

ANALYSIS
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Economic Shocks Impact on Mortgage Credit Loss Modeling

Introduction

The U.S. housing market sharply slowed during 2022 as a result of rapid price growth and higher financing costs, which brought this segment of the economy to a standstill. Measures of housing affordability are at historically low levels. Prices skyrocketed since late 2020, and once the Federal Reserve started raising short-term interest rates in early 2022, the required monthly principal and interest payments to maintain a mortgage at current house prices pushed many would-be homebuyers out of the market. Home sales, which surpassed an annualized rate of 6.5 million units at the beginning of 2022, plummeted to just over 4.5 million units by the fourth quarter. As demand faded, house prices also retreated. Depending on the metric used, valuations peaked this summer and have declined during the second half of the year.

Economic Shocks Impact on Mortgage Credit Loss Modeling

BY BAHAR KARTALCIKLAR AND KYLE HILLMAN

The U.S. housing market sharply slowed during 2022 as a result of rapid price growth and higher financing costs, which brought this segment of the economy to a standstill. Measures of housing affordability are at historically low levels. Prices skyrocketed since late 2020, and once the Federal Reserve started raising short-term interest rates in early 2022, the required monthly principal and interest payments to maintain a mortgage at current house prices pushed many would-be homebuyers out of the market. Home sales, which surpassed an annualized rate of 6.5 million units at the beginning of 2022, plummeted to just over 4.5 million units by the fourth quarter. As demand faded, house prices also retreated. Depending on the metric used, valuations peaked this summer and have declined during the second half of the year.

Moody's Analytics expects housing to weaken through 2025—but these projections assume the U.S. does not fall into recession. Declining prices and slowing sales will weigh on future originations; however, they will also affect the performance of mortgages already on book. This paper quantifies the performance of select portfolios in the context of several house price and interest rate forecasts. The analysis was performed using the Moody's Analytics Mortgage Portfolio Analyzer platform. MPA is a loan-level model that forecasts expected loss as the product of default, prepayment and severity rates; expected loss forecasts are conditioned on individual loan characteristics such as FICO, loan to value, property and loan type; and economic drivers, including the change in house prices, interest rates and unemployment. The first section of this paper discusses the economic projections used in the analysis, the second section details the selected sample mortgage portfolios, while the remainder highlights the interaction of mortgage credit performance and various economic assumptions.

Economic projections

The MPA mortgage credit forecasts are conditioned on borrower characteristics and the business cycle. The platform's default, prepayment and loss-given default models incorporate three sets of economic drivers:

- » House prices, which capture the change in the collateral value against which a mortgage is held
- » Interest rates, which reflect the financing costs of a mortgage
- » The unemployment rate, which captures labor market vitality and is an approximation of a borrower's ability, in the aggregate, to pay a mortgage

MPA also leverages the geographic breadth of Moody's Analytics forecast databases. Housing trends are local and wherever possible, MPA will use the metropolitan statistical area or state-specific house price and unemployment rate forecasts. Interest rate forecasts are always incorporated at the national level. Finally, while the economic projections used in the platform vary across concept and geography, they also differ across scenarios. Each scenario follows a given narrative with bespoke assumptions and risks. For the current analysis, economic projections were drawn from four scenarios, all based on the October 2022 forecast vintage:¹

- » Baseline—the most likely economic outcome, located at the 50th percentile of forecast projections
- » Downside (S3)—a moderate recession scenario located at the 90th percentile of forecast projections
- » Severe Downside (S4)—a severe recession located at the 96th percentile of forecast projections
- » Flat scenario—a synthetic forecast where the historical economic values as of the second quarter of 2022 are held constant throughout the forecast period.

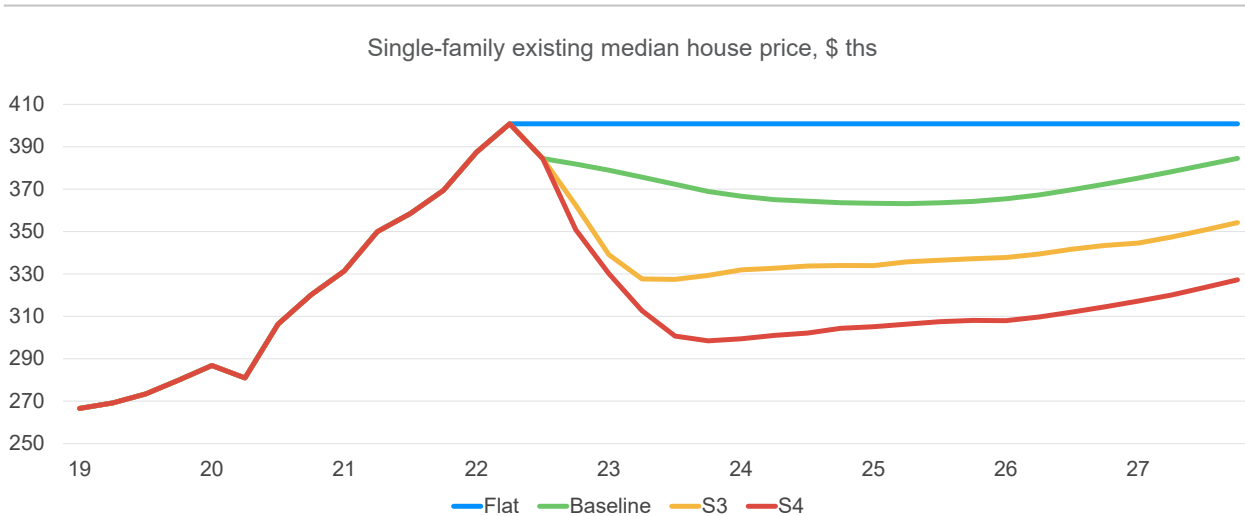
The main economic drivers across the four scenarios are plotted in Charts 1, 2 and 3.

Sample portfolios

Two portfolios were used for this analysis: mortgages originated in 2018 and in 2022. Using two separate portfolios originated in different timeframes captures the impact of loan age on performance, and the difference in the impact of macroeconomic variables for different mortgage vintages. Loan age, or the seasoning effect, is the tendency for mortgage performance to vary given the length of time a loan has been on book. This dynamic is determined solely by loan age and is observed even after controlling for borrower characteristics—FICO, loan to value, property type, and location—across loans. Tables 1 and 2 offer descriptive statistics for the sample portfolios.

We ran four analyses in MPA. All forecasts were projected over a five-year horizon using a March 31, 2022, as-of date. In the first exercise, we updated all economic variables to reflect one of the flat, baseline, S3 or S4 scenarios.

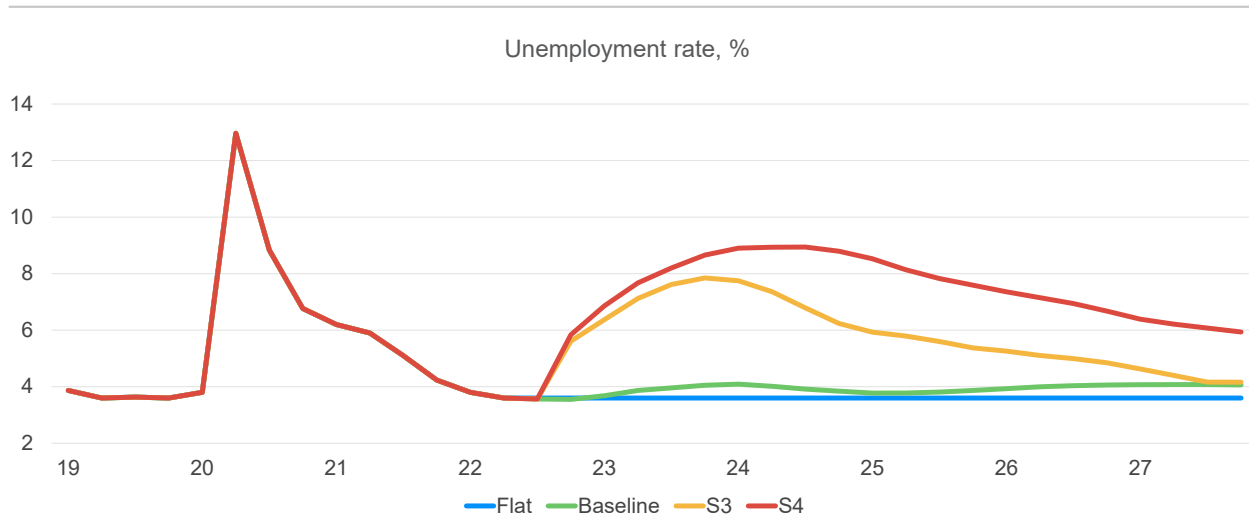
Chart 1: House Prices Decline Across Scenarios



Sources: NAR, Moody's Analytics

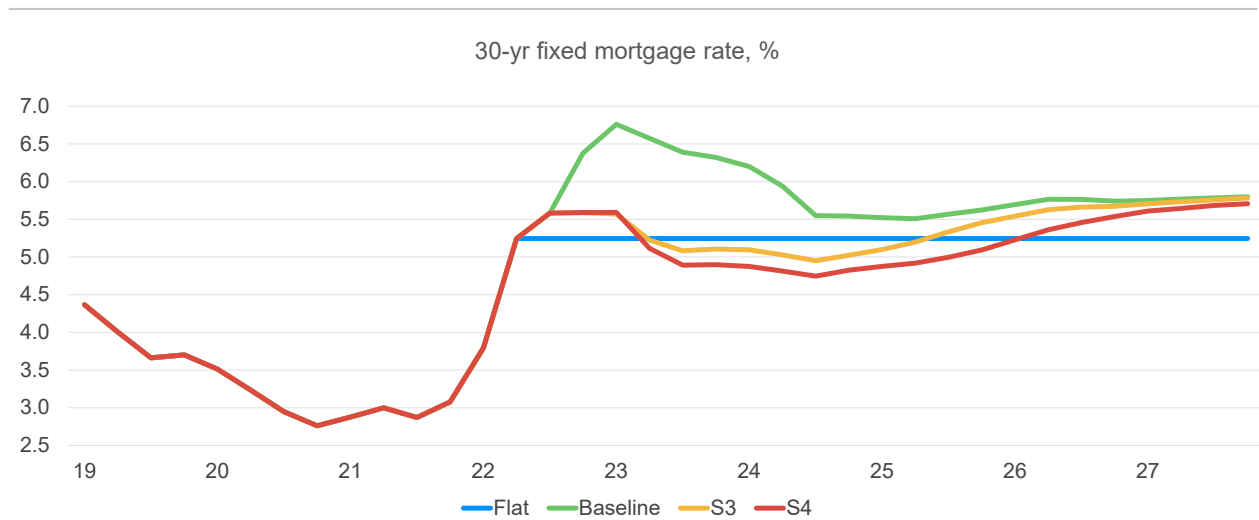
¹ Scenario narratives and comparison tables are available in Appendix 1.

Chart 2: Joblessness Sharply Higher Under S3 and S4 Scenarios



Sources: BLS, Moody's Analytics

Chart 3: Interest Rates to Rise Under Baseline Forecast



Sources: Freddie Mac, Moody's Analytics

Table 1: 2018 Vintage Descriptive Statistics

Loan characteristics, vintage=2018

| Statistic | Value |
|----------------------|------------------|
| Vintage | 2018 |
| As-of date | 2022 mo 3 |
| Analysis horizon | 5 yrs |
| Segment | First-lien fixed |
| Number of loans | 35,796 |
| Total balance | 5,775,639,038 |
| Avg CLTV | 75.06 |
| Avg FICO | 743.75 |
| Avg original balance | 182,653 |
| Loan age | 39 mo to 50 mo |
| Original term | 180 mo to 360 mo |

Source: Moody's Analytics

Table 2: 2022 Vintage Descriptive Statistics

Loan characteristics, vintage=2022

| Statistic | Value |
|----------------------|------------------|
| Vintage | 2022 |
| As-of date | 2022 mo 3 |
| Analysis horizon | 5 yrs |
| Segment | First-lien fixed |
| Number of loans | 23,051 |
| Total balance | 6,819,607,000 |
| Avg CLTV | 70.26 |
| Avg FICO | 748.00 |
| Avg original balance | 297,753 |
| Loan age | 1 mo to 2 mo |
| Original term | 180 mo to 360 mo |

Source: Moody's Analytics

In the second exercise, we set house prices to one of the baseline, S3 or S4 projections while the rest of the macro variables were kept flat. This process was repeated in the third analysis, with the interest rate projections fluctuating while house prices and the unemployment rate held flat. Finally, in the final exercise, both the house price and interest rate forecasts were updated based on the different scenario projections while the unemployment rate was kept flat. We then compared the lifetime expected loss, default and prepayment rates to the flat economic scenario, highlighting the relative change in mortgage credit loss projections due to each set of economic variables.

All-driver shock

The portfolio-specific expected loss rates from shocking house prices, interest rates, and the unemployment rate, in tandem, can be found in Table 3.

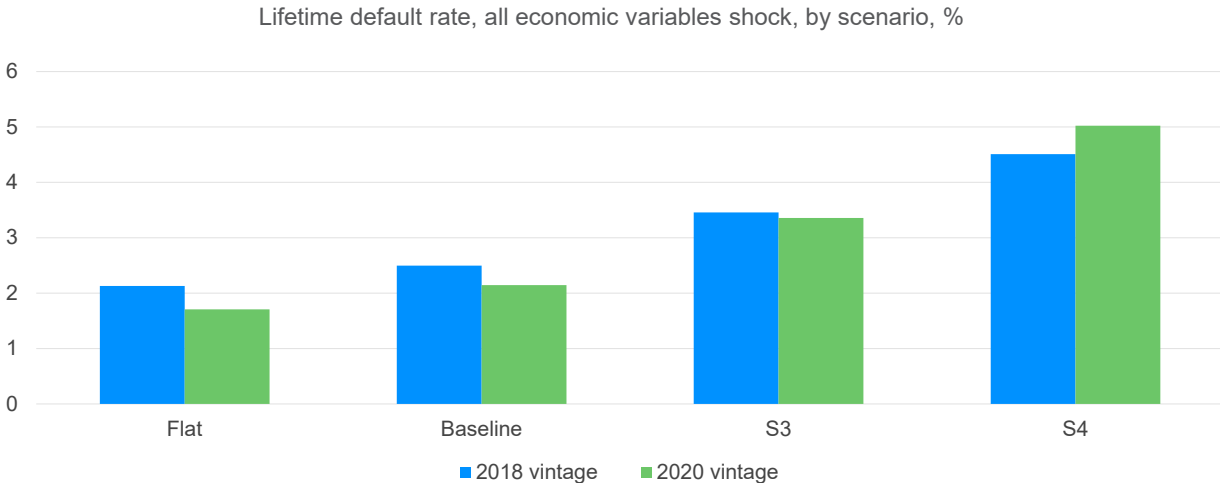
Table 3: Forecast Results - All Driver Shock

| Scenario | 2018 loan pool | | | 2022 loan pool | | |
|----------|--------------------|-----------------|--------------|--------------------|-----------------|--------------|
| | Expected loss rate | Prepayment rate | Default rate | Expected loss rate | Prepayment rate | Default rate |
| Flat | 0.28% | 24.69% | 2.13% | 0.16% | 20.69% | 1.71% |
| S0 | 0.35% | 20.34% | 2.50% | 0.25% | 19.18% | 2.14% |
| S3 | 0.53% | 23.69% | 3.46% | 0.49% | 17.73% | 3.36% |
| S4 | 0.75% | 25.44% | 4.51% | 0.91% | 16.14% | 5.02% |

Source: Moody's Analytics

Unsurprisingly, loss rates increase under the S3 and S4 recession scenarios. House prices decline sharply and the unemployment rate rises quickly under these outlooks, which push default rates higher across the 2018 and 2020 loan pools (see Chart 4).

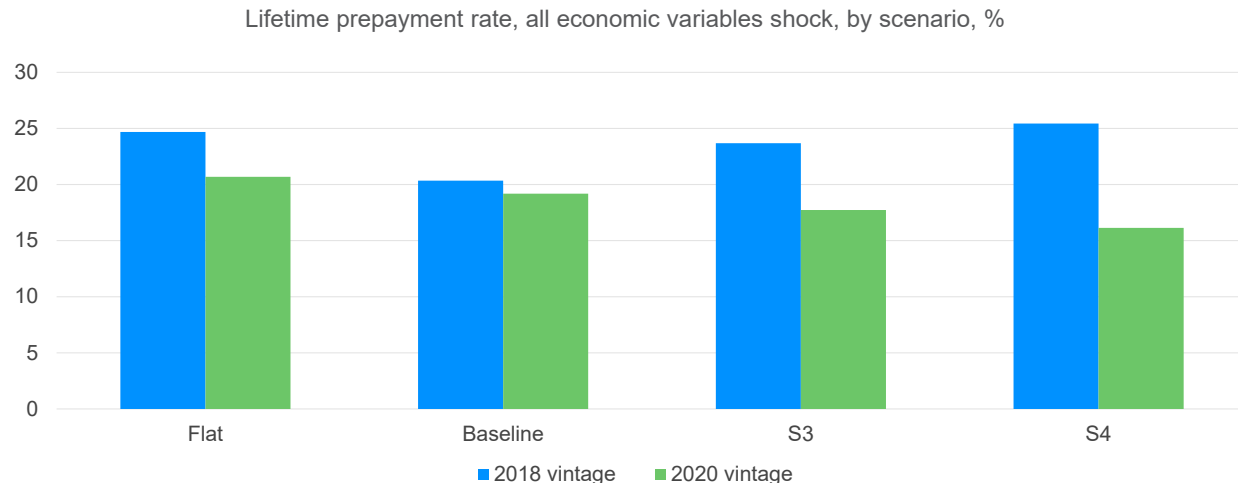
Chart 4: Default Rates Higher Than Flat Under Baseline and Recession Scenarios



Source: Moody's Analytics

In addition, the loss rate under the baseline forecast is higher than under the flat scenario, a reflection of modestly declining house price projections embedded in the baseline scenario. Across loan samples, the 2022 portfolio experiences lower prepayment rates (see Chart 5) relative to the 2018 portfolio. The difference reflects the impact of loan age on performance; all else equal, younger loans tend to prepay at a slower

Chart 5: Prepayment Response to Economic Shock Varies by Loan Age



Source: Moody's Analytics

rate than older loans. Further, the 2022 loans are unlikely to experience a near-term decline in interest rates under any of the scenarios, which also pushes prepayment rates lower.

On the other hand, we observe that for the 2018 loans, prepayment rates decline from the flat scenario to the baseline scenario, reflecting the combined effect of a house price decline and interest rate hike. However, they rise in the S3 and S4 scenarios, in which house prices and interest rates decline, pulling the prepayments in opposite directions. This divergence suggests the interest rate effect has more impact relative to the house price shock for older loans.

House price shock

Next, house prices are shocked while the unemployment and interest rate series are held constant. The impact on expected losses is found in Table 4.

Table 4: Forecast Results - House Price Shock

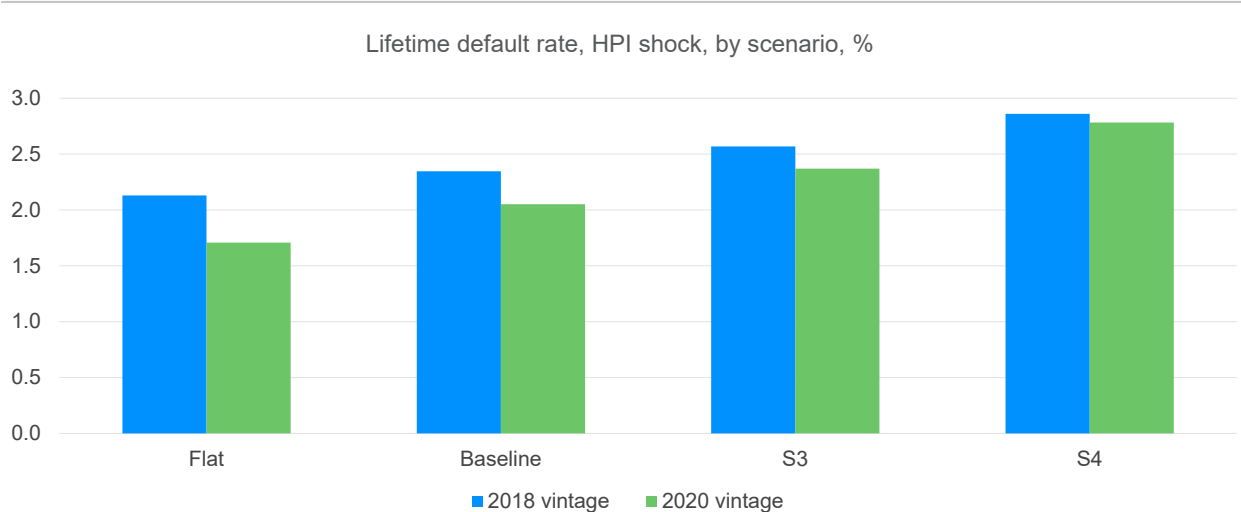
| Scenario | 2018 loan pool | | | 2022 loan pool | | |
|----------|--------------------|-----------------|--------------|--------------------|-----------------|--------------|
| | Expected loss rate | Prepayment rate | Default rate | Expected loss rate | Prepayment rate | Default rate |
| Flat | 0.28% | 24.69% | 2.13% | 0.16% | 20.69% | 1.71% |
| S0 | 0.33% | 24.60% | 2.35% | 0.24% | 19.22% | 2.05% |
| S3 | 0.39% | 24.34% | 2.57% | 0.34% | 17.82% | 2.37% |
| S4 | 0.47% | 23.81% | 2.86% | 0.49% | 16.25% | 2.78% |

Source: Moody's Analytics

The house price projections are a key driver in the MPA platform as they influence updated combined LTV calculations. This field is the sum of first- and second-lien obligations relative to the value of the underlying collateral. The "loan" portion of the LTV ratio is updated over time based on the instrument's amortization schedule; the "value" portion is updated through the house price forecast for the market where a given loan is located. Updated CLTV is a key determinant of default and prepayment. Further, the impact of CLTV on borrower behavior is nonlinear. Borrowers tend to prepay at an accelerated rate as CLTV approaches zero and default more quickly as CLTV exceeds various thresholds. These dynamics are captured explicitly within MPA.

Both the 2018 and 2020 vintage experience an increase in default rates under the baseline, S3 and S4 scenarios relative to the flat scenario (see Chart 6). Declining house prices diminish homeowner equity; borrowers are less likely to stay current on their mortgage if the property value is not meaningfully greater than their outstanding loan balance.

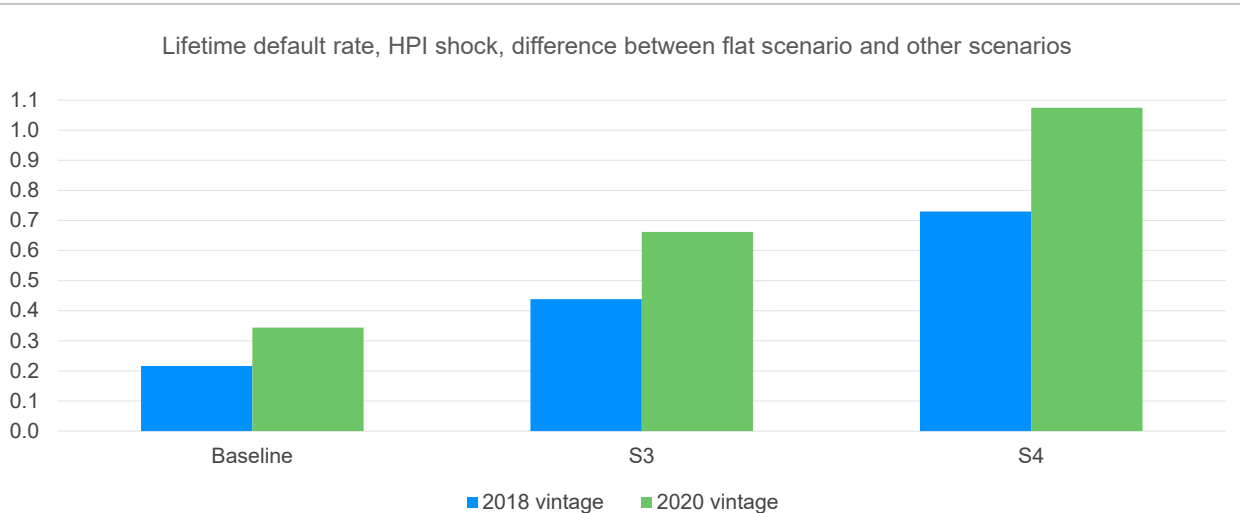
Chart 6: Expect Higher Default Rates as House Prices Fall



Source: Moody's Analytics

Looking across the two loan pools, the relative increase in default rates given a house price shock is larger for the 2020 portfolio, suggesting younger loans—which have not acquired significant equity since origination—are more responsive to changes in property values (see Chart 7).

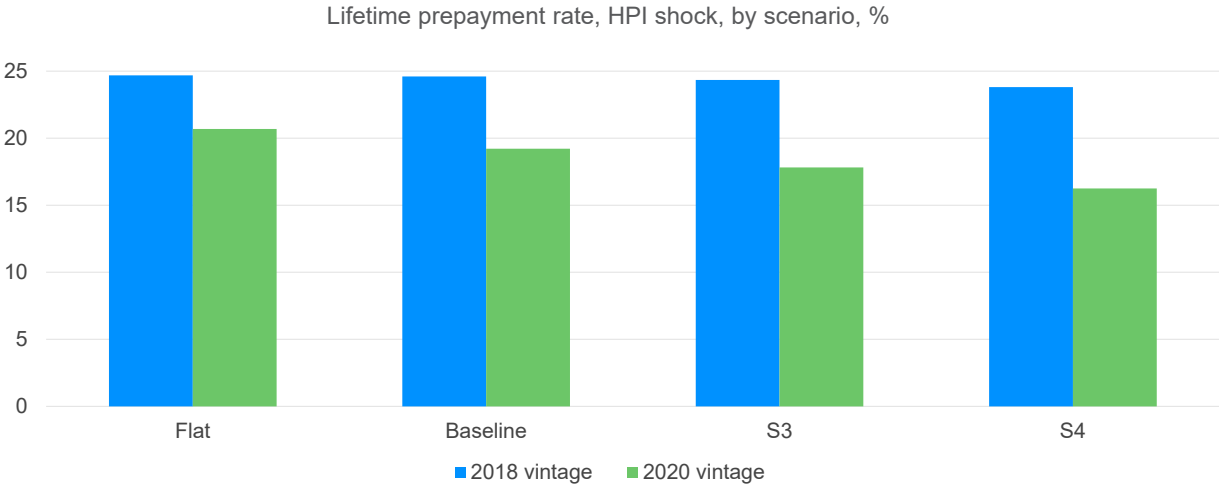
Chart 7: PD Rates Increase More for 2020 Loans Given a House Price Shock



Source: Moody's Analytics

The house price shock also leads to lower prepayment rates for the 2022 vintage under the baseline, S3 and S4 scenarios relative to the flat scenario; they are roughly unchanged for the 2018 vintage (see Chart 8).

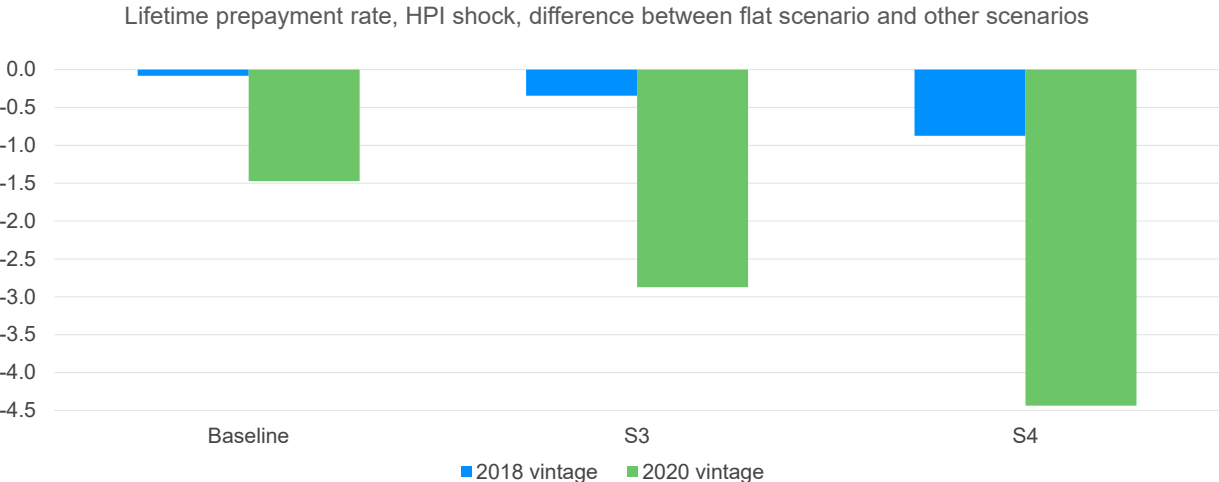
Chart 8: Falling House Prices Translate to Lower Prepayment Rates



Source: Moody's Analytics

This reflects the interaction of the different origination timeframes and house prices across the two loan pools. Loans originated in 2018 experienced significant house price gains in 2020 and 2021; even given the house prices declines embedded in the S3 and S4 scenarios, it is likely borrowers have seen their equity position meaningfully increase since origination. These borrowers may be incentivized to prepay—through a sale to capture the higher home values—as a result. In contrast, mortgages written in 2022 originated at the peak of the current price cycle and have seen valuations decline since. The likelihood they will prepay is lower, with the decline in prepayment rates greater for the S4 scenario relative to the S3 scenario (see Chart 9).

Chart 9: Prepayment Rates for Younger Loans More Sensitive to Price Shock



Source: Moody's Analytics

Interest rate shock

The third analysis shocks interest rates while holding the unemployment rate and house price forecasts constant. The impact on expected losses can be found in Table 5.

Table 5: Forecast Results - Interest Rate Shock

| Scenario | 2018 loan pool | | | 2022 loan pool | | |
|----------|--------------------|-----------------|--------------|--------------------|-----------------|--------------|
| | Expected loss rate | Prepayment rate | Default rate | Expected loss rate | Prepayment rate | Default rate |
| Flat | 0.28% | 24.69% | 2.13% | 0.16% | 20.69% | 1.71% |
| S0 | 0.29% | 20.41% | 2.22% | 0.16% | 20.66% | 1.71% |
| S3 | 0.28% | 24.19% | 2.13% | 0.16% | 20.69% | 1.71% |
| S4 | 0.27% | 26.73% | 2.09% | 0.16% | 20.75% | 1.70% |

Source: Moody's Analytics

The interest rate shock has a marginal impact on the performance of the 2022 vintage. Prepayment rates for loans originated in 2022 are slightly lower, while the default rates remain almost constant under the baseline forecast, as interest rates increase in this scenario. In contrast, prepayment is slightly higher and default rates are lower under the S3 and S4 forecasts, as interest rates under the recession scenarios are modestly lower than under the flat scenario, resulting in a marginal impact on overall losses (see Chart 10).

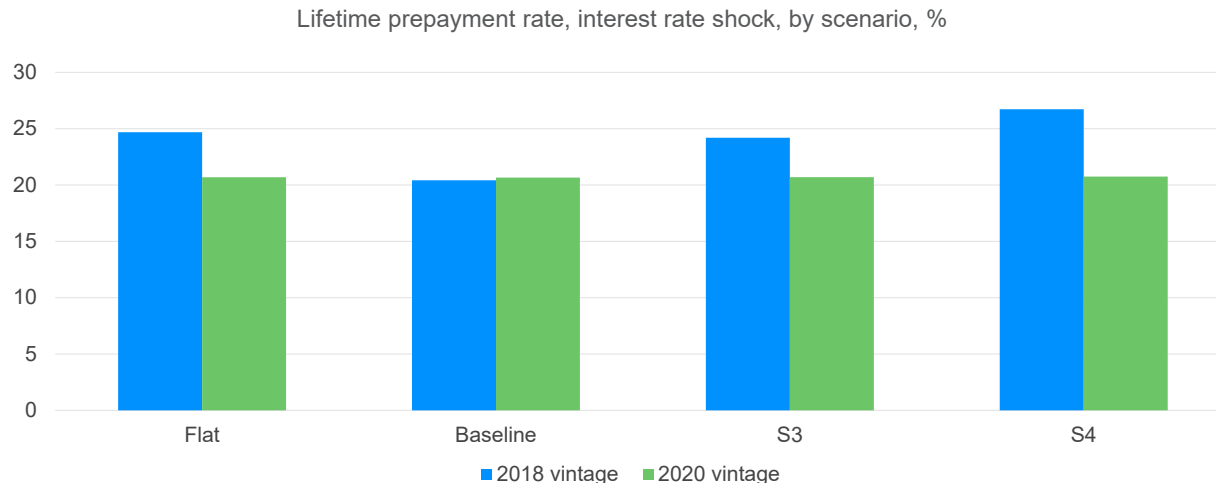
Chart 10: Default Rates Relatively Unaffected Given Interest Rate Shock



Source: Moody's Analytics

The interest rate shock has a greater impact on the 2018 vintage. Prepayment rates for this loan pool under the baseline forecast are significantly lower than under the flat scenario (see Chart 11). This is not surprising; loans originated in 2018 likely carry an interest rate below what the baseline forecast projects. There is little incentive for these borrowers to prepay, whether through refinancing or purchasing a new home. In contrast, the change in default rates for the 2018 vintage is more moderate. There is a slight uptick in defaults between the flat and baseline scenarios, while they remain roughly unchanged between the flat, S3 and S4 scenarios.

Chart 11: Newly Booked Loans Show Little Response to Interest Rate Shock



Source: Moody's Analytics

House price and interest rate shock

The fourth analysis shocks house prices and interest rates while holding the unemployment rate constant. The impact on expected losses can be found in Table 6.

Table 6: Forecast Results - House Price and Interest Rate Shock

| Scenario | 2018 loan pool | | | 2022 loan pool | | |
|----------|--------------------|-----------------|--------------|--------------------|-----------------|--------------|
| | Expected loss rate | Prepayment rate | Default rate | Expected loss rate | Prepayment rate | Default rate |
| Flat | 0.28% | 24.69% | 2.13% | 0.16% | 20.69% | 1.71% |
| S0 | 0.35% | 20.35% | 2.44% | 0.24% | 19.19% | 2.05% |
| S3 | 0.39% | 23.84% | 2.57% | 0.34% | 17.82% | 2.37% |
| S4 | 0.46% | 25.72% | 2.81% | 0.49% | 16.29% | 2.78% |

Source: Moody's Analytics

The output from this scenario is similar to the first analysis where all the economic drivers were shocked. Note that expected loss and default rates are lower under the house price and interest rate shock, highlighting the impact the unemployment rate variable has on overall mortgage performance, particularly default.

Conclusion

Housing trends have reversed since the second quarter of 2022; interest rates are trending higher, while sales and prices are in decline. This market shift will have a significant effect on mortgage credit performance in the coming years. The MPA platform's models, which are conditioned on borrower risk and economic data, can quantify the impact of changing market conditions on mortgage credit losses. This paper highlights the relative impact of each economic driver—house prices, interest rates, and the unemployment rate—on performance, differentiating between newly originated and more seasoned loans. Specifically, falling house prices and rising interest rates will have a greater impact on expected losses for younger loans relative to

older cohorts. The analysis suggests a larger increase in losses for loans originated in 2022 compared with loans originated in 2018. While younger loans face a significant decline in home values, they are less likely to be affected by rising interest rates. Thus, they have a lower tendency to prepay and a higher tendency to default.

In contrast, more seasoned loans, having benefited from rising house prices in recent years, are more affected by the rise in interest rates. Prepayment rates experience a larger decline under the baseline scenario for older loans relative to the younger loans; there is also a significant increase in prepayment rates between the flat scenario and the S3 and S4 scenarios, where interest rates fall. Overall, while fluctuations in house prices appear to be a dominant factor in determining the losses for younger loans, older loans are more sensitive to interest rate movements.

Appendix 1

S3: Alternative Scenario 3 – Downside – 90th Percentile

In this scenario, there is a 90% probability that the economy will perform better, broadly speaking, and a 10% probability that it will perform worse.

Key assumptions/risks

- » OPEC oil supply cuts are more than expected, and the Russian invasion of Ukraine worsens significantly and persists longer than anticipated. In response, import bans of Russian oil purchases increase the net loss of Russian oil on the global market to 2.5 million barrels per day, higher than the 2.3 million in the baseline. This causes oil prices to rise back to above \$120 per barrel for Brent, increasing inflation substantially. Higher gasoline prices cut into disposable income that would otherwise be available for other spending.
- » The worsening invasion, higher oil prices, rising inflation, and the Fed's response to raise interest rates faster than in the baseline together cause the stock market to fall further. The economy falls into recession in the fourth quarter of 2022.
- » Supply-chain conditions also erode, with increased shortages of many goods, also boosting inflation. Additionally, the supply of neon, used in the production of semiconductors, much of which comes from Ukraine, declines even more. Further, Russia is the source of a large proportion of the pig iron consumed in the U.S., which is used in a range of products, including motor vehicles. The supply-chain shortages weaken manufacturing.
- » China briefly blockades the Taiwan Strait, also worsening the chip shortage since Taiwan is a major producer.
- » Declines in European economics hurt U.S. exports and also corporate earnings from European subsidiaries.
- » New cases, hospitalizations and deaths from COVID-19 start to rise again, slowing growth in spending on air travel, retail and hotels.
- » Unemployment begins to increase in the fourth quarter of 2022. From the third quarter of 2022 through the second quarter of 2023, real GDP declines cumulatively by 2.4%. The unemployment rate peaks at 7.9% in late 2023.
- » The downturn begins to subside when the economic impact of the Russian invasion begins to resolve in late 2023. The economy does not return to full employment until the third quarter of 2027.

Epidemiological assumptions

- » Confirmed case counts increase to their January 2022 peak. Increased severity of the disease results in more individuals seeking official testing facilities and medical treatment.
- » Hospitalizations rise near their prior peak as the efficacy of vaccinations and treatments is reduced. Hospitals are operating at capacity and actively triaging noncritical care patients.

Appendix 1 (Cont.)

- » ICU utilization is at physical capacity but there is a staffing shortage as a large share of healthcare workers become infected.
- » Daily deaths attributable to COVID-19 rise above 1,000 a day.
- » Deaths are concentrated among the unvaccinated but increase broadly as the efficacy of prior vaccinations fades.

Monetary policy assumptions

- » Increases in the fed funds rate are higher than in the baseline in the fourth quarter of 2022 and the first half of 2023, peaking at 5%, as the Fed works to address the accelerating inflation despite the recession. However, by the third quarter of 2023, as inflation starts to decelerate, the Fed shifts gears and starts to lower the fed funds rate to support the economy.
- » The 10-year Treasury declines slightly because of the flight to quality amid the decline in the stock market and the contracting economy. However, the worsening inflation outlook prevents a deeper decline. The yield curve inverts in the fourth quarter of 2022 and throughout 2023.

Fiscal policy assumptions

- » The American Rescue Plan Act stimulus of \$1.8 trillion was enacted in March 2021, composed of stimulus checks, enhanced unemployment benefits, public health spending, tax credits, and aid to state and local governments. This was deficit-financed.
- » The Infrastructure Investment and Jobs Act provides \$572 billion in new infrastructure spending over the next decade, half of which will go to transportation infrastructure and the rest to other needs such as the power grid and broadband. Congress passed the legislation in November, and its implementation began in early 2022.
- » Democrats enacted the Inflation Reduction Act on their own via budget reconciliation. The bill will spend more than \$400 billion in tax credits and additional federal government appropriations to address climate change and pay for lower health insurance premiums for Americans benefiting from the Affordable Care Act.
- » One-third of the IJJA is financed by a delay of former President Trump's Medicare rebate rule, and enhanced reporting requirements for digital assets, among other pay-fors. The IRA is more than paid for by more than \$700 billion in higher corporate and individual income tax revenue, as well as prescription drug savings. The approximately \$300 billion that is left over will go toward reducing the federal government's budget deficits over the next decade.
- » The IJJA was enacted in the fourth quarter of 2021, and its implementation began in early 2022. Democrats passed the IRA in the third quarter of 2022, with implementation beginning in the final three months of 2022.

In the downside scenario "S3: Alternative Scenario 3 – Downside – 90th Percentile," OPEC oil supply cuts are more than expected and the Russian invasion of Ukraine worsens and persists longer than anticipated. In response, import bans and self-sanctioning of Russian oil purchases increase the loss of oil on the global

Appendix 1 (Cont.)

market to 2.5 million barrels per day, more than the 2.3 million in the baseline. This causes oil prices to rise back to \$120 a barrel. Worsening inflationary pressures cause the Fed to raise interest rates more than in the baseline to a peak of more than 5% by mid-2023. Rising gasoline prices reduce disposable income available for other spending. From the third quarter of 2022 through mid-2023, the stock market falls 37% and the cumulative decline from the end of 2021 is 45%. The economy drops into recession in the fourth quarter of 2022.

Supply-chain problems also worsen, with increased shortages of many goods, also boosting inflation. The supply of neon, used in the production of semiconductors, declines because much of the world's supply comes from Ukraine. Further, Russia is the source of a large proportion of the pig iron consumed in the U.S., which is used in a range of products, including motor vehicles. The supply-chain shortages weaken manufacturing. Moreover, China briefly blockades the Taiwan Strait, further limiting the supply of chips, since Taiwan is a major producer. Additionally, new cases, hospitalizations and deaths from COVID-19 start to rise significantly again, slowing spending on air travel, retail and hotels. Moreover, the rise in COVID-19 cases in China contributes to supply-chain issues.

Rising unemployment and supply-chain issues cause unit auto sales to drop back to the low 13 million-unit range by mid-2023, compared with the 16 million range in the baseline at that time. The economies of Europe also go into recession because of Russia's invasion. Populism in Europe rises, once again raising uncertainties about the longevity of the euro zone. This contributes to the economic and financial stress faced by heavily indebted nations in the region, especially Italy. These developments lower U.S. exports and also corporate earnings of foreign subsidiaries of U.S. companies.

Increases in the fed funds rate are higher than in the baseline during the fourth quarter of 2022 and the first half of 2023, as the Fed works to address the accelerating inflation despite the recession. However, by the second half of 2023, as inflation starts to decelerate, the Fed shifts gears and starts to lower the fed funds rate to support the economy. The 10-year Treasury declines slightly because of the flight to quality amid the decline in the stock market and the contracting economy. However, the worsening inflation outlook prevents a deeper decline. The yield curve inverts during the fourth quarter of 2022 and throughout 2023.

Real GDP declines from the fourth quarter of 2022 through the second quarter of 2023. The cumulative decline is 2.4%. The unemployment rate peaks at 7.9% in the fourth quarter of 2023. The rising unemployment causes house prices to drop cumulatively by 14% from mid-2022 through mid-2023. By comparison, in the baseline, house prices decline by 2.4% during that time. The economy does not return to full employment until mid-2027.

The change in real GDP, on an annual average basis, is 1.7% in 2022, -2% in 2023, and 1.6% in 2024, compared with 1.7%, 0.7% and 2.2%, respectively, in the baseline. Reduced business investment lowers productivity so that the level of real GDP remains below the baseline indefinitely.

Appendix 1 (Cont.)

| U.S. MACRO S3 SCENARIO —FORECAST SUMMARY—October 2022 | | | | | | | | | | |
|---|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | Units | 22Q2 | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 |
| Gross Domestic Product | bcw\$ | 19,895.3 | 19,977.6 | 19,939.2 | 19,587.8 | 19,499.0 | 19,502.8 | 19,558.7 | 19,643.9 | 19,760.2 |
| Change | %AR | -0.6 | 1.7 | -0.8 | -6.9 | -1.8 | 0.1 | 1.2 | 1.8 | 2.4 |
| Federal Budget | \$ bil | 153.2 | -347.9 | -426.7 | -495.0 | -342.5 | -503.8 | -512.4 | -433.0 | -270.0 |
| Total Employment | mil | 151.6 | 152.7 | 149.1 | 147.5 | 146.3 | 145.5 | 145.3 | 145.7 | 146.4 |
| Change | %AR | 3.3 | 3.1 | -9.3 | -4.2 | -3.3 | -2.0 | -0.6 | 1.0 | 2.0 |
| Unemployment Rate | % | 3.6 | 3.6 | 5.6 | 6.4 | 7.1 | 7.6 | 7.8 | 7.7 | 7.4 |
| Light Vehicle Sales | mil, SAAR | 13.3 | 13.3 | 13.4 | 13.3 | 13.2 | 13.2 | 13.1 | 13.2 | 13.6 |
| Residential Housing Starts | mil, SAAR | 1.6 | 1.5 | 1.2 | 1.0 | 0.9 | 0.8 | 0.8 | 0.8 | 0.9 |
| Median Existing-Home Price | \$ ths | 400.8 | 384.5 | 362.4 | 339.1 | 327.6 | 327.5 | 329.3 | 331.9 | 332.7 |
| Change | %YA | 14.5 | 7.2 | -1.9 | -12.5 | -18.3 | -14.8 | -9.1 | -2.1 | 1.6 |
| Consumer Price Index | %AR | 10.5 | 5.8 | 5.5 | 5.6 | 2.8 | 0.7 | 1.6 | 1.6 | 1.5 |
| Federal Funds Rate | % | 0.8 | 2.2 | 3.9 | 4.9 | 5.0 | 4.2 | 3.6 | 2.9 | 2.2 |
| Treasury Yield: 10-Yr Bond | % | 2.9 | 3.1 | 2.8 | 2.8 | 2.8 | 2.9 | 2.9 | 3.0 | 3.0 |
| Baa Corp. - 10-Yr Treasury | DIFF | 2.1 | 2.3 | 3.0 | 4.4 | 3.7 | 3.4 | 3.0 | 2.9 | 2.8 |
| Corporate Profits With IVA & CCA | \$ bil | 3,001.3 | 3,032.6 | 2,551.7 | 2,348.0 | 2,209.5 | 2,201.6 | 2,253.5 | 2,316.9 | 2,400.5 |
| Change | %YA | 7.7 | 6.7 | -11.0 | -18.2 | -26.4 | -27.4 | -11.7 | -1.3 | 8.6 |
| S&P 500 | 1941=10 | 4,110.2 | 3,973.6 | 3,283.9 | 2,743.9 | 2,517.3 | 2,589.2 | 2,617.7 | 2,675.7 | 2,753.8 |
| Change | %YA | -1.7 | -10.1 | -28.6 | -38.6 | -38.8 | -34.8 | -20.3 | -2.5 | 9.4 |
| CRE Price Index | index | 347.3 | 352.5 | 349.3 | 333.4 | 312.2 | 296.7 | 281.1 | 277.4 | 279.3 |
| NCREIF Property Index: Rate of Return | %, NSA | 3.2 | 4.1 | 1.8 | -2.2 | -0.4 | -0.3 | 0.0 | 1.9 | 2.2 |
| C&I Loans Outstanding | \$ bil | 2,607.7 | 2,712.0 | 2,594.7 | 2,623.6 | 2,607.7 | 2,647.6 | 2,732.8 | 2,836.2 | 2,906.0 |
| BAA spread | % | 2.1 | 2.3 | 3.0 | 4.4 | 3.7 | 3.4 | 3.0 | 2.9 | 2.8 |

| | Units | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---------------------------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Gross Domestic Product | bcw\$ | 18,609.1 | 19,036.1 | 18,509.1 | 19,609.8 | 19,934.0 | 19,537.1 | 19,842.2 | 20,517.6 | 21,258.2 |
| Change | %AR | 2.9 | 2.3 | -2.8 | 5.9 | 1.7 | -2.0 | 1.6 | 3.4 | 3.6 |
| Federal Budget | \$ bil | -873.0 | -1,022.0 | -3,348.2 | -2,577.0 | -912.0 | -1,853.6 | -1,605.4 | -1,820.4 | -1,669.5 |
| Total Employment | mil | 148.9 | 150.9 | 142.1 | 146.1 | 150.9 | 146.1 | 147.1 | 150.7 | 152.7 |
| Change | %AR | 1.6 | 1.3 | -5.8 | 2.8 | 3.3 | -3.2 | 0.7 | 2.4 | 1.3 |
| Unemployment Rate | % | 3.9 | 3.7 | 8.1 | 5.4 | 4.1 | 7.2 | 7.0 | 5.7 | 5.1 |
| Light Vehicle Sales | mil, SAAR | 17.2 | 17.0 | 14.5 | 14.9 | 13.5 | 13.2 | 14.1 | 16.5 | 17.5 |
| Residential Housing Starts | mil, SAAR | 1.2 | 1.3 | 1.4 | 1.6 | 1.5 | 0.9 | 0.9 | 1.2 | 1.5 |
| Median Existing-Home Price | \$ ths | 259.5 | 272.3 | 298.6 | 352.3 | 383.8 | 330.9 | 333.1 | 335.8 | 340.6 |
| Change | %YA | 4.8 | 4.9 | 9.7 | 18.0 | 8.9 | -13.8 | 0.7 | 0.8 | 1.4 |
| Consumer Price Index | %AR | 2.4 | 1.8 | 1.2 | 4.7 | 8.2 | 4.5 | 1.5 | 1.9 | 2.1 |
| Federal Funds Rate | % | 1.8 | 2.2 | 0.4 | 0.1 | 1.8 | 4.4 | 2.0 | 1.5 | 1.9 |
| Treasury Yield: 10-Yr Bond | % | 2.9 | 2.1 | 0.9 | 1.4 | 2.7 | 2.8 | 3.0 | 3.4 | 3.8 |
| Baa Corp. - 10-Yr Treasury | DIFF | 1.9 | 2.2 | 2.7 | 1.9 | 2.3 | 3.6 | 2.7 | 2.5 | 2.4 |
| Corporate Profits With IVA & CCA | \$ bil | 2,311.9 | 2,402.2 | 2,260.1 | 2,771.1 | 2,863.8 | 2,253.2 | 2,442.0 | 2,700.1 | 2,888.0 |
| Change | %YA | 8.6 | 3.9 | -5.9 | 22.6 | 3.3 | -21.3 | 8.4 | 10.6 | 7.0 |
| S&P 500 | 1941=10 | 2,744.7 | 2,912.5 | 3,218.5 | 4,266.8 | 3,958.7 | 2,617.0 | 2,791.3 | 3,068.5 | 3,323.5 |
| Change | %YA | 12.1 | 6.1 | 10.5 | 32.6 | -7.2 | -33.9 | 6.7 | 9.9 | 8.3 |
| CRE Price Index | index | 272.2 | 293.4 | 309.4 | 351.6 | 349.3 | 281.1 | 294.7 | 337.9 | 374.8 |
| NCREIF Property Index: Rate of Return | %, NSA | 1.6 | 1.6 | 0.4 | 4.2 | 3.6 | -0.7 | 2.5 | 3.1 | 2.4 |
| C&I Loans Outstanding | \$ bil | 2,211.2 | 2,352.5 | 2,709.1 | 2,492.1 | 2,604.2 | 2,652.9 | 2,925.2 | 3,131.2 | 3,313.7 |
| BAA spread | % | 1.9 | 2.2 | 2.7 | 1.9 | 2.3 | 3.6 | 2.7 | 2.5 | 2.4 |

Appendix 1 (Cont.)

S4: Alternative Scenario 4 – Downside – 96th Percentile

In this scenario, there is a 96% probability that the economy will perform better, broadly speaking, and a 4% probability that it will perform worse.

Key assumptions/risks

- » OPEC oil supply cuts are larger than expected and the Russian invasion of Ukraine worsens dramatically. Worries rise that the invasion would expand beyond Ukraine. In response, import bans and self-sanctioning of Russian oil purchases increase the loss of oil on the global market to 2.6 million barrels per day, well above the 2.3 million barrels per day assumed to be lost in the baseline. This causes oil prices to rise above \$140 a barrel by early 2023. Inflation increases substantially and the Fed raises the fed funds rate higher than in the baseline. Higher gasoline prices cut into disposable income that would otherwise be available for other spending.
- » The worsening invasion, higher oil prices, rising inflation, and higher interest rates cause the stock market to collapse. From the third quarter of 2022 through mid-2023, the stock market falls 46% and the cumulative decline from the end of 2021 is 53%. The economy falls into a deep recession in the fourth quarter of 2022.
- » Supply-chain issues also worsen, with increased shortages of many goods, also boosting inflation. The supply of neon, used in the production of semiconductors, declines substantially because much of the world's supply comes from Ukraine. Further, Russia is the source of a large proportion of the pig iron consumed in the U.S., which is used in a range of products, including motor vehicles. The supply-chain shortages weaken manufacturing.
- » In addition, China blockades the Taiwan Strait for several months, further limiting chip supply as Taiwan is a major producer.
- » Recession in Europe hurts U.S. exports and also corporate earnings from European subsidiaries.
- » New cases, hospitalizations and deaths from COVID-19 rise significantly once again, slowing spending on air travel, retail and hotels.
- » The downturn lasts for more than a year and begins to subside when the economic impact of the invasion begins to resolve. From the third quarter of 2022 through the third quarter of 2023, real GDP declines cumulatively by 4.2%.
- » The economy does not return to full employment until 2031.

Epidemiological assumptions

- » Confirmed case counts rise well above their January 2022 peak. Increased severity of the disease results in more individuals seeking official testing facilities and medical treatment straining the system.
- » Hospitalizations rise above their prior peaks as a new variant renders prior vaccinations and treatments ineffective. Hospitals are operating at capacity and having to turn away sick individuals.
- » ICU utilization is below physical capacity due to significant staffing shortages as healthcare workers become infected.
- » Daily deaths attributable to COVID-19 rise above 2,000 a day.
- » Deaths are concentrated in older populations and those with other health issues.

Appendix 1 (Cont.)

Monetary policy assumptions

- » Increases in the fed funds rate are higher than in the baseline during the fourth quarter of 2022 and the first half of 2023, as the Fed works to address the accelerating inflation despite the recession. The fed funds rate peaks at more than 5.2%. However, by mid-2023, as the recession deepens, the Fed shifts gears and starts to lower the fed funds rate to support the economy.
- » The 10-year Treasury declines because of the flight to quality amid the decline in the stock market and the contracting economy. However, the worsening inflation outlook prevents a deeper decline. The yield curve inverts during the fourth quarter of 2022 and throughout 2023.

Fiscal policy assumptions

- » The American Rescue Plan Act stimulus of \$1.8 trillion was enacted in March 2021, composed of stimulus checks, enhanced unemployment benefits, public health spending, tax credits, and aid to state and local governments. This was deficit-financed.
- » The Infrastructure Investment and Jobs Act provides \$572 billion in new infrastructure spending over the next decade, half of which will go to transportation infrastructure and the rest to other needs such as the power grid and broadband. Congress passed the legislation in November, and its implementation began in early 2022.
- » Democrats enacted the Inflation Reduction Act on their own via budget reconciliation. The bill will spend more than \$400 billion in tax credits and additional federal government appropriations to address climate change and pay for lower health insurance premiums for Americans benefiting from the Affordable Care Act.
- » One-third of the IIJA is financed by a delay of former President Trump's Medicare rebate rule, and enhanced reporting requirements for digital assets, among other pay-fors. The IRA is more than paid for by more than \$700 billion in higher corporate and individual income tax revenue, as well as prescription drug savings. The approximately \$300 billion that is left over will go toward reducing the federal government's budget deficits over the next decade.
- » The IIJA was enacted in the fourth quarter of 2021, and its implementation began in early 2022. Democrats passed the IRA in the third quarter of 2022, with implementation beginning in the final three months of 2022.

In the downside 4% scenario "S4: Alternative Scenario 4 – Downside – 96th Percentile" OPEC oil supply cuts are more than expected and the Russian invasion of Ukraine worsens dramatically. Worries rise that the invasion would expand beyond Ukraine. In response, import bans of Russian oil purchases increase the loss of oil on the global market to 2.6 million barrels per day, well above the 2.3 million barrels per day assumed to be lost in the baseline. As a result, oil prices rise more sharply than in the baseline, to more than \$140 per barrel for Brent, and inflation increases substantially. Higher gasoline prices cut deeply into disposable income that would otherwise be available for other spending. The stock market collapses. From the third quarter of 2022 through mid-2023, the stock market falls 46% and the cumulative decline from the end of 2021 is 53%. The economy falls into a deep recession in the fourth quarter of 2022.

Supply-chain problems also erode, with increased shortages of many goods, also boosting inflation. Additionally, the supply of neon, used in the production of semiconductors, declines substantially because much of the world's supply comes from Ukraine. Further, Russia is the source of a large proportion of the pig iron con-

Appendix 1 (Cont.)

sumed in the U.S., which is used in a range of products, including motor vehicles. The supply-chain shortages weaken manufacturing. Further, new cases, hospitalizations and deaths from COVID-19 rise significantly once again, slowing spending on air travel, retail and hotels. Additionally, China blocks the Taiwan Strait for several months, further limiting the supply of chips since Taiwan is a major producer. Further, another COVID-19 surge once again disrupts Chinese supply chains, further raising inflation.

Because of the accelerating inflation, the Fed chooses to raise the fed funds rate despite the downturn, and the increases are higher than in the baseline during the fourth quarter of 2022 through mid-2023. However, by mid-2023, as the recession deepens and inflation starts to decelerate, the Fed shifts gears and starts to lower the fed funds rate to support the economy. The 10-year Treasury declines moderately as the flight to quality amid the decline in the stock market and the contracting economy more than offsets the worsening inflation outlook. The yield curve inverts during the fourth quarter of 2022 and throughout 2023.

The economies across Europe contract for similar reasons. Populism in Europe accelerates, once again putting the euro zone's existence at risk. This contributes to the economic and financial stress faced by heavily indebted nations, especially Italy. The declines in Europe lower corporate earnings of foreign subsidiaries of U.S. companies, contributing to the decline in the stock market, and also reduce U.S. exports to Europe, deepening the U.S. recession.

The downturn lasts for more than a year. The unemployment rate reaches a peak of nearly 9% by mid-2024. From the third quarter of 2022 through the fourth quarter of 2023, real GDP declines cumulatively by 4.2%.

Unit auto sales drop to the low 11 million range by late 2023, compared with more than 16 million in the baseline. Rising joblessness causes house prices to drop cumulatively by more than 17% from mid-2022 to mid-2023 compared with a drop of 2.4% in the baseline. Disagreements in Congress prevent stimulus measures to stem the downturn. The economy does not return to full employment until 2031.

The changes in real GDP on an annual average basis are 1.5% in 2022, -3.3% in 2023, and 0.2% in 2025, compared with 1.7%, 0.7% and 2.3%, respectively, in the baseline. Reduced business investment lowers productivity so that the level of real GDP remains below the baseline indefinitely.

Appendix 1 (Cont.)

| U.S. MACRO S4 SCENARIO —FORECAST SUMMARY—October 2022 | | | | | | | | | | |
|---|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| | Units | 22Q2 | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 |
| Gross Domestic Product | bcw\$ | 19,895.3 | 19,977.6 | 19,845.0 | 19,520.3 | 19,188.6 | 19,154.9 | 19,131.1 | 19,163.9 | 19,248.9 |
| Change | %AR | -0.6 | 1.7 | -2.6 | -6.4 | -6.6 | -0.7 | -0.5 | 0.7 | 1.8 |
| Federal Budget | \$ bil | 153.2 | -347.9 | -418.4 | -493.5 | -344.2 | -512.6 | -532.3 | -458.0 | -301.9 |
| Total Employment | mil | 151.6 | 152.7 | 148.8 | 146.9 | 145.4 | 144.5 | 143.9 | 143.5 | 143.6 |
| Change | %AR | 3.3 | 3.1 | -9.9 | -4.9 | -4.1 | -2.3 | -1.8 | -0.9 | 0.2 |
| Unemployment Rate | % | 3.6 | 3.6 | 5.8 | 6.9 | 7.7 | 8.2 | 8.7 | 8.9 | 8.9 |
| Light Vehicle Sales | mil, SAAR | 13.3 | 13.3 | 13.3 | 13.0 | 12.6 | 12.3 | 11.2 | 11.3 | 11.5 |
| Residential Housing Starts | mil, SAAR | 1.6 | 1.5 | 1.1 | 0.9 | 0.8 | 0.8 | 0.6 | 0.6 | 0.6 |
| Median Existing-Home Price | \$ ths | 400.8 | 384.5 | 350.8 | 330.1 | 312.7 | 300.7 | 298.4 | 299.4 | 301.0 |
| Change | %YA | 14.5 | 7.2 | -5.0 | -14.8 | -22.0 | -21.8 | -14.9 | -9.3 | -3.7 |
| Consumer Price Index | %AR | 10.5 | 5.8 | 5.8 | 5.9 | 3.1 | 2.1 | 1.7 | 1.0 | 0.7 |
| Federal Funds Rate | % | 0.8 | 2.2 | 4.0 | 5.0 | 5.2 | 4.3 | 3.7 | 2.9 | 2.2 |
| Treasury Yield: 10-Yr Bond | % | 2.9 | 3.1 | 2.7 | 2.6 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 |
| Baa Corp. - 10-Yr Treasury | DIFF | 2.1 | 2.3 | 3.7 | 5.2 | 4.3 | 3.6 | 3.5 | 3.3 | 3.0 |
| Corporate Profits With IVA & CCA | \$ bil | 3,001.3 | 3,032.6 | 2,528.0 | 2,279.5 | 2,081.6 | 1,945.2 | 1,909.0 | 1,941.4 | 1,997.7 |
| Change | %YA | 7.7 | 6.7 | -11.8 | -20.6 | -30.6 | -35.9 | -24.5 | -14.8 | -4.0 |
| S&P 500 | 1941=10 | 4,110.2 | 3,973.6 | 3,143.7 | 2,521.2 | 2,399.5 | 2,249.1 | 2,158.7 | 2,184.6 | 2,197.2 |
| Change | %YA | -1.7 | -10.1 | -31.7 | -43.6 | -41.6 | -43.4 | -31.3 | -13.4 | -8.4 |
| CRE Price Index | index | 347.3 | 352.5 | 348.5 | 328.9 | 303.4 | 281.1 | 257.3 | 248.3 | 245.3 |
| NCREIF Property Index: Rate of Return | %, NSA | 3.2 | 4.1 | -0.3 | -4.6 | -2.0 | -1.7 | -1.3 | 1.1 | 1.6 |
| C&I Loans Outstanding | \$ bil | 2,607.7 | 2,712.0 | 2,511.5 | 2,446.3 | 2,382.0 | 2,365.6 | 2,366.6 | 2,375.8 | 2,381.8 |
| BAA spread | % | 2.1 | 2.3 | 3.7 | 5.2 | 4.3 | 3.6 | 3.5 | 3.3 | 3.0 |

| | Units | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
|---------------------------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Gross Domestic Product | bcw\$ | 18,609.1 | 19,036.1 | 18,509.1 | 19,609.8 | 19,910.5 | 19,248.7 | 19,290.7 | 19,926.4 | 20,766.7 |
| Change | %AR | 2.9 | 2.3 | -2.8 | 5.9 | 1.5 | -3.3 | 0.2 | 3.3 | 4.2 |
| Federal Budget | \$ bil | -873.0 | -1,022.0 | -3,348.2 | -2,577.0 | -903.6 | -1,882.6 | -1,743.6 | -2,004.0 | -1,817.5 |
| Total Employment | mil | 148.9 | 150.9 | 142.1 | 146.1 | 150.9 | 145.2 | 143.7 | 145.8 | 148.4 |
| Change | %AR | 1.6 | 1.3 | -5.8 | 2.8 | 3.3 | -3.8 | -1.0 | 1.4 | 1.8 |
| Unemployment Rate | % | 3.9 | 3.7 | 8.1 | 5.4 | 4.2 | 7.8 | 8.9 | 8.0 | 7.0 |
| Light Vehicle Sales | mil, SAAR | 17.2 | 17.0 | 14.5 | 14.9 | 13.5 | 12.3 | 12.1 | 14.8 | 15.7 |
| Residential Housing Starts | mil, SAAR | 1.2 | 1.3 | 1.4 | 1.6 | 1.5 | 0.8 | 0.7 | 0.9 | 1.2 |
| Median Existing-Home Price | \$ ths | 259.5 | 272.3 | 298.6 | 352.3 | 380.9 | 310.5 | 301.7 | 306.7 | 311.0 |
| Change | %YA | 4.8 | 4.9 | 9.7 | 18.0 | 8.1 | -18.5 | -2.8 | 1.7 | 1.4 |
| Consumer Price Index | %AR | 2.4 | 1.8 | 1.2 | 4.7 | 8.2 | 4.8 | 1.4 | 1.5 | 1.9 |
| Federal Funds Rate | % | 1.8 | 2.2 | 0.4 | 0.1 | 1.8 | 4.6 | 2.0 | 0.7 | 0.7 |
| Treasury Yield: 10-Yr Bond | % | 2.9 | 2.1 | 0.9 | 1.4 | 2.7 | 2.6 | 2.7 | 3.0 | 3.5 |
| Baa Corp. - 10-Yr Treasury | DIFF | 1.9 | 2.2 | 2.7 | 1.9 | 2.5 | 4.2 | 3.0 | 2.6 | 2.4 |
| Corporate Profits With IVA & CCA | \$ bil | 2,311.9 | 2,402.2 | 2,260.1 | 2,771.1 | 2,857.9 | 2,053.8 | 2,029.9 | 2,241.3 | 2,442.3 |
| Change | %YA | 8.6 | 3.9 | -5.9 | 22.6 | 3.1 | -28.1 | -1.2 | 10.4 | 9.0 |
| S&P 500 | 1941=10 | 2,744.7 | 2,912.5 | 3,218.5 | 4,266.8 | 3,923.6 | 2,332.1 | 2,210.8 | 2,424.9 | 2,710.7 |
| Change | %YA | 12.1 | 6.1 | 10.5 | 32.6 | -8.0 | -40.6 | -5.2 | 9.7 | 11.8 |
| CRE Price Index | index | 272.2 | 293.4 | 309.4 | 351.6 | 348.5 | 257.3 | 247.7 | 281.0 | 325.9 |
| NCREIF Property Index: Rate of Return | %, NSA | 1.6 | 1.6 | 0.4 | 4.2 | 3.1 | -2.4 | 1.8 | 2.6 | 2.5 |
| C&I Loans Outstanding | \$ bil | 2,211.2 | 2,352.5 | 2,709.1 | 2,492.1 | 2,583.4 | 2,390.1 | 2,395.9 | 2,539.3 | 2,720.3 |
| BAA spread | % | 1.9 | 2.2 | 2.7 | 1.9 | 2.5 | 4.2 | 3.0 | 2.6 | 2.4 |

Appendix 1 (Cont.)

| U.S. REAL GDP, % CHANGE YR AGO —SCENARIO COMPARISON—October 2022 | | | | | | | | | |
|--|------|-------|-------|-------|-------|-------|-------|------|------|
| | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 | 24Q3 |
| Baseline | 1.55 | -0.09 | 0.30 | 0.61 | 0.71 | 1.21 | 1.80 | 2.29 | 2.50 |
| S0: Upside 4th Percentile | 1.55 | 1.81 | 3.77 | 5.39 | 6.49 | 5.36 | 4.35 | 3.79 | 3.31 |
| S1: Upside 10th Percentile | 1.55 | 1.41 | 2.90 | 4.13 | 5.14 | 3.77 | 3.08 | 2.62 | 1.70 |
| S2: Downside 75th Percentile | 1.55 | -0.29 | -0.77 | -1.04 | -1.25 | -0.47 | 1.13 | 2.41 | 3.29 |
| S3: Downside 90th Percentile | 1.55 | -0.33 | -1.69 | -1.99 | -2.38 | -1.91 | 0.29 | 1.34 | 1.95 |
| S4: Downside 96th Percentile | 1.55 | -0.81 | -2.03 | -3.55 | -4.12 | -3.60 | -1.83 | 0.31 | 0.93 |

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|------------------------------|------|------|-------|------|------|------|------|------|------|
| Baseline | 5.95 | 1.72 | 0.70 | 2.33 | 2.93 | 2.98 | 2.81 | 2.63 | 2.39 |
| S0: Upside 4th Percentile | 5.95 | 2.20 | 5.25 | 3.69 | 3.06 | 2.71 | 2.21 | 1.93 | 2.06 |
| S1: Upside 10th Percentile | 5.95 | 2.10 | 3.98 | 2.32 | 2.18 | 3.07 | 2.81 | 2.21 | 2.06 |
| S2: Downside 75th Percentile | 5.95 | 1.67 | -0.88 | 2.58 | 3.28 | 3.04 | 2.88 | 2.69 | 2.22 |
| S3: Downside 90th Percentile | 5.95 | 1.65 | -1.99 | 1.56 | 3.40 | 3.61 | 2.97 | 2.90 | 2.55 |
| S4: Downside 96th Percentile | 5.95 | 1.53 | -3.32 | 0.22 | 3.30 | 4.22 | 3.33 | 2.95 | 2.84 |

| U.S. CPI, % CHANGE YR AGO —SCENARIO COMPARISON—October 2022 | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|
| | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 | 24Q3 |
| Baseline | 8.33 | 7.28 | 5.80 | 3.95 | 3.07 | 2.70 | 2.48 | 2.32 | 2.32 |
| S0: Upside 4th Percentile | 8.33 | 7.10 | 5.43 | 3.40 | 2.35 | 1.99 | 1.85 | 1.72 | 1.83 |
| S1: Upside 10th Percentile | 8.33 | 7.19 | 5.62 | 3.67 | 2.71 | 2.34 | 2.18 | 1.99 | 2.03 |
| S2: Downside 75th Percentile | 8.33 | 7.56 | 6.43 | 4.53 | 3.59 | 2.86 | 2.26 | 2.06 | 2.08 |
| S3: Downside 90th Percentile | 8.33 | 7.72 | 6.81 | 4.90 | 3.61 | 2.65 | 1.67 | 1.33 | 1.56 |
| S4: Downside 96th Percentile | 8.33 | 7.80 | 6.97 | 5.12 | 4.19 | 3.17 | 1.97 | 1.39 | 1.17 |

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|------------------------------|------|------|------|------|------|------|------|------|------|
| Baseline | 4.69 | 8.04 | 3.86 | 2.35 | 2.17 | 2.13 | 2.10 | 2.15 | 2.19 |
| S0: Upside 4th Percentile | 4.69 | 8.00 | 3.27 | 1.84 | 2.07 | 2.13 | 2.10 | 2.15 | 2.19 |
| S1: Upside 10th Percentile | 4.69 | 8.02 | 3.56 | 2.07 | 2.09 | 2.13 | 2.10 | 2.15 | 2.19 |
| S2: Downside 75th Percentile | 4.69 | 8.12 | 4.33 | 2.13 | 2.12 | 2.11 | 2.10 | 2.15 | 2.19 |
| S3: Downside 90th Percentile | 4.69 | 8.16 | 4.46 | 1.54 | 1.87 | 2.12 | 2.14 | 2.15 | 2.17 |
| S4: Downside 96th Percentile | 4.69 | 8.18 | 4.83 | 1.40 | 1.52 | 1.90 | 2.10 | 2.11 | 2.14 |

| U.S. FEDERAL FUNDS RATE, % —SCENARIO COMPARISON—October 2022 | | | | | | | | | |
|--|------|------|------|------|------|------|------|------|------|
| | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 | 24Q3 |
| Baseline | 2.20 | 3.78 | 4.52 | 4.61 | 4.58 | 4.54 | 4.30 | 4.05 | 3.78 |
| S0: Upside 4th Percentile | 2.20 | 3.77 | 4.32 | 4.41 | 4.38 | 4.34 | 4.10 | 3.85 | 3.58 |
| S1: Upside 10th Percentile | 2.20 | 3.78 | 4.42 | 4.51 | 4.48 | 4.44 | 4.20 | 3.95 | 3.68 |
| S2: Downside 75th Percentile | 2.20 | 3.87 | 4.65 | 4.80 | 4.05 | 3.51 | 2.89 | 2.67 | 2.47 |
| S3: Downside 90th Percentile | 2.20 | 3.94 | 4.89 | 5.04 | 4.21 | 3.63 | 2.89 | 2.21 | 1.61 |
| S4: Downside 96th Percentile | 2.20 | 4.04 | 5.04 | 5.24 | 4.31 | 3.72 | 2.89 | 2.21 | 1.61 |

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|------------------------------|------|------|------|------|------|------|------|------|------|
| Baseline | 0.08 | 1.72 | 4.56 | 3.93 | 2.96 | 2.50 | 2.50 | 2.49 | 2.42 |
| S0: Upside 4th Percentile | 0.08 | 1.71 | 4.36 | 3.73 | 2.82 | 2.49 | 2.50 | 2.48 | 2.42 |
| S1: Upside 10th Percentile | 0.08 | 1.72 | 4.46 | 3.83 | 2.90 | 2.49 | 2.50 | 2.48 | 2.42 |
| S2: Downside 75th Percentile | 0.08 | 1.74 | 4.25 | 2.60 | 2.46 | 2.50 | 2.50 | 2.49 | 2.42 |
| S3: Downside 90th Percentile | 0.08 | 1.76 | 4.44 | 2.02 | 1.54 | 1.91 | 2.31 | 2.48 | 2.42 |
| S4: Downside 96th Percentile | 0.08 | 1.78 | 4.58 | 1.97 | 0.74 | 0.69 | 0.87 | 1.53 | 2.15 |

| U.S. S&P 500, % CHANGE YR AGO —SCENARIO COMPARISON—October 2022 | | | | | | | | | |
|---|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| | 22Q3 | 22Q4 | 23Q1 | 23Q2 | 23Q3 | 23Q4 | 24Q1 | 24Q2 | 24Q3 |
| Baseline | -10.12 | -19.46 | -15.89 | -5.57 | 0.45 | 7.57 | 5.75 | 2.28 | -0.48 |
| S0: Upside 4th Percentile | -10.12 | -14.21 | -7.02 | 5.72 | 11.37 | 11.15 | 5.19 | 0.79 | -0.71 |
| S1: Upside 10th Percentile | -10.12 | -15.82 | -9.17 | 2.61 | 6.43 | 8.25 | 2.91 | -0.88 | -0.94 |
| S2: Downside 75th Percentile | -10.12 | -21.16 | -27.33 | -26.28 | -20.66 | -12.58 | -1.66 | 6.36 | 3.28 |
| S3: Downside 90th Percentile | -10.12 | -28.63 | -38.57 | -38.75 | -34.84 | -20.29 | -2.49 | 9.39 | 9.36 |
| S4: Downside 96th Percentile | -10.12 | -31.67 | -43.56 | -41.62 | -43.40 | -31.33 | -13.35 | -8.43 | -1.65 |

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 |
|------------------------------|-------|-------|--------|-------|------|-------|-------|-------|------|
| Baseline | 32.57 | -4.75 | -3.94 | 1.90 | 4.87 | 5.71 | 6.05 | 5.28 | 4.54 |
| S0: Upside 4th Percentile | 32.57 | -3.33 | 4.93 | 1.57 | 4.84 | 3.47 | 5.44 | 5.66 | 5.27 |
| S1: Upside 10th Percentile | 32.57 | -3.77 | 1.66 | 0.43 | 4.11 | 3.43 | 5.38 | 5.66 | 5.27 |
| S2: Downside 75th Percentile | 32.57 | -5.21 | -22.12 | 2.98 | 6.87 | 6.17 | 5.35 | 5.50 | 5.09 |
| S3: Downside 90th Percentile | 32.57 | -7.22 | -33.89 | 6.66 | 9.93 | 8.31 | 7.65 | 6.74 | 5.70 |
| S4: Downside 96th Percentile | 32.57 | -8.04 | -40.56 | -5.20 | 9.68 | 11.79 | 10.09 | 10.22 | 9.16 |

About the Authors

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