement Reform Process: Other Countries' Experiences Provide Useful Insights for the United States." Report to the Committee on the Budget, US Senate, GAO-08–372, Washington, DC.

US Social Security Administration. 2018. "Social Security Programs Throughout the World: Europe." Washington, DC.

US Social Security Board of Trustees. 2020. "The 2020 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds." Washington, D.C.

Velasquez, Agustin, and Svetlana Vtyurina. 2019. "How does Taxation affect Hours Worked in EU New Member States?" IMF Working Paper 19/130, International Monetary Fund, Washington, DC.

Verbič, Miroslav, and Rok Spruk. 2019. "Political economy of pension reforms: an empirical investigation." *European Journal of Law and Economics* 47: 171–232.

Wilke, Christina Benita. 2005. "Rates of Return of the German PAYG System – How They Can be Measured and How They Will Develop." MEA Discussion Paper Series, Munich Center for the Economics of Aging, Munich.

Wong, Boris. 2016. "Formal Sector Labor Supply Responses to the 2008 Chilean Pension System Reform." Manuscript, University of California San Diego, San Diego, CA.

Zimčík, Petr. 2017. "Tax Wedge in OECD Countries - A New Evidence." Organisation for Economic Co-operation and Development, Paris.