Nonfinancial Defined Return (NDR) pension framework and a new perspective on pension system sustainability

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We propose Nonfinancial Defined Return (NDR) as a novel abstract framework for pension systems, building upon the Nonfinancial Defined Contributions (NDC) scheme. NDC has been implemented in several countries, including Sweden. It shares key features with the German pension system. NDR emphasizes a direct link between contributions and benefits, with each unit of contribution corresponding to one expected unit of benefit. Participants accumulate index points according to specific contribution rules. These index points are then converted into annual pensions via an insurance mechanism. Balancing rules manage the difference between contribution revenues and pension expenses.

NDR-GDP represents the special case where the indexation method is tied to GDP, balanced through government transfers by default. We further introduce the concept of delta-sustainability. A pension system is called delta-sustainable if the sum of unfunded liabilities relative to GDP remains constant over time, and government transfers reduce liabilities by the amount of the transfer. NDR-GDP is delta-sustainable, justifying the balancing via government transfers.

The NDR framework and the concept of delta-sustainability offer fresh perspectives on pension system sustainability, with NDR-GDP presenting a novel approach to address demographic challenges in pension reforms.

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1. Introduction

Pension systems constitute a critical component of social welfare programs, providing financial support to retirees after they leave the workforce. Pension systems serve as a safeguard against poverty among the elderly and contribute to the overall stability of society. However, with demographic shifts and economic challenges becoming increasingly prevalent, questions surrounding the sustainability of pension systems have come to the forefront of public discourse.

While it is commonly argued that a declining contribution base, driven by demographic shifts, poses a threat to the sustainability of public pay-as-you-go (PAYG) pension schemes, we propose a new perspective on this issue. Traditionally, to maintain sustainability, adjustments such as increasing contributions or decreasing benefits, including implicit measures like raising the retirement age, are considered necessary. This perspective is supported by the existence of automatic adjustment mechanisms[1] in several countries, such as Sweden and Germany (OECD 2021). However, in this paper, we challenge this popular view by introducing the concept of *delta-sustainability*, which offers a new perspective on pension system viability. Delta-sustainability allows to incorporate government transfers as a means to address demographic challenges. In fact, delta-sustainability provides an argument for why this approach can be viewed as sustainable.

In essence, delta-sustainability suggests that declining contributions also lead to a reduction in pension claims. From a holistic state perspective, even if an increase in government debt is required to finance rising transfers to the pension system, this can be seen a sustainable due to a corresponding decrease in pension debt. The concept of delta-sustainability focuses on examining implicit debt over time. However, implicit debt itself has been discussed by various authors, for example Holzmann et al. (2004).

Nonfinancial (or Notional) Defined Contributions (NDC) schemes have played a pivotal role in shaping pension reforms. These schemes have been implemented in various countries including Sweden, Latvia, Poland, and Italy. Furthermore, there is a wealth of literature on NDC schemes, most notably the anthologies of the World Bank edited by Holzmann et al. (2006; 2012; 2013; 2020a; 2020b), providing a theoretical foundation of pension schemes and offering practical guidelines based on empirical experience.

The generic theoretical NDC scheme incorporates a rate of return based on an automatic balancing mechanism. However, the practical implementation of this concept is challenging; currently, only Sweden has implemented automatic balancing, and even then, it relies on an approximation (Holzmann 2017).

We propose a generalization of the generic NDC scheme into an abstract framework termed Nonfinancial Defined Return (NDR). This framework encompasses the fundamental elements of a public unfunded pension system while adhering to the equivalence

[1] These are automatic in the sense that pension system parameters, such as benefit rates, are adjusted automatically when indicators, in this case demographic, change.

principle[2]. Furthermore, to illustrate the implications of delta-sustainability, we introduce NDR-GDP, a different pension scheme that also conforms to the NDR framework. We will subsequently compare NDR-GDP with the traditional NDC scheme, which aligns with the conventional perspective on pension system sustainability.

NDR-GDP closely resembles an NDC scheme that does not employ an automatic balancing mechanism. Therefore, NDR-GDP and the concept of delta-sustainability provide a theoretical foundation for pension systems that are already used in practice.

The remainder of the paper unfolds as follows:

Firstly, we will provide a brief, simplified description of the NDC scheme and elucidate the concept of financial balance within the context of NDC schemes. Following this, we will delve into the abstract NDR framework, which serves as a generalized extension of NDC schemes.

A key principle of the NDR framework is the equivalence principle. To underscore the implications of adopting the NDR framework, we will compare it with the participation equivalence principle[3], a fundamental principle in the German pension system. This comparison highlights the underlying value judgments inherent in the NDR framework.

Subsequently, we will introduce NDR-GDP, a pension scheme grounded in the principles of delta-sustainability. We will define delta-sustainability, demonstrate its applicability to NDR-GDP, and compare the perspectives of financial balance and delta-sustainability on pension system sustainability. We will outline the high-level reform strategy implied by NDR-GDP, emphasizing its reliance on invariants and flexibility as guiding principles. Lastly, we will describe the crucial differences between NDC and NDR-GDP, particularly in terms of their respective notions of sustainability.

The following are our key contributions:

- The NDR framework provides a clearer picture of pension systems due to its abstraction mechanisms. In particular, the introduction of index points and the segregation of the insurance mechanism greatly simplify notation and clarify concepts. For instance, the framework facilitates the formulation of notions such as the equivalence principle and participation equivalence with greater precision. Furthermore, the nature of abstraction allows for more flexibility and choice. For example, NDR does not mandate that contributions are linked to wages.
- The concept of delta-sustainability introduces a precise new definition, providing an approach for analyzing pension system sustainability within a broader economic context.
- The proposed NDR-GDP scheme offers a novel pension reform strategy, particularly valuable in demographically challenging situations. Comparing it to the NDC

[2]Roughly, the equivalence principle states that contributions equal expected benefits.

[3]Participation equivalence also relates benefits to contributions, but in a much less restrictive manner compared to the equivalence principle.

model enhances understanding of the different strategic choices made in pension system design.

Given the intricate nature of pension systems, it is essential to acknowledge their complexity. In this paper, while exploring various aspects of pension sustainability and reform, we will intentionally simplify certain elements that are not central to our main focus. For instance, we will set aside discussions on the insurance aspect and distributional concerns for social reasons, allowing us to concentrate on the core themes "high-level system design" and "sustainability". By narrowing our scope in this manner, we aim to provide a clearer and more focused analysis of the key issues at hand.

2. Simplified description of NDC

For a detailed technical understanding of the Nonfinancial Defined Contributions (NDC) scheme, Palmer (2005) provides an exhaustive analysis, while Holzmann (2017) offers a comprehensive non-technical overview.

The NDC scheme, implemented in countries like Sweden, Latvia, Poland, and Italy, bears economic similarities to the German point system (Börsch-Supan 2003).

NDC functions as a PAYG pension scheme with fixed or externally determined contribution rates. Contributions are allocated to individual accounts but are not invested in financial market assets. Instead, they are used to cover pensions for other participants, hence the designation "nonfinancial" or "notional".

Over time, the values in individual accounts accumulate with a specified rate of return. For example, if the rate of return is 2% per year, then without further contributions, the value in the individual account of every participant grows by 2% every year. Contributions can, of course, increase the value of individual accounts further. We will discuss later how the rate of return is chosen.

Upon reaching the minimum retirement age, participants have the option to convert any portion of their individual account balance into a lifelong annuity. The conversion factor adheres to actuarial principles based on life expectancies, and the annuity can be adjusted over time with a potentially different rate of return. Alternatively, or in addition, one can allow direct lump-sum payouts of benefits from the individual accounts.

An illustration of the basic mechanics of NDC from a single participant's point of view Figure 1.

The revenue from contributions may differ from pension expenses, necessitating a balancing mechanism. Measures such as a reserve fund and the selection of rates of return are employed to achieve balance.

For simplicity, we neglect the insurance aspect for now and assume that only direct payouts from the individual accounts are allowed. Consequently, there is also only

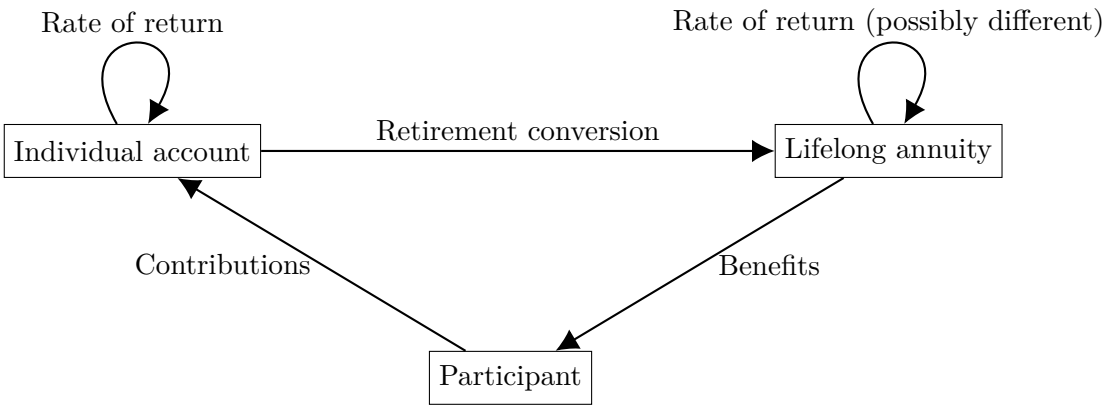

Figure 1: Schematic of an individual account based pension system from a single participant's point of view

one rate of return. A more sophisticated approach instead of this simplification, the separation of the insurance mechanism, will be introduced in Section 3.2.

Financial balance in an NDC scheme In an NDC scheme where individual accounts are not backed by real assets, understanding financial balance is crucial. Financial balance in this context refers to a state where assets and liabilities within the scheme are equal.

Liabilities in an NDC scheme encompass the values associated with individual accounts and the lifelong annuities. In the simplified setting without annuities, the liabilities are the values on individual accounts. The rate of return is not considered which can be justified by choosing the rate of return such that the system is in balance.

Assets, on the other hand, consist of funded reserves and the PAYG asset, which represents expected future contributions. In Sweden, for instance, the PAYG asset is determined by multiplying total contributions by the turnover duration (Settergren 2020) — a metric reflecting the expected average duration that a unit of contribution remains within the system.

To give a better intuition for the concept of future contributions and the turnover duration, we offer a simplified example:

Consider government bonds with a running time of 10 years and no interest rates. Suppose that the total debt is 10 monetary units, but every year 1 monetary unit can be taken as new debt. If the remaining running time of the 10 monetary units is spread evenly, this can run indefinitely. The liabilities in this case are 10 monetary units, and the turnover duration is 10 years because every unit of taken-up debt remains within the system for 10 years. The PAYG asset is the product of the contributions per year multiplied by the turnover duration, which is 10 monetary units in total. The system is in financial balance, capturing the meaning that the system can run indefinitely. This

calculation provides only an approximation because future contributions do not have to be stable at 1 monetary unit, and the remaining running time of liabilities is not considered.

Financial balance does not imply that contributions and benefits are equal every year. For this reason, a reserve fund is used to cushion temporary imparities.

For this paper, a basic understanding of the concept of future contributions, as illustrated by the above example, is sufficient. The key point is that future contributions are conceptually integrated into the consideration of financial balance. Settergren and Mikula (2005) provide a comprehensive definition of the turnover duration and the future contributions.

Rate of return and automatic balancing mechanism (ABM) By leveraging the concepts of liabilities and assets, an automatic balancing mechanism (ABM) can be implemented within an NDC scheme. When assets and liabilities are unequal, adjustments to the rate of return can restore equilibrium.

In theory, one could directly manipulate the value of liabilities to maintain parity with assets, thereby implying a continuous change of values in individual accounts. However, in practice, an a priori choice of the rate of return is made — for instance, tied to changes in the wage sum. If the disparities between liabilities and assets become significant, the ABM intervenes to adjust the rate of return accordingly.

In this paper, NDC refers to a scheme where the rate of return is determined by financial balance, similarly to what Palmer (2005) refers to as generic NDC.

3. Nonfinancial Defined Return framework

Within this section, we present the novel abstract pension framework Nonfinancial Defined Return (NDR). Similar to the NDC scheme, the NDR framework employs the concept of notional individual accounts. However, unlike the NDC scheme, it does not require fixed contribution rates or a rate of return induced by financial balance; instead, it only necessitates the existence of what we call contribution rules and any rate of return. Before delving into the intricacies of the NDR framework, we will first introduce two fundamental components of abstraction: the concept of index points and the separation of the insurance mechanism.

3.1. Index points

Instead of representing a notional value directly on individual accounts, the framework utilizes *index points*. These index points possess a fixed value at any given time. Rather than applying the rate of return directly to the monetary value within individual accounts, it is applied to the value of an index point. While this approach is equivalent in

outcome, the number of index points remains constant when the rate of return is applied. Consequently, this method captures what remains constant when no contributions are made.

Subsequently, we will describe contributions noted on individual accounts as the process of buying index points.

3.2. Separating the insurance mechanism

In a pension system, a key function is to insure individuals against the risk of outliving their savings by providing lifelong income upon retirement. It is worth noting that there exists the possibility to separate the accumulation of pension claims from this insurance aspect. Given that insurance naturally entails the possibility of generating surpluses or deficits, the idea is to segregate this aspect from the broader pension system. Rather than allowing for the conversion of value from the individual account into a lifelong annuity within the pension system, a dedicated pension insurance mechanism is introduced.

The pension insurance is responsible for disbursing lifelong annuities, while any surpluses or deficits within the insurance mechanism are internally managed.

For a visual representation of these mechanics, refer to Figure 2. The administration handles the buying and selling of index points, a process that may potentially result in imbalances, a topic we will explore further.

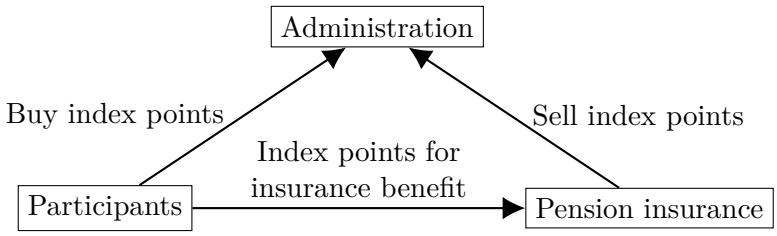

Figure 2: Separating the insurance mechansim

3.3. Description of NDR

The NDR framework[4] puts a strong emphasis on the contribution-benefit link, ensuring that every unit of contribution results in one unit of pension insurance benefit. These units are represented by index points, the value of which changes according to an *indexation method*.

Contribution rules delineate how participants contribute to the system, involving the purchase of index points at their current value, which are then recorded on individual accounts.

[4] A discussion on the terminology of the NDR framework can be found in Appendix A.

Through an *insurance mechanism*, participants have the option to exchange index points for pension benefits, such as a lifelong annuity. Subsequently, the pension insurance sells index points to cover the cost of these benefits.

Similar to the NDC scheme, the revenue from contributions is not invested in financial market assets but is utilized to pay pensions for other participants, albeit indirectly through the pension insurance.

The total revenue from contributions may differ from the expenses of the pension insurance, resulting in a discrepancy between the numbers of index points bought and sold, respectively. *Balancing rules* are employed to address such situations.

Examples of balancing rules include the establishment of a reserve fund, the formulation of contribution rules and indexation methods, and the provision of government transfers.

In summary, the NDR framework comprises the following components:

- Contribution rules
- Indexation method
- Insurance mechanism
- Balancing rules

It is important to note that the NDR framework remains abstract, as it, for example, does not prescribe specific contribution rules. Rather, it mandates that any concrete pension system following this framework must define its contribution rules.

Later on, we will delve into how NDC aligns with the NDR framework. Additionally, we will introduce NDR-GDP, which also conforms to the framework but implements different choices than NDC.

3.4. Equivalence principle versus participation equivalence

The NDR framework operates on the core principle that one index point of contribution corresponds to one unit of (expected) pension benefit, a principle termed the *equivalence principle*. In contrast, the German pension system relies on the principle of "Teilhabeäquivalenz" (participation equivalence), where every unit of contribution at the same point in time must lead to the same expected pension claim.

To illustrate the concept of participation equivalence within the NDR framework, we utilize the notions of index points and the separated insurance mechanism. Participation equivalence entails that at time t, a contribution of one index point leads to a pension benefit of x_t index points, where x_t is equal for all participants. Unlike the equivalence principle, x_t may vary over time, and it may differ from 1. It is important to note that the equivalence principle directly implies participation equivalence.

The call for the equivalence principle represents a stronger claim than advocating for participation equivalence. While the former demands an exact correspondence between contributions and benefits, the latter only requires proportionality, with the factor possibly varying over time. However, statements about the implications of participation equivalence are a stronger claim than those about the equivalence principle. This is because any statement implied by participation equivalence is also covered by the more specific equivalence principle.

The possibility of changing x_t over time can of course have effects on intergenerational redistribution. Furthermore, even if x_t remains constant but differs from 1, there are effects on intragenerational redistribution. For instance, if $x_t = 1.2$ for all t, the total rate of return per year is higher for contributions held for shorter periods because the bonus of 20% is spread over a shorter period of time. This redistributes income intragenerationally from early to late earners. Additionally, one can argue that a proportional factor different from 1 affects redistribution, irrespective of this temporal perspective. In the special case where $x_t = 0$ for all t, there are no pension claims at all and those with larger contributions pay more but receive nothing in return. Conversely, if $x_t = 1000$ for all t, doubling the contribution has a significantly smaller impact than doubling the benefit. These effects are much less pronounced but still present if x_t is close to 1 but different.

While both the equivalence principle and participation equivalence have implications for redistribution, the dynamic valuation over time and different life expectancies complicate assertions about redistribution under either principle.

4. NDR-GDP

In this section, we will describe NDR-GDP, a pension scheme that adheres to the NDR framework, and compare it with the NDC scheme.

4.1. Description

NDR-GDP adopts GDP as the indexation method, where the value of index points is determined by a constant factor times the current GDP. Unlike NDC, NDR-GDP offers complete flexibility in contribution rules and imposes no restrictions on the insurance mechanism. This flexibility extends to the ability to change contribution rules, making NDR-GDP particularly adaptable to evolving circumstances. Balancing within NDR-GDP is achieved through government transfers, where the government buys and sells index points to ensure the total number of bought and sold index points remains equal (see Figure 3). The administration thus never holds index points. An initial amount of index points is given by existing pension claims.

For simplicity, we assume that the government always holds a nonnegative balance of index points. This can be practically achieved by combining the system with a funded system or utilizing forced payout mechanisms.

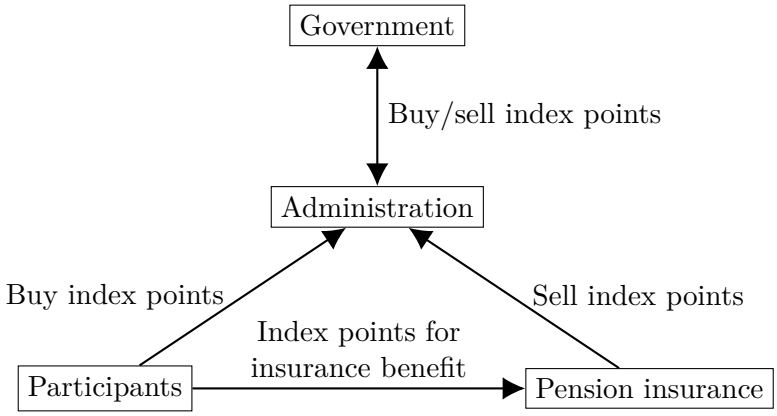

Figure 3: Schematic of NDR-GDP

A fundamental characteristic of NDR-GDP is that the total sum of index points across participants, the pension insurance, and the government remains constant over time. This property ensures that the number of index points held by the government is bounded by the initial amount in the system, limiting the total transfers relative to GDP.

The justification for government transfers is provided by delta-sustainability, which we will introduce in Section 5.

4.2. NDR-GDP and NDC within the context of NDR

Figure 4 illustrates the different choices made by NDC and NDR-GDP for the core components of the NDR framework.

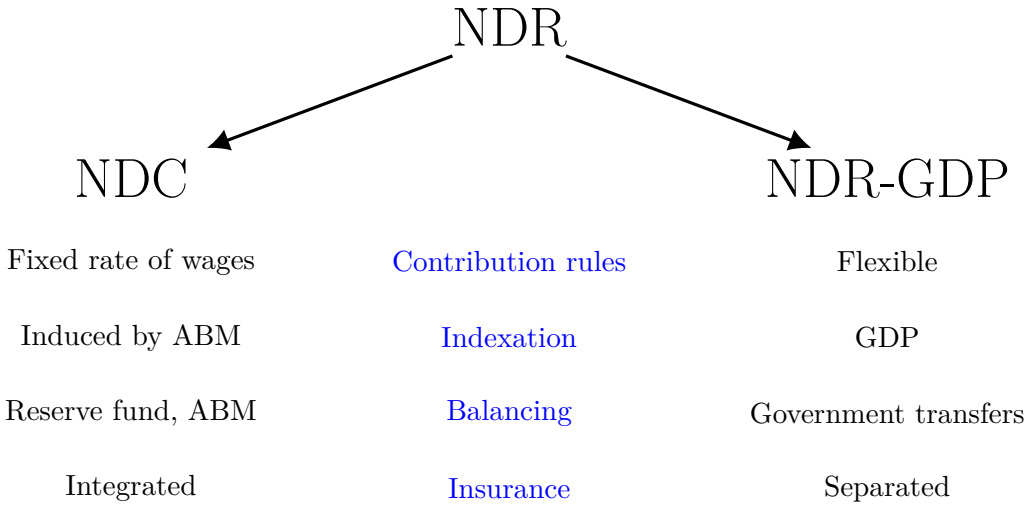

Figure 4: Choices of NDC and NDR-GDP

NDC typically employs a fixed rate of wages as its contribution rule, ensuring that contributions are set to allow for the computation of the contribution asset. In contrast, NDR-GDP offers flexibility in contribution rules.

Regarding indexation, NDC relies on the automatic balancing mechanism, while NDR-GDP opts for GDP-based indexation. Long-term balancing in NDC is achieved through the automatic balancing mechanism, while shorter-term balancing is often facilitated by a reserve fund. Conversely, NDR-GDP relies on government transfers for balancing.

In many descriptions of NDC, the insurance mechanism is portrayed as an integrated component, whereas in NDR-GDP, it is entirely separated and accounted for independently. It is possible to also separate the insurance aspect in NDC schemes.

This comparison highlights the technical disparities between NDC and NDR-GDP. In Section 7, we will delve into the critical conceptual difference between NDC and NDR-GDP, particularly focusing on the notion of pension system sustainability.

5. Delta-sustainability

In this section, we introduce the central concept of this paper: delta-sustainability. We begin by presenting its definition. Subsequently, we demonstrate that NDR-GDP adheres to the principle of delta-sustainability. Furthermore, we undertake a comparative analysis, contrasting delta-sustainability with other notions of pension system sustainability, in particular with the concept of financial balance prevalent in NDC schemes.

5.1. Definition

A pension system is termed *delta-sustainable* if the sum of unfunded liabilities[5] relative to an economic indicator does not increase over time. Additionally, any transfer of value x into the system must lead to a decrease in the sum of unfunded liabilities by x. Similarly, in the case of a negative x, an increase by $|x|$ is permitted.

When the economic indicator is not explicitly designated, it defaults to GDP, given its prevalence as the primary indicator for relative public debt.

Delta-sustainability does not provide a snapshot of the current status but instead focuses on how the pension system's status evolves over time.

5.2. NDR-GDP is delta-sustainable

We will demonstrate that NDR-GDP, with an insurance mechanism that is separately accounted for, adheres to delta-sustainability.

[5]These are liabilities not backed by financial assets, for example index points that are not held by the government.

Recall that the total sum of index points held by the participants, the pension insurance, and the government remains constant.[6] Without any transfers, as index points are indexed via GDP, the total value of index points of participants and the pension insurance relative to GDP remains constant. These index points represent the unfunded liabilities of the system. Thus, without transfers, the sum of unfunded liabilities relative to GDP remains constant.

When the government makes a transfer of value x, it purchases an amount of index points of total value x. As the total sum of index points is constant, the number of index points held by participants and the pension insurance decreases by that amount. Consequently, the value of unfunded liabilities decreases by x.

In summary, NDR-GDP fulfills both conditions of delta-sustainability.

Note that NDR, when employing an arbitrary indexation method alongside government transfers as a balancing rule, maintains delta-sustainability relative to the chosen indexation method. Consequently, NDR-GDP holds a distinct position, with GDP assuming a fundamental role in assessing relative debt levels.

5.3. Comparison with similar notions of pension system sustainability

Various notions of pension system sustainability exist in the literature, each offering a unique perspective. We will focus on a comparison of delta-sustainability with the closest ones suggested before and to financial balance. Devesa and Devesa (2010) provide a comprehensive overview of notions of pension system sustainability for typical PAYG pension systems that are not NDC. An important concept related to delta-sustainability mentioned in their paper is the sum of unfunded liabilities, often referred to as implicit debt. For instance, Herd and van den Noord (1993) have computed implicit debt for several large economies.

However, Devesa and Devesa (2010) note that solely measuring implicit debt does not provide a comprehensive definition of pension system sustainability, as it remains unclear what the maximum level of implicit debt should be. To address this, they introduce the concepts of actuarial imbalance and unitary pension cost. These concepts compare the total benefits received by a group of participants to their total contributions. This idea resembles the notion of delta-sustainability in that the sustainability of the running system is considered. Nevertheless, their approach assumes a closed system and does not directly account for changes in unfunded liabilities.

Holzmann et al. (2004) emphasize the importance of measuring implicit debt and suggest assessing pension reforms by considering explicit debt and implicit debt jointly, but do not provide an explicit tool to do so. The notion of delta-sustainability constitutes a way to implement this suggestion.

[6] The administration does never hold index points in NDR-GDP.

Financial balance, as defined within NDC schemes, is a critical metric used to evaluate pension system sustainability. It reflects the equilibrium between future contributions and pension benefits. More precisely, the notion of financial balance suggests that the system, under predetermined contribution rates, can potentially operate autonomously without necessitating transfers. In essence, achieving financial balance indicates that contributions are projected to sufficiently cover pension benefits over the long term.

Financial balance, however, does not imply that having a pension system in financial balance absolves the state from overall liabilities. A state lacking such a pension system could introduce one and effectively allocate the resulting unfunded pension claims to itself. Hence, having the pension system in financial balance at least represents an "opportunity liability". Indeed, the liability can also be understood as the obligation to maintain the set contribution rates.

Additionally, assuming no funded reserves, proportionally increasing pension benefits and contribution rates does not alter whether an NDC scheme is in financial balance. This scenario effectively generates additional pension claims without increasing financial assets.

In contrast, delta-sustainability offers a different perspective. It does not treat the pension system as a closed entity and explicitly permits government transfers. Delta-sustainability considers the holistic liabilities of the pension system and focuses solely on changes over time. When transitioning from a legacy pension system to a new one, delta-sustainability does not hold the new system accountable for existing liabilities. Instead, it evaluates whether the new system introduces further liabilities over time.

In summary, financial balance and delta-sustainability address distinct aspects of pension system sustainability. While financial balance pertains to the self-sufficiency of the system given predetermined contribution rates, delta-sustainability offers a broader evaluation, considering the system's evolution over time and its impact on overall liabilities.

6. High-level reform strategy: Invariants and flexibility

In this section, we explore the overarching reform strategy implied by the NDR-GDP scheme. As previously mentioned, the implementation of NDR-GDP involves converting existing pension claims into index points. However, the specifics of this process are complex and contingent upon the nuances of the current pension system. Determining existing pension claims involves political considerations, such as whether they should be computed based on past contributions or promised benefits.

As a fundamental characteristic, NDR-GDP integrates invariants with flexibility. It upholds the equivalence principle, guaranteeing that participant contributions, measured in GDP terms, directly correspond to the total pension insurance benefits provided. Furthermore, NDR-GDP maintains delta-sustainability as a systemic guarantee. Notably, these aspects remain unchanged irrespective of real-world conditions, although their im-

plications may vary based on contextual factors. Despite these unchanging invariants, NDR-GDP boasts considerable flexibility, primarily stemming from the possibility to implement arbitrary contribution rules. This feature allows policymakers to adjust contribution rates in response to demographic shifts, ensuring the system's adaptability to evolving circumstances.

7. Crucial difference of NDC and NDR-GDP

In this section, we delve into the primary distinction between NDC and NDR-GDP and explore its implications.

The fundamental variance lies in the concept of pension system sustainability each scheme follows. While the generic NDC scheme aligns with the principles of financial balance, NDR-GDP prioritizes delta-sustainability. The different perspectives of these notions have already been elaborated on in Section 5.3.

An evident consequence of this disparity emerges in how each scheme responds to demographic challenges. In the case of NDC, diminishing contributions compelled by demographic shifts mandate corresponding reductions in pension benefits to uphold a financial equilibrium. Conversely, NDR-GDP, guided by delta-sustainability, operates without necessitating such adjustments, albeit indirectly through the influence of demographic changes on GDP. Instead, government transfers are allowed, but they are regarded as sustainable because they directly reduce liabilities.

However, it is crucial to note that due to the possibility of government transfers, NDR-GDP is not engineered to function independently and self-sufficiently.

Both NDC and NDR-GDP adhere to the NDR framework and uphold the equivalence principle. However, a crucial divergence exists in their indexation mechanisms. While generic NDC relies on the automatic balancing mechanism, directly linked to financial balance, NDR-GDP's indexation is anchored to the economic indicator GDP.

Transitioning from a legacy pension system to NDC presents a notable challenge, notably the issue of transition costs. This challenge becomes especially pronounced if the system lacks financial balance upon introduction due to substantial existing pension claims (Holzmann 2017). However, as delta-sustainability primarily focuses on temporal changes, this issue is not relevant to NDR-GDP, although the initial sum of unfunded liabilities might indeed be significant.

Furthermore, the concept of financial balance, inherent to NDC, necessitates predetermined future contributions. In contrast, delta-sustainability and NDR-GDP allow for greater flexibility in this regard.

In summary, despite their structural similarities, the differing notions of pension system sustainability between NDC and NDR-GDP represent a significant divergence in their design philosophies.

8. Conclusion and outlook

In this paper, we introduced the abstract NDR framework, encapsulating the essential components of an individual account-based nonfinancial pension system. Within this framework, we considered two pension schemes: NDC and NDR-GDP. The primary distinction between these schemes lies in the notion of sustainability they fulfill. While NDC adheres to financial balance, NDR-GDP aligns with the novel concept of delta-sustainability, which takes into account the broader context and evolution over time.

It is important to recognize that pension systems are inherently complex, and our analysis in this paper has focused on simplifying many core components. We acknowledge that factors such as the insurance aspect of pension systems and variations in life expectancies, particularly among different socioeconomic groups, are crucial considerations (Kinge et al. 2019; Chetty et al. 2016). Additionally, the equivalence principle does not guarantee sufficient pensions.

However, the difference between NDC and NDR-GDP may not be as significant when considering these additional complexities of pension systems. Many implementations of NDC do not incorporate an automatic balancing mechanism, and even when they do, future contributions are often approximated. In cases where the rate of return is aligned with GDP and no balancing mechanism is utilized, NDR-GDP essentially mirrors the respective implementation of NDC.

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A. Terminology of Nonfinancial Defined Return framework

The term "nonfinancial" is chosen because contributions within this framework are not directed towards financial market assets. Instead, individual accounts and index points represent notional values. One could alternatively use the term "notional", similar to how NDC schemes are often referred to as nonfinancial or notional.

The term "defined return" is selected because it signifies that the benefit per contribution is fixed, expressed in index points. This property is inherently tied to the use of individual accounts. This concept has also been referred to as "Defined Contributions", for example by Góra and Palmer (2019):

> The DC design builds on a foundation of individual accounts, the accumulation of savings (through contributions) on these accounts, and the creation of a life annuity at retirement based on the individual's account balance and life expectancy at retirement.

However, the term "Defined Contributions" has also been used with a completely different meaning in PAYG pension systems. For example, Börsch-Supan (2007) uses the term defined contributions in the sense that contributions are fixed and benefits of current pensioners are determined by these contributions.

The crucial difference is that in the first definition, benefits are determined by the individual's contributions. In the second definition, benefits are determined by the current contributions of other participants.

Moreover, "Defined Contributions" can also refer to defining contribution rules, such as fixing contribution rates, without necessarily implying benefits. For instance, in the generic NDC scheme, defining contribution rules is essential for computing future contributions.

Therefore, in the NDC scheme, both the contribution-benefit link and the definition of contribution rules are crucial. However, in the abstract NDR framework, the emphasis is only on the contribution-benefit link.

We also note that the NDR framework does not prescribe any specific decisions regarding risk-sharing, as both the insurance mechanism and the indexation method remain abstract. In accounting, the terms "Defined Contribution" and "Defined Benefit" denote how the risk of an insurance is allocated[7].

Given the overloaded nature of the term "Defined Contributions", we introduce the term "Defined Return" to encapsulate the contribution-benefit link and the concept of individual accounts.

[7] See International Accounting Standard 19