Methodology for Inflation Scenario Analysis

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The goal of this exercise is to illustrate how a sudden bout of high inflation affects older households’ standard of living, as measured by consumption and wealth. The key challenge is that we cannot draw many lessons from prior experiences because inflation has been so low over the past 30 years. Hence, we conduct scenario analysis to predict the path of consumption and wealth under different macroeconomic conditions, using economic theory as a guide.

The rest of this memo is organized as follows. The first section outlines three hypothetical scenarios for the paths of inflation and GDP, as well as the policy response by the Federal Reserve (“the Fed”). The second section develops a simple accounting framework to demonstrate how inflation affects current and future consumption. The third section introduces the hypothetical households whose finances will be analyzed in our model. The fourth section describes our methodology for revaluing household resources under each macroeconomic scenario.

**Three Macroeconomic Scenarios**

Our analysis runs from January 2021 through December 2025. Inflation and interest rates were still low at the beginning of 2021, reflecting a long period of loose monetary policy (see Figure 1). Although the economy had largely recovered from the brief but severe pandemic recession, the output gap (actual versus potential GDP) was still significantly negative.[[1]](#footnote-1)

Figure 1. *Inflation, Federal Funds Rate, and Real Output Gap, January 2000- June 2023*

Notes: Inflation measures the year-over-year change (June to June) in the CPI-U. The output gap measures the percent difference in real GDP from real potential GDP as estimated by the Congressional Budget Office.

*Sources*: Congressional Budget Office (2023); Federal Reserve Bank of St. Louis (2000-2023a); and U.S. Bureau of Labor Statistics (2000-2023).

The first (rather unrealistic) scenario we consider is a transitory inflation shock. The objective is to understand how inflation affects household finances independent of any confounding policy change by the Fed. Hence, this scenario considers what might have happened had inflation suddenly spiked at 4 percent in May 2021 – as was actually the case – but remained at that level thereafter, with no change in the Federal Funds Rate or real economic activity.

The second scenario considers a more realistic trajectory for the economy, where the Fed uses monetary policy to achieve a soft landing. Specifically, the economy follows its actual observed trajectory from January 2021 through December 2023. Our projections begin in January 2024, with the Fed adjusting the Federal Funds Rate so that inflation declines steadily from its current rate of 3 percent to the Fed’s 2 percent target by the end of 2025 (see Figure 2).[[2]](#footnote-2) In this scenario, the economy remains stable throughout the inflation episode, and the long-run Federal Funds Rate settles at 3 percent in nominal terms.

Figure 2. *Soft Landing Scenario, January 2021-December 2025*

Notes: Inflation measures the year-over-year change (June to June) in the CPI-U. The output gap measures the percent difference in real GDP from real potential GDP as estimated by the Congressional Budget Office.

*Sources*: Authors’ illustration based on Congressional Budget Office (2023); Federal Reserve Bank of St. Louis (2000-2023a); and U.S. Bureau of Labor Statistics (2021-2023).

The third scenario envisions a recession as a result of aggressive Fed policy to tamp down inflation. As before, the economy follows its actual observed trajectory from January 2021 through December 2023. Our projections begin in January 2024, with inflation rising to 4 percent by December despite ongoing efforts by the Fed. As a result, in January 2025 the FOMC hikes the Federal Funds Rate to 8 percent. This unanticipated increase in the interest rate triggers a recession, with the output gap falling to negative 2 percent. For context, this hypothetical recession is half as severe as the Great Recession (and brings the economy back to where it stood at the beginning of 2021). Realizing its mistake, the Fed takes corrective action and the economy recovers – although this recovery is not fully complete by the end of our analysis in December 2025 (see Figure 3).

Figure 3. *Recession Scenario, January 2021-December 2025*

Notes: Inflation measures the year-over-year change (June to June) in the CPI-U. The output gap measures the percent difference in real GDP from real potential GDP as estimated by the Congressional Budget Office.

*Sources*: Authors’ illustration based on Congressional Budget Office (2023); Federal Reserve Bank of St. Louis (2000-2023a); and U.S. Bureau of Labor Statistics (2021-2023).

**A Conceptual Framework for Measuring Inflation’s Impact on Standard of Living**

Intuitively, the bundle of goods and services that a household can consume each year (denoted $Q$) depends on its income, prevailing price levels, and the extent to which the household has recurring fixed expenses such as a home mortgage. For working households, this intuition can be expressed with an accounting identity:

$PQ=I-M-S$ (1)

Where $P$ denotes a single price of goods and services (such as the CPI-U), and $Q$ reflects the quantity consumed; $I$ represents income; $M$ is the fixed mortgage payment; and $S$ reflects any saving that the household is doing to build a stock of wealth.[[3]](#footnote-3) Note that saving can be negative (dissaving) if households draw down their existing assets or take on additional debt.

The math is very similar for retired households, who receive income from external sources – such as Social Security or an employer pension – and also fund consumption by drawing down their stock of wealth (particularly their liquid assets):

$PQ=I+dA-M$ (2)

Where ($d$) represents the drawdown rate.

The change in quantity consumed ($Q$) from one year to the next depends on the growth rates of the different components of equations (1) and (2). For example, consider a working household that earns $100,000, pays $10,000 per year towards the mortgage, and saves 6 percent of its earnings in a 401(k). Using equation (1), expenditures in the first year can be written:

$P\_{1}Q\_{1}=100,000-10,000-6,000=84,000$ (3)

In the second year, assume that prices and earnings each grow by 4 percent, the mortgage payment stays constant, and the household maintains its 6-percent saving rate.[[4]](#footnote-4) Then, expenditures become:

$(1.04)P\_{1}Q\_{2}=\left(1.04\right)100,000-10,000-\left(1.04\right)6,000=87,760$ (4)

While expenditures increase in the second year, prices have also risen. However, even after adjusting for the new price level, the household consumes more goods and services – equivalent to spending an additional $385 in the first year:

$Q\_{2}-Q\_{1}= \frac{87,760}{1.04}-84,000=385$ (5)

Intuitively, the household has more purchasing power because prices and earnings rise in lockstep, but the required mortgage payment stays constant.

Conversely, assume instead that prices grow by 6 percent while earnings only grow by 4 percent. Then, the household must reduce its consumption by $1,208 (in year-one dollars):

$Q\_{2}-Q\_{1}= \frac{87,760}{1.06}-84,000=-1,208 $ (6)

Here, the declining importance of the mortgage payment is not enough to compensate for the fact that earnings lagged prices.

Hence, the next step of the analysis is to understand how the various components of equations (1) and (2) – earnings, other income, and wealth – evolve in each of our macroeconomic scenarios. While wealth is obviously an important metric for retired households, we will also model it for households *approaching* retirement, since working households feel more secure when their savings are growing and may “loosen their belts.”

The next section begins by introducing the hypothetical households whose consumption and wealth are projected in our model.

**A Financial Profile of Older Households**

Our analysis considers two groups of hypothetical households, whose starting levels of income and wealth are designed to reflect actual households in the 2019 *Survey of Consumer Finances* (SCF):[[5]](#footnote-5)

1. *Near retirement:* for households in this group,the survey-designated “household head” is 55 to 61 in 2021 and employed full-time. Sixty-two percent of these households are married, and we stipulate that the spouse is not yet receiving Social Security or pension income. In practice, most of the spouses are employed.[[6]](#footnote-6)
2. *Retired:* households in this group have a head over the age of 62. Both the head and spouse self-identify as retired (46 percent of these households are married); and the household receives Social Security income.

Table 1 shows the major sources of income received by households near and in retirement, by wealth tercile.[[7]](#footnote-7) Most households approaching retirement have few sources of income beyond labor earnings. Those in the top wealth tercile also have investment income and income from “other” sources such as businesses. Additionally, a modest number of working households already receive an employer pension (for instance, from a plan with an early retirement date).

Table 1. *Average Annual Income, by Retirement Status and Wealth Tercile, 2018*

|  |  |  |
| --- | --- | --- |
|  | Near retirement | Retired |
|  | Bottom Tercile | Middle Tercile | Top Tercile | Bottom Tercile | Middle Tercile | Top Tercile |
| Labor earnings | 50,658  | 71,903  | 198,462  | 1,386  | 2,675  | 7,641  |
| Capital income | 6  | 246  | 14,137  | 54  | 502  | 19,219  |
| Social Security | 0  | 0  | 0  | 16,816  | 23,110  | 29,989  |
| Employer pension | 1,166  | 2,780  | 4,074  | 7,870  | 16,495  | 24,575  |
| DC withdrawals | 147 | 157 | 826 | 1,824 | 3,017 | 17,787 |
| Other | 1,486  | 2,899  | 13,354  | 2,344  | 2,620  | 14,717  |

Source: Authors’ calculations from the 2019 *Survey of Consumer Finances.*

Retired households, meanwhile, receive most of their income from Social Security and defined benefit pensions. Those in the top wealth tercile also make substantial withdrawals from their defined contribution plans (which include IRAs) and have notable investment and “other” income.

Similarly, Table 2 shows the components of wealth by retirement status and wealth tercile. Housing is the primary asset for all households. Additionally, those in the middle and top terciles have substantial holdings of fixed income and equities – primarily through employer sponsored defined contribution plans – as well as cash (which includes certificates of deposit). Other assets (including businesses, the cash value of annuity and other managed accounts, vehicles, and life insurance, among other categories) are also important for the top two terciles.

Table 2. *Average Assets and Liabilities, by Retirement Status and Wealth Tercile, 2018*

|  |  |  |
| --- | --- | --- |
|  | Near retirement | Retired |
|  | Bottom Tercile | Middle Tercile | Top Tercile | Bottom Tercile | Middle Tercile | Top Tercile |
| Assets | 111,842 | 351,531 | 3,639,395 | 72,589 | 308,002 | 2,151,343 |
|  Real estate | 75,484 | 216,625 | 1,055,196 | 53,191 | 212,474 | 723,536 |
|  Fixed income | 7,306 | 40,796 | 381,061 | 951 | 11,845 | 294,496 |
|  Equities | 6,065 | 35,846 | 731,731 | 1,632 | 18,476 | 585,782 |
|  Cash | 4,913 | 23,213 | 186,985 | 5,701 | 31,045 | 164,101 |
|  Other | 18,074 | 35,051 | 1,284,423 | 11,114 | 34,163 | 383,429 |
| Liabilities | 61,520 | 97,689 | 255,003 | 27,289 | 38,622 | 69,699 |
|  Mortgage debt | 41,678 | 74,158 | 181,783 | 18,569 | 30,854 | 49,958 |
|  Other debt | 19,842 | 23,531 | 73,220 | 8,720 | 7,767 | 19,742 |

Notes:

Real estate: value of the primary residence + other residential real estate + net equity in non-residential real estate.

Fixed income: bonds, savings bonds, (1/2) of combination mutual funds, tax-free mutual funds, gov. bond mutual funds, other bond mutual funds, other mutual funds, non-equity holdings in DC and IRA accounts.

Equities: stocks, stock mutual funds, (1/2) of combination mutual funds, and equities in DC and IRA accounts.

Cash: checking, saving, money market accounts, call accounts at brokerages and certificates of deposits.

Other: cash value of whole life insurance, prepaid cards, other financial assets, cash value of annuity and other managed accounts, vehicles, businesses, other non-financial assets.

*Source:* Authors’ calculations from the 2019 *Survey of Consumer Finances.*

On the liabilities side of the balance sheet, the average household has mortgage debt even in retirement. Table 3 shows the average annual payment made to service this debt. For consistency with Table 2, the averages in this table include households who no longer have a mortgage (for whom mortgage payments are zero).

Table 3. *Average Annual Mortgage Payment, by Retirement Status and Wealth Tercile, 2018*

|  |  |  |
| --- | --- | --- |
| Tercile | Near retirement | Retired  |
| Bottom | 4,448  | 1,545  |
| Middle | 8,406  | 3,047  |
| Top | 16,405  | 4,784  |

*Source:* Authors’ calculations from the 2019 *Survey of Consumer Finances.*

Although households across the wealth distribution are all impacted by inflation, our study will particularly focus on those in the middle and top wealth terciles since households in the bottom tercile have few investable financial assets.

**Methodology for Projecting Income and Wealth Under Different Scenarios**

To apply our conceptual framework, we must make assumptions about how different types of income and assets evolve in our three macroeconomic scenarios. On the income side, we make the following assumptions:

*Wages:* in the first scenario (transitory shock), wages keep pace with inflation after a one-year adjustment lag, consistent with historical patterns (see Figure 4).[[8]](#footnote-8) In the second scenario (soft landing), wages follow their observed trajectory through 2023, after which they lag inflation by one year, eventually settling back at 2 percent growth in the medium run. In the third scenario (recession), wages follow their observed trajectory through 2023, rise by 3 percent in 2024, then freeze for the duration of the recession. At baseline, we assume no change in labor supply, so earnings growth mirrors wage growth.

Figure 4. *Inflation and Wage Growth for Workers Ages 55 Plus, January 2000-June 2023*

Note: inflation is measured as the year-over-year change in the CPI-U.

*Sources*: Federal Reserve Bank of Atlanta (2000-2023) and U.S. Bureau of Labor Statistics (2000-2023).

*Social Security:* Social Security benefits are fully indexed for inflation.

*Defined Benefit Pension:* most private DBs do not provide cost-of-living (COLA) adjustments, whereas government plans typically grant CPI up to a cap of 3 percent.[[9]](#footnote-9) In the SCF, over half of households with pension income report receiving COLA adjustments, and the share with a COLA is increasing over time (see Table 4). These trends are consistent with private DBs becoming less available, and also with government plans having relatively early retirement ages. Consequently, we assume that 60 percent of pension income receives an adjustment, with the COLA capped at 3 percent.

Table 4. *Share of Households with a DB Pension Receiving a COLA, by Retirement Status and Wealth Tercile, 2018*

|  |  |  |
| --- | --- | --- |
| Tercile | Near retirement | Retired |
| Bottom | 70% | 55% |
| Middle | 59 | 49 |
| Top | 62 | 56 |

*Source:* Authors’ calculations from the 2019 *Survey of Consumer Finances.*

*Capital and other income:* remains a constant 2.5 percent of current non-housing assets (consistent with Tables 1 and 2).

*Savings rate for working households:* working households contribute 10.5 percent of their labor earnings to a defined-contribution retirement plan each year (employee and employer contributions).[[10]](#footnote-10)

*Drawdown rate for retired households:* a growing literature suggests that households use rules of thumb – such as the 4 percent rule or the Required Minimum Distribution (RMD) Schedule – to withdraw a set percentage of their non-housing assets each year.[[11]](#footnote-11) For our baseline analysis, we assume that retirees take RMDs (which are designed to slowly deplete balances in defined contribution plans over the course of an average lifespan).[[12]](#footnote-12)

Predicting the path of wealth under each macroeconomic scenario is a much more challenging exercise. Mechanically, the change in wealth from one year to the next depends on the growth rate of the various assets held by the household, the share of the portfolio allocated to each asset class, and the decline in remaining mortgage principal (if the household still holds a mortgage). [[13]](#footnote-13) Since we assume that the decline in mortgage principal is determined solely by the terms of the mortgage, the challenge is how to relate the growth of each asset class to macroeconomic conditions.[[14]](#footnote-14) Our analysis begins with the 10-year Treasury bond, which is a key instrument in the valuation of most financial assets.[[15]](#footnote-15)

*Projecting the 10-year Treasury bond:* we model the price of Treasuries as the present discounted value of future cash flows (coupon payments and return of principal). The key parameter is the yield, or discount rate. The market yield on Treasuries depends on three factors: 10-year inflation expectations, expected real GDP growth, and investors’ taste for risk (which together determine the real return).

For inflation, we assume that expectations remain anchored around the Fed’s target, which is 4 percent in the first scenario and 2 percent in the second two scenarios. As shown in Figure 5, expectations have remained relatively anchored throughout the most recent bout of inflation. For the real return, we assume 1 percent when the economy is not in a recession (the average yield on 10-year TIPS since 2003). During the recession in our third scenario, the real return drops to zero before slowly rising again to 1 percent.

Figure 5. *Expected Inflation and 10-Year TIPS Yield, January 2003- June 2023*

*Source*: Authors' calculations from the Federal Reserve Bank of St. Louis (2003-2023a and 2003-2023b).

*Projecting households’ fixed income investments:* once we have the Treasury yield, projecting households’ fixed income investments is relatively simple. We assume a bond fund similar to Vanguard’s Total Bond Market Index Fund (which is the largest fixed-income component of Vanguard’s Target Date fund). As noted above, the aggregate holdings of Vanguard’s index closely resemble the features of a 10-year Treasury bond.[[16]](#footnote-16) Hence, whenever the actual price of the index is not available, we simply model the index as a 10-year Treasury.[[17]](#footnote-17)

*Projecting households’ equity investments:* we use the standard Gordon formula to project the value of equity investments over time:

$P\_{t}=\frac{D\_{t+1}}{\left(R-G\right)}$ (7)

Where $P\_{t}$ denotes the price of a stock in time *t*, $D\_{t+1}$ is the expected dividend in the following period, $R$ captures the expected long-term rate of return on stocks, and $G$ is the expected growth rate of dividends.

We assume that the expected return on stocks ($R$) equals the nominal yield on 10-year Treasuries plus a risk premium. In theory, the risk premium should vary depending on expected dividend growth: periods of high expected growth generally follow recessions when investors are also highly uncertain about the future. However, investors’ taste for risk is hard to predict, so we simply assume that dividends track GDP – growing at the same rate as potential GDP in the long run – and for every percentage point increase in expected dividend growth, the equity risk premium over Treasury rates also increases by 1 percent.[[18]](#footnote-18)

*Projecting house prices:* Glaeser, Gottlieb, and Gyourko (2010) simulate how a one percentage-point increase in the real interest rate impacts house prices.[[19]](#footnote-19) Since the simulated relationship depends on the baseline rate of inflation and real mortgage interest rate, we will take an estimate from their paper that most closely reflects current conditions in each of our macroeconomic scenarios.[[20]](#footnote-20)

*Projecting other types of assets:* lastly, we assume that most assets in the “other” category derive from businesses – particularly for households in the top wealth tercile – so we grow these assets at the same rate as projected GDP.

**Results**

Ultimately, this analysis will yield a series of six graphs – one for each of the six hypothetical households described above – showing how the household’s consumption declines between 2021 and 2025 in our three macroeconomic scenarios.[[21]](#footnote-21)

It will also produce six corresponding tables showing how the household’s total and non-housing wealth evolves in each scenario.

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1. The output gap measures the percent deviation of actual GDP to potential GDP, in real terms, as estimated by the Congressional Budget Office. [↑](#footnote-ref-1)
2. The Taylor Rule is an equation specifying the optimal level of the Federal Funds Rate (r) given a level of inflation (p) and output gap (y). Bernanke (2015) demonstrates that the specification: r = p + y + 0.5(p-2) + 2 best fits the Fed’s decision-making in practice. [↑](#footnote-ref-2)
3. The household also pays income and consumption taxes that reduce the amount of disposable income. While income tax brackets are indexed for inflation, the household might shift brackets as a result of inflation (both because mortgage payments are tax deductible and because household income might not fully keep pace with inflation). We do not model this shift because it is complex and – for most households – has a relatively small impact on average tax rates. [↑](#footnote-ref-3)
4. 6 percent was the median employee contribution rate to Vanguard defined contribution plans in 2021 (Vanguard 2022). [↑](#footnote-ref-4)
5. The final analysis will update these profiles with data from the 2022 SCF, which will be released in the fall. [↑](#footnote-ref-5)
6. Specifically, 70 percent of spouses are also employed. [↑](#footnote-ref-6)
7. The terciles are based on total wealth excluding Social Security and defined benefit pensions but including housing. [↑](#footnote-ref-7)
8. As shown in Figure 4, most workers over age 50 no longer experience real wage growth. [↑](#footnote-ref-8)
9. Munnell, Aubry, and Cafarelli (2014). [↑](#footnote-ref-9)
10. 10.5 percent was the median total contribution rate (employee and employer) to Vanguard defined contribution plans in 2021 (Vanguard 2022). We assume that these contributions are split between fixed-income, equities, and cash as implied by the wealth holdings in Table 2. [↑](#footnote-ref-10)
11. Munnell, Wettstein, and Hou (2020) and citations therein. [↑](#footnote-ref-11)
12. This assumption is consistent with a growing body of empirical work suggesting that RMDs have become the default drawdown strategy for many retirees (see, for example, Brown, Poterba, and Richardson 2023). [↑](#footnote-ref-12)
13. Technically, assets in the second period can be written as a function of assets in the first period and the previous year’s saving or drawdown: $A\_{t+1}=\left(A\_{t}+S\_{t}\right)\*\sum\_{c}^{}\left(a\_{c,t+1}\*g\_{c,t+1}\right)$ where $S\_{t}$ denotes saving (negative values indicate drawdown) and $\sum\_{c}^{}\left(a\_{c,t+1}\*g\_{c,t+1}\right)$ reflects an average of the growth rates of the various asset classes from year *t* to *t+1* weighted by the share of the portfolio held in each class ($a\_{c,t+1})$. [↑](#footnote-ref-13)
14. Researchers and practitioners have developed complex stochastic models to simulate the future performance of various asset classes based on initial market conditions (see Jakhria et al. 2019 for a review of these models). However, we adopt a much simpler approach both for transparency and to avoid overstating the degree of confidence in our projections. [↑](#footnote-ref-14)
15. Most major bond indices hue closely to the maturity and duration of the 10-year Treasury. Stock valuations often rely on the 10-year treasury yield to construct discount rates to value future earnings and dividends. And, the yield on the 10-year Treasury is used as a base for mortgage rates, impacting home values. [↑](#footnote-ref-15)
16. For example, in August 2023, Vanguard’s fund had an average maturity of 8.9 years and duration of 6.5 years (compared to 7 for the 10-year Treasury). See https://investor.vanguard.com/investment-products/mutual-funds/profile/vbtlx#portfolio-composition. [↑](#footnote-ref-16)
17. Specifically, at the start of the projection period (January 2024) we presume the index consists solely of 10-year Treasury bonds with coupon payments equal to the market yield on Treasuries as of the last observed point. In each future period, the index sells its holdings and re-purchases new 10-year bonds with the prevailing market yield. [↑](#footnote-ref-17)
18. The Congressional Budget Office provides long-run estimates of potential GDP. [↑](#footnote-ref-18)
19. the canonical user-cost model (Poterba 1984) shows how the ratio of rent to house price depends on the mortgage interest rate. Unfortunately, however, empirical studies have long noted that prices are much less sensitive to interest rates than predicted by the model (see Liu et al. 2021 for a review). One issue is that the canonical model ignores homebuyers’ forward-looking expectations about future interest rates. Glaeser, Gottlieb, and Gyourko (2010) propose an extension to account for this issue. [↑](#footnote-ref-19)
20. Additionally, the strength of the labor market also determines demand for housing. Our analysis will use the estimated relationship between wages and house prices from past literature to put additional downward pressure during our third “recession” scenario. See, for example, Baffoe-Bonnie (1998) and Sommer, Sullivan, and Verbrugge (2012). [↑](#footnote-ref-20)
21. Specifically, these graphs will plot the decline in potential consumption measured in 2021 dollars, or $Q\_{2}-Q\_{1}$ from our conceptual framework. [↑](#footnote-ref-21)