Brief: Social Security & Solvency

CDJ Economics & Public Policy

October 10, 2024

1 Introduction

Social Security plays a vital role in providing financial security for millions of Americans, serving as a primary source of income for retirees, individuals with disabilities, and survivors of deceased workers.

Established in 1935, the program has evolved to meet the changing needs of society, becoming an essential component of the social safety net. However, as demographics shift and the population ages, concerns regarding the program's long-term solvency, or ability to fulfill promised benefits to entitlement recipients, have intensified.

This brief examines the structure and funding of Social Security, highlighting its key components and the mechanisms by which benefits are calculated and distributed. Additionally, it explores various policy solutions aimed at achieving Social Security solvency, offering insights into their potential implications for beneficiaries and the broader economic landscape.

2 Overview of Social Security

Social Security is a federal program in the United States that provides retirement, disability, and survivors' benefits. Established in 1935, the program is primarily funded through payroll taxes, with current workers contributing to the benefits of current retirees. The program encompasses two primary components:

- **Old-Age, Survivors, and Disability Insurance (OASDI)**: The main component, commonly referred to simply as Social Security, which provides retirement benefits, disability benefits, and survivors' benefits.
- **Supplemental Security Income (SSI)**: A separate program that provides financial assistance to elderly, blind, or disabled individuals with low income and resources.

2.1 Retirement Benefits

Workers qualify for retirement benefits based on their earnings history, which is recorded as part of their *Average Indexed Monthly Earnings* (AIME). The formula used to calculate benefits includes bend points that ensure progressive benefits, where lower-income workers receive a higher percentage of their pre-retirement earnings as benefits.

2.2 Disability Benefits

Social Security Disability Insurance (SSDI) provides benefits to individuals who have a sufficient work history and become disabled before reaching retirement age. Benefits are calculated similarly to retirement benefits, using the AIME formula.

2.3 Survivors' Benefits

Survivors' benefits are paid to eligible family members of deceased workers. This includes spouses, children, and in some cases, dependent parents. Eligibility and the benefit amount are based on the deceased worker's earnings history.

2.4 Funding Structure

Social Security is primarily funded through the Federal Insurance Contributions Act (FICA) taxes, where both employers and employees contribute. The payroll tax rate is currently 12.4%, split evenly between employers and employees (6.2% each). Self-employed individuals pay the full 12.4%.

- **OASDI Trust Fund**: Revenue from FICA taxes is deposited into two trust funds: the Old-Age and Survivors Insurance (OASI) Trust Fund and the Disability Insurance (DI) Trust Fund. These trust funds are used to pay out benefits to eligible individuals.
- **Supplemental Security Income (SSI)**: Funded through general tax revenue, not payroll taxes. The SSI program is designed to assist individuals who have not worked enough to qualify for Social Security benefits but are in financial need due to age or disability.

3 Funding and Payout Structure of Social Security Components

The Social Security system is funded primarily through payroll taxes, with additional support from general tax revenues for programs like SSI. This section outlines how the different components of the program are funded and how benefits are paid out.

3.1 Old-Age, Survivors, and Disability Insurance (OASDI)

3.1.1 Funding

The OASDI program is funded through a dedicated payroll tax, known as the Federal Insurance Contributions Act (FICA) tax. This tax rate is 12.4%, with 6.2% paid by employees and 6.2% by employers. Self-employed workers pay the full 12.4%. The revenue from these taxes is split between the Old-Age and Survivors Insurance (OASI) Trust Fund and the Disability Insurance (DI) Trust Fund, which hold the reserves used to pay out benefits. As of 2024, the OASI tax rate is 5.3% while the DI tax rate is 0.9%, summing to the OASDI of 6.2% both employer and employee pay.[1]

The total tax rate is applied to earnings up to a specific limit, called the *taxable maximum*, which is adjusted each year to account for wage growth. In 2024, for instance, this cap is $168,600[2] ($176,100 starting 2025)[3]. Earnings above this limit are not subject to the payroll tax. Social security's revenue structure, then, is regressive while its payout structure is progressive.

3.1.2 Payout

- **Retirement Benefits**: Monthly benefits are paid to retired workers and their eligible dependents. The benefit amount is based on the worker's *Primary Insurance Amount* (PIA), which is calculated from the worker's *Average Indexed Monthly Earnings* (AIME).
- **Disability Benefits**: Individuals who qualify for SSDI based on their work history and disability status receive monthly benefits, calculated similarly to retirement benefits.
- **Survivors' Benefits**: Family members of deceased workers, such as widows, children, and dependent parents, are eligible for survivors' benefits. These are based on the deceased worker's earnings history and contributions to Social Security.

[1] See SSA Social Security Tax Rates at https://www.ssa.gov/oact/progdata/oasdiRates.html

[2] See SSA's Contribution and Benefit Base at https://www.ssa.gov/oact/cola/cbb.html

[3] See SSA change at https://news.bloombergtax.com/payroll/social-security-wage-base-increasing-to-176-100-for-2025

3.2 Supplemental Security Income (SSI)

3.2.1 Funding

Unlike OASDI, the Supplemental Security Income (SSI) program is funded through general tax revenues from the federal government, rather than payroll taxes. This means that it draws from the general federal budget, and is not tied directly to the Social Security Trust Funds.

3.2.2 Payout

SSI provides a flat monthly benefit to low-income individuals who are aged, blind, or disabled. The amount varies depending on factors like income, living arrangements, and other benefits received. The federal government sets a standard payment, but some states provide supplementary payments.

- **SSI and Medicaid**: Recipients of SSI are automatically eligible for Medicaid in most states, which helps cover healthcare costs for low-income individuals.
- **Means-Tested**: SSI benefits are means-tested, meaning that eligibility depends on both income and asset thresholds. Recipients must have limited income and resources to qualify for assistance.

4 Solvency Crisis

The financial sustainability of Social Security has become a pressing concern as the program faces a projected solvency crisis in the coming years. As more individuals retire and begin to draw benefits, the balance between income and expenditures within the Social Security system is increasingly tilted. Recent analyses indicate that without substantial reform, the program's ability to fulfill its obligations will be severely compromised. The following key facts from the SSA Trustees 2024 Report Summary[4] illustrate the magnitude of this challenge:

- The Old-Age and Survivors Insurance (OASI) Trust Fund will be able to pay 100 percent of total scheduled benefits until 2033... At that time, the fund's reserves will become depleted and continuing program income will be sufficient to pay 79 percent of scheduled benefits.
- The Disability Insurance (DI) Trust Fund is projected to be able to pay 100 percent of total scheduled benefits through at least 2098...
- If the OASI Trust Fund and the DI Trust Fund projections are combined, the resulting projected fund (designated OASDI) would be able to pay 100 percent of total scheduled benefits until 2035, one year later than reported last year. At that time, the projected fund's reserves will become depleted and continuing total fund income will be sufficient to pay 83 percent of scheduled benefits. (The two funds could not actually be combined unless there were a change in the law, but the combined projection of the two funds is frequently used to indicate the overall status of the Social Security program.)

[4] See https://www.ssa.gov/oact/trsum/

5 Overview of Policy Solutions to Achieve Social Security Solvency

Social Security solvency refers to the program's ability to meet its long-term financial obligations, specifically ensuring that the trust funds have enough money to pay out all benefits promised to current and future retirees, survivors, and people with disabilities. When the program is "solvent," it can fully cover these benefits without cutting payments or requiring additional funds. Currently, Social Security faces future shortfalls as more people retire and live longer, creating an imbalance between what's collected in taxes and what needs to be paid out in benefits. Several policy solutions have been proposed to restore solvency. Here's a summary of four key options:

1. Reducing Benefits

One direct way to improve Social Security's finances is to reduce the benefits paid out to recipients. This could take many forms, such as cutting the initial benefit amounts for future retirees or modifying how benefits grow over time. Reducing benefits would immediately lower the amount Social Security has to pay, which helps balance out the system's long-term costs. However, it would also reduce income for retirees, which may create financial strain for some individuals.

2. Reducing the Cost-of-Living Adjustment (COLA)

Social Security benefits are adjusted annually based on inflation through the **Cost-of-Living Adjustment (COLA)**. This adjustment helps benefits keep up with rising prices for goods and services. One proposal to improve solvency is to reduce the COLA by using a different measure of inflation or lowering the adjustment amount. This would gradually reduce the amount paid out in benefits over time, but it could also mean that beneficiaries' purchasing power doesn't keep up with rising costs, particularly as they age.

3. Increasing Payroll Taxes

Social Security is primarily funded through payroll taxes, which workers and employers pay into the system. Currently, both workers and employers pay 6.2% of wages up to a certain income cap. Increasing these taxes, either by raising the tax rate or by lifting the income cap, would bring in more revenue to the system, improving its solvency. This approach spreads the burden across all workers and could generate significant additional funding, but it also means higher taxes on earnings.

4. Raising the Retirement Age

Another option is to raise the **retirement age**, the age at which people become eligible for full Social Security benefits. Currently, the full retirement age is between 66 and 67, depending on the year of birth. Raising this age would mean people have to work longer before receiving full benefits, and it would reduce the number of years they collect payments. This reduces the overall costs to the system but can be challenging for those who are unable to work longer due to health or job market reasons.

5. Universal Social Security Benefits

Some have proposed expanding Social Security to provide **universal benefits**, meaning every individual would receive a basic Social Security payment, regardless of their work history. While this might seem like it would increase costs, advocates argue it could be structured in a way that simplifies the system and spreads the financial burden across a larger tax base. This proposal would be a more radical departure from the current system but could potentially address long-term solvency by ensuring everyone participates and contributes.

Each of these solutions comes with trade-offs, and a combination of approaches may be needed to fully restore Social Security's solvency while balancing fairness, financial sustainability, and the well-being of future retirees.

A Average Indexed Monthly Earnings (AIME) and Bend Point Calculations

The calculation of Social Security retirement benefits begins with the worker's earnings history. To ensure fairness and progressivity, Social Security uses a formula that relies on the worker's *Average Indexed Monthly Earnings* (AIME), which takes into account inflation and the individual's lifetime earnings. The calculated benefits then incorporate *bend points* to ensure that lower-income workers receive a higher percentage of their pre-retirement earnings compared to higher-income workers.

A.1 Step 1: Calculating AIME

The AIME is derived from the worker's highest 35 years of earnings. If the individual worked for fewer than 35 years, years with no earnings are included as zeros. Earnings in each of these years are indexed to reflect wage growth across the economy, using the *National Average Wage Index* (NAWI). The formula for AIME is as follows:

$$AIME = \frac{\sum_{i=1}^{35} \text{Indexed Earnings}_i}{420}$$

Where:

- $\text{Indexed Earnings}_i$ represents the inflation-adjusted earnings in year i.
- 420 is the number of months in 35 years (35 years $\times$ 12 months/year).

If a worker has fewer than 35 years of earnings, the missing years are counted as 0. This produces the worker's average indexed earnings on a monthly basis.

A.2 Step 2: Bend Points and the Primary Insurance Amount (PIA)

Once the AIME is calculated, it is used to determine the worker's *Primary Insurance Amount* (PIA), which is the base amount of benefits a worker is entitled to receive at full retirement age. The formula applies bend points, which introduce progressivity into the benefits structure.

In 2024, the formula for calculating the PIA is:

$$\begin{aligned} PIA = {} & 0.90 \times \min(\text{AIME}, 1^{\text{st}} \text{ bend point}) \\ & + 0.32 \times \min\Big(\max(\text{AIME} - 1^{\text{st}} \text{ bend point}, 0), 2^{\text{nd}} \text{ bend point} - 1^{\text{st}} \text{ bend point}\Big) \\ & + 0.15 \times \max(\text{AIME} - 2^{\text{nd}} \text{ bend point}, 0) \end{aligned}$$

Where:

- The *1st bend point* for 2024 is \$1,115.

- The *2nd bend point* for 2024 is $6,721.

This formula ensures that workers with lower AIME receive a higher replacement rate of their pre-retirement income than those with higher AIME.

A.2.1 Example of PIA Calculation

Consider a worker with an AIME of $5,000. Using the 2024 bend points:

$$PIA = 0.90 \times 1,115 + 0.32 \times (5,000 - 1,115) + 0.15 \times 0$$

Breaking this down:

$$PIA = 1,003.50 + 1,243.20 + 0 = 2,246.70$$

Thus, this worker's PIA would be $2,246.70 per month at full retirement age.

A.3 Step 3: Adjustments to Benefits

While the PIA is the amount a worker would receive at their full retirement age, adjustments are made depending on when the worker chooses to begin receiving benefits:

- **Early Retirement**: Benefits can be claimed as early as age 62, but they are permanently reduced. The reduction is roughly 6.67% per year for the first three years and 5% for each additional year before full retirement age.
- **Delayed Retirement**: If the worker delays receiving benefits past full retirement age (up to age 70), benefits increase by approximately 8% per year.

B Social Security Disability Insurance (SSDI) Payout Calculation

The calculation of Social Security Disability Insurance (SSDI) benefits follows a similar structure to the retirement benefits, with adjustments tailored for individuals who are unable to work due to a disability. The amount of SSDI benefits an individual is eligible to receive is based on their past earnings, much like retirement benefits. However, instead of using the highest 35 years of earnings, SSDI may look at a shorter period depending on the worker's age when they become disabled.

B.1 Step 1: Calculating AIME for SSDI

Just like in the retirement benefit calculation, the *Average Indexed Monthly Earnings* (AIME) is first computed based on a worker's earnings history. However, since many SSDI beneficiaries do not have a full 35 years of earnings due to the onset of their disability, the calculation is adjusted.

The number of years used for AIME in the SSDI calculation depends on the individual's age at the time of disability. The general formula is:

$$\text{AIME} = \frac{\sum_{i=1}^{N} \text{Indexed Earnings}_i}{N \times 12}$$

Where:

- $\text{Indexed Earnings}_i$ represents the inflation-adjusted earnings in year i.
- N is the number of years from the time the individual turned 21 until the year before the disability onset. This number is then reduced by up to 5 *drop-out years* (years with lowest earnings), depending on the worker's age and the circumstances.

For younger workers, who may not have many years of earnings, this adjustment ensures that the benefit is not unduly low.

B.2 Step 2: Bend Points and Primary Insurance Amount (PIA) for SSDI

After determining the AIME, SSDI uses the same bend points as retirement benefits to calculate the *Primary Insurance Amount* (PIA). The PIA is the amount of the monthly benefit that the worker is entitled to receive. The formula applied to the AIME is:

$$\begin{aligned} PIA = {} & 0.90 \times \min(\text{AIME}, 1^{\text{st}} \text{ bend point}) \\ & + 0.32 \times \min\Big(\max(\text{AIME} - 1^{\text{st}} \text{ bend point}, 0), 2^{\text{nd}} \text{ bend point} - 1^{\text{st}} \text{ bend point}\Big) \\ & + 0.15 \times \max(\text{AIME} - 2^{\text{nd}} \text{ bend point}, 0) \end{aligned}$$

Where the bend points for 2024 are as follows:

- The 1st bend point is \$1,115.
- The 2nd bend point is \$6,721.

B.3 Step 3: No Early Retirement Adjustment

Unlike retirement benefits, SSDI benefits are not reduced if they are claimed early. A disabled worker is entitled to receive their full PIA regardless of age, provided that their disability meets the program's requirements.

B.4 Step 4: Example Calculation for SSDI

Let's consider an example for a worker with an AIME of \$3,000. Using the 2024 bend points:

$$PIA = 0.90 \times 1,115 + 0.32 \times (3,000 - 1,115) + 0.15 \times 0$$

Breaking this down:

$$PIA = 1,003.50 + 602.88 + 0 = 1,606.38$$

Thus, this individual's monthly SSDI benefit would be approximately $1,606.38.

B.5 Family Benefits Under SSDI

In addition to the worker's SSDI benefit, family members may also be eligible for benefits based on the worker's earnings record. A spouse, child, or dependent parent could receive additional benefits, typically ranging from 50% to 100% of the worker's PIA, subject to a maximum family benefit (MFB) limit. The MFB is generally calculated using a formula that limits the total amount payable to the family based on the worker's PIA, ensuring that total benefits remain within sustainable limits for the system.

$$MFB = 1.50 \times \text{PIA (rough estimate; actual varies by case)}$$

B.6 Key Differences Between SSDI and Retirement Benefits

While SSDI benefits use the same AIME and bend point structure as retirement benefits, key differences include:

- SSDI benefits are not reduced for early retirement.
- SSDI eligibility depends on the worker's ability to work, not age.
- The number of earnings years used to calculate the AIME can be fewer than 35, depending on the worker's age at disability onset.

C Economic Models and Equations

Economists and policymakers have developed several models to evaluate and propose reforms to ensure the long-term solvency of Social Security. These models typically focus on balancing the inflow of revenue (primarily through payroll taxes) with the outflow of benefits (payments to retirees, survivors, and disabled individuals). Some of the prevailing models are:

C.1 Overlapping Generations (OLG) Model

C.1.1 Overview:

The OLG model is one of the most common frameworks used to analyze the economic effects of Social Security. It divides the population into different age cohorts (e.g., young workers, middle-aged workers, retirees) and models how they interact economically over time. Each generation is affected by Social Security policies, as workers contribute payroll taxes while retirees receive benefits. The model captures how policy changes affect savings, labor supply, consumption, and intergenerational wealth transfers.

C.1.2 Key Insights:

- **Intergenerational Equity:** The OLG model helps evaluate how different policy changes (such as increasing the retirement age or altering benefits) affect different generations. It shows the trade-offs between higher taxes on current workers and lower benefits for future retirees.
- **Labor Supply and Retirement Decisions:** OLG models can simulate how changes in benefits or taxes impact retirement decisions, labor force participation, and savings behavior.

C.1.3 Policy Scenarios Modeled:

- Raising the retirement age, which delays benefit payments.
- Adjusting benefit formulas to lower payouts for higher-income earners.
- Increasing payroll taxes to boost Social Security revenue.

C.2 Model Specification

OLG models focus on the interactions of different generations over time and are typically characterized by individuals optimizing consumption, savings, and labor supply over their lifecycle, subject to a budget constraint. The government collects taxes and redistributes these to retirees through Social Security benefits.

C.2.1 Equations

1. **Lifetime Budget Constraint**:
   Each individual maximizes utility subject to a lifetime budget constraint:

$$\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^{t}(c_t+s_t)=w\times(1-\tau)\times\sum_{t=0}^{T}l_t$$

   Where:

   - c_t is consumption in period t,
   - s_t is savings in period t,
   - w is wages,
   - l_t is labor supplied in period t,
   - τ is the payroll tax rate,
   - r is the real interest rate,
   - T is the total working life of the individual.

2. **Government Budget Constraint**:
   The government collects payroll taxes and pays out benefits:

$$\tau\times W_t\times L_t=B_t$$

   Where:

   - W_t is total wages in period t,
   - L_t is total labor supply in period t,
   - B_t is total Social Security benefits in period t.

3. **Welfare Maximization**:
   The utility function for individuals typically takes the form:

$$U=\sum_{t=0}^{T}\left(\frac{1}{1+\rho}\right)^{t}\left[\frac{c_t^{1-\sigma}}{1-\sigma}+\gamma\log(l_t)\right]$$

   Where:

   - ρ is the subjective discount factor,
   - σ is the coefficient of relative risk aversion,
   - γ captures the trade-off between consumption and leisure.

C.3 Data Sources

- **Current Population Survey (CPS)**: Labor supply, income, and demographic characteristics.
- **Survey of Income and Program Participation (SIPP)**: Wealth and income data across different age cohorts.
- **Social Security Administration (SSA) Microdata**: Longitudinal earnings records and Social Security benefits for individuals.

C.4 Key Variables

- Individual earnings, consumption, labor force participation, retirement age.
- Social Security benefit amounts, payroll tax rates, and wage distribution by cohort.

C.5 Dynamic Stochastic General Equilibrium (DSGE) Models

C.5.1 Overview:

General equilibrium models, particularly dynamic stochastic general equilibrium (DSGE) models, incorporate a broader set of macroeconomic variables and shocks, such as productivity growth, interest rates, demographic changes, and policy uncertainty. These models aim to capture the complex interactions between households, firms, and the government within an economy over time, making them useful for analyzing long-term policies like Social Security reform.

C.5.2 Key Insights:

- **Economic Growth and Social Security:** DSGE models show how Social Security reforms might affect overall economic growth, investment, and consumption. For example, increasing payroll taxes can affect household income and consumption, while adjusting benefits can influence savings behavior.
- **Impact of Shocks:** The model can simulate how unexpected economic shocks (such as recessions or demographic shifts) affect Social Security's solvency and how policy changes might mitigate these risks.

C.5.3 Policy Scenarios Modeled:

- Increasing the taxable wage base to capture more income from high earners.
- Implementing progressive benefit cuts, particularly for wealthier beneficiaries.
- Linking benefits to longevity, where future beneficiaries receive lower benefits if life expectancy increases.

C.6 Model Specification

DSGE models are built on the idea of forward-looking, optimizing agents (households and firms) and the interaction of these agents in markets, with an explicit focus on stochastic shocks (e.g., productivity, demographic shifts).

C.6.1 Equations

1. **Household Problem (Maximizing lifetime utility)**:

$$\max \sum_{t=0}^{\infty} \beta^t U(C_t, L_t)$$
$$\text{s.t. } C_t + K_{t+1} = (1-\tau) \times W_t \times L_t + (1+r_t) \times K_t + B_t$$

Where:

- C_t is consumption in period t,
- K_t is capital,
- L_t is labor,
- W_t is wages,
- r_t is the return on capital,
- β is the discount factor,
- τ is the tax rate,
- B_t is Social Security benefits.

2. **Firm Production Function**:

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

Where:

- Y_t is output,
- A_t is technology,
- K_t is capital,
- L_t is labor,
- α is the capital share of output.

3. **Government Budget Constraint**:

$$\tau \times W_t \times L_t = B_t + G_t$$

Where:

- G_t is government spending, including Social Security benefits B_t.

C.7 Data Sources

- **National Income and Product Accounts (NIPA)**: Aggregate output, consumption, investment, and government spending.
- **Federal Reserve Economic Data (FRED)**: Interest rates, wages, capital stock.
- **SSA Actuarial Projections**: Future benefit obligations, worker/retiree ratios.

C.8 Key Variables

- Aggregate consumption, investment, output, Social Security revenues, and benefits.
- Productivity growth, interest rates, and population growth rates.

C.9 Actuarial Balance Model

C.9.1 Overview:

Actuarial balance models are widely used by the Social Security Administration (SSA) and the Congressional Budget Office (CBO) to assess the solvency of the program. These models calculate the long-term financial balance of Social Security by comparing expected inflows (revenue from payroll taxes) to outflows (benefits and administrative costs) over a fixed period, typically 75 years. The goal is to estimate the program's actuarial balance—the difference between the present value of future revenues and future expenditures.

C.9.2 Key Insights:

- **Baseline Projections:** These models generate baseline projections for Social Security's solvency, allowing policymakers to assess how various reforms would improve or worsen the program's financial health.
- **Cost and Revenue Ratios:** The model often presents outcomes in terms of cost and revenue ratios, showing how changes in tax rates or benefit formulas affect long-term balances.

C.9.3 Policy Scenarios Modeled:

- Changing the payroll tax rate to restore actuarial balance (e.g., a 1–2% increase to fully fund benefits).
- Gradually increasing the retirement age to account for longer life expectancies.
- Applying benefit reductions or means-testing to wealthier beneficiaries.

C.10 Model Specification

The Actuarial Balance Model is a long-term assessment tool that calculates the present value of Social Security's income and costs over a specified projection period, typically 75 years. This model evaluates whether the system is financially sustainable under current laws and forecasts any financial shortfalls or surpluses.

C.10.1 Equations

1. **Actuarial Balance Formula**:
   The actuarial balance is the difference between the present value of projected income and costs as a percentage of taxable payroll:

$$AB = \frac{\text{PV of Income} - \text{PV of Costs}}{\text{PV of Taxable Payroll}}$$

   Where:

- PV of Income represents the present value of expected payroll tax revenue and other income,
- PV of Costs represents the present value of projected benefit payments and administrative expenses,
- PV of Taxable Payroll represents the present value of total wages and salaries subject to Social Security taxes.

C.11 Data Sources

- **Social Security Trust Fund Reports**: Data on income, expenditures, and reserves.
- **Census Bureau**: Information on workforce demographics and taxable payroll.

C.12 Key Variables

- Social Security trust fund income, costs, reserves, and payroll tax rates.
- Present value of projected income and costs, actuarial deficits or surpluses.

C.13 Present-Value Budget Models

C.13.1 Overview:

These models calculate the present value of future Social Security obligations relative to future revenues to assess whether the system is on a sustainable path. By discounting future cash flows, economists can determine how much additional revenue or cost reductions are needed to bring Social Security into balance.

C.13.2 Key Insights:

- **Immediate vs. Long-Term Reforms:** Present-value budget models highlight the need for prompt reforms to avoid larger, more disruptive changes in the future. They often show that delaying reforms increases the magnitude of future changes required to restore solvency.
- **Trade-Offs of Reforms:** By discounting future payments and revenues, these models help clarify the trade-offs between current contributions and future benefits.

C.13.3 Policy Scenarios Modeled:

- Applying immediate tax increases or benefit cuts to achieve solvency over a 75-year horizon.
- Transitioning to a partially funded system (rather than fully pay-as-you-go) to accumulate assets for future benefits.
- Introducing personal accounts as part of a hybrid funding model to lower the program's liabilities.

C.14 Model Specification

The Present Value Budget Model assesses Social Security's finances by estimating the present value of future income and expenditures. It offers a snapshot of the program's long-term financial sustainability by discounting future cash flows to present values.

C.14.1 Equations

1. **Present Value Formula**:
   The present value of future income or costs is calculated as:
   $$PV = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$
   Where:
   - PV is the present value of future income or costs,
   - C_t is the income or cost at time t,
   - r is the discount rate, and
   - T is the time horizon.

C.15 Data Sources

- **Social Security Administration**: Financial projections of income and expenditures.
- **Trustees' Reports**: Long-term forecasts and present value estimates.

C.16 Key Variables

- Social Security income, benefit payments, discount rate, and projection horizon.

C.17 Life-Cycle Models

C.17.1 Overview:

Life-cycle models focus on individual behavior over a person's life, such as their decisions regarding savings, labor supply, retirement, and consumption. These models assume that individuals plan their financial lives based on expected future Social Security benefits, private pensions, and savings. They are useful for analyzing how individuals respond to changes in Social Security policy.

C.17.2 Key Insights:

- Savings and Consumption Behavior: Life-cycle models show how Social Security benefits influence personal savings rates and consumption patterns over a lifetime. For instance, reducing benefits could lead to increased private savings, while increasing taxes might reduce labor force participation.
- Retirement Decisions: These models are often used to study how changes in retirement age or benefit formulas influence when individuals choose to retire.

C.17.3 Policy Scenarios Modeled:

- Changing the benefit formula to increase incentives for delayed retirement.
- Introducing tax incentives for private savings to complement reduced Social Security benefits.
- Varying replacement rates (percentage of pre-retirement income replaced by Social Security) based on income levels.

C.18 Model Specification

The Life-Cycle Model is used to predict how individuals optimize consumption and savings over their lifetime. In the context of Social Security, it evaluates how individuals' retirement behavior and private savings are influenced by the Social Security system.

C.18.1 Equations

1. **Lifetime Utility Function**:
   Individuals maximize utility by smoothing consumption and savings over time:

   $$U = \sum_{t=0}^{T} \beta^t u(c_t)$$

   Where:

   - U is lifetime utility,
   - $u(c_t)$ is utility from consumption at time t,

- β is the time preference factor, and
- T is the lifetime horizon.

2. **Budget Constraint**:
Individuals are constrained by their income, savings, and Social Security benefits:

$$\sum_{t=0}^{T} \left(\frac{1}{1+r}\right)^t (c_t + s_t) = w \times (1 - \tau) \times \sum_{t=0}^{T} l_t$$

Where:

- c_t is consumption in period t,
- s_t is savings in period t,
- w is wages,
- l_t is labor supplied in period t,
- τ is the payroll tax rate,
- r is the real interest rate.

C.19 Data Sources

- **Survey of Consumer Finances (SCF)**: Data on household income, savings, and consumption patterns.
- **Social Security Administration Microdata**: Earnings records and Social Security benefit histories.

C.20 Key Variables

- Consumption, savings, labor supply, wages, and Social Security benefits.

C.21 Microsimulation Models

C.21.1 Overview:

Microsimulation models, such as the Social Security Policy Simulation Model (PENSIM) and the Urban Institute's DYNASIM model, simulate the effects of Social Security policy on individual-level data, often over time. These models capture demographic changes like fertility rates, immigration, and mortality rates, and can simulate how different groups (e.g., by income, age, gender) are affected by policy changes.

C.21.2 Key Insights:

- **Distributional Effects:** Microsimulation models are particularly valuable for analyzing the distributional effects of reforms. They show how changes in benefits or taxes affect different socioeconomic groups, helping to assess equity concerns.
- **Demographic Changes:** These models can incorporate the effects of demographic shifts, such as population aging, to simulate future demand for benefits and revenue generation.

C.21.3 Policy Scenarios Modeled:

- Introducing means-tested benefits to reduce payouts to high-income retirees.
- Adjusting the payroll tax base to account for changing workforce demographics.
- Testing policy responses to different immigration or fertility scenarios.

C.22 Model Specification

Microsimulation models simulate the behavior of individuals and households over time based on demographic, economic, and policy factors. They are used to evaluate how Social Security policy changes affect various population subgroups.

C.22.1 Equations

1. **Simulated Life Histories**:
   The model simulates individual life histories, capturing:
   - Entry into the workforce,
   - Earnings progression,
   - Retirement,
   - Death,
   - Social Security benefit claiming behavior.

C.23 Data Sources

- **Current Population Survey (CPS)**: Provides detailed demographic and economic data for individual households.
- **Social Security Administration Microdata**: Longitudinal data on earnings and benefits.

C.24 Key Variables

- Earnings, labor force participation, retirement age, Social Security benefits, and tax contributions.

D Dynamic Representation of Policy Solutions and Their Impact on Social Security Solvency

To analyze the impact of the proposed policy solutions on Social Security solvency, we can employ the economic models previously discussed. These models allow us to quantify how changes in benefits, adjustments to cost-of-living, payroll taxes, and retirement age affect the program's financial status. By incorporating these variables into the relevant equations, we can create a dynamic representation of potential outcomes.

D.1 1. Reducing Benefits

Let B represent the total benefits paid out. If we reduce benefits by a unit amount ΔB, the new benefits paid out would be:

$$B' = B - \Delta B$$

The effect on solvency can be modeled by assessing the new payout ratio:

$$\text{New Payout Ratio} = \frac{B'}{R}$$

Where R represents total revenue from payroll taxes. A reduction in benefits directly decreases the payout ratio, improving solvency.

D.2 2. Reducing the Cost-of-Living Adjustment (COLA)

The COLA can be defined as C, and if it is reduced by a unit amount ΔC, we can express the adjusted COLA as:

$$C' = C - \Delta C$$

This reduction affects the annual increase in benefits:

$$B' = B + (C' \times B)$$

Where B' is the adjusted benefit amount after applying the new COLA. The new payout ratio can then be modeled as:

$$\text{New Payout Ratio} = \frac{B'}{R}$$

D.3 3. Increasing Payroll Taxes

Let T represent the payroll tax rate. An increase in the tax rate by a unit amount ΔT can be expressed as:

$$T' = T + \Delta T$$

The total revenue R' from the new tax rate would then be:

$$R' = (W \times T')$$

Where W is the total wages subject to tax. This increase in revenue affects the solvency ratio:

$$\text{New Solvency Ratio} = \frac{R'}{B}$$

An increase in revenue improves the solvency of the program.

D.4 4. Raising the Retirement Age

If the retirement age is raised, we can denote the new retirement age as A'. The effect on benefits can be modeled by the expected reduction in payouts over time:

$$\Delta B = \text{Estimated Reduction in Benefits due to Increased Retirement Age}$$

As individuals wait longer to receive benefits, this results in fewer years of payout, thus:

$$B' = B - \Delta B$$

The solvency ratio can be calculated similarly to the reduction in benefits:

$$\text{New Payout Ratio} = \frac{B'}{R}$$

D.5 5. Universal Social Security Benefits

For universal benefits, let U represent the universal benefit payment. The total cost C_U of providing universal benefits can be expressed as:

$$C_U = U \times N$$

Where N is the number of recipients. To determine the impact on solvency, we would assess the total revenue R generated from taxes and compare it against C_U:

$$\text{Solvency Ratio} = \frac{R}{C_U}$$

This ratio indicates the financial sustainability of universal benefits.

D.6 Dynamic Model Simulation

To create a dynamic representation of how each policy solution affects Social Security solvency, we can develop a simulation model that incorporates the above equations. By adjusting the parameters ΔB, ΔC, ΔT, and A', we can visualize the impact on solvency ratios over time.

For instance, a simulation could iterate through various scenarios, such as reducing benefits by specific amounts or increasing tax rates, to observe changes in the solvency ratio. This approach allows policymakers to assess the potential effectiveness of each policy solution and make informed decisions based on quantitative analysis.

By employing these equations and modeling techniques, we can dynamically illustrate the financial implications of proposed policy changes and their potential to restore Social Security solvency.