NATIONAL PENSIONS REGULATORY AUTHORITY

Pension Unification, Recognition Bonds and Fiscal Sustainability in Ghana: A Dynamic General Equilibrium Approach

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Abstract:

Ghana's National Pensions Act, 2008 (Act 766) established a three-tier contributory pension system and mandated the unification of all existing public pension schemes into this framework. Nearly two decades after enactment, the most significant legacy scheme, Cap 30, a non-contributory defined-benefit arrangement covering well over 100,000 active workers and retirees across multiple security, intelligence, and judicial institutions, remains outside the contributory system. This study develops a dynamic general equilibrium model with overlapping generations to evaluate the fiscal, macroeconomic, distributional, and political-economy implications of migrating legacy public sector workers into Ghana's existing three-tier pension system.

The model is calibrated to Ghana's demographic structure, macroeconomic aggregates, SSNIT administrative parameters, and Cap 30 scheme characteristics. The transition is simulated through recognition bonds, explicit government debt instruments that compensate legacy workers for accrued rights while crediting their Tier 2 accounts. Seven reform scenarios are evaluated, varying the compensation ratio (λ), the speed of migration, and the degree of age-based protection.

The simulation results support four principal findings. First, pension unification is fiscally beneficial under all tested scenarios, with net fiscal improvements ranging from 0.37 to 0.42 percent of GDP per year and a cumulative debt-to-GDP improvement of 8 to 9 percentage points over a 20-year horizon relative to the no-reform baseline. Second, unification alone cannot stabilise Ghana's debt trajectory: even under the best-performing reform scenario, the debt-to-GDP ratio continues to rise from approximately 62 percent to approximately 238 percent over 20 years, reflecting the dominance of the structural primary deficit and real interest costs over pension reform parameters. Third, the real government borrowing rate is the single most powerful determinant of long-run debt sustainability, plausible variations in the real interest rate generate a 289-percentage-point range in projected debt outcomes, dwarfing the

effects of all pension reform design parameters combined. Fourth, all working-age cohorts benefit from unification through higher equilibrium wages, while retirees are unaffected, confirming that the recognition bond mechanism successfully protects accrued benefits.

The sensitivity analysis demonstrates that the compensation ratio has only a modest effect on fiscal outcomes, a 50-percentage-point reduction in λ improves the debt ratio at year 20 by only 1.3 percentage points, creating substantial fiscal space for generosity in political negotiations with Cap 30 institutions. The study recommends phased migration over five years, full recognition for workers within ten years of retirement, and the embedding of pension unification within a broader fiscal consolidation programme.

The paper contributes both methodologically and to policy. Methodologically, it introduces the dynamic general equilibrium framework into Ghanaian pension policy analysis, moving beyond the partial-equilibrium actuarial approaches that have dominated previous discussions. For policy, it provides the quantitative evidence base, net fiscal effects, cohort welfare estimates, compensation schedules, and robustness analyses that are necessary to support a negotiated transition from Ghana's fragmented legacy pension arrangements to the unified contributory system envisioned by Act 766.

JEL Classification: E62, H55, H63, J26

Keywords: Pension reform, Recognition bonds, Fiscal sustainability, Overlapping generations, dynamic general equilibrium, Ghana, Cap 30, Public debt

1. Introduction

Ghana's National Pensions Act, 2008 (Act 766) represented a landmark attempt to consolidate a fragmented, unfunded public pension system into a unified three-tier contributory framework. Nearly two decades later, that consolidation remains incomplete, and a 2023 legislative amendment has made it permanently so for the country's security services. Designed to replace an inequitable pre-reform structure characterized by narrow formal-sector coverage and disparate public-sector arrangements, Act 766 introduced a mandatory defined-benefit first tier managed by the Social Security and National Insurance Trust (SSNIT), a mandatory funded defined-contribution second tier, and a voluntary third tier. Administrative data from the National Pensions Regulatory Authority (NPRA) indicate that the contributory system now covers over 3.1 million active contributors and manages assets exceeding GHS 86 billion (approximately 7.4 percent of GDP). Crucially, because 73 percent of private pension assets are held in government securities, these funds have become foundational to Ghana's domestic sovereign debt market.

The original structural design of Act 766 included a critical transitional mandate under Section 213, which required the unification of all parallel public pension schemes into the three-tier framework. The primary legacy scheme was, and remains, the Cap 30 arrangement: a non-contributory, defined-benefit system covering a total baseline in excess of 65,000 active workers and over 60,000 pensioners across the security, intelligence, judicial, and oversight institutions. In March 2023, Parliament passed the National Pensions (Amendment) Act, formally exempting security and intelligence agencies, including the Police, Immigration, Prisons, and Fire Services, from this unification requirement. This legislative pivot, justified by operational bottlenecks in employee data verification and the unique conditions of security-sector service, mandated a separate, parallel pension arrangement for these agencies that remains under active development. For the remaining judicial and constitutional bodies within Cap 30, the Judicial Service, Audit Service, Electoral Commission, and CHRAJ, the unification mandate persists as an unimplemented legal obligation.

The persistence of a fragmented Cap 30 infrastructure represents a highly concentrated, unfunded liability borne directly by the state's balance sheet. The structural vulnerability of the legacy scheme is underscored by an adverse active-to-pensioner dependency ratio that is orders of magnitude lower than the corresponding ratio observed under the mainstream Social Security and National Insurance Trust (SSNIT) framework. This structural asymmetry imposes a disproportionate, continuous fiscal draw on the Consolidated Fund, with annualized expenditures consuming a non-trivial share of domestic tax revenue. While successive administrations have politically acknowledged the institutional necessity of the statutory unification mandate, operational execution has consistently stalled. This systemic policy inertia is driven by the concentrated institutional bargaining power of non-unified public sectors, intense political sensitivities surrounding civil service

deferred compensation, and acute sovereign macro-fiscal constraints that restrict transitional funding capacity.

Crucially, this paper leverages this 2023 legislative pivot to address a fundamental question in public economics: what is the long-run macroeconomic and welfare cost of policy reversal and institutional fragmentation? Rather than treating the 2023 amendment as a settled administrative endpoint, this study utilizes the original full unification mandate of Act 766 as an optimal counterfactual benchmark. By simulating the comprehensive transition path that was legally aborted for the security sectors, we quantify the exact fiscal, welfare, and structural penalties that an emerging economy incurs when choosing long-term policy fragmentation over system integration.

Our dynamic general equilibrium (DGE) simulations show that the opportunity cost of this fragmentation is substantial. We find that achieving full unification under the original Act 766 framework, financed via a structured recognition bond mechanism, delivers an annual net fiscal improvement of 0.394 percent of GDP, culminating in an 8.8 percentage point reduction in the long-run debt-to-GDP ratio by year 20 relative to the post-amendment fragmented baseline. Furthermore, the model demonstrates that full system integration triggers a general equilibrium interest rate feedback loop, lowering real domestic interest rates by 14 basis points. This interest rate reduction drives a 2.0 percent capital deepening across the wider economy, generating a 0.8 percent expansion in real wages and a permanent 0.78 to 0.79 percent lifetime consumption gain for working-age cohorts.

By presenting these metrics, this paper makes a threefold contribution to the public finance literature. First, it provides the first quantitative evaluation of a Sub-Saharan African public pension transition using a fully calibrated overlapping generations (OLG) DGE framework, moving past the static, partial-equilibrium actuarial projections that dominate developing-market policy design. Second, it establishes a rigorous empirical counterfactual demonstrating that institutional fragmentation leaves a permanent structural premium on domestic borrowing costs and stunts national savings. Third, its welfare analytics show that the 2023 policy reversal was economically unnecessary: an optimally parameterized recognition bond can secure fiscal consolidation while generating positive welfare gains for active cohorts, providing a clear political-economy roadmap for the remaining non-exempted constitutional holdouts.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on pension transitions, implicit liabilities, OLG modeling, and the political economy of reform. Section 3 describes the institutional framework of Ghana's pension system and the Cap 30 legacy scheme, including the 2023 amendment. Section 4 presents the dynamic general equilibrium model. Section 5 describes the calibration strategy and simulation design. Section 6 documents the data construction framework. Section 7 presents the baseline results. Section 8 provides sensitivity and robustness analysis. Section 9 discusses political economy and implementation pathways. Section 10 concludes.

2: Literature Review and Theoretical Framework

This study builds upon the macroeconomic literature concerning structural pension transitions, public liability formalization, and the dynamic general equilibrium modeling of fiscal policy. It synthesizes four foundational thematic pillars: the economics of pension transition design, the macro-fiscal dynamics of converting implicit liabilities into explicit debt, overlapping generations (OLG) modeling applications in developing market contexts, and the political economy of social security retrenchment. Across each pillar, a common gap emerges: while the theoretical and empirical literature has established the potential gains from pension unification, few studies have quantified the cost of *not unifying*, that is, the fiscal, macroeconomic, and welfare penalties imposed by structural fragmentation and policy reversal. This paper fills that gap by introducing a formal counterfactual framework.

2.1 Operational Structure and Welfare Dynamics of Structural Transitions

The theoretical rationale for transitioning from unfunded defined-benefit frameworks to funded contributory configurations is deeply rooted in structural growth theory. Feldstein (1974, 1996) demonstrated that pay-as-you-go (PAYG) regimes systematically depress national savings and long-run capital accumulation relative to funded alternatives, inducing structural welfare losses in dynamically efficient economies. Conversely, Diamond (1977) noted that PAYG configurations can be Pareto-improving under conditions of dynamic inefficiency, where capital accumulation exceeds the golden rule. However, because modern emerging economies typically face acute capital scarcity, subsequent empirical literature has focused heavily on mitigating the structural transition costs associated with moving toward funded systems.

The global empirical literature on large-scale transitions is dominated by the Latin American experience, most notably Chile's 1981 structural overhaul. Chile replaced its fragmented, multi-tiered PAYG apparatus with a system of individualized accounts, financing the structural transition via recognition bonds (*bonos de reconocimiento*) designed to compensate active workers for accrued rights under the legacy regime (Corbo & Schmidt-Hebbel, 2003; Acuña & Iglesias, 2001). These indexed, interest-bearing instruments peaked at approximately 80 percent of GDP, demonstrating the protracted fiscal horizon and significant structural frictions required for systemic recognition debt redemptions. Similar transition designs, fiscal shocks, and accompanying structural frictions have been documented across Colombia, Mexico, and Peru (Mesa-Lago, 2002; Arenas de Mesa et al., 2008).

Within the Sub-Saharan African context, the empirical literature remains sparse but highly instructive. Nigeria's 2004 structural unification migrated public sector employees into a unified contributory landscape under the Pension Reform Act, though the transition has been constrained by systemic contribution arrears and protracted litigation over transitional provisions (Casey & Dostal, 2013). As emphasized by Stewart and Yermo (2009), successful structural transitions in developing market

contexts are strictly contingent upon three institutional prerequisites: *ex-ante* quantification of transition costs, transparent tracking mechanisms for accrued rights, and macro-fiscal frameworks capable of absorbing transitional debt issuance. Notably, none of these studies quantify the counterfactual cost of *not* transitioning, the fiscal and welfare penalties that accumulate when a government chooses administrative fragmentation over integration. This paper provides that counterfactual for Ghana.

2.2 Implicit Pension Debt, Structural Liabilities, and Macro-Fiscal Constraints

The conceptual distinction between implicit and explicit public obligations is central to analyzing the fiscal sustainability of structural pension reforms. Holzmann, Palacios, and Zviniene (2004) conceptualize "implicit pension debt" (IPD) as the present value of future pension promises under legacy non-contributory regimes, arguing that structural reform does not generate new liabilities but rather formalizes implicit obligations into explicit, marketable sovereign debt instruments. The macro-fiscal consequences of this formalization depend heavily on the recognition ratio, the applied discount rate, and the prevailing macroeconomic environment.

The International Monetary Fund's fiscal transparency framework (IMF, 2018) underlines the critical importance of integrating IPD into public sector balance sheets, observing that developing economies consistently understate their structural fiscal obligations by omitting unfunded public service pension guarantees. For Ghana, this formalization process intersects with acute, binding macro-fiscal constraints. Following the implementation of the Domestic Debt Exchange Programme (DDEP), Ghana's public debt stabilized at approximately 61.8 percent of GDP, down from its peak of 79.2 percent in late 2024 (Ministry of Finance, 2024). Operating under an IMF Extended Credit Facility (ECF) arrangement, the sovereign faces stringent fiscal consolidation criteria that severely restrict the space for unbacked debt issuance.

Consequently, the fiscal mechanism required to execute the original National Pensions Act, 2008 (Act 766) mandate, specifically, the issuance of recognition bonds to compensate Cap 30 beneficiaries, must be evaluated within a framework that balances legacy legal rights against sovereign debt sustainability thresholds. The literature on implicit debt has thoroughly documented *how* to formalize liabilities but has paid less attention to the opportunity cost of leaving them unformalized. This paper contributes by quantifying the debt, interest rate, and capital accumulation penalties that arise when implicit liabilities are left unfunded and fragmented across the public sector.

2.3 Methodological Paradigms: Dynamic General Equilibrium vs. Actuarial Frameworks

To capture the macroeconomic feedback loops inherent in fiscal policy overhauls, the overlapping generations (OLG) general equilibrium framework has become the standard analytical paradigm. Building on the canonical simulation design established by Auerbach and Kotlikoff (1987), researchers have utilized OLG configurations to evaluate the intergenerational welfare dynamics of social security restructuring (Kotlikoff, Smetters, & Walliser, 1999; Fehr, Jokisch, & Kotlikoff, 2008). Crucially, Nishiyama and Smetters (2007) demonstrated that the interaction between social security design, capital accumulation, and precautionary savings under uninsurable wage risk can only be accurately captured within a dynamic general equilibrium configuration.

While OLG frameworks have been successfully calibrated to evaluate structural pension dynamics in major emerging markets like China (Song et al., 2015) and India (Gillingham & Kanda, 2001), their application to lower-middle-income African economies remains severely limited. Actuarial and partial-equilibrium models dominate the policy landscape in these contexts, failing to account for how shifting pension dynamics alter aggregate savings, domestic interest rates, and capital-labor ratios.

No existing study has applied a dynamic general equilibrium OLG configuration to analyze the macroeconomic implications of public pension unification or recognition bond issuance within the Ghanaian economy. This paper directly addresses this gap. By calibrating an OLG-DGE model to Ghana's demographic structure, fiscal parameters, and pension system rules, we provide the first general equilibrium evaluation of pension unification in a Sub-Saharan African context, and, critically, the first quantification of the macroeconomic cost of legislative fragmentation.

2.4 The Political Economy of Institutional Retrenchment and Policy Reversals

The political economy of pension restructuring is defined by distributional asymmetries that frequently trigger policy deadlocks. As documented by Pierson (1996) and Bonoli (2000), welfare retrenchment operates under a "politics of blame avoidance," where highly concentrated losses imposed on organized interest groups generate political resistance that eclipses the diffuse benefits accrued by the general taxpayer base. James and Brooks (2001) extend this paradigm to developing economies, noting that structural reforms require the strategic construction of policy coalitions and targeted compensation mechanisms to secure institutional compliance.

While Pareto-improving transitions, wherein no generation or cohort experiences a net welfare loss , are theoretically possible (Fenge, 1995), they impose substantial upfront fiscal burdens on the state. In Ghana, this political economy dynamic was vividly illustrated by the passage of the National Pensions (Amendment) Act, 2023. The legislative exemption of security and intelligence agencies from the Act 766 unification

mandate reflects the institutional bargaining power of those sectors, exercised in response to acute administrative bottlenecks in member data verification and benefit payment reconciliation (National Pensions Regulatory Authority, 2024).

For the remaining non-exempted Cap 30 institutions, including the Judicial Service, Audit Service, and key constitutional oversight bodies, the unification mandate remains legally binding. The political economy challenge for these remaining sectors is further complicated by constitutional protections designed to safeguard judicial independence. The political economy literature has excelled at diagnosing *why* reform stalls. It has been less successful at providing quantitative tools to overcome that stalling. By introducing a rigorous empirical framework that quantifies the net fiscal improvement (0.394 percent of GDP annually), the debt reduction (8.8 percentage points), and the welfare gains (0.78 percent of lifetime consumption) available through unification, this paper provides the quantitative foundation necessary to design politically viable, legally compliant compensation structures for remaining institutional holdouts. In doing so, it demonstrates that the 2023 policy reversal was driven more by institutional bargaining than by economic necessity.

2.5 Synthesis of Literature Gaps and Methodological Contribution

The literature reviewed above establishes four clear gaps that this paper addresses.

First, the empirical literature on pension transitions in Sub-Saharan Africa is sparse, and no study has applied a dynamic general equilibrium framework to Ghana's pension unification challenge. Second, while the implicit pension debt literature has thoroughly documented the concept of IPD, it has not systematically quantified the opportunity cost of leaving implicit liabilities unformalized through systemic fragmentation. Third, existing OLG applications to pension policy have focused almost exclusively on mature economies or large emerging markets, leaving lower-middle-income African economies unmodeled. Fourth, the political economy literature has diagnosed the causes of reform deadlock but has not provided the quantitative welfare analytics needed to resolve those deadlocks.

This paper addresses all four gaps by:

1. Calibrating a full OLG-DGE model to Ghanaian demographic, fiscal, and institutional data.
2. Explicitly modeling the counterfactual of full unification versus the fragmented baseline.
3. Quantifying the fiscal, interest rate, capital, wage, and welfare penalties imposed by the 2023 amendment.
4. Providing a measurable roadmap for negotiating unification with remaining non-exempted constitutional institutions.

In doing so, it moves the literature from describing *why* reform stalls to measuring *what it costs* when it does.

3. Institutional Framework of Ghana's Pension System

This section describes the institutional structure within which Ghana's pension unification debate unfolds. It proceeds in four parts:

- An outline of the three-tier contributory system established under Act 766.
- A description of the Cap 30 legacy scheme that remains outside this framework.
- An explanation of the March 2023 amendment that exempted security agencies from unification and its implications for the remaining non-exempted institutions.
- A situational analysis of Ghana's experience within the broader comparative context of pension transitions in emerging economies.

3.1 Ghana's Three-Tier Pension System

Ghana's pension reform, enacted through the National Pensions Act, 2008 (Act 766), established a three-tier contributory pension system that replaced the largely unfunded defined-benefit arrangements that had characterized the country's retirement income structure since independence. The reform was motivated by four interrelated concerns: the fiscal sustainability of the existing system, the inequitable distribution of benefits across different categories of public-sector workers, the absence of pension coverage for the informal sector (which accounts for approximately 80–85 percent of the workforce), and the desire to deepen domestic capital markets through funded pension savings.

The three-tier structure comprises the following components:

- **Tier 1 (Basic National Social Security Scheme):** A mandatory defined-benefit scheme managed by the Social Security and National Insurance Trust (SSNIT). It is financed on a pay-as-you-go (PAYG) basis, with a statutory contribution rate of 13.5 percent of insurable earnings. A portion of this contribution,approximately 2.5 percentage points, is transferred to the National Health Insurance Authority (NHIA), leaving a net SSNIT contribution rate of approximately 11 percent. Benefits are computed as a function of the contributor's best three years of indexed earnings, years of contribution, and a replacement-rate parameter, subject to a minimum pension floor (GHS 300 per month for new pensioners as of 2024) and an insurable earnings ceiling (GHS 52,000 per month as of January 2024). As of the fourth quarter of 2025, Tier 1 covered approximately 2.14 million active contributors and managed assets of approximately GHS 29.07 billion.

- **Tier 2 (Mandatory Funded Occupational Scheme):** A mandatory funded defined-contribution occupational pension scheme, with a contribution rate of 5 percent of basic salary paid by employers. Contributions are deposited into individual accounts managed by licensed corporate trustees and invested according to guidelines issued by the National Pensions Regulatory Authority (NPRA). At retirement, accumulated balances are converted into retirement income through annuitization or programmed withdrawals. As of 2024, Tier 2 covered approximately 4.04 million member accounts and, together with Tier 3, managed assets of approximately GHS 63.8 billion.
- **Tier 3 (Voluntary Scheme):** A voluntary defined-contribution scheme comprising provident funds, personal pension plans, and group pension schemes. It is open to both formal-sector workers seeking supplementary retirement savings and informal-sector workers seeking any retirement coverage. Contributions are tax-advantaged up to a statutory ceiling. As of 2024, Tier 3 had enrolled approximately 983,000 members, the majority from the informal sector.

The three-tier system has been structurally successful. Total pension assets under management reached GHS 86.22 billion by the end of 2024, equivalent to approximately 7.4 percent of GDP. The funded components (Tiers 2 and 3) have deepened Ghana's domestic capital market, with pension funds now among the largest institutional investors in government securities. Contribution inflows have consistently exceeded benefit outflows, and the regulatory framework administered by NPRA has matured considerably since the reform's inception.

3.2 The Cap 30 Legacy Scheme

Despite the comprehensive nature of the 2008 reform, Section 213 of Act 766 originally mandated the unification of all existing public pension schemes into the three-tier framework. The most significant scheme remaining outside the contributory system is Cap 30, a non-contributory defined-benefit arrangement covering employees of selected public institutions, with benefits financed entirely from general taxation. Cap 30 originated in the colonial-era pension ordinances and was consolidated under Chapter 30 of the 1950 Laws of the Gold Coast. It provides retirement benefits with no employee contributions required.

Benefits are computed as a function of final salary and years of service, with a standard accrual factor of 1/60th per year of service (i.e., a worker with 30 years of service receives a pension equal to 50 percent of final salary). Judges and certain categories of judicial officers benefit from enhanced accrual provisions, producing substantially higher replacement rates. As of early 2025, Cap 30 covered approximately 66,700 active workers and 63,200 pensioners across a number of institutions.

The scheme's demographic structure has become increasingly strained. With an active-worker-to-pensioner ratio of approximately 1:1, compared with roughly 8:1 under SSNIT, Cap 30 represents a growing fiscal commitment. By the first quarter of 2025, the scheme disbursed GHS 735.8 million in benefits, comprising GHS 582.7 million in monthly pension payments and GHS 153.1 million in lump-sum payments. Annualized, this implies a fiscal cost of approximately GHS 2.9 billion, or roughly 0.25 percent of GDP, all financed through the consolidated fund.

3.3 The 2023 Amendment: Exempted and Non-Exempted Institutions

In March 2023, Parliament passed the National Pensions (Amendment) Act, which amended Section 213 of Act 766 to exempt security and intelligence agencies from the unification requirement. The amendment was justified on grounds of operational challenges in data verification and the unique conditions of service in security roles. For these institutions, the legal requirement to unify into the three-tier system no longer applies. They are instead to have a separate pension arrangement, the design of which remains under development. The Ghana Armed Forces are covered under separate armed forces pension legislation and are not part of the Cap 30 unification framework.

For the remaining Cap 30 institutions, the unification mandate remains legally binding and wholly unimplemented.

Among these, the Judicial Service and the Audit Service are particularly significant due to their constitutional status as independent bodies whose compensation arrangements are protected from unilateral executive modification. The persistence of these non-exempted institutions within the Cap 30 framework, alongside the continued existence of a separate, unfunded arrangement for security agencies, represents an ongoing implicit pension liability on the government's balance sheet. For the exempted security agencies, the 2023 amendment resolved the political impasse by legislative fiat rather than by integration into the contributory system. For the non-exempted institutions, the impasse continues.

3.4 The Comparative Context

Ghana's experience is not unique. Many emerging and developing economies have confronted the challenge of transitioning from fragmented, largely unfunded legacy pension arrangements toward unified contributory systems. The international experience offers both precedents and cautionary lessons:

- Chile (1981): Chile's pension reform replaced a fragmented PAYG system with individual retirement accounts, financing the transition through recognition bonds (*bonos de reconocimiento*) issued to workers who had accrued rights under the legacy regime. The bonds carried a 4 percent real interest rate and matured at retirement, amounting to approximately 80 percent of GDP at their

peak. This experience demonstrated that recognition bonds are a technically feasible instrument for honoring accrued rights during a transition, but that the fiscal cost can be substantial and prolonged—with final redemptions extending over six decades after the reform [2, 3].

- Nigeria's 2004 structural pension reform unified a highly fragmented public-sector landscape by migrating federal public servants into a mandatory Contributory Pension Scheme (CPS) under the Pension Reform Act of 2004 (Casey & Dostal, 2013). While transitional arrangements were legally established for workers close to retirement, initially managed by ministerial departments and later centralized under the Pension Transitional Arrangement Directorate (PTAD) via the Pension Reform Act of 2014, the operational execution has faced systemic bottlenecks. Accumulating public sector contribution arrears, delays in the funding of historic accrued rights, and intense disputes over the actuarial adequacy of transitional provisions have continued to generate protracted litigation and acute political friction between labor unions and the federal government.
- Kenya (Ongoing): Kenya's ongoing transition from a non-contributory civil service pension scheme to a contributory system has encountered similar structural challenges. These include disputes over the actuarial valuation of accrued rights, the adequacy of transitional funding, and the administrative capacity to manage large-scale worker migrations.

The common lesson from these experiences is that pension unification is technically feasible but politically demanding. Success requires four distinct conditions: credible estimates of the transition cost, transparent mechanisms for recognizing accrued rights, fiscal frameworks capable of absorbing transitional debt issuance, and political processes that secure the consent of affected workers. The 2023 amendment effectively conceded that the political and administrative challenges for Ghana's security agencies were sufficiently acute to warrant an exemption. This paper does not dispute that concession; instead, it provides the quantitative evidence that was missing from that legislative deliberation: the exact macroeconomic price of the path Parliament chose.

3.5 Summary: The Institutional Baseline for the Counterfactual

The institutional framework described above establishes the baseline for the counterfactual analysis that follows. The fragmented status quo (Scenario S0) consists of:

- The three-tier contributory system for formal-sector workers covered under Act 766.

- The Cap 30 non-contributory arrangement for security agencies (exempted from unification by the 2023 amendment).
- The Cap 30 non-contributory arrangement for judicial and constitutional bodies (still legally required to unify, but wholly unimplemented).

The unified counterfactual (Scenarios S1–S6) consists of the full integration of all Cap 30 institutions, including both the exempted security agencies and the non-exempted constitutional bodies, into the three-tier contributory framework, with accrued rights compensated through structured recognition bonds. The difference between these two paths constitutes the opportunity cost of the 2023 amendment, which the remainder of this paper quantifies.

4. Methodology

4.1 Overview

This section develops a dynamic overlapping-generations general equilibrium (OLG-DGE) model designed to quantify the opportunity cost of the 2023 National Pensions (Amendment) Act. The model simulates two primary counterfactual pathways:

- The Fragmented Baseline (Scenario S0): This represents the post-2023 status quo in which security agencies remain outside the three-tier contributory system under a separate, unfunded arrangement.
- The Unified Counterfactual (Scenarios S1–S6): This represents full unification under the original Act 766 mandate, in which all Cap 30 workers, including those in exempted security agencies, are migrated into the three-tier framework and compensated for accrued rights through structured recognition bonds.

The difference between these pathways constitutes the fiscal, macroeconomic, and welfare penalty imposed by the legislative decision to exempt security agencies from unification.

The framework evaluates four interrelated dimensions of the reform process:

1. Fiscal Restructuring: It measures the fiscal implications of converting implicit, unfunded pension obligations into explicit recognition bond liabilities.
2. Distributional and Cohort Dynamics: It evaluates the distributional consequences of reform across heterogeneous worker cohorts, explicitly isolating older legacy workers with limited adjustment horizons from younger workers who can accumulate pension wealth over longer periods.

3. Macroeconomic Transmission: It captures how shifting pension contributions alter household savings, labor supply, pension fund asset accumulation, and public debt dynamics.
4. Political Economy Optimization: It evaluates the trade-offs associated with alternative transition paths, compensation ratios, age protections, and implementation schedules.

Unlike traditional actuarial pension projections, the framework incorporates behavioral responses and economy-wide feedback effects. Pension unification changes household disposable income, contribution obligations, retirement incentives, and pension wealth accumulation. These adjustments alter aggregate labor supply, private savings, capital accumulation, wages, interest rates, and pension fund assets, which subsequently redefine the government's fiscal position. The model therefore treats pension reform as a dynamic general equilibrium transition problem rather than a static accounting exercise.

More fundamentally, the framework distinguishes between implicit and explicit pension liabilities. Under the fragmented baseline, Cap 30 pension obligations constitute implicit future claims on government revenue financed through the consolidated fund. Unification does not create these liabilities; rather, it formalizes them into explicit, marketable recognition bond obligations. The relevant policy question, and the one this paper answers, is therefore not whether recorded debt increases mechanically during transition, but whether the reform improves the long-run fiscal position after accounting for avoided future pension payments and additional contribution inflows into the contributory system. The difference between the fragmented baseline and the unified path defines the true structural cost of the 2023 amendment.

4.2 Model Environment

The economy is populated by overlapping generations of heterogeneous households who live for a maximum of 100 years. Individuals enter economic life at age $j = 20$ and face age-specific survival probabilities, $\psi_{j,t}$, calibrated to Ghanaian demographic data. Time is discrete, with each period representing one year. This demographic framework tracks the evolution of contributors, retirees, pension liabilities, recognition bond obligations, and public debt dynamics over time.

The population is divided into three distinct worker categories (m):

Category 1 (Formal SSNIT Sector): Formal-sector workers already participating in the Act 766 three-tier pension system. These workers are indirectly affected by reform through general equilibrium variations in wages, interest rates, capital taxes, pension fund returns, and public debt dynamics.

Category 2 (Legacy Cap 30 Sector): Legacy public-sector workers covered under Cap 30 and related special arrangements. This group constitutes the primary transition cohort. Prior to migration, they participate in a non-contributory defined-benefit

arrangement financed entirely through the consolidated fund. Following reform, they are migrated into the contributory three-tier framework and compensated via recognition bonds. In the fragmented baseline (S_0), these workers remain in the legacy arrangement indefinitely.

Category 3 (Informal Sector): Informal-sector workers who remain outside mandatory Tier 1 and Tier 2 participation. These households may participate voluntarily through Tier 3 arrangements.

Households choose consumption ($c_{j,t}$), labor supply ($l_{j,t}$), private asset accumulation ($a_{j+1,t+1}$), and voluntary Tier 3 contributions ($v_{j,t}$) to maximize expected lifetime utility. The representative household of age j, worker type m, at time t solves the dynamic programming problem:

$$V_{j,t}^{m} = \max_{c_{j,t}, l_{j,t}, a_{j+1,t+1}, v_{j,t}} \{u(c_{j,t}, l_{j,t}) + \beta \psi_{j,t} V_{j+1,t+1}^{m}\}$$

Household preferences are represented by a constant-relative-risk-aversion (CRRA) utility function with endogenous labor supply:

$$u(c_{j,t}, l_{j,t}) = \frac{c_{j,t}^{1-\sigma}}{1-\sigma} - \theta \frac{l_{j,t}^{1+\gamma}}{1+\gamma}$$

where σ governs the coefficient of relative risk aversion, γ determines the inverse Frisch elasticity of labor supply, and θ scales the structural disutility of labor. The parameters β and θ are calibrated to reproduce Ghana's observed capital-output ratio and average labor supply in the baseline equilibrium.

The optimization problem is subject to an intertemporal budget constraint specific to each worker category during their working-age phase ($j < R$) and retirement phase ($j \geq R$), where $R = 60$ is the statutory retirement age.

Formal SSNIT-Covered Workers (Category 1, Working Age, $j < R$):

$$c_{j,t} + a_{j+1,t+1} + v_{j,t} = (1 + r_t(1 - \tau_k))a_{j,t} + w_t e_j l_{j,t}(1 - \tau_l - \tau_{\text{ssnit}} - \tau_{t2}) + \text{transfers}_t$$

where w_t denotes the equilibrium wage rate, r_t represents the real interest rate, e_j is the age-specific labor efficiency index, τ_l is the labor income tax rate, τ_{ssnit} is the mandatory Tier 1 contribution rate, τ_{t2} is the mandatory Tier 2 contribution rate, and τ_k is the capital income tax rate.

Legacy Cap 30 Workers (Category 2, Pre-Reform Working Age, $j < R$):

$$c_{j,t} + a_{j+1,t+1} = (1 + r_t(1 - \tau_k))a_{j,t} + w_t e_j l_{j,t}(1 - \tau_l) + \text{transfers}_t$$

Because the legacy Cap 30 arrangement is entirely non-contributory, these workers face no mandatory pension deductions ($\tau_{\text{ssnit}} = \tau_{t2} = 0$) in the fragmented baseline (S_0).

Informal Workers (Category 3, Working Age, $j < R$):

$$c_{j,t} + a_{j+1,t+1} + v_{j,t} = (1 + r_t)a_{j,t} + y_{i,t}(1 - \tau_v) + \text{transfers}_t$$

where τ_v represents the indirect consumption tax rate capturing the informal tax burden. Informal income $y_{i,t}$ follows an idiosyncratic autoregressive process:

$$\log\, y_{i,t} = \rho \log\, y_{i,t-1} + \varepsilon_{i,t}, \varepsilon_{i,t} \sim \mathcal{N}(0, \sigma_\varepsilon^2)$$

Retired Households (All Formal Categories, $j \geq R$):

$$c_{j,t} + a_{j+1,t+1} = (1 + r_t(1 - \tau_k))a_{j,t} + b_{j,t}^{T1} + b_{j,t}^{T2} + b_{j,t}^{T3} + \text{transfers}_t$$

where $b_{j,t}^{T1}$, $b_{j,t}^{T2}$, and $b_{j,t}^{T3}$ represent pension benefit disbursements received from Tier 1 (SSNIT or Cap 30 depending on the scenario), Tier 2, and voluntary Tier 3 funds, respectively.

4.3 Pension System Structure

The pension system consists of three pillars, each governed by distinct financing and benefit determination rules.

Tier 1 (SSNIT Defined Benefit PAYG): Benefits are determined by the statutory formula:

$$b_{j,t}^{T1} = \max\left(b_{\min}, \phi \cdot AIE \cdot \min\left(1, \frac{s_{\text{SSNIT}}}{s_{\text{full}}}\right)\right)$$

where AIE is the average of the best three years of indexed insurable earnings, s_{SSNIT} is the worker's accumulated years of SSNIT contributions, $s_{\text{full}} = 35$ years, and ϕ is the replacement rate parameter ($\phi \approx 0.50$ for full-career workers under current rules).

Tier 2 (Mandatory Defined Contribution): The individual account balance evolves according to:

$$A_{j+1,t+1}^{T2} = (1 + r_t^p)A_{j,t}^{T2} + \tau_{t2} w_t e_j l_{j,t}$$

where $A_{j,t}^{T2}$ denotes the Tier 2 asset balance, r_t^p is the net pension fund investment return, and $\tau_{t2} = 0.05$ is the statutory Tier 2 contribution rate. At retirement ($j = R$), the accumulated balance is annuitized:

$$b_{j,t}^{T2} = \frac{A_{j,R}^{T2}}{\ddot{a}_R}, \ddot{a}_R = \frac{1 - (1 + r_p)^{-LER}}{r_p}$$

where LER denotes the actuarial life expectancy at retirement age R.

Tier 3 (Voluntary Defined Contribution): The individual account balance evolves according to:

$$A_{j+1,t+1}^{T3} = (1 + r_t^p)A_{j,t}^{T3} + v_{j,t}$$

At retirement, Tier 3 balances are annuitized following the same actuarial conventions as Tier 2.

4.4 Legacy Scheme and Recognition Bonds

Before reform, legacy civil servants accrue pension rights under the non-contributory Cap 30 scheme. Legacy benefits are modeled as:

$$\text{Pension}_{j,t}^{\text{Cap30}} = \alpha_{\text{cap}} \cdot \text{FinalSalary}_j \times \text{YearsService}_j$$

where α_{cap} is the scheme-specific accrual factor ($1/60$ per year for standard workers, with enhanced scales applied to judicial and oversight officers).

At the reform execution date (t_0), accumulated rights are valued as the present value of expected future legacy pension payments:

$$PV_j = \sum_{s=R}^{T} \frac{\text{ExpectedBenefit}_{j,s}}{(1+i_{rb})^{s-t_0}}$$

The government replaces this implicit claim by issuing an explicit recognition bond equal to a fraction λ of this present value:

$$RB_j = \lambda \cdot PV_j$$

where $\lambda \in [0,1]$ represents the recognition ratio or policy compensation parameter. Recognition bonds are credited directly to the workers' Tier 2 accounts at the point of migration:

$$A_{j,t}^{T2,\text{new}} = A_{j,t}^{T2,\text{old}} + RB_j$$

Following migration, legacy workers participate under standard contributory pension rules. In the fragmented baseline (S_0), no recognition bonds are issued ($\lambda = 0$), and legacy workers remain under the unfunded Cap 30 arrangement indefinitely.

4.5 Production and General Equilibrium

Production is undertaken by a representative competitive firm operating a Cobb-Douglas production technology:

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

where Y_t denotes aggregate output, K_t is the aggregate capital stock, L_t is aggregate effective labor supply, Z_t is total factor productivity (normalized to 1 in the baseline), and α is the capital share parameter.

Factor markets are perfectly competitive. Firms hire labor and rent capital until factor prices equal their respective marginal products:

$$w_t = (1-\alpha) Z_t \left(\frac{K_t}{L_t}\right)^{\alpha}$$

$$r_t = \alpha Z_t \left(\frac{K_t}{L_t}\right)^{\alpha-1} - \delta$$

where δ is the capital depreciation rate.

Aggregate effective labor supply equals the weighted sum of labor supplied by all active generations:

$$L_t = \sum_{j=20}^{R-1} N_{j,t} \cdot e_j \cdot l_{j,t}$$

Aggregate capital consists of private household savings and accumulated pension fund assets under Tier 2 and Tier 3 arrangements:

$$K_t = \sum_j N_{j,t} \cdot a_{j,t} + A_t^{\text{T2,total}} + A_t^{\text{T3,total}}$$

The direct integration of pension assets into aggregate capital captures the general equilibrium transmission channel of expanding funded coverage through legacy worker migration. The capital accumulation divergence between the fragmented baseline and the unified path isolates the macroeconomic penalty of the 2023 amendment.

4.6 Government Budget Constraint

The government finances public expenditure, legacy pension obligations, and recognition bond redemptions through taxation and sovereign debt issuance. The consolidated government budget constraint satisfies:

$$D_{t+1} = (1 + r_t)D_t + G_t + PB_t + \text{Cap30Payments}_t + \text{RBRed}_t - \text{TaxRevenue}_t$$

where D_t denotes outstanding government debt, G_t is non-pension public consumption, PB_t is the Tier 1 pension balance, Cap30Payments_t is legacy benefit expenditure, and RBRed_t represents recognition bond redemptions.

The Tier 1 operational balance evolves as:

$$PB_t = \text{Benefits}_t^{T1} - \text{Contributions}_t^{T1}$$

Tax revenue aggregates labor, capital, consumption, and mandatory SSNIT contributions:

$$\text{TaxRevenue}_t = \tau_l \cdot w_t L_t + \tau_k \cdot r_t K_t + \tau_v \cdot C_t + \tau_{\text{ssnit}} \cdot \text{WageBase}_t$$

Recognition bond liabilities evolve according to:

$$RB_{t+1} = (1 + i_{rb})RB_t - \text{Redemption}_t + \text{NewIssuance}_t$$

where RB_t is the outstanding recognition bond stock and i_{rb} is the recognition bond interest rate.

The net fiscal effect of reform — the central metric for quantifying the cost of fragmentation — is measured as:

$$\Delta\text{Fiscal}_t = \text{RBRed}_t - \text{AvoidedCap30}_t - \text{NewSSNITContributions}_t$$

where negative values indicate fiscal improvement relative to the no-reform baseline. In this framework, the net fiscal effect represents the annual cost savings from full unification relative to the fragmented baseline — that is, the fiscal penalty of the 2023 amendment.

4.7 Competitive Equilibrium

A competitive equilibrium consists of sequences of household allocations, pension assets, government debt paths, recognition bond liabilities, factor prices $\{w_t, r_t\}$, and aggregate quantities such that:

1. Households optimize expected lifetime utility subject to their respective budget constraints;
2. Firms maximize profits competitively;
3. Pension system rules and recognition bond parameters are satisfied;
4. The government budget constraint holds in every period; and
5. Goods, labor, and capital markets clear simultaneously.

4.8 Transition Dynamics

The model is solved as a finite-horizon transition problem starting from Ghana's existing fragmented pension structure. The initial equilibrium corresponds to the pre-reform economy in which SSNIT-covered workers participate in the three-tier system while legacy workers remain under Cap 30. This initial equilibrium is identical for both the fragmented baseline and the unified counterfactual.

At the reform date ($t = 5$), legacy workers are migrated into the contributory framework according to the rules of each reform scenario. The transition path then evolves endogenously through adjustments in household savings, labor supply, pension accumulation, government debt, recognition bond liabilities, wages, and interest rates.

Aggregate capital stocks and pension funds evolve according to:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

$$A_{t+1}^{\text{pension}} = (1 + r_t^p)A_t^{\text{pension}} + \text{Contributions}_t - \text{Benefits}_t$$

The framework captures both the immediate fiscal variations of pension unification and the longer-run macroeconomic adjustments generated through expanding funded pension accumulation and changing household behavior.

4.9 Calibration Strategy

The model is calibrated to reproduce Ghana's macroeconomic, demographic, fiscal, and pension system structure prior to reform. The baseline equilibrium represents the post-2023 fragmented status quo (S_0), in which SSNIT-covered workers participate in the three-tier contributory system while legacy public sector workers, including those in exempted security agencies, remain under Cap 30. Calibration proceeds in three sequential stages.

Stage 1 (Demographic Calibration): Population projections by single year of age ($20 \leq j \leq 100$) for the 2021–2050 horizon are sourced from the Ghana Statistical Service (GSS) 2021 Population and Housing Census projections. Survival probabilities, $\psi_{j,t}$, are derived from the United Nations World Population Prospects (2024) abridged life tables for Ghana, interpolated to single-year ages using a cubic spline specification. For years beyond 2050, cohort sizes are projected forward using estimated survival probabilities and entry rates consistent with GSS medium-variant fertility assumptions.

Stage 2 (Macroeconomic Calibration): Parameters are calibrated to reproduce Ghana's observed steady-state fiscal and production structure. The household discount factor, β, is pinned down using the steady-state Euler equation:

$$\beta = \frac{1}{1+r}$$

Using an estimated steady-state real government borrowing rate of 4.07 percent yields a calibrated value of $\beta = 0.9609$. The labor disutility parameter, θ, is calibrated to match an average formal sector labor supply at approximately one-third of total available time (matching a standard 40-hour work week). Production parameters $\alpha = 0.40$ and $\delta = 0.08$ are chosen to reproduce Ghana's observed capital-output ratio of approximately 2.0 and investment-to-GDP dynamics.

Stage 3 (Pension System Calibration): Parameters are mapped directly from Ghana's institutional pension rules. Contribution rates, accrual profiles, minimum pensions, retirement ages, and insurable earnings ceilings are taken from Act 766, SSNIT administrative guidelines, and National Pensions Regulatory Authority (NPRA) regulatory files. Tier 2 and Tier 3 asset accumulation rules are calibrated from NPRA fund metrics, while Cap 30 liabilities are parameterized using administrative expenditure records from the Controller and Accountant-General's Department (CAGD).

Table 4.1 summarizes the principal structural parameters, baseline values, and empirical calibration targets.

Table 4.1: Calibration Parameters

Parameter	Symbol	Value	Calibration Basis
Risk aversion	σ	2.0	Standard DGE literature
Inverse Frisch elasticity	γ	2.0	Literature benchmark
Discount factor	β	0.9609	Pinned by steady-state $r = 4.07\%$
Labor disutility	θ	2.5312	Matches labor supply target (0.306)
Capital share	α	0.40	National accounts
Depreciation rate	δ	0.08	Investment-to-GDP calibration
Labor tax rate	τ_l	0.06	GRA 2024 (PIT as % of GDP)
Capital tax rate	τ_k	0.04	GRA 2024 (CIT and royalties)
Consumption tax rate	τ_v	0.05	GRA 2024 (VAT, NHIL, and GETFund)
SSNIT contribution (net)	τ_{ssnit}	0.11	Act 766 (13.5% less NHIA transfer)
Tier 2 contribution	τ_{t2}	0.05	Act 766 statutory rate
SSNIT replacement rate	ϕ	0.50	SSNIT statutory benefit formula
SSNIT max insurable	—	GHS 52,000/mo	SSNIT ceiling, effective January 2024
SSNIT min pension (new)	—	GHS 300/mo	SSNIT statutory baseline
Cap 30 accrual (standard)	α_{cap}	$1/60$	Cap 30 legal instruments
Real govt borrowing rate	r	4.07%	Fisher equation: $\frac{1+0.28}{1+0.23} - 1$
Initial debt-to-GDP ratio	D_0/Y	0.618	Ministry of Finance, post-DDEP

Retirement age	R	60	Act 766 mandatory threshold
Pension fund return	r_p	0.14	NPRA long-run industrial average
Recognition bond rate	i_{rb}	0.08	Long-run real discount rate

The calibrated baseline equilibrium captures the structural properties of Ghana's pension framework, labor market, and fiscal environment under the post-2023 fragmented regime. The unified counterfactual scenarios (S_1 through S_6) represent structural deviations from this baseline, isolating the true opportunity cost of the 2023 amendment.

5: Simulation Design and Policy Experiments

This section describes the reform experiments implemented within the model and the principal indicators used to evaluate alternative pension unification strategies. The simulations compare Ghana's post-2023 fragmented pension structure (the baseline) with alternative migration pathways through which legacy public sector workers are integrated into the contributory three-tier pension system.

The baseline economy assumes that Cap 30 and related legacy pension schemes continue unchanged under the post-2023 fragmented arrangement, while SSNIT and the funded Tier 2 and Tier 3 arrangements operate under their current institutional structure. Reform scenarios are introduced as structural deviations from this baseline path. The difference between the baseline and each reform scenario constitutes the estimated cost of the 2023 amendment.

The purpose of these simulations is not merely to estimate the fiscal cost of transition, but to evaluate the broader trade-offs between fiscal sustainability, pension adequacy, intergenerational fairness, and political feasibility. The framework combines macroeconomic indicators, pension system outcomes, and cohort-level welfare measures within a unified transition analysis.

5.1 Baseline Economy and Calibration Logic

The baseline equilibrium (Scenario S_0) represents Ghana's post-2023 pension system. Formal sector workers already covered under the National Pensions Act participate in the three-tier pension system, while legacy public sector workers, including both exempted security agencies and non-exempted constitutional bodies, remain under Cap 30 and related non-contributory schemes financed directly through the consolidated fund.

The baseline calibration reproduces Ghana's observed macroeconomic and pension system structure, including the capital-output ratio, labor supply, public debt position,

pension contribution flows, and SSNIT financing structure. The economy is initialized near a steady-state equilibrium, after which reform scenarios are simulated as transition deviations from the baseline path. The calibration combines demographic projections, labor market data, pension administrative records, and macroeconomic aggregates obtained from the Ghana Statistical Service, SSNIT, NPRA, the Ministry of Finance, the Bank of Ghana, and the Controller and Accountant-General's Department.

5.2 Reform Scenarios

The simulations compare the no-reform fragmented baseline (S_0) with alternative pension unification designs differing in compensation generosity, transition timing, and protection for vulnerable worker cohorts. The reform date is denoted by $t_0 = 5$ (year 5 of the simulation horizon). From this date onward, legacy workers are migrated into the contributory pension framework according to the rules of each scenario.

The scenarios are intentionally designed to span the principal policy trade-offs facing pension unification in Ghana. Higher compensation ratios improve cohort protection and political acceptability but increase explicit public debt through larger recognition bond issuance. Lower compensation ratios reduce fiscal pressure but may generate welfare losses among affected workers, especially older cohorts with limited time to accumulate pension wealth under the funded system.

Table 5.1: Reform Scenarios

Scenario	Name	Description
S_0	Baseline: Fragmented Status Quo	Cap 30 and legacy schemes continue unchanged under the post-2023 amendment. Security agencies remain exempt from unification.
S_1	Full Recognition	All accrued rights compensated fully through recognition bonds ($\lambda = 1.00$). Immediate migration.
S_2	Partial Recognition: 80%	Recognition bonds compensate 80% of accrued rights ($\lambda = 0.80$). Immediate migration.
S_3	Partial Recognition: 70%	Recognition bonds compensate 70% of accrued rights ($\lambda = 0.70$). Immediate migration.
S_4	Age-Protected Reform	Older workers (age ≥ 50) receive full recognition ($\lambda = 1.00$); younger workers receive 70% recognition ($\lambda = 0.70$). Immediate migration.
S_5	Phased Migration	80% recognition ($\lambda = 0.80$) with gradual migration over a 5-year phase-in period.

S_6	Fiscal-Neutral Reform	Compensation ratio ($\lambda = 0.618$) calibrated specifically to minimize the initial fiscal impact of the transition. Immediate migration.

5.3 Recognition Bond Design

Recognition bonds constitute the central transition instrument within the reform framework. Their purpose is to compensate legacy workers for accrued pension rights accumulated under Cap 30 prior to migration into the contributory system.

For each legacy worker, the recognition bond is defined as:

$$RB_j = \lambda_j \cdot PV_{\text{legacy},j}$$

where $PV_{\text{legacy},j}$ denotes the present value of accrued legacy pension rights and λ_j is the compensation ratio applied during migration.

The framework distinguishes between three broad recognition structures:

- Uniform Recognition: All workers receive the same compensation ratio ($\lambda_j = \lambda$) regardless of age (Scenarios S_1, S_2, S_3, S_6).
- Age-Protected Recognition: Older workers receive more generous compensation because of shorter adjustment horizons ($\lambda_{\text{older}} > \lambda_{\text{younger}}$) (Scenario S_4).
- Phased Recognition: Compensation is applied gradually over a multi-year migration window (Scenario S_5).

Recognition bonds are redeemed as annuitized payments over a 15-year maturity at an 8 percent real discount rate. Annuitized redemption smooths the fiscal burden over time.

The model also computes the minimum recognition ratio required to prevent welfare losses among affected workers:

$$\lambda_j^{\min}: W_j^{\text{reform}} \geq W_j^{\text{baseline}}$$

This produces a cohort-specific compensation schedule to guide negotiations between stakeholders.

5.4 Output Indicators

The simulations produce five categories of outputs corresponding to the principal objectives of the study.

Fiscal Sustainability Indicators: Measures long-run fiscal implications. The debt ratio evolves as $\frac{D_t}{Y_t}$. The recognition bond stock relative to GDP is measured as $\frac{RB_{\text{Stock},t}}{Y_t}$.

The model also tracks the Tier 1 balance, $\frac{\text{Deficit}_t^{T1}}{Y_t}$. The central fiscal indicator is the net fiscal effect of reform:

$$\Delta\text{Fiscal}_t = \text{RBRedemptions}_t - \text{AvoidedCap30Payments}_t - \text{NewSSNITContributions}_t$$

This separates the explicit fiscal cost of recognition bond redemption from the avoided cost of continuing legacy pension payments and the additional contribution inflows generated by migration into the contributory system. Negative values indicate fiscal improvement relative to the fragmented baseline.

Cohort Welfare Indicators: For each cohort, the model computes lifetime welfare under the baseline and reform scenarios:

$$\Delta W_j = W_j^{\text{reform}} - W_j^{\text{baseline}}$$

Welfare effects are reported as consumption-equivalent variation (CEV) — the percentage change in lifetime consumption that would make a household indifferent between the baseline and reform scenarios.

Pension Adequacy Indicators: Replacement rates are calculated as:

$$RR_j = \frac{b_{j,t}^{T1} + b_{j,t}^{T2} + b_{j,t}^{T3}}{\text{FinalSalary}_j}$$

The simulations compare retirement income adequacy under the fragmented baseline (Cap 30) with adequacy under the unified contributory structure.

Macroeconomic Indicators: The model reports the effects of reform on aggregate capital stock (K_t), real wages (w_t), real interest rates (r_t), output (Y_t), and formal labor supply (L_t^{formal}). These indicators evaluate whether pension unification increases funded pension accumulation, deepens domestic capital markets, alters factor prices, and affects formal labor supply.

Recognition Bond Indicators: The model reports the aggregate recognition bond stock, annual redemptions, and the fiscal cost of servicing recognition bond liabilities under each scenario.

5.5 Policy Evaluation Framework

The simulations are evaluated using a multi-dimensional policy framework combining fiscal sustainability, cohort welfare, pension adequacy, and political feasibility. Differentiated recognition structures receive particular focus because they balance fiscal adjustment with protection for near-retirement workers.

Table 5.2: Policy Decision Matrix Framework

Scenario	Fiscal Sustainability	Cohort Fairness	Pension Adequacy	Political Feasibility
S_0: Baseline	Weak (debt rises to 247.5% by year 20)	Existing inequities persist	Legacy benefits preserved	Avoids reform conflict
S_1: Full Recognition	Moderate fiscal cost	Strongest protection	Strong adequacy	Politically acceptable but costly
S_2: 80% Recognition	Moderate fiscal cost	Moderate welfare losses possible	Moderate adequacy	Politically negotiable
S_3: 70% Recognition	Lower fiscal cost	Larger welfare losses	Lower adequacy	Higher resistance
S_4: Age-Protected	Balanced	Protects near-retirement workers	Stronger adequacy for older cohorts	Strong political appeal
S_5: Phased Migration	Smooth fiscal transition	Gradual adjustment	Depends on phase-in structure	Administratively practical
S_6: Fiscal-Neutral	Debt stabilization prioritized	Compensation constrained	Potential adequacy trade-offs	Technically strong, politically sensitive

5.6 Interpretation of Results

The results presented in Section 7 report outcomes for each scenario relative to the fragmented baseline (S_0). The difference between S_0 and any reform scenario (S_1 through S_6) is interpreted as the opportunity cost of the 2023 amendment , the fiscal, macroeconomic, and welfare penalty that Ghana incurs by maintaining fragmented, non-contributory pension arrangements for security agencies rather than pursuing full unification under the original Act 766 mandate.

Four scenarios receive primary attention in the analysis:

- S_2 **(80% Recognition, Immediate Migration):** Represents a moderate, politically feasible reform with reasonable fiscal cost.

- S_4 **(Age-Protected Reform):** Addresses the most politically sensitive dimension of reform by protecting workers within ten years of retirement.
- S_5 **(Phased Migration over 5 Years):** Balances fiscal adjustment with administrative practicality and political acceptability.
- S_6 **(Fiscal-Neutral Reform):** Provides a lower-bound estimate of the compensation ratio ($\lambda = 0.618$) that minimizes the initial fiscal impact of transition.

The sensitivity analysis in Section 8 evaluates the robustness of all results to alternative assumptions about key parameters including the recognition bond compensation ratio, real interest rate, bond maturity, capital deepening, primary deficit, and transition speed.

6: Data and Calibration

The empirical credibility of the model depends fundamentally on the quality and consistency of the underlying demographic, pension, labor market, and fiscal data. While the model equations follow a standard overlapping-generations general equilibrium structure, the policy relevance of the simulations depends on accurately reproducing the institutional and macroeconomic characteristics of Ghana's pension system.

To ensure consistency between the model structure and the underlying data, the calibration framework is organized into six integrated data modules covering demographics, macroeconomic aggregates, SSNIT operations, funded pension schemes, legacy public-sector pension liabilities, and household labor market behavior. These modules form the empirical backbone of the transition simulations and determine the evolution of contributors, retirees, pension assets, recognition bond liabilities, wages, savings, and public debt throughout the reform horizon.

Unless otherwise stated, all monetary values are converted into real terms and aligned to the baseline calibration year. Where complete administrative data are unavailable, parameters are estimated using auxiliary survey evidence, actuarial reports, or calibration targets consistent with observed macroeconomic aggregates.

6.1 Demographic and Labor Market Data

The demographic structure of the model is calibrated using Ghana Statistical Service (GSS) population projections, national life tables, and supplementary United Nations demographic projections. The overlapping-generations framework tracks individuals from age 20 through age 100 and incorporates age-specific survival probabilities, retirement transitions, labor force participation, and cohort population shares.

Household labor market behavior is calibrated using the Ghana Living Standards Survey (GLSS), SSNIT administrative records, and labor force survey data. The labor

module captures earnings profiles, labor supply behavior, formal versus informal employment dynamics, household savings, and voluntary pension participation patterns.

The informal sector income process is modeled as:

$$\log\, y_{i,t} = \rho \log\, y_{i,t-1} + \varepsilon_{i,t}$$

where ρ governs earnings persistence and $\varepsilon_{i,t}$ represents idiosyncratic income shocks distributed $\mathcal{N}(0, \sigma_\varepsilon^2)$.

Table 6.1: Demographic and Labor Market Variables

Variable	Definition	Primary Source
$N_{j,t}$	Population by age and year	GSS
$\psi_{j,t}$	Survival probabilities	GSS / UN WPP
Retirement hazards	Retirement transitions	GLSS / estimated
Labor income	Earnings by age and sector	GLSS
Labor supply	Hours worked	GLSS
Informality	Formal vs. informal employment	GLSS / LFS
Tier 3 participation	Voluntary pension participation	NPRA

6.2 Macroeconomic and Fiscal Data

The macroeconomic module calibrates the production structure, fiscal environment, and debt dynamics of the Ghanaian economy. The purpose of this module is to ensure that the baseline equilibrium reproduces observed macroeconomic aggregates prior to reform.

Capital stock estimates are constructed using the perpetual inventory method:

$$K_{t+1} = (1 - \delta)K_t + I_t$$

Government debt data are sourced primarily from the Ministry of Finance and the Bank of Ghana, while GDP, labor market, and investment data are obtained from the Ghana Statistical Service and World Development Indicators.

Table 6.2: Macroeconomic Variables

Variable	Definition	Primary Source
Y_t	GDP	GSS
K_t	Capital stock	GSS / WDI
L_t	Employment	GLSS / LFS
w_t	Wage level	GLSS / SSNIT
r_t	Real interest rate	BoG
D_t	Government debt	MoF / BoG
G_t	Government expenditure	MoF
R_t	Government revenue	MoF

6.3 Pension System Data

The pension system module calibrates the operational structure of Ghana's three-tier pension system, including the PAYG defined-benefit Tier 1 structure administered by SSNIT and the funded Tier 2 and Tier 3 arrangements regulated by NPRA.

The model incorporates contribution inflows, pension expenditures, pensioner demographics, earnings profiles, insurable earnings ceilings, minimum pension provisions, pension fund assets, investment returns, and fee structures.

An important feature of the Ghanaian pension system is the substantial allocation of pension assets toward domestic government securities (approximately 73 percent of private pension assets). Consequently, the funded pension module serves not only as a retirement savings mechanism but also as a major channel linking pension accumulation to domestic government financing and financial market development.

Table 6.3: Pension System Variables

Variable	Tier 1	Tier 2	Tier 3	Primary Source
Contributors	✓	✓	✓	SSNIT / NPRA
Contributions	✓	✓	✓	SSNIT / NPRA
Benefits	✓	—	—	SSNIT
Pensioners	✓	—	—	SSNIT

Assets under management	—	✓	✓	NPRA
Investment returns	—	✓	✓	NPRA
Fees	—	✓	✓	NPRA

6.4 Legacy Scheme and Recognition Bond Data

The legacy public-sector pension system constitutes the central transition component of the model. The purpose of this module is to estimate the implicit pension liabilities embedded within Cap 30 and related public-sector schemes and to translate those obligations into recognition bond liabilities under alternative unification scenarios.

The present value of accrued pension rights is computed as:

$$PV^{\text{Cap30}} = \sum_{t=R}^{T} \psi_t \, (1+r)^{-(t-\text{age})} \text{Benefit}_t$$

This present value forms the basis for recognition bond issuance during migration into the contributory pension system.

Table 6.4: Legacy Pension Variables

Variable	**Definition**	**Primary Source**
Active members	By age and grade	CAGD
Salary structure	By grade	Fair Wages Commission
Years of service	By age	CAGD
Pensioners	By age	CAGD
Pension levels	By grade	CAGD
Budget cost	Annual expenditure	MoF

6.5 Calibration Summary

The model is calibrated to reproduce Ghana's observed pension system structure, macroeconomic environment, labor market dynamics, and fiscal position prior to unification reform. Table 6.5 summarizes the principal calibration targets and parameter values.

Table 6.5: Calibration Summary

Parameter	Value / Target	Calibration Basis
β	0.9609	Steady-state real interest rate (4.07%)
θ	2.5312	Labor supply target (0.306)
K/Y target	2.0	Macro calibration
Average labor supply	0.33	Household calibration
Real interest rate	4.07%	Government borrowing conditions
Retirement age	60	SSNIT rules
Recognition ratio (λ)	Scenario dependent	Reform design
Population structure	2021 Census projections	GSS
Survival probabilities	Life tables	GSS / UN WPP

6.6 Data Sources Summary

Table 6.6: Comprehensive Data Sources

Module	Primary Source	Description
Demographics	GSS 2021 Census; UN WPP 2024	Population by age, survival probabilities, life expectancy
Macroeconomic	GSS StatsBank; MoF; BoG	GDP, investment, consumption, fiscal flows, debt, interest rates, inflation

SSNIT Tier 1	SSNITReports; NPRA Annual Reports	Active contributors, pensioners, contributions, benefits, fund assets
Private Pensions (Tier 2/3)	NPRA Annual Reports; NPRA Statistical Bulletin Q4 2025	AUM, membership, contributions, returns, fees
Cap 30 Legacy Scheme	CAGD Quarterly Reports to NPRA	Active members, pensioners, expenditure, benefit range
Tax Parameters	GRA 2024 Annual Tax Revenue Performance Report	Effective tax rates by category
Public Debt	MoF Public Debt Statistical Bulletin Q3-2024	Debt stock, composition, holders
Household/Labor	GLSS (pending microdata access)	Age-earnings profiles, labor supply, informality (fallback estimates used)

7: Results

7.1 Fiscal Sustainability

7.1.1 Debt Dynamics Under the Fragmented Baseline

Under the fragmented baseline (Scenario S_0), which represents the post-2023 status quo in which security agencies remain outside the three-tier contributory system, Ghana's public debt-to-GDP ratio rises from an initial 61.8 percent, the post-Domestic Debt Exchange Programme (DDEP) outturn as of the fourth quarter of 2024, to 247.5 percent by year 20 of the simulation horizon (Table 7.2). This trajectory reflects the compounding interaction of three structural forces: a structural primary deficit of approximately 2 percent of GDP, a real government borrowing rate of 4.07 percent, and the continued burden of legacy Cap 30 pension payments amounting to roughly 0.3 percent of GDP annually.

The structural debt decomposition detailed in Table 7.1 confirms that the dominant driver of this expansion is the compounding interest burden on outstanding sovereign debt. The interest expense rises from 2.51 percent of GDP in year 1 to 10.14 percent of GDP by year 20 as the debt stock compounds.

Table 7.1: Debt Dynamics Decomposition — Fragmented Baseline (S_0)

Driver (% of GDP)	Year 1	Year 5	Year 10	Year 20
Primary Balance	-2.00	-2.00	-2.00	-2.00
Interest Cost	+2.51	+4.09	+5.72	+10.14
Pension Cost	+0.80	+0.80	+0.80	+0.80
Growth Effect	0.00	0.00	0.00	0.00
Annual Change in D/Y (pp)	+5.31	+6.89	+8.52	+12.94

Notes: Primary balance is defined as tax revenue minus non-pension expenditure. Pension cost includes the Tier 1 PAYG operational deficit (0.5% of GDP) plus Cap 30 legacy payments (0.3% of GDP). The growth effect captures the denominator impact of real GDP growth on the debt ratio, which is normalized to zero in the baseline calibration.

7.1.2 Reform Scenarios: Fiscal Effects and the Cost of the Amendment

All simulated unification pathways generate persistent fiscal improvements relative to the fragmented baseline, though the scale of adjustment is marginal relative to the underlying macroeconomic debt trajectory (Table 7.2). By year 20, the debt-to-GDP ratio under the most restrictive reform scenario (Scenario S_6, Fiscal-Neutral) reaches 238.2 percent, compared with 247.5 percent under the baseline, a cumulative general equilibrium improvement of 9.3 percentage points of GDP. This structural variance represents the long-run macro-fiscal cost of the 2023 amendment: the debt penalty that the Ghanaian state incurs by maintaining fragmented, non-contributory arrangements for the security sector instead of pursuing full unification.

Table 7.2: Debt-to-GDP Ratio Under Alternative Unification Scenarios

Scenario	D/Y ($t = 0$)	D/Y ($t = 5$)	D/Y ($t = 10$)	D/Y ($t = 20$)	Net Fiscal Effect ($t = 10$, % of GDP)
S_0: Fragmented Baseline	67.6%	100.4%	140.0%	247.5%	0.000
S_1: Full Recognition ($\lambda = 1.00$)	67.6%	99.9%	137.4%	239.2%	-0.367
S_2: Partial Recognition ($\lambda = 0.80$)	67.6%	99.9%	137.3%	238.7%	-0.394

S_3: Partial Recognition ($\lambda = 0.70$)	67.6%	99.9%	137.2%	238.4%	-0.407
S_4: Age-Protected Reform	67.6%	99.9%	137.2%	238.4%	-0.407
S_5: Phased Migration (5-year)	67.6%	99.9%	137.3%	238.7%	-0.394
S_6: Fiscal-Neutral ($\lambda = 0.618$)	67.6%	99.9%	137.1%	238.2%	-0.418

Notes: D/Y at $t = 0$ reflects the debt ratio after first-period interest accrual and primary deficit flows. The pre-reform stock debt ratio is 61.8 percent (Q4 2024, post-DDEP). Net fiscal effect is defined as recognition bond redemptions minus avoided Cap 30 payments minus new SSNIT contributions from migrated workers. Negative values indicate fiscal improvement relative to the fragmented baseline.

The net fiscal effect of reform is consistently negative across all transition configurations, ranging from -0.367 percent of GDP per year under full recognition (S_1) to -0.418 percent of GDP under the fiscal-neutral design (S_6). This confirms that full unification reduces the state's structural fiscal burden relative to the post-2023 fragmented baseline: the combination of avoided Cap 30 payouts and new SSNIT contribution revenue exceeds the explicit cost of recognition bond redemptions under all tested compensation designs. These negative values quantify the annualized fiscal penalty of the 2023 amendment — the fiscal savings that Ghana foregoes each year by maintaining institutional fragmentation.

Three structural insights emerge from this fiscal analysis.

Diminishing Returns to Compensation Retrenchment: The compensation ratio, λ, is an important policy lever but displays clear diminishing returns. Moving from full recognition ($\lambda = 1.00$) to 80 percent recognition ($\lambda = 0.80$) improves the net fiscal effect by 0.027 percentage points of GDP per year (shifting from -0.367 to -0.394). Compressing the ratio further to 70 percent ($\lambda = 0.70$) yields an incremental gain of only 0.013 percentage points (shifting from -0.394 to -0.407). The marginal fiscal benefit of reducing compensation generosity declines as λ falls because the recognition bond stock represents a relatively small component of Ghana's aggregate public debt portfolio.

Optimization via Fiscal Neutrality: The fiscal-neutral calibration (S_6) produces the most optimal fiscal outcome. By establishing the compensation ratio at $\lambda = 0.618$, this scenario achieves the maximum net fiscal improvement (-0.418 percent of GDP per year) and minimizes the long-run debt ratio at 238.2 percent by year 20. However, its structural improvement over the standard 70 percent partial recognition scenario (S_3,

year-20 D/Y of 238.4 percent) is marginal, suggesting limited policy utility in compressing compensation parameters beyond this threshold.

The Primacy of Broad Fiscal Consolidation: Pension unification is not a standalone substitute for wider structural fiscal adjustments. Under all simulated policy pathways, the debt-to-GDP ratio continues an upward trajectory, expanding from roughly 62 percent to approximately 247 percent over 20 years under the baseline, with the most restrictive reform scenario containing this expansion to approximately 238 percent. The structural primary deficit and compounding real interest costs dominate the macroeconomic horizon. Pension unification optimizes the fiscal path at the margin, contributing between 0.37 and 0.42 percentage points of GDP in annual net savings, but it does not alter the underlying fiscal arithmetic. Reversing the 2023 amendment must therefore be integrated into a comprehensive, multi-sector fiscal consolidation strategy.

7.2 Cohort Welfare Effects

The welfare analysis evaluates how pension unification affects the lifetime well-being of different worker cohorts, measured as the consumption-equivalent variation (CEV), the percentage change in lifetime consumption that would make a household indifferent between the fragmented baseline and the unified reform scenarios. These welfare gains represent the lifetime consumption benefits that working-age Ghanaians forgo under the post-2023 fragmented status quo.

Table 7.3: Cohort Welfare Effects of Pension Unification

Age Cohort	CEV (% of Lifetime Consumption)
20	+0.79%
30	+0.78%
40	+0.78%
50	+0.78%
59	+0.78%
65	0.00%

Notes: Welfare effects are computed as the percentage change in lifetime consumption required to equalize utility between the fragmented baseline (S_0) and the reform (S_2/S_5) scenarios. Values above zero indicate welfare gains. Values for ages 65 and above are effectively zero, reflecting the protection of accrued benefits and the absence of labor market participation among retirees.

Three structural insights emerge from the welfare analysis. Uniform Working-Age Gains: All working-age cohorts benefit from unification. The welfare gain of approximately 0.78 to 0.79 percent of lifetime consumption is near uniform across cohorts aged 20 to 59. This uniformity reflects the fact that the macroeconomic effects of the reform, specifically, the 0.8 percent increase in equilibrium real wages from capital deepening, benefit all active workers proportionally through their labor income. These positive values indicate that the 2023 amendment imposes a uniform welfare penalty of approximately 0.78 percent of lifetime consumption on every working-age Ghanaian.

Retiree Grandfathering Integrity: Current retirees are unaffected by the reform. The welfare effect for cohorts aged 65 and above is effectively zero. This is a deliberate structural feature of the reform design: existing pensioners' benefits are grandfathered, and recognition bonds protect accrued rights for those already retired. The general equilibrium model confirms that this protection remains intact. Consequently, reversing the 2023 amendment would impose no welfare loss on current retirees.

Primacy of General Equilibrium Transmission: The welfare effects are driven by general equilibrium adjustments rather than direct pension transfers. The near-uniform gain across working-age cohorts suggests that the primary welfare channel is the macroeconomic response, higher capital accumulation and higher wages, rather than cohort-specific differences in direct pension payouts. In a more detailed micro-level extension of the model that tracks individual pension balances and contribution histories, one would expect larger variances between legacy Cap 30 workers and already-covered SSNIT workers. The current welfare analysis captures the aggregate macro-effects common to all formal-sector workers and should be interpreted as the lower bound of welfare gains from unification — and therefore the lower bound of the welfare penalty imposed by the 2023 amendment.

7.3 Macroeconomic Effects

Pension unification affects the macroeconomy through the expansion of funded pension assets. When Cap 30 workers are migrated into the three-tier system, their recognition bonds and new Tier 2 contributions enter the funded pension system, increasing the supply of investable funds in the domestic capital market. The structural variances reported below represent the macroeconomic penalties that Ghana incurs under the fragmented post-2023 arrangement.

Table 7.4: Macroeconomic Effects of Pension Unification (Long-Run)

Variable	**Fragmented Baseline (S_0)**	**Unified Path (S_2/S_5)**	**Structural Divergence**
Capital Stock (K)	Baseline	Baseline + 2.00%	+2.00%

Effective Labor (L)	Baseline	Baseline	Unchanged
Aggregate Output (Y)	Baseline	Baseline + 0.80%	+0.80%
Real Wage Rate (w)	Baseline	Baseline + 0.80%	+0.80%
Real Interest Rate (r)	4.07%	3.93%	-14 basis points
Average Labor Supply	0.306	0.306	Unchanged

Notes: Long-run effects represent the post-transition equilibrium after the capital stock has fully adjusted. The transition is modeled as a 10-year phase-in of capital deepening effects.

The long-run macroeconomic effects are positive but modest:

Capital Deepening: A 2.0 percent expansion in the long-run capital stock is driven by the infusion of recognition bond assets (approximately 2 percent of GDP at full recognition) and new Tier 2 contributions from approximately 66,700 migrated workers into the funded pension system. This 2.0 percent capital deficit represents the cumulative investment that Ghana foregoes under the 2023 amendment.

Real Wage Growth: The real wage rate increases by 0.8 percent, reflecting the higher capital-labor ratio in production. This benefits all formal-sector workers through higher labor income and accounts for the welfare gains reported in Section 7.2. This 0.8 percent wage premium is foregone under the fragmented baseline.

Interest Rate Decompression: The real interest rate declines by 14 basis points, from 4.07 percent to 3.93 percent, providing a positive fiscal externality through lower government borrowing costs on the existing debt stock. This 14 basis point interest premium represents the additional borrowing cost that Ghana pays as a consequence of maintaining fragmentation.

Labor and Output Response: Labor supply is unchanged in the aggregate, as the substitution effect of mandatory contributions and the income effect of higher pension wealth approximately cancel out. Output increases by 0.8 percent, directly attributable to capital accumulation with an output elasticity consistent with Ghana's estimated capital share of 0.40.

7.4 Pension Adequacy and Replacement Rates

This section requires individual-level tracking of pension balances through the transition path, which will be incorporated in the next iteration of the model. The framework is designed to compute replacement rates for each worker type and cohort

under baseline and reform scenarios. Preliminary calibration suggests that Cap 30 provides replacement rates of approximately 50–80 percent of final salary, while the three-tier system's replacement rate depends on SSNIT benefits, Tier 2 accumulation, and voluntary Tier 3 savings. The model will report the distribution of these replacement rates across worker cohorts and identify any cohorts for whom unification reduces expected retirement income. This extension is a priority for future research.

7.5 Policy Decision Matrix

Table 7.5 synthesizes the simulation findings across three core evaluation criteria: fiscal sustainability, cohort fairness, and political feasibility.

Table 7.5: Policy Decision Matrix

Scenario	**Fiscal Sustainability**	**Cohort Fairness**	**Political Feasibility**	**Debt-to-GDP ($t = 20$)**
S_0: Baseline	Weak	Moderate	Moderate	247.50%
S_1: Full Recognition ($\lambda = 1.00$)	Weak	Strong	Moderate	239.20%
S_2: 80% Recognition ($\lambda = 0.80$)	Weak	Strong	Moderate	238.70%
S_3: 70% Recognition ($\lambda = 0.70$)	Weak	Moderate	Moderate	238.40%
S_4: Age-Protected Reform	Weak	Moderate	Strong	238.40%
S_5: Phased Migration (5-year)	Weak	Strong	Strong	238.70%
S_6: Fiscal-Neutral ($\lambda = 0.618$)	Weak	Moderate	Moderate	238.20%

Notes: Fiscal sustainability is rated Weak for all scenarios because debt continues to rise under all reform designs due to underlying primary deficit dynamics. Cohort fairness reflects the generosity of recognition bond compensation. Political feasibility incorporates implementation complexity and likely acceptability to Cap 30 institutions.

The decision matrix reveals a clear policy hierarchy:

- S_5 **(Phased 5-Year Migration)** achieves the most optimal balance, combining strong cohort fairness ($\lambda = 0.80$), strong political feasibility through gradual implementation, and a debt-to-GDP ratio improvement of 8.8 percentage points relative to the fragmented baseline by year 20.
- S_6 **(Fiscal-Neutral)** produces the best absolute fiscal outcome (D/Y of 238.2 percent at year 20) but scores lower on cohort fairness ($\lambda = 0.618$) and contains no explicit political feasibility configurations.
- S_4 **(Age-Protected Reform)** offers the highest political feasibility by fully protecting workers aged 50 and above while applying partial recognition to younger cohorts, directly addressing the most politically sensitive dimension of reform.

7.6 Summary of Results

The simulation results support five broad conclusions:

1. Fiscal Optimization: Public pension unification systematically improves Ghana's fiscal trajectory. Under all scenarios, the net fiscal effect is negative (fiscally beneficial), ranging from -0.367 to -0.418 percent of GDP per year, representing a cumulative debt-to-GDP improvement of 8.3 to 9.3 percentage points relative to the fragmented baseline by year 20. These values quantify the annual fiscal penalty of the 2023 amendment.
2. Consolidation Interdependency: Unification is not a substitute for broader fiscal consolidation. The debt-to-GDP ratio continues to rise from approximately 62 percent to approximately 238–247 percent over 20 years under all scenarios. The structural primary deficit and interest dynamics dominate the fiscal outlook. Reversing the 2023 amendment must therefore be part of a comprehensive fiscal consolidation strategy.
3. Welfare Penalization: All working-age cohorts gain from unification, with welfare improvements of approximately 0.78 to 0.79 percent of lifetime consumption driven by higher equilibrium real wages. Retirees are unaffected. These values represent the uniform welfare penalty that the 2023 amendment imposes on every working-age Ghanaian.
4. Macroeconomic Deficits: The macroeconomic effects are positive but modest, with capital deepening of 2.0 percent, wage increases of 0.8 percent, and a 14 basis point decline in the equilibrium real interest rate. These metrics capture the capital, wage, and interest rate penalties of maintaining fragmentation.
5. Policy Frontier: Phased migration (S_5) offers the best structural balance of fiscal improvement, cohort fairness, and political feasibility, while the fiscal-neutral

calibration (S_6) produces the best fiscal outcome if political constraints permit a compressed compensation ratio.

These findings are conditional on the model's structural assumptions and calibrated parameter values. Section 8 provides sensitivity analysis.

8 Sensitivity Analysis

This section evaluates the robustness of the baseline results to alternative assumptions about key structural parameters. Seven sensitivity dimensions are examined: the recognition bond compensation ratio, the real government borrowing rate, bond maturity, the pace of capital deepening from pension fund deployment, the primary fiscal deficit, the speed of macroeconomic transition, and a best-case/worst-case combination spanning the full parameter space.

8.1 Compensation Ratio (λ)

Table 8.1 reports the sensitivity of debt dynamics to the recognition bond compensation ratio, varied from $\lambda = 0.50$ (50 percent recognition) to $\lambda = 1.00$ (full recognition).

Table 8.1: Sensitivity to Recognition Bond Compensation Ratio

Compensation Ratio (λ)	D/Y ($t = 20$)	Net Fiscal Effect ($t = 10$, % of GDP)
100% (Full Recognition)	237.20%	-0.367
90%	236.90%	-0.380
80% (Baseline)	236.70%	-0.394
70%	236.40%	-0.407
60%	236.10%	-0.420
50%	235.90%	-0.434

The compensation ratio has a measurable but modest effect on the long-run debt trajectory. Moving from full recognition to 50 percent recognition improves the debt-to-GDP ratio at year 20 by only 1.3 percentage points (shifting from 237.2 to 235.9 percent). The net fiscal effect improves more noticeably, moving from -0.367 to -0.434 percent of GDP per year, reflecting the direct reduction in recognition bond issuance and redemption costs. Each 10-percentage-point reduction in λ contributes approximately 0.013 percentage points of GDP in additional annual fiscal

improvement, and the relationship behaves approximately linearly across the tested range.

Policy Implication: While lower compensation ratios improve fiscal outcomes, the gains are small relative to Ghana's overall fiscal challenge. The choice of λ should therefore be driven primarily by political-economy considerations, specifically, the minimum compensation required to secure agreement from Cap 30 institutions, rather than by fiscal optimization alone. A difference of 50 percentage points in compensation generosity (from 50 to 100 percent) alters the long-run debt ratio by less than 2 percentage points of GDP.

8.2 Real Interest Rate

Table 8.2 reports the sensitivity of debt dynamics to the real government borrowing rate, varied from 2.0 percent to 8.0 percent.

Table 8.2: Sensitivity to Real Interest Rate

Real Interest Rate (r)	**D/Y ($t = 20$)**
2.00%	168.80%
3.00%	198.50%
4.07% (Baseline)	236.70%
5.00%	276.20%
6.00%	326.60%
8.00%	457.90%

The real interest rate is the single most powerful determinant of debt sustainability in the model. A reduction in the real borrowing rate from the baseline 4.07 percent to 2.0 percent, consistent with Ghana achieving investment-grade credit status, accessing significant concessional financing, or maintaining elevated inflation that erodes the real value of nominal debt, reduces the debt-to-GDP ratio at year 20 by 67.9 percentage points (from 236.7 to 168.8 percent). Conversely, an increase to 8.0 percent, consistent with a loss of international market access or a sharp rise in sovereign risk premia, nearly doubles the debt ratio to 457.9 percent, an increase of 221.2 percentage points above baseline.

The sensitivity is non-linear: the marginal effect of a 100-basis-point increase in r is larger at higher levels of the interest rate, reflecting the compounding effect of interest on the growing debt stock. At $r = 2.0$ percent, a 100-bps increase raises D/Y at $t = 20$ by approximately 29.7 percentage points; at $r = 6.0$ percent, the same 100-bps increase raises D/Y by approximately 65.7 percentage points.

Policy Implication: Ghana's debt sustainability depends far more on the path of real interest rates than on the design of pension unification. The entire range of variation in D/Y at $t = 20$ across all recognition bond compensation ratios (1.3 percentage points) is less than one-twentieth of the variation generated by plausible changes in the real interest rate (289.1 percentage points). Policies that reduce the government's marginal borrowing cost, including fiscal consolidation to improve creditworthiness, access to concessional financing, and maintenance of the inflation tax on nominal debt, will have a substantially larger impact on long-run debt dynamics than any feasible variation in recognition bond parameters.

8.3 Recognition Bond Maturity

Table 8.3 reports the sensitivity of debt dynamics to the maturity of recognition bonds, varied from 5 to 25 years.

Table 8.3: Sensitivity to Bond Maturity

Maturity (years)	$\boldsymbol{D/Y}$ **(**$\boldsymbol{t = 20}$**)**	$\boldsymbol{RB}$**/GDP (**$\boldsymbol{t = 20}$**)**
5	240.90%	0.00%
10	237.70%	0.00%
15 (Baseline)	236.70%	0.76%
20	236.10%	1.29%
25	235.80%	1.61%

Longer bond maturities improve the debt-to-GDP ratio at year 20 by spreading redemption payments over a longer horizon, reducing the annual fiscal burden. Moving from a 5-year to a 25-year maturity improves D/Y at $t = 20$ by 5.1 percentage points. However, longer maturities also result in a larger outstanding recognition bond stock, rising from effectively zero at a 5-year maturity to 1.61 percent of GDP at a 25-year maturity, since bonds remain on the government's balance sheet for longer before being fully redeemed.

The trade-off is clear: shorter maturities eliminate the recognition bond liability more quickly but impose a higher annual redemption cost, worsening near-term debt dynamics. Longer maturities smooth the fiscal cost and improve long-run debt ratios but maintain a larger stock of explicit pension-related liabilities on the government balance sheet. Notably, even at a 25-year maturity, the outstanding recognition bond stock remains modest at 1.61 percent of GDP.

Policy Implication: A maturity horizon of 15 to 25 years is recommended. Very short maturities (5 years or less) are inadvisable, as the concentrated redemption schedule

would materially worsen the debt trajectory during the critical first post-reform decade. The additional liability from longer maturities is small relative to Ghana's total public debt stock (approximately 62 percent of GDP), making the smoothing benefits of longer maturities the dominant consideration.

8.4 Capital Deepening from Pension Fund Deployment

Table 8.4 reports the sensitivity of debt dynamics to the extent of capital deepening generated by the deployment of additional pension fund assets into productive domestic investment.

Table 8.4: Sensitivity to Capital Deepening

Capital Deepening	$D/Y\ (t = 20)$
0% (No deployment)	238.30%
1%	237.50%
2% (Baseline)	236.70%
3%	235.90%
5%	234.40%

The macroeconomic feedback from pension fund deployment has a modest but non-negligible effect. If recognition bond assets and new Tier 2 contributions are fully deployed into productive investment, generating a 5 percent increase in the aggregate capital stock, the debt-to-GDP ratio at year 20 improves by approximately 3.9 percentage points relative to a scenario with no deployment. The mechanism operates through higher output (the denominator of the debt ratio) and, to a lesser extent, through the lower equilibrium interest rate reducing government borrowing costs.

Policy Implication: Maximizing the domestic investment impact of pension fund assets amplifies the fiscal benefits of unification. Regulatory frameworks that facilitate productive deployment of pension assets, including diversification beyond the current 73 percent allocation to government securities, would strengthen the macroeconomic feedback channel. However, the effect is modest relative to the dominant influence of the real interest rate and the primary deficit.

8.5 Primary Fiscal Deficit

Table 8.5 reports the sensitivity of debt dynamics to the structural primary deficit, varied from 0.0 percent of GDP (balanced primary budget) to 4.0 percent of GDP.

Table 8.5: Sensitivity to Primary Fiscal Deficit

Primary Deficit (% of GDP)	$\boldsymbol{D/Y\ (t = 20)}$

0.00%	172.50%
1.00%	204.60%
2.00% (Baseline)	236.70%
3.00%	268.70%
4.00%	300.80%

The primary deficit is the second most powerful determinant of debt sustainability after the real interest rate. Eliminating the primary deficit entirely, achieving a balanced primary budget, reduces the debt-to-GDP ratio at year 20 by 64.2 percentage points relative to baseline (from 236.7 to 172.5 percent). Conversely, a deterioration to a 4.0 percent primary deficit raises the ratio to 300.8 percent, a deterioration of 64.1 percentage points. Each percentage point of GDP in additional primary deficit adds approximately 32 percentage points to the debt-to-GDP ratio at year 20, a relationship that is roughly linear across the tested range.

Policy Implication: Fiscal consolidation, specifically, narrowing the gap between government expenditure and revenue, has a first-order effect on long-run debt sustainability. The combined effect of eliminating the primary deficit (64.2 pp improvement) and reducing the real interest rate to 2.0 percent (67.9 pp improvement) would bring the debt-to-GDP ratio at year 20 to approximately 104 percent, a trajectory consistent with long-run fiscal sustainability. Pension unification contributes to this adjustment at the margin, but the bulk of the required fiscal effort lies in broader budgetary consolidation.

8.6 Transition Speed

Table 8.6 reports the sensitivity of debt dynamics to the speed at which capital deepening effects materialize, varied from 1 to 20 years.

Table 8.6: Sensitivity to Transition Speed

Transition Period (years)	D/Y $(t = 20)$
1	236.80%
5	236.80%
10 (Baseline)	236.70%
15	236.60%
20	237.00%

The speed of macroeconomic transition has a negligible effect on long-run debt outcomes. Whether capital deepening occurs rapidly (1 year) or gradually (20 years), the debt-to-GDP ratio at year 20 varies within a range of only 0.4 percentage points. This reflects the fact that the long-run capital stock is determined by the total volume of additional pension saving, not the speed at which it is deployed.

Policy Implication: The pace of transition does not materially affect long-run fiscal outcomes. Policymakers can therefore choose a transition speed based on administrative and political considerations, including the capacity of pension fund administrators to absorb new members, the readiness of the regulatory framework, and the time required to negotiate acceptable terms with Cap 30 institutions, without concern that a slower pace will undermine the fiscal benefits of reform.

8.7 Best-Case and Worst-Case Combinations

Table 8.7 reports debt dynamics under stylized best-case and worst-case parameter combinations to illustrate the full range of potential outcomes.

Table 8.7: Best-Case and Worst-Case Scenarios

Scenario	Parameters	D/Y $(t = 20)$
Best-Case	$r = 2\%$, $\lambda = 100\%$, $K = +5\%$, zero primary deficit	116.60%
Baseline Reform (S_2)	$r = 4.07\%$, $\lambda = 80\%$, $K = +2\%$, 2% deficit	236.70%
Worst-Case	$r = 8\%$, $\lambda = 50\%$, $K = 0\%$, 4% deficit	561.00%

The range of potential debt outcomes is extremely wide, from 116.6 percent of GDP in the best case to 561.0 percent in the worst case, a span of 444.4 percentage points. This underscores the dominance of macroeconomic conditions over pension reform parameters in determining Ghana's long-run fiscal trajectory.

In the best-case scenario, combining low real interest rates, fiscal consolidation to a balanced primary budget, and full deployment of pension assets into productive investment, the debt-to-GDP ratio at year 20 is approximately 117 percent, a trajectory consistent with long-run sustainability. This scenario demonstrates that debt stabilization is achievable but requires improvement across multiple dimensions simultaneously.

In the worst-case scenario, high real interest rates, a 4 percent primary deficit, and no capital deepening from pension fund deployment, the debt ratio reaches 561.0 percent, a clearly unsustainable trajectory. Even in this environment, pension

unification provides a small fiscal improvement relative to the no-reform counterfactual, but the effect is overwhelmed by adverse macroeconomic conditions.

Policy Implication: Pension unification should be pursued as part of a broader macroeconomic stabilization strategy. In a favorable macroeconomic environment, unification contributes to achieving a sustainable long-run debt path. In an unfavorable environment, even the best-designed reform cannot prevent debt from rising to unsustainable levels. The combination of low real interest rates and primary fiscal balance is the necessary condition for debt sustainability; pension reform is a complementary but not substitutable policy.

8.8 Summary of Sensitivity Findings

The sensitivity analysis supports five conclusions:

1. The real interest rate is the dominant parameter: It accounts for the largest share of variation in long-run debt outcomes across all sensitivity tests. The 289 percentage point range in D/Y at $t = 20$ across plausible interest rate assumptions dwarfs the 1.3 percentage point range across compensation ratios and the 5.1 percentage point range across bond maturities.

2. The primary fiscal deficit is the second most important parameter: Each percentage point of GDP in additional primary deficit adds approximately 32 percentage points to the long-run debt ratio. Eliminating the primary deficit would improve D/Y at $t = 20$ by 64.2 percentage points — an effect comparable in magnitude to a 200-basis-point reduction in the real interest rate.

3. Pension reform parameters have modest but consistent effects: The compensation ratio, bond maturity, and capital deployment all affect the debt trajectory in the expected direction, but their combined influence is approximately two orders of magnitude smaller than the real interest rate.

4. The results are robust to transition speed: Whether reform is implemented rapidly or gradually, long-run outcomes differ by less than half a percentage point of GDP, giving policymakers substantial flexibility on implementation timelines.

5. Debt stabilization is achievable under favorable macroeconomic conditions: The best-case scenario (D/Y at $t = 20$ of 116.6 percent) demonstrates that a combination of low real interest rates, fiscal consolidation, and productive pension asset deployment can bring the debt trajectory onto a sustainable path. Pension unification contributes to this outcome but is neither necessary nor sufficient for achieving it.

These findings have a clear hierarchy of policy importance. The most impactful actions available to Ghanaian policymakers are, in descending order: (i) reducing the real government borrowing rate through improved creditworthiness, concessional financing, and prudent monetary policy; (ii) achieving primary fiscal balance through

expenditure control and revenue mobilization; (iii) maximizing the productive domestic investment of pension fund assets; and (iv) optimizing the design parameters of pension unification. The current paper addresses (iv); its findings underscore the greater importance of (i) through (iii).

9: Political Economy and Implementation Principles

9.1 The Political Economy of Pension Unification

The quantitative results established in the preceding sections demonstrate that public pension unification is structurally beneficial, improving Ghana's long-run debt trajectory across all scenarios relative to the fragmented baseline, but that the absolute scale of fiscal adjustment is marginal compared to the overriding influence of systemic macroeconomic parameters. Consequently, the policy core shifts from whether unification should proceed to how system integration can be executed in a manner that remains fiscally optimized, politically viable, and administratively executable.

The political economy of pension restructuring is shaped by sharp distributional asymmetries. Large-scale structural transitions impose concentrated modifications on specific, highly organized interest groups, in this instance, the baseline pool of approximately 66,700 active Cap 30 civil servants and 63,200 current pensioners, while generating diffuse fiscal benefits spread across the general taxpayer base. The legacy Cap 30 cohorts possess significant institutional bargaining power within the state apparatus, enabling them to impose high political costs on unilateral structural changes. Conversely, the direct beneficiaries of reform, future taxpayers and the broader macroeconomy, are unorganized and politically diffuse.

This structural imbalance explains why the unification mandate has stalled for nearly two decades despite clear statutory backing under Section 213 of Act 766. The empirical framework developed in this study addresses this exact friction by making these macro-fiscal flows transparent and measurable, providing the empirical baseline needed to anchor a negotiated structural settlement.

9.2 Principles for Implementation

The dynamic general equilibrium simulations and accompanying sensitivity matrices support five core policy principles to guide the operational design and execution of public pension unification.

Principle 1: Direct Protection of Accrued Rights. The structural deployment of a recognition bond mechanism ensures that legacy workers are explicitly compensated for liabilities accumulated under Cap 30 prior to transition. The welfare analytics verify that current retirees remain entirely insulated from welfare shifts, while active workers

receive marketable assets matching their legacy tenure. Preserving the legal and economic integrity of accrued rights is a baseline political prerequisite for structural compliance.

Principle 2: Strategic Generosity in Compensation Allocation. The sensitivity analysis regarding the compensation ratio (λ) demonstrates that compressing compensation parameters yields negligible long-run macro-fiscal gains. A wide 50-percentage-point variation in λ alters the year-20 debt-to-GDP ratio by less than 2 percentage points. This indicates that the fiscal authority has the structural space to utilize a high compensation ratio ($\lambda = 1.00$) as an institutional bargaining tool. The political utility of securing systemic compliance via adequate compensation outweighs the marginal fiscal savings generated by aggressive parameter compression.

Principle 3: Operational Phasing of the Transition Pathway. The phased migration model (Scenario S_5) optimizes the frontier between fiscal adjustment and administrative feasibility. A five-year implementation window allows the domestic pension infrastructure to absorb new accounts incrementally, avoids concentrated balance-sheet shocks from immediate debt formalization, and gives workers stable adjustment horizons. Because the transition speed has a negligible impact on long-run debt stocks, there is no structural justification for high-speed execution.

Principle 4: Targeted Protection for Near-Retirement Cohorts. The age-protected framework (Scenario S_4) explicitly insulates workers within ten years of statutory retirement ($j \geq 50$), who face rigid horizons for accumulation under a funded defined-contribution system. The general equilibrium model proves that safeguarding these older cohorts via full recognition ($\lambda = 1.00$) while executing partial recognition ($\lambda = 0.70$) for younger workers can be achieved with no marginal debt penalty relative to a uniform partial compensation scheme, directly optimizing political feasibility.

Principle 5: Structural Integration into Wider Macro-Fiscal Consolidation. The sensitivity parameters show that pension unification cannot serve as a standalone anchor for sovereign debt stabilization. Long-run fiscal sustainability is dictated by the domestic real interest rate and the primary budget balance. Pension system integration must therefore be framed and executed as a complementary micro-structural component of a comprehensive macroeconomic stabilization program, rather than an isolated remedy for state fiscal imbalances.

10. Conclusion

10.1 Summary of Findings

This study has developed a dynamic general equilibrium model with overlapping generations to evaluate the fiscal, macroeconomic, distributional, and political-economy implications of migrating Ghana's Cap 30 and other legacy public pension schemes into the existing three-tier contributory system. The analysis was motivated by the nearly two-decade policy impasse that has persisted despite the clear unification mandate originally contained in the National Pensions Act, 2008 (Act 766),

and the subsequent 2023 amendment that exempted security agencies from this mandate.

The simulation results support seven principal findings:

- Pension Unification is Fiscally Beneficial Under All Tested Scenarios: The net fiscal effect of reform, measuring the direct budgetary impact, ranges from -0.367 to -0.418 percent of GDP per year depending on the compensation ratio and implementation design. Over a 20-year horizon, unification reduces the debt-to-GDP ratio by approximately 8.3 to 9.3 percentage points relative to the fragmented baseline. These values quantify the annual fiscal penalty of the 2023 amendment.
- Unification is Not a Substitute for Broader Fiscal Consolidation: Even under the best-performing reform scenario, Ghana's debt-to-GDP ratio continues to rise from approximately 62 percent to approximately 238 percent over 20 years. The structural primary deficit and the compounding effect of real interest costs dominate the fiscal outlook. Pension reform improves the trajectory at the margin but does not alter the fundamental fiscal arithmetic.
- The Real Interest Rate is the Dominant Parameter Determining Debt Sustainability: The sensitivity analysis demonstrates that plausible variations in the real government borrowing rate, from 2.0 percent to 8.0 percent, generate a 289-percentage-point range in the debt-to-GDP ratio at year 20, dwarfing the effects of all pension reform parameters combined. The primary fiscal deficit is the second most important parameter, with each percentage point of GDP in additional deficit adding approximately 32 percentage points to the long-run debt ratio.
- The Compensation Ratio Has Only a Modest Effect on Fiscal Outcomes: A 50-percentage-point reduction in the recognition bond compensation ratio, from full recognition to 50 percent, improves the debt-to-GDP ratio at year 20 by only 1.3 percentage points. This creates substantial fiscal space for generosity in political negotiations with Cap 30 institutions.
- All Working-Age Cohorts Benefit from Unification: The welfare analysis shows improvements of approximately 0.78 to 0.79 percent of lifetime consumption for all cohorts aged 20 to 59, driven by higher equilibrium wages from capital deepening. Retirees are unaffected, confirming that the recognition bond mechanism successfully protects accrued benefits. These values represent the uniform welfare penalty that the 2023 amendment imposes on every working-age Ghanaian.
- The Macroeconomic Effects are Positive but Modest: Capital deepening of approximately 2.0 percent, wage increases of 0.8 percent, and a 14-basis-point decline in the equilibrium real interest rate are the expected long-run macroeconomic consequences of expanding funded pension coverage to

formerly excluded Cap 30 workers. These metrics capture the capital, wage, and interest rate penalties of maintaining fragmentation.

- Phased Migration with Age Protection is the Preferred Implementation Pathway: This design combines the largest fiscal improvement with strong political feasibility and explicit protection for the most vulnerable cohorts. The sensitivity analysis confirms that the speed of transition has a negligible effect on long-run fiscal outcomes, giving policymakers flexibility to implement the reform gradually.

10.2 Policy Recommendations

Based on these findings, the study makes five policy recommendations:

1. Proceed with Pension Unification: The fiscal benefits, while modest, are consistently positive. The macroeconomic effects, while small, are favorable. The analytical basis for proceeding is now established.
2. Offer Generous Recognition: The government can afford to be generous in compensating Cap 30 workers for their accrued rights. The fiscal cost of full recognition ($\lambda = 1.00$) is only marginally higher than partial recognition, and the political value of securing agreement through generosity is likely to be substantial.
3. Protect Near-Retirees: Workers within ten years of retirement should receive full recognition of their accrued rights. Younger workers can be offered partial recognition, since their longer adjustment horizons allow them to accumulate additional pension wealth under the contributory system.
4. Phase the Transition Over Five Years: Phased migration allows workers and institutions to adjust, avoids a concentrated debt shock, and enables the necessary administrative systems to be developed. The speed of transition does not affect long-run fiscal outcomes.
5. Embed Unification Within a Broader Fiscal Consolidation Strategy: Pension reform alone cannot stabilize Ghana's debt. It should be implemented alongside measures to reduce the structural primary deficit and to maintain access to low-cost financing, including through the ongoing IMF program and continued engagement with development partners.

10.3 Contribution and Limitations

- Methodological Contribution: This study introduces the dynamic general equilibrium framework with overlapping generations into Ghanaian pension policy analysis. It moves beyond the partial-equilibrium actuarial projections that have dominated previous discussions by explicitly incorporating behavioral responses, macroeconomic feedback effects, and the fiscal dynamics of recognition bond issuance and redemption. The framework is modular and

calibratable to other emerging and developing economy contexts where legacy pension unification remains an unresolved policy challenge.

- Policy Contribution: The study provides to the best of our knowledge, the first comprehensive quantification of the fiscal, distributional, and macroeconomic implications of completing Ghana's pension reform, and, critically, the first empirical estimate of the opportunity cost of the 2023 amendment. It generates the specific analytical inputs, net fiscal effects, cohort welfare estimates, compensation schedules, sensitivity analyses, that the NPRA Board, the Ministry of Finance, Cabinet, and the leadership of the Cap 30 institutions need to move from impasse to negotiation.
- Limitations: The analysis is subject to several limitations:
    - The household block currently uses a representative-agent approach to lifecycle aggregation; a full heterogeneous-agent extension would permit more detailed analysis of the distribution of welfare effects across legacy worker cohorts.
    - The pension adequacy analysis (replacement rates by worker type and cohort) requires individual-level tracking of pension balances through the transition path, which has been flagged as a future extension.
    - The model abstracts from aggregate uncertainty, including stochastic interest rates, demographic shocks, and macroeconomic cycles; a stochastic extension would permit a more complete assessment of fiscal risk.
    - The informal sector is modeled only in a simplified manner; a richer treatment of informality, including endogenous formal-informal transitions, would strengthen the framework's applicability to the broader challenge of extending pension coverage in Ghana.

These limitations represent productive directions for future research. They do not, however, undermine the core findings, which are robust across the full range of sensitivity tests reported in Section 8.

10.4 Concluding Remarks

Ghana's pension unification mandate has remained largely unimplemented for nearly two decades. The reasons are multiple: the institutional complexity of integrating the Cap 30 agencies, the political sensitivity surrounding changes to public-sector and security-service pension arrangements, uncertainty regarding the magnitude and financing of transition costs, and the broader fiscal constraints within which any reform must operate. The 2023 amendment exempting security agencies added a new layer of legislative fragmentation to this already complex landscape.

This study does not seek to resolve all of these challenges. Rather, it addresses one important gap: the absence of a coherent quantitative framework for evaluating the fiscal, distributional, and macroeconomic implications of alternative unification designs. By developing such a framework, the study provides analytical evidence that may support more informed policy discussion and future negotiations regarding the long-delayed unification of Ghana's pension system, and, in particular, quantifies the opportunity cost of the legislative path Parliament chose in 2023.

The findings are simultaneously encouraging and cautionary. They are encouraging because the simulations suggest that pension unification is administratively feasible, fiscally beneficial at the margin, and capable of generating modest welfare gains for affected working-age cohorts. They are cautionary because the results also show that unification alone cannot resolve Ghana's deeper structural fiscal challenges. The long-run trajectory of public debt remains driven primarily by the underlying primary balance, real borrowing costs, and broader macroeconomic conditions.

The results therefore suggest that pension unification should not be viewed as a standalone solution to fiscal sustainability. Rather, it is best understood as one component of a broader program of fiscal consolidation, debt management, and macroeconomic stabilization. Within such a framework, unification can improve the efficiency, coherence, and long-run sustainability of Ghana's pension system, even if it cannot by itself alter the country's fundamental fiscal arithmetic.

TECHNICAL APPENDIX

A.1 Model Equations

A.1.1 Household Problem

The representative household of age j, worker type $\tau \in \{F, L, I\}$ (Formal SSNIT, Legacy Cap 30, Informal), at time t solves:

$$V_{j,t}^{\tau}(x) = \max_{c,l,a',v}\{u(c,l) + \beta\psi_{j,t}\mathbb{E}_t[V_{j+1,t+1}^{\tau}(x')]\}$$

subject to the budget constraints specified by worker type below. The period utility function is:

$$u(c,l) = \frac{c^{1-\sigma}}{1-\sigma} - \theta\frac{l^{1+\gamma}}{1+\gamma}$$

The state vector x includes private assets a, Tier 2 balance A_{T2}, Tier 3 balance A_{T3}, and, for legacy workers pre-reform, years of service and reference salary.

Formal SSNIT-Covered Worker (Working Age):

$$c + a' = (1 + r_t(1-\tau_k))a + w_t e_j l(1 - \tau_l - \tau_{\text{ssnit}} - \tau_{t2}) + \text{transfers}_t$$

Legacy Cap 30 Worker (Pre-Reform, Working Age):

$$c + a' = (1 + r_t(1-\tau_k))a + w_t e_j l(1 - \tau_l) + \text{transfers}_t$$

Informal Worker (Working Age):

$$c + a' + v = (1 + r_t)a + y_{i,t}(1 - \tau_v) + \text{transfers}_t$$

with informal income following $\log\, y_{i,t} = \rho\log\, y_{i,t-1} + \varepsilon_{i,t}$, $\varepsilon \sim \mathcal{N}(0, \sigma_\varepsilon^2)$.

Retirement (All Formal Workers):

$$c + a' = (1 + r_t(1-\tau_k))a + b_{T1} + b_{T2} + b_{T3} + \text{transfers}_t$$

A.1.2 Pension System

Tier 1 — SSNIT Defined Benefit (PAYG):

$$b_{T1} = \max\left(b_{\min}, \phi \cdot AIE \cdot \min\left(1, \frac{s_{\text{SSNIT}}}{s_{\text{full}}}\right)\right)$$

where AIE is the average of the best three years of indexed insurable earnings, s_{SSNIT} is years of SSNIT contributions, $s_{\text{full}} = 35$ years, and ϕ is the replacement rate parameter.

Tier 2 — Mandatory Defined Contribution:

$$A'_{T2} = (1 + r_t^p)A_{T2} + \tau_{t2} \cdot w_t e_j l$$

At retirement, the Tier 2 balance is annuitized:

$$b_{T2} = \frac{A_{T2,R}}{\ddot{a}_R}, \ddot{a}_R = \frac{1 - (1 + r^p)^{-LE_R}}{r^p}$$

Tier 3 — Voluntary Defined Contribution:

$$A'_{T3} = (1 + r_t^p)A_{T3} + v$$

Recognition Bond:

At reform date t_0, accrued Cap 30 rights are valued:

$$PV_j = \sum_{s=R}^{T} \frac{\psi_t \cdot b_{\text{Cap30,projected}}}{(1+r_{rb})^{s-t_0}}$$

The recognition bond is:

$$RB_j = \lambda \cdot PV_j$$

credited to the worker's Tier 2 account. The bond stock evolves as:

$$RB_{\text{Stock},t+1} = (1 + r_{rb})RB_{\text{Stock},t} + RB_{\text{Issuance},t} - RB_{\text{Redemptions},t}$$

A.1.3 Production

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha}$$

$$w_t = (1-\alpha)Z_t \left(\frac{K_t}{L_t}\right)^{\alpha}, r_t = \alpha Z_t \left(\frac{K_t}{L_t}\right)^{\alpha-1} - \delta$$

$$L_t = \sum_{j=20}^{R-1} N_{j,t} \cdot e_j \cdot l_{j,t}, K_t = \sum_j N_{j,t} \cdot a_{j,t} + A_{T2,t}^{\text{total}} + A_{T3,t}^{\text{total}}$$

A.1.4 Government Budget

$$D_{t+1} = (1 + r_t)D_t + G_t + \text{Deficit}_t^{T1} + \text{Cap30Payments}_t + \text{RBRedemptions}_t - \text{TaxRevenue}_t$$

$$\text{Deficit}_t^{T1} = \text{Benefits}_t^{T1} - \text{Contributions}_t^{T1}$$

$$\text{Tax Revenue}_t = \tau_l \cdot w_t L_t + \tau_k \cdot r_t K_t + \tau_v \cdot C_t + \tau_{\text{ssnit}} \cdot \text{WageBase}_t$$

Net Fiscal Effect:

$$\Delta\text{Fiscal}_t = \text{RBRedemptions}_t - \text{AvoidedCap30}_t - \text{NewSSNITContributions}_t$$

Negative values indicate fiscal improvement.

A.2 Calibrated Parameters

Parameter	Symbol	Value	Source/Method
Risk aversion	σ	2.0	Standard DGE literature
Inverse Frisch elasticity	γ	2.0	Literature benchmark

Discount factor	β	0.9609	Pinned by steady-state condition $\beta = 1/(1+r)$ at $r = 4.07\%$
Labour disutility	θ	2.5312	Calibrated to match average labour supply of 0.306
Capital share	α	0.40	National accounts
Depreciation rate	δ	0.08	Investment/GDP calibration
Labour tax rate	τ_l	0.06	GRA 2024 Tax Report: PIT as % GDP
Capital tax rate	τ_k	0.04	GRA 2024: CIT + royalties as % GDP
Consumption tax rate	τ_v	0.05	GRA 2024: VAT + NHIL + GETFund + excise as % GDP
SSNIT contribution (net)	τ_{ssnit}	0.11	Act 766: 13.5% gross less NHIA transfer
Tier 2 contribution	τ_{t2}	0.05	Act 766
SSNIT replacement rate	ϕ	0.50	SSNIT benefit formula
SSNIT max insurable	—	GHS 52,000/month	SSNIT, effective January 2024
SSNIT min pension (new)	—	GHS 300/month	SSNIT 2024
SSNIT min pension (existing)	—	GHS 396.58/month	SSNIT 2024 (indexed)
SSNIT max pension	—	GHS 186,778/month	SSNIT 2023 Annual Report
Cap 30 accrual (standard)	$f_{accrual}$	1/60	Cap 30 legal instrument
Cap 30 accrual (judges)	$f_{accrual}^{judge}$	1/3	Judicial pension norms
Cap 30 max pension	—	GHS 49,730/month	CAGD administrative data

Real govt borrowing rate	r	4.07%	Fisher equation: (1+0.28)/(1+0.23)−1
Initial debt/GDP	D_0/Y	0.618	MoF Q4 2024, post-DDEP
Retirement age (normal)	R	60	Act 766
Retirement age (early)	R_{early}	55	Act 766
Pension fund return (net)	r^p	0.14	NPRA industry average (13–15%)
Tier 2 admin fee	—	0.015	NPRA estimate (midpoint below 2.5% cap)
Recognition bond rate	r_{rb}	0.08	Long-run real discount rate
Cap 30 PV share of GDP	—	0.02	Estimated from per-worker accrued rights

A.3 Demographic Calibration

Population projections by single year of age (20–100) for 2021–2050 are sourced from the Ghana Statistical Service 2021 Population and Housing Census projections. Survival probabilities are derived from UN World Population Prospects 2024 abridged life tables for Ghana, interpolated to single-year ages using cubic spline methods. For years beyond 2050, cohort sizes are projected forward using estimated survival probabilities and entry rates consistent with GSS medium-variant fertility assumptions.

The age-efficiency profile for formal-sector workers is derived from SSNIT administrative data on insurable earnings by age. In the absence of GLSS microdata at the time of calibration, the informal-sector efficiency profile is constructed by scaling the formal profile by a factor of 0.6 and applying a flatter slope across ages, consistent with the comparative literature on formal-informal wage gaps in sub-Saharan Africa.

A.4 Data Sources

Module	Primary Source	Description
Demographics	GSS 2021 Census; UN WPP 2024	Population by age, survival probabilities, life expectancy
Macroeconomic	GSS StatsBank; MoF; BoG	GDP, investment, consumption, fiscal flows, debt, interest rates, inflation
SSNIT Tier 1	SSNIT Actuarial Reports; NPRA Annual Reports	Active contributors, pensioners, contributions, benefits, fund assets
Private Pensions (Tier 2/3)	NPRA Annual Reports; NPRA Statistical Bulletin Q4 2025	AUM, membership, contributions, returns, fees
Cap 30 Legacy Scheme	CAGD Quarterly Reports	Active members, pensioners, expenditure, benefit range
Tax Parameters	GRA 2024 Annual Tax Revenue Performance Report	Effective tax rates by category
Public Debt	MoF Public Debt Statistical Bulletin Q3-2024	Debt stock, composition, holders
Household/Labour	Pending GLSS microdata	Age-earnings profiles, labour supply, informality (using fallback estimates)

A.5 Computational Methods

The model is solved in Python (version 3.14) using the following computational approach.

Household problem: The lifecycle optimization is solved by backward induction using value function iteration on a discretized asset grid of 150 points (quadratically spaced, range GHS 0 to GHS 100,000). The labor supply choice is discretized over 20 grid points (0.0 to 1.0). At each age and asset state, the optimal consumption-saving and labor supply decisions are found by grid search over a local continuous savings grid (40 points, linear spacing) constructed from the household's cash-on-hand. The value function at the next age is interpolated using linear interpolation.

Steady-state calibration: The discount factor β is pinned analytically by the steady-state condition $\beta = 1/(1+r)$ at the calibrated real interest rate of 4.07 percent. The labor disutility parameter θ is calibrated by iterative adjustment until average labor supply converges to 0.306 (approximately one-third of available time, consistent with a 40-hour work week). The calibration converges within four iterations using a multiplicative update rule with asymmetric adjustment speeds.

Transition dynamics: The transition path from the pre-reform to the post-reform steady state is computed over an 80-year horizon. The reform is implemented at year 5. The capital stock adjusts gradually over a 10-year phase-in period toward its new steady-state level. Factor prices (wages, interest rates) adjust endogenously through the production function at each point along the transition path.

Fiscal dynamics: Government debt and recognition bond stocks are updated recursively using the government budget constraint. The debt decomposition follows the methodology described in Section 4.6, separating the change in the debt-to-GDP ratio into primary balance, interest cost, pension cost, transition cost, and GDP growth effects.

Welfare analysis: Cohort welfare is measured as the consumption-equivalent variation (CEV) — the percentage change in lifetime consumption that would equalize expected lifetime utility between the baseline and reform scenarios. Value functions are computed at the calibrated steady-state prices, and welfare differences are calculated for each cohort at age of labor market entry.

A.6 Scenario Definitions

Scenario	Compensation Ratio (λ)	Migration Speed	Age Protection	Description
S0	—	—	—	Baseline: Cap 30 continues indefinitely
S1	1.00	Immediate	None	Full recognition of accrued rights
S2	0.80	Immediate	None	80% recognition
S3	0.70	Immediate	None	70% recognition
S4	0.70 (1.00 for age ≥ 50)	Immediate	Age ≥ 50 fully protected	Age-protected reform
S5	0.80	5-year phase-in	None	Phased migration

S6	0.618	Immediate	None	Fiscal-neutral calibration

All scenarios assume recognition bonds are annuitised over a 15-year maturity at an 8 percent real discount rate unless otherwise specified in the sensitivity analysis.

A.7 Sensitivity Analysis Parameters

Dimension	Baseline	Range Tested
Compensation ratio (λ)	0.80	0.50–1.00
Real interest rate (r)	4.07%	2.0%–8.0%
Bond maturity	15 years	5–25 years
Capital deepening	2.0%	0.0%–5.0%
Primary deficit	2.0% of GDP	0.0%–4.0% of GDP
Transition speed	10 years	1–20 years

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