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## 2024 CCAR SCENARIOS: MANDATORY AND EXPLORATORY STRESS-TESTING THROUGH AD&CO'S ANALYTICS

*By Alex Levin and Daniel Swanson*

### Summary

On February 15, the Federal Reserve Board (Fed) released two scenarios—Base and Severely Adverse—for the 2024 Comprehensive Capital Analysis and Review (CCAR). In addition, the Fed released two exploratory scenarios (A and B) that combine economic stresses with higher, rather than lower, interest rates, thereby increasing the cost of funding. These scenarios describe three-year trajectories based on key economic indicators. Of the 28 variables, the ones used by AD&Co's mortgage models are home price (CoreLogic national HPI); interest rates (3-month, 5-year, and 10-year Treasury, prime index, and mortgage primary rate); and national unemployment.

The information provided by the Fed is not sufficient to project credit losses and bank capital levels without some transformation (including interpolation and extrapolation) of its assumptions. In order to assess lifetime losses or changes in market values, a much longer projection of the variables is required. Furthermore, most adjustable-rate mortgages are not indexed to the three Treasury rates provided, and the forecast of the national HPI is not an accurate indicator of diverse geographical stresses.

Therefore, after each annual release, Andrew Davidson & Co., Inc. (AD&Co) prepares a set of data files that convert the Fed's scenarios into a form more suitable for modeling; our internal valuation model restores a full set of economic variables. The process is described in the Appendix, and some useful information can also be found in our annual articles published from 2013 through 2023.<sup>1</sup> The current article focuses on the 2024 version and compares results from the CCAR stresses to our standard credit-scenario grid.

Clients who license one of AD&Co's valuation/risk systems (RiskProfiler, LoanKinetics, or Kinetics) can replicate these projections. Those who license the LoanDynamics Model (LDM) can use our extended scenario files through their vendor systems' interface.

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<sup>1</sup> See, for example, A. Levin, and D. Swanson, "[CCAR 2023 Scenarios: A Decade of Empowering Stress Testing Through AD&Co's Analytics](#)," *The Pipeline* 181 (February 2023).

## 2024 CCAR Scenarios

We begin with a summary and a brief description of the four scenarios in Table 1.

**Table 1. Four Fed’s Scenarios for the 2024 Stress Testing**

Scenario	Home Prices*	Unemployment	Mortgage Rates	Comments
Base case	Anemic growth	Slight increase	Gradual 2% decline	Typical
Severely Adverse	Plummets 36%	Up to 10%	Plummets 3.5% - 4.0%	Severe recession
Exploratory A	Declines 20%	Up to 6.7%	Up, then gradually down 2%	Recession
Exploratory B	Plummets 32%	Up to 10%	Up, then gradually down 1.2%	Severe recession

\* Core Logic US HPI

The 2024 capital adequacy calculations utilize only the base case and the severe scenarios. Comparing them to 2023, we found only minor differences which are not discussed in this article. We would also like to mention that higher or lower projected market rates affect both the credit outcome (asset losses) and asset market prices. Our Advanced CCAR function implemented in AD&Co’s financial engineering systems allows users to gauge both effects.<sup>2</sup> This article focuses on the 2024 CCAR scenarios as the cause of credit losses and leaves out the topic of duration gap in Asset-Liability Management (ALM).

The Fed economic scenarios cannot be used in our models immediately. The 13-quarter series is interpolated (to obtain other variables), extrapolated (to reach a 30-year horizon) and in some cases, transformed. These operations are explained in the Appendix; immediately below are results and comments.

Interest rate scenarios are provided for three tenors of the Treasury curve (3-month, 5-year, and 10-year), mortgage primary rate (from the Freddie Mac originator survey), and prime index. At every forward point in time, we fill in the missing points on the Treasury curve and reconstruct the SOFR-swap curve (see Appendix). At the end of the Fed’s forecast, we then utilize this restored interest rate market and project each tenor using its forward rate trajectory.

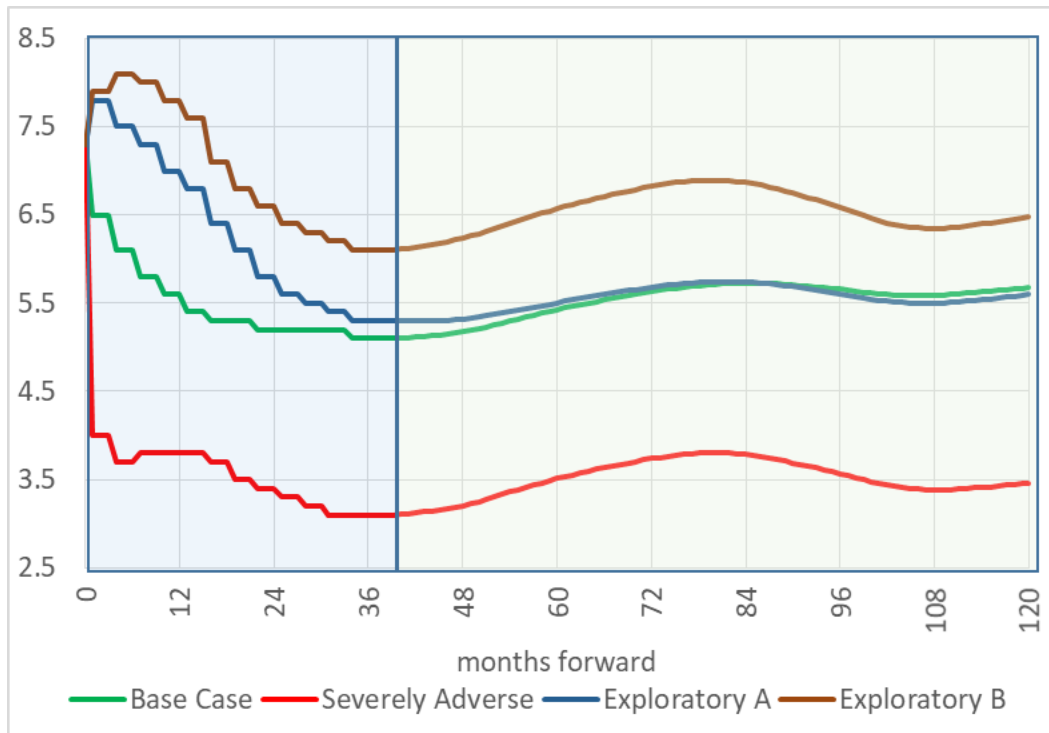
Additionally, both secondary and primary mortgage rates are subject to their own modeling steps, which are linked to market benchmarks (Treasury curve, in AD&Co’s case). The resulting scenarios for primary mortgage rate are shown in Figure 1.

All four scenarios start with a rate of 7.3%. The Severely Adverse scenario features a quick collapse in mortgage rates, followed by their further decline, totaling about 400 bps. This mere fact, so different from the exploratory scenarios, will mitigate credit risk and partially offset the much stronger stresses in the home price index (HPI) for borrowers with refinancing incentives, as demonstrated further in the article.

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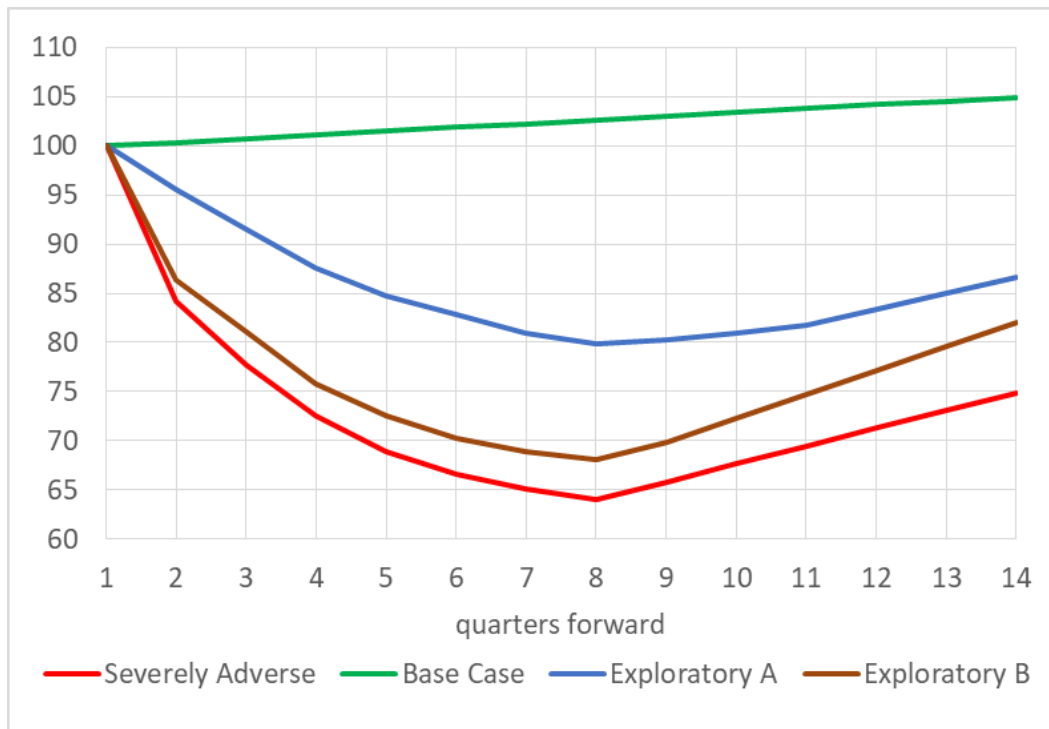
<sup>2</sup> A. Levin and L. Wu, “[CCAR 2017: Forward Valuation without Foresight \(“Advanced CCAR”\)](#),” The Pipeline 150 (June 2017).

**Figure 1. Primary Mortgage Rate Scenarios**



**HPI scenarios** are provided for the CoreLogic (CL) national index only. The 2024 edition includes a 36% projected HPI decline in the Severely Adverse scenario (compared with 38% for the 2023 edition). The exploratory scenarios feature their own stresses in Figure 2.

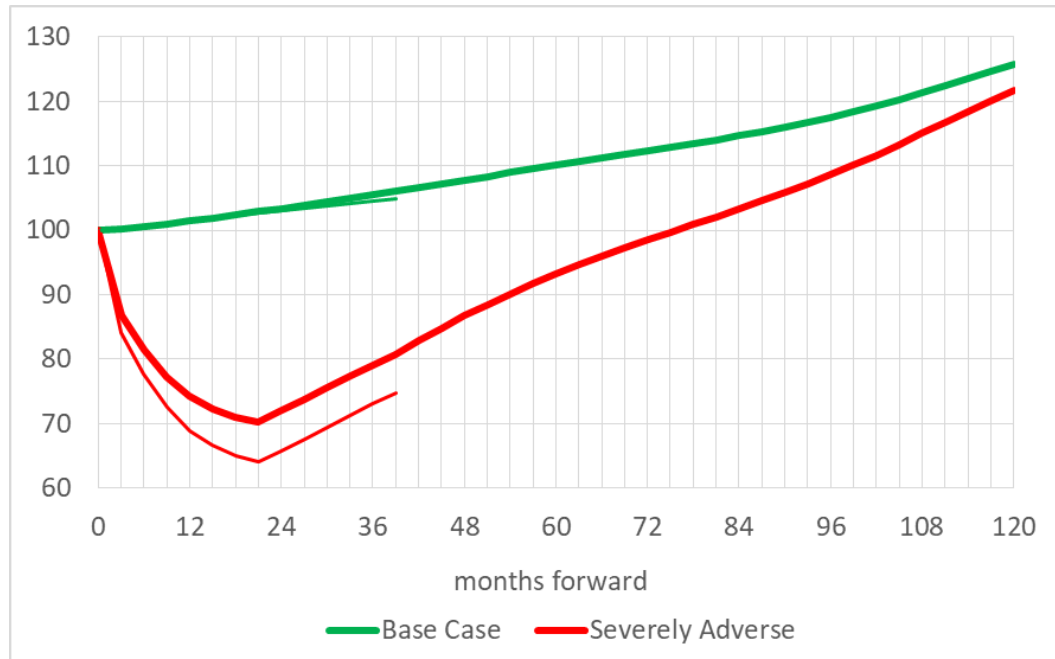
**Figure 2. 2024 CoreLogic HPI Scenarios**



AD&Co transforms the provided scenarios in three ways (explained in the Appendix); the first two transformations are illustrated in Figure 3 (for clarity, we limit the exposition to base and severe scenarios):

1. We convert CoreLogic’s scale into the Federal Housing Finance Agency (FHFA) scale used in our credit model. In simple terms, stresses are expected to be 20% weaker, net of a common national affordability driver.
2. We extend HPI for the full 30-year period of modeling.
3. Stresses are localized so that HPIs in high-volatility areas (CA, FL, AZ, and NV) will be stressed more deeply.

**Figure 3. Converted and Extended 2024 CCAR US HPI Projections**

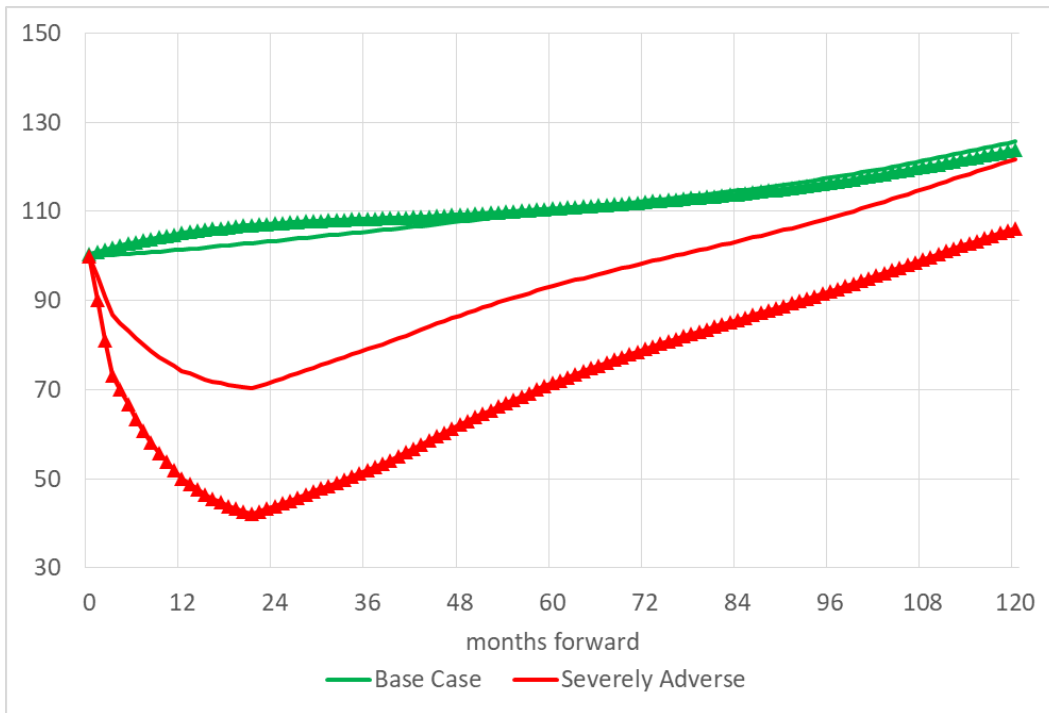


*Thin lines = CoreLogic raw series; Thick lines = AD&Co - constructed FHFA equivalent*

To illustrate localization (transformation 3 in the list above), Figure 4 compares 2024 HPI scenarios in California to those in the US as a whole, using the FHFA scale. Note that home prices in California are projected to decline much more than the national index in the Severely Adverse Case. As for the Base Case, California’s HPI is projected by our model to be similar to the US HPI in the near term but somewhat less positive in the long term.

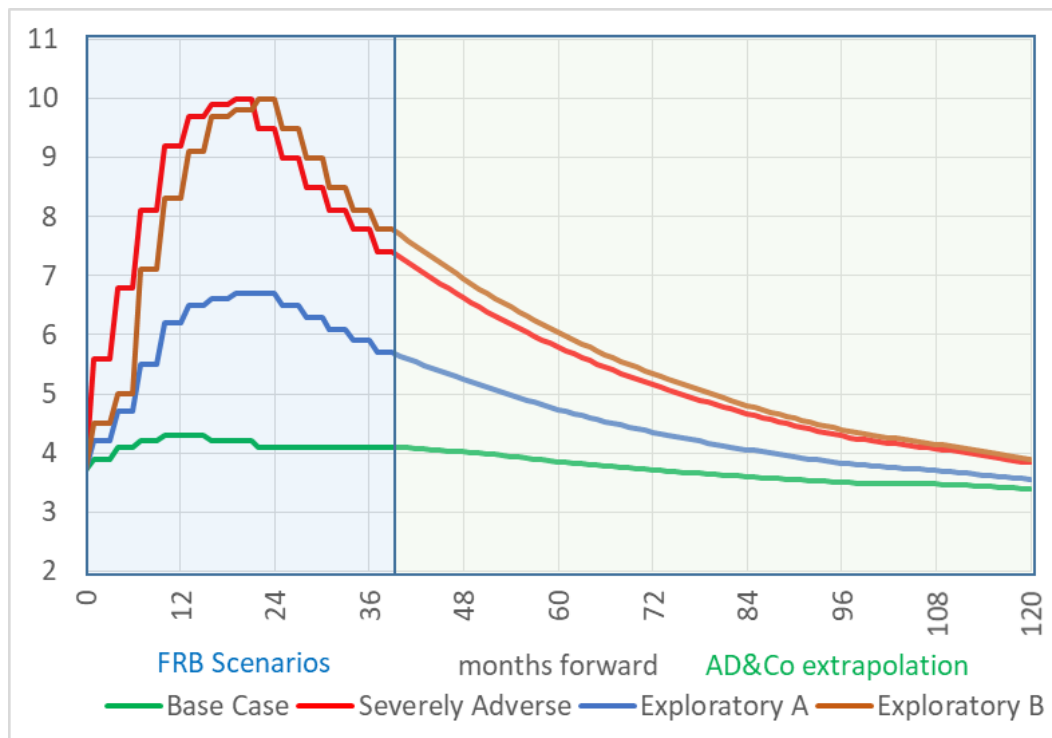
Although the Fed doesn’t provide geographical HPI scenarios, its description of the 2024 Severely Adverse scenario specifies that “declines in aggregate U.S. house prices should be assumed to be concentrated in regions that have experienced rapid price gains over the past few years.” While our modeling view doesn’t necessarily contain an explicit prediction of counter-cyclical movements, California HPI has indeed outpaced other regions in recent years.

**Figure 4. Geographical Comparison of HPI Scenarios US (solid) vs CA (triangles)**



**Unemployment scenarios** are provided at the national level. Figure 5 depicts the extrapolation beyond the CCAR horizon performed using our unemployment model and pointing to a gradual unemployment decline; the model also localizes the stresses -- based on the localized HPI.

**Figure 5. US Unemployment Rate Scenarios**



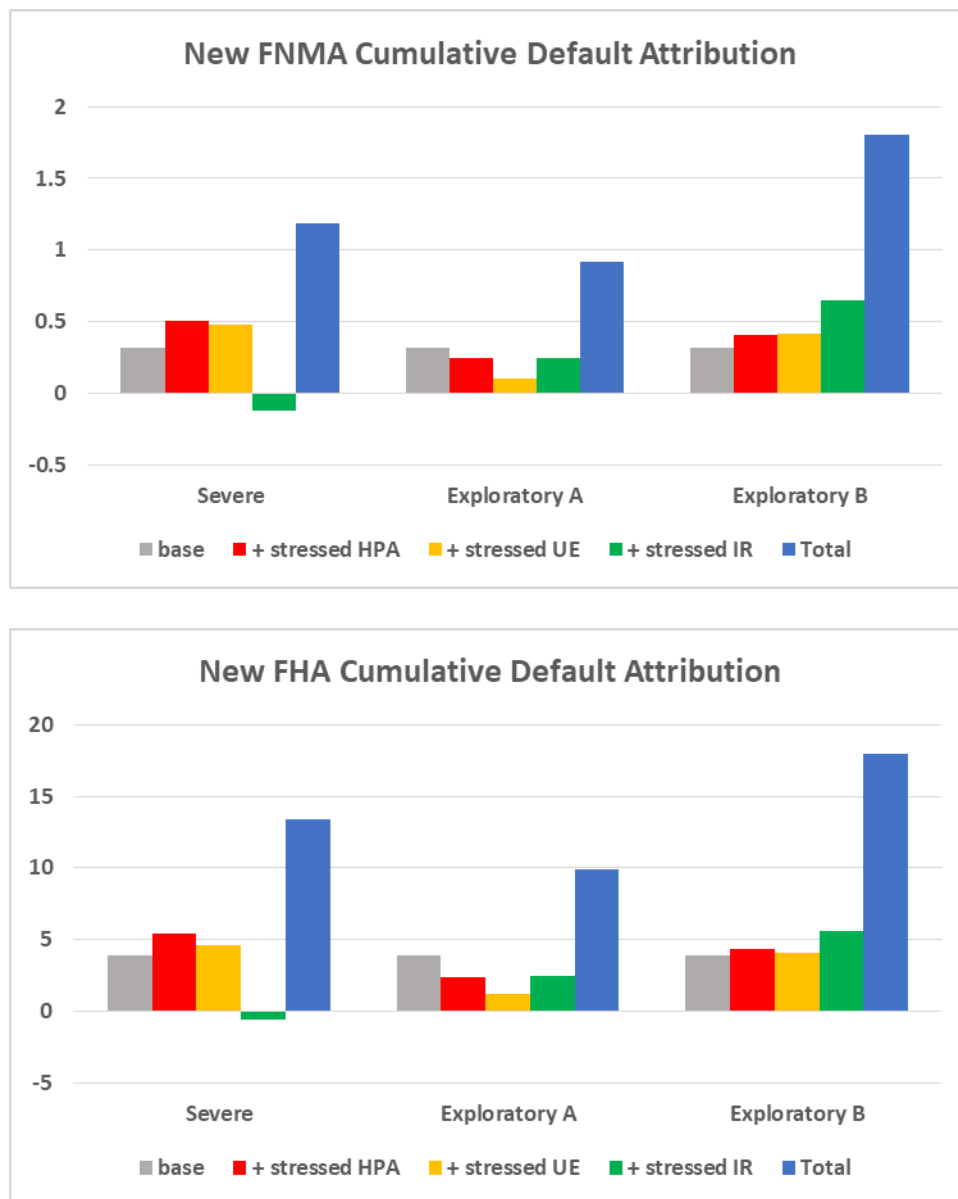
In the Appendix, we describe the use of unemployment scenarios in LDM of different generations.

## Not All Loans Are Born Equal: Model Attribution Results

In last year’s article, we inspected the drivers of 2023 severe stress (rates, home prices, unemployment) by applying them one factor at a time; we now expand this analysis style to include the exploratory scenarios. Given the mighty move of interest rates during 2022, a question may arise as to which loans benefit from the fallen rates of the Base Case and Severely Adverse scenarios and which loans suffer from the higher rates of the two exploratory scenarios. We will analyze a pair of FNMA loans and a pair of FHA loans; in each pair, one loan is a 2.75% 2020 loan, and another is a new 6.75% 2023 loan.<sup>3</sup>

Figures 6 (new loans, Age = 0) and 8 (seasoned loans, Age = 36 months) depict contributors of different factors to cumulative default.

**Figure 6. Attribution of Macroeconomic Drivers: New Current-Rate Loans (6.75%)**

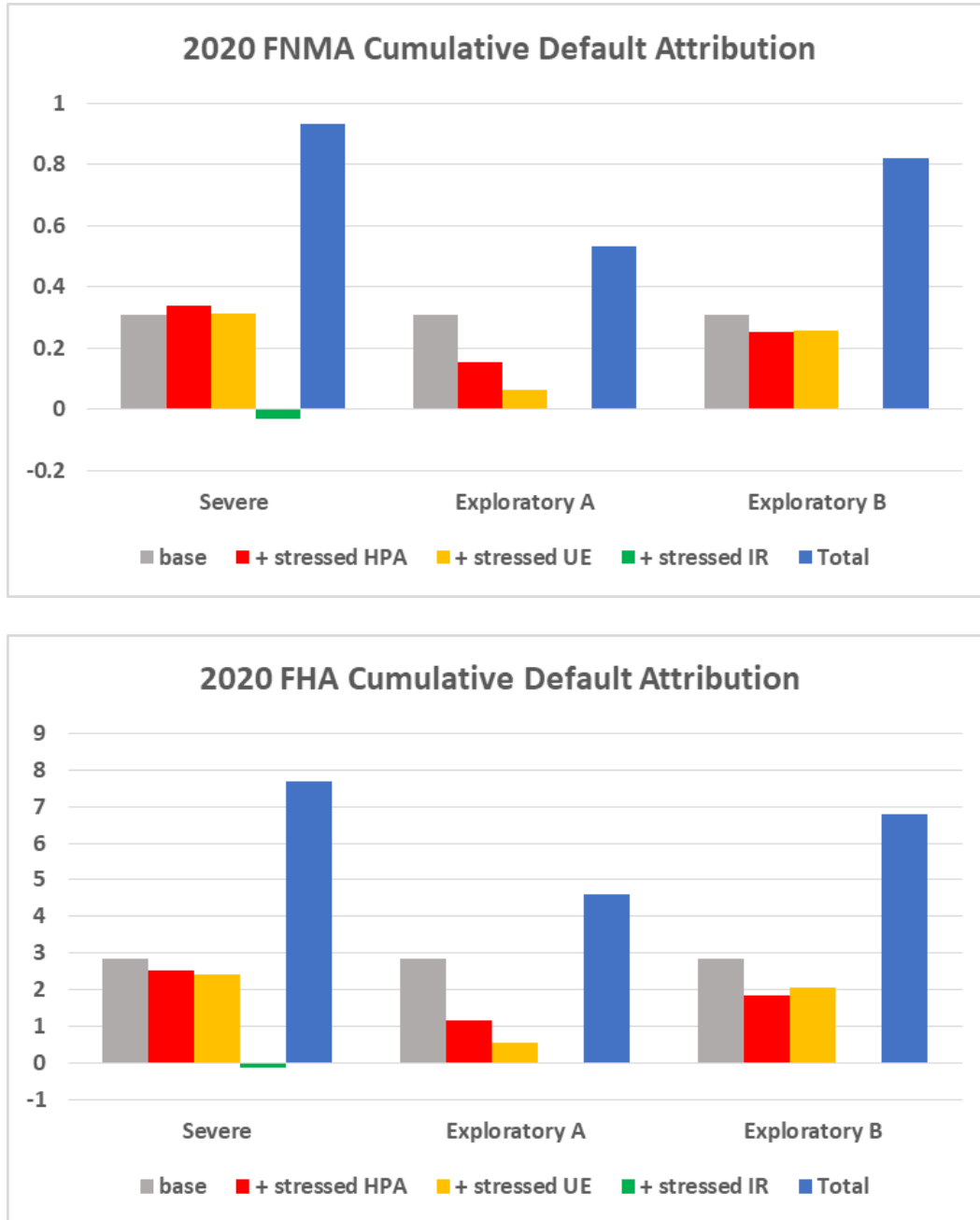


<sup>3</sup> FNMA: FICO=750, LTV=75, Bal=400K, Geo=US

FHA: FICO=680, LTV=95, Bal=350K, Geo=US

The new loans are quite sensitive to the interest-rate effect (green bars). Under severe scenario, they benefit from the plummeting rates; under the two exploratory scenarios, they suffer. The HPI and UE factor contributions are commensurate with their magnitudes. At the end, Exploratory B scenario is worse than Severe for both FNMA and FHA loans.

**Figure 7. Attribution of Macroeconomic Drivers: 2020 Low-Rate Loans (2.75%)**



The seasoned low-rate loans enjoyed substantial home price appreciation and built-in equity; they look less risky than the new loans. However, the green bars are all nearly missing in Figure 7: their assumed loan rate of 2.75% means that they are unlikely to refinance in any scenario. In total, the Severe scenario has the highest risk based on its HPI decline and UE increase.

## 2024 CCAR vs AD&Co’s Standard Scenario Grid

One of the most interesting questions we are asked regarding the CCAR scenarios is their “location” within the AD&Co standard-scenario grid, which is used for many analyses. The description of the scenario-grid method for credit analysis can be found in a number of our publications. Below is a very brief overview.

We construct 20 deterministic scenarios (numbered from 0 to 19) sorted in order of stresses. Each scenario features changes in interest rates, home prices, and LDM scales. Therefore, to account for possible model errors, we combine market stresses with model stresses. Scenario 7 is our typical base case (median scenario), where rates follow their respective forward curves, HPs follow the AD&Co model (without randomness), and LDM’s outputs are used without alterations. Scenario 19 is the extreme stress case, projecting a long and deep FHFA national home price decline, when high interest rates make it difficult to refinance. Furthermore, we assume that, in stresses, the model understates defaults and losses and overstates prepayments. Thus, it is a compounded combination of stresses.

Each scenario is assigned a theoretical probability that follows what we call “3-group Vasicek” distribution. This is an adaptation of the O. Vasicek theory of loan defaults, in which defaults are bounded between minimal and maximal levels computed from the scenario grid. In Figure 8, those are 0.04% and 8.74%, respectively. The median default rate, 0.33%, is another important parameter. Finally, the correlation parameter entering Vasicek’s formula is set at 25% (this level is calibrated to a Monte Carlo-generated distributional tail). The theoretical Cumulative Distribution Function (CDF) and scenario weights are shown in the last two columns.

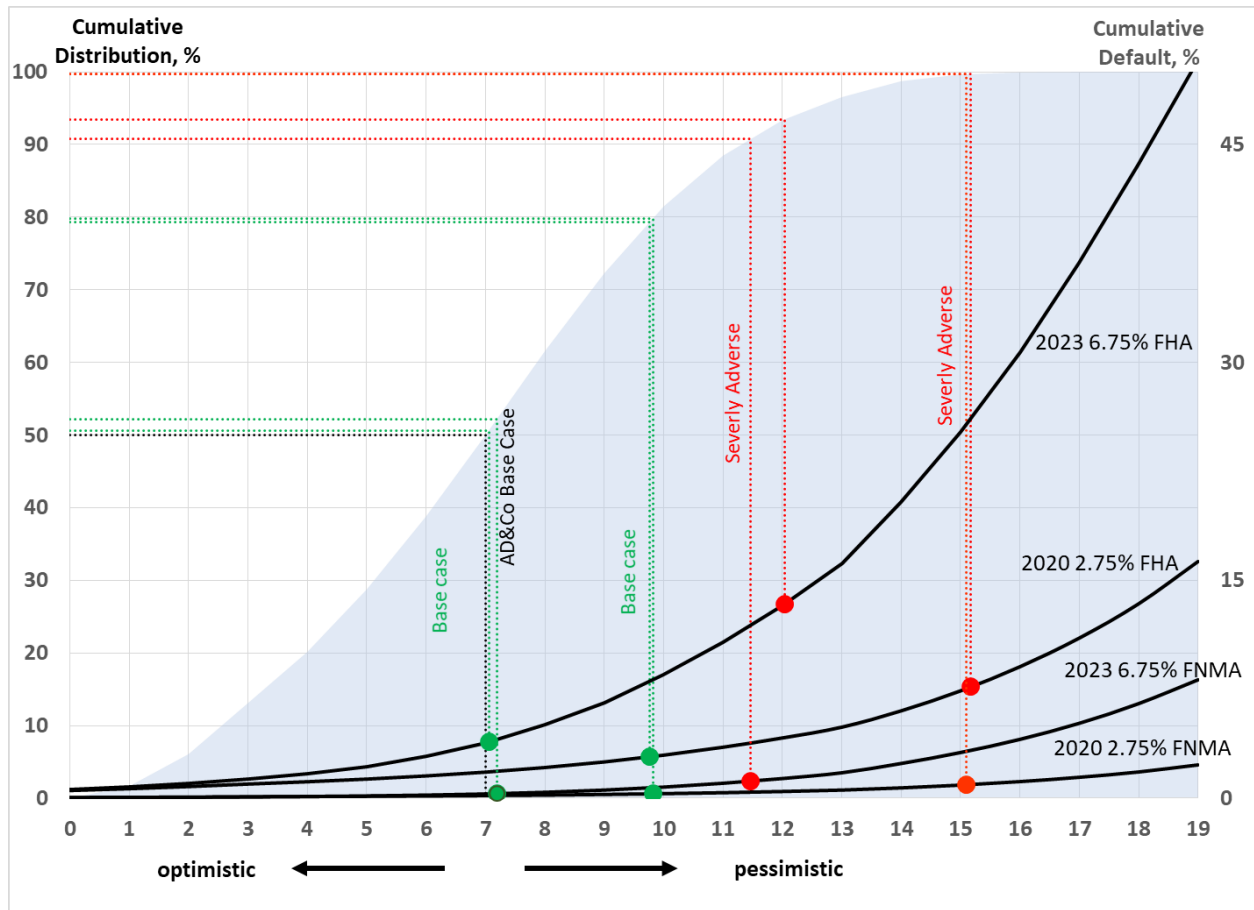
**Figure 8. Standard AD&Co Economic and Model Stresses (New FNMA Loan)**

Scenario type	Scenario	HPA	HPA	HPA	IR Shock	Model Scales			Cumulative		Probability	
		1-yr	2-yr	Trough		Default	Severity	Prepay	Loss	Default	CDF	Weight
Best	0	17.91	36.69		-125	0.75	0.875	1.25	0.01	0.04	0.00	0.57
	1	15.83	32.38		-100	0.8	0.9	1.2	0.01	0.06	1.14	2.25
	2	13.79	28.20		-75	0.85	0.925	1.15	0.01	0.07	4.50	4.87
	3	11.79	24.16		-50	0.9	0.95	1.1	0.02	0.10	10.88	6.56
Improving	4	10.04	20.72		-37.5	0.925	0.9625	1.075	0.03	0.13	17.62	7.79
	5	8.32	17.37	9900.00	-25	0.95	0.975	1.05	0.04	0.18	26.47	9.88
	6	6.62	14.12	9900.00	-12.5	0.975	0.9875	1.025	0.05	0.24	37.39	11.77
Base	7	4.95	10.96	9900.00	0	1	1	1	0.07	0.33	50.00	12.70
	8	3.31	7.88	-0.24	12.5	1.025	1.0125	0.975	0.11	0.45	62.79	12.38
	9	1.70	4.90	-0.50	25	1.05	1.025	0.95	0.16	0.61	74.75	10.93
Moderate Stress	10	0.11	1.99	-0.77	37.5	1.075	1.0375	0.925	0.23	0.84	84.65	8.44
	11	-1.46	-0.83	-2.02	50	1.1	1.05	0.9	0.32	1.12	91.63	5.64
	12	-3.00	-3.57	-4.09	62.5	1.125	1.0625	0.875	0.45	1.48	95.93	3.32
	13	-4.51	-6.24	-7.08	75	1.15	1.075	0.85	0.63	1.92	98.27	1.81
Stress	14	-6.18	-9.17	-11.26	100	1.2	1.1	0.8	0.95	2.61	99.55	0.82
	15	-7.82	-12.01	-15.91	125	1.25	1.125	0.75	1.39	3.42	99.91	0.22
	16	-9.43	-14.76	-20.78	150	1.3	1.15	0.7	1.98	4.39	99.99	0.04
	17	-11.01	-17.41	-25.69	175	1.35	1.175	0.65	2.78	5.57	100.00	0.01
	18	-12.55	-19.98	-30.56	200	1.4	1.2	0.6	3.84	7.00	100.00	0.00
Extreme Stress	19	-14.07	-22.46	-35.45	225	1.45	1.225	0.55	5.22	8.74	100.00	2E-06

Figure 9 compares AD&Co’s projected default rates from the 20 scenarios to those using the 2024 CCAR scenarios. As before, we considered loans of vastly different credit quality and rate: a FNMA loan of a typical high quality and a high-risk FHA loan; as before, we analyze both 2023 (new, high-rate) with 2020 (seasoned, low-rate) loans.



Figure 9. 2024 CCAR Scenarios (dots) on the AD&Co Scenario Grid



Despite very vast differences in loans’ characteristics, the CCAR 2024 Base Case scenario lies neatly on 7 (i.e., AD&Co’s base case) for both FNMA and FHA new loans; the Severely Adverse scenario maps to a range of scenarios 11-12. Note that for every CCAR scenario, its probability assignment only modestly depends on loan type. This is an interesting fact that should not be taken for granted since the Vasicek CDF is a function of the default rate that varies vastly across loan types.

As for the seasoned pair, its projected default rate under the 2024 CCAR scenarios maps differently: AD&Co’s scenario 10 for the Fed’s Base Case and scenario 15 for the Severely Adverse scenario. The main reason for such a glaring mismatch is the construction of the Fed’s CCAR scenarios, which project drastic risk-mitigating drops in mortgage rates that benefit high-rate loans but not low-rate loans. Our review mentioned in the last year article proved that this discrepancy is not a defect of the 20-scenario method: a similar discrepancy is observed if the CDF is constructed by Monte Carlo simulations.

Looking at the probability assessment (the left y-axis), we see that the Severely Adverse scenario is given a CDF of about 0.997 (1:300 odds of occurring) for the seasoned loans, but much lower for the new loans (0.907 to 0.935 meaning 1:11 to 1:15 odds of occurring). This range of assessment does not contradict our common intuition as we don’t assess probability of a scenario but of the default rates generated.

To keep Figure 9 clean and concise, we have not included the exploratory scenarios. As mentioned, exploratory scenario B would be worse than the severe for new loans but better for the seasoned ones. As for exploratory scenario A, representing a moderate recession, it is worse than the base case but better than severe.

Table 2 lists the history of AD&Co’s scenario mapping. The Base Case scenario mapping had remained mostly unchanged through the previous years of stress testing, but it has varied recently due to the difference between AD&Co’s and Fed’s dependence on recent market trend.

Mapping of the Severely Adverse scenario has been more volatile. According to the aforementioned Fed’s 2024 CCAR document, the year-over-year change “reflects the Scenario Design Framework, which calls for a more pronounced economic downturn when current conditions are stronger.” This is in contrast to the design of AD&Co’s 20-scenario grid that keeps “scenario distances” from its Base Case (#7).

Finally, in prior years of steady rates, the map was fairly consistent between new and seasoned loans. When rates rose in 2022, the two types of loans bifurcated. To illustrate that, two separate rows are shown for 2023 and 2024.

**Table 2. Historical CCAR Scenario Map on the AD&Co 20 Scenario Grid**

Year of Stress Testing	Base Case	Adverse	Severely Adverse
2017	8	11	12–13
2018	8–9	10–11	15
2019	8	10±	13±
2020	8	N/A	13–14
2021	9	N/A	13–14
2022	8–9	N/A	13–14
2023*	6-7	N/A	13
2023**	3	N/A	8-9
2024*	10	N/A	15
2024**	7	N/A	11-12

\* low rate seasoned loans

\*\* high rate new loans

## What Are Our Clients Getting?

The information set facilitating CCAR analysis depends on whether our clients use one of our financial engineering (FE) tools (OAS Subroutine assessed directly or via RiskProfiler or LoanKinetics applications) or exclusively use LoanDynamics Model (LDM) via a third-party vendor.

**AD&Co’s FE Tools** are capable of reading interest rates, home prices, and unemployment scenarios (stored in files) directly and employing them in a CCAR analysis. For example, the CtoD dialing vectors used in older versions of LDM (and depicted in Figure A.2 of Appendix of this article) will be computed during run time; the HPI stresses will be localized by the HPI model (a part of OAS Subroutine); and interest rates will be interpolated and extended using forward rates computed by our interest rate model (another part of OAS Subroutine).

**Advanced CCAR Analytics** is incorporated in AD&Co's FE Tools and enables valuation of mortgage assets at future points, using one of the CCAR scenarios. This valuation method utilizes market information known at those points, without foresight. Our 2017 article explains this important function that is mandatory for mark-to-market assets such as held-to sale assets or Mortgage Servicing Rights.<sup>4</sup>

For users of **LDM** through **Third-Party Vendors**, the aforementioned home price and interest rate files are available to plug into third-party vendor systems. Depending on the vendor, the format of the files may need to be transformed. Custom tuning files, which employ the appropriate CtoD tuning depending on the scenario in question, are also available for older versions of LDM.

Finally, we have created a version of the **LDM Spreadsheet** with the CCAR scenarios for interest rates, home prices, and unemployment (pre-loaded for each scenario).

For more information, please contact [alex@ad-co.com](mailto:alex@ad-co.com), [daniel@ad-co.com](mailto:daniel@ad-co.com) or [support@ad-co.com](mailto:support@ad-co.com).

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<sup>4</sup> A. Levin and L. Wu, "[CCAR 2017: Forward Valuation without Foresight \("Advanced CCAR"\)](#)," The Pipeline 150 (June 2017).

## APPENDIX

We describe herein the interpolation/extrapolation processes that are necessary, given the limitations of the CCAR scenario data, to run fixed income analysis.

### Interest Rates

As a first step, the interest rates are interpolated and extended forward. The CCAR scenarios only describe the 3-month, 5-year, and 10-year Treasury rate, the Prime rate, and the primary mortgage rate, for a three-year horizon. Modeling and valuation require much more—rates for all maturity tenors and for up to 30 years in the future. For example, both OTTI (other-than-temporary impairment) and mark-to-market require us to project cash flows of an MBS (mortgage-backed security) at the end of the CCAR horizon, which would assume knowledge of the entire market at that point.

We first fill in missing rates for the three-year horizon specified by the Fed. Although we only know the three Treasury-point trajectories, we can compare them with the starting points and interpolate the entire curve reasonably well. For example, a move in the one-year point would be the weighted average of moves in the 3-month and 5-year tenors from respected forwards, with weights being commensurate with the distances to those tenors. This will let us predict all yield-curve points for the next three years. Once we have the yield curve three years in the future, we can construct forward rates at the end of the CCAR horizon and extend the projection using the no-arbitrage assumptions.

SOFR rates are projected similarly; using the established distance from any point of the Treasury curve from today's forward rate, we place the matching SOFR or swap tenor off its known forward curve.

Mortgage rates are projected according to our model. In order to project primary mortgage rates, we first “invert” our primary/secondary spread (PSS) model to derive the current coupon yields (CCY) from the primary rates. At the end of the three-year horizon, we compare CCYs thus obtained to the 2-year point and the 10-year point. This allows us to establish the regression's intercept (Alpha) for our widely used empirical CCY model. Once this is done, CCY can be projected in the distant future using that Alpha and the two benchmark rates. Primary rates are then computed using this extrapolated CCY and the PSS from its model.

Finally, 15-yr mortgage rates are projected off the 30-yr ones using a simple regression.

### Home Prices

Our home price model is essentially utilized to extend the scenarios, but it is also used to convert the CoreLogic HPI forecast into an equivalent FHFA HPI forecast and to “localize” national stresses.

### HPI Conversion

Our key tool in generating borrower behavior response to economic stresses is the LoanDynamics Model (LDM). It was built using publicly available FHFA home price indices. Those indices declined less during the 2008–09 crises than the CoreLogic (CL) HPI or the Case-Shiller (CS) HPI. Therefore, in order to pass economic stresses to LDM, we first need to convert HPI projections stated in the CoreLogic form into the approximately similar FHFA form. Note that historically CL HPI was a different and a slightly more volatile index than CS HPI. After CoreLogic acquired the rights to Case Shiller HPI from Fiserv in 2013, it began producing what they termed “CoreLogic Case-Shiller HPI” and the two indices became identical. We think that the CS index's volatility is more relevant for the

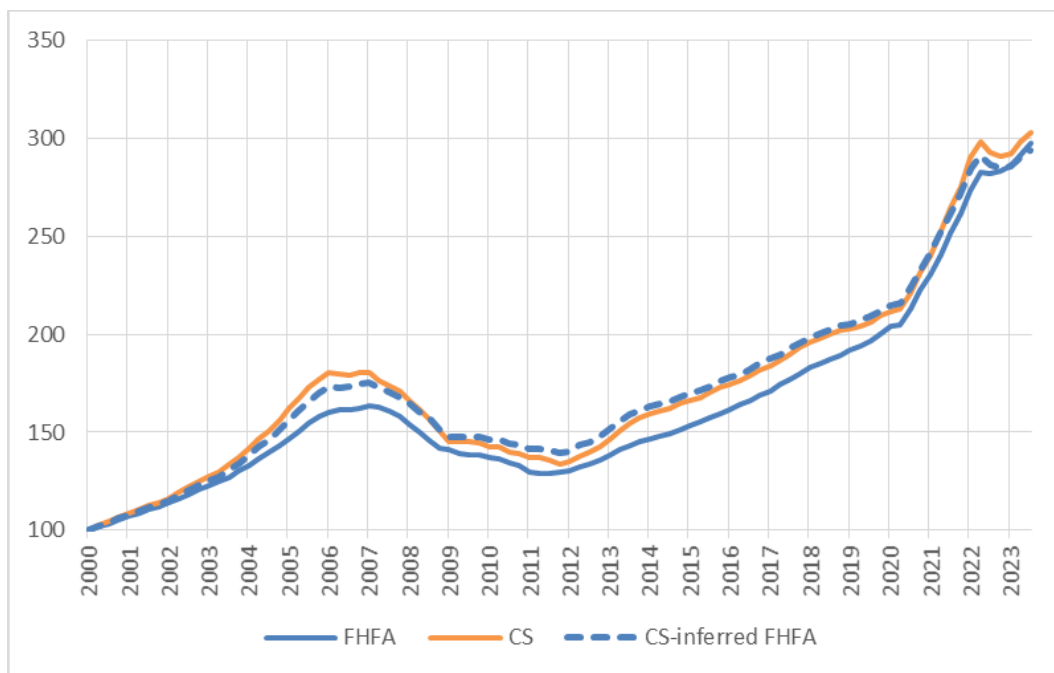
future projections than the CL ones (before the acquisition), hence assume the CS property for the HPA conversion.

The conversion is performed using a simple variation of our Geographical Localizer (a regression):

$$HPA_{FHFA}(t) - F(t) = \beta[HPA_{CS}(t) - F(t)]$$

Where  $F(t)$  is the common HPA factor and Beta is the regression’s coefficient, estimated at 0.833. Understanding the common factor  $F(t)$  is the key to appreciating this conversation. As stated, the FHFA indices have historically been less volatile than the Case-Shiller/CoreLogic indices. However, this difference should be controlled for the common factors that measure borrower economics—primarily, interest rates, size of down payment, and income. If a stress is solely attributed to that common factor, there will be no difference between the two HPI projections. Our 2017 article contains a historical “in sample” data series that supports the conversion. We confirm that the conversion still does a good job out of the sample (Figure A1). While all three lines look similar, the decline during the Global Financial Crisis suggests that a stress in the Case-Shiller/CoreLogic indices should be reduced if a model is trained using the FHFA HPI indices.

**Figure A1. Case-Shiller vs FHFA HPI since 2000**



### Geographical Localization of Stresses

A uniform propagation of national HPI stress to states and MSAs (metropolitan statistical areas) would understate losses. A simple explanation for this is that any loan cohort contains a large portfolio of default options. Due to the nonlinear nature of an option exercise, the averaged HPI volatility does not point to the averaged option value, but rather to a lower one. Therefore, we “localize” HPI stresses by following the coefficients in our Geographical Localizer. For example, if region X is N times more volatile (net of the common factor) than the national index, its decline will be N times the national decline (again, net of the common factor). In addition, home prices in California are projected to decline much more than the national index in the Adverse and Severely Adverse Cases despite being possibly more optimistic in the Base Case.

## The Role of Unemployment

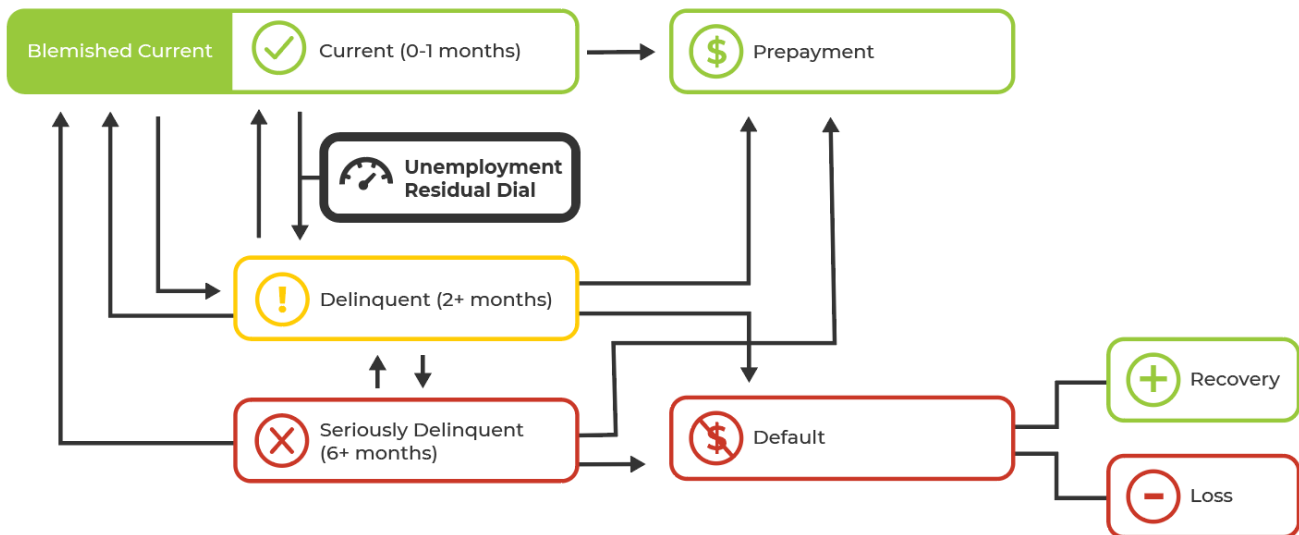
### LDM v3.0 (ALDM+)

Version 3.0 explicitly takes unemployment projection for agency loans.<sup>5</sup> No additional tunings are required if the LDM vendor system allows for passing unemployment projections. AD&Co distributes extrapolated values for the Fed’s unemployment scenarios in a file. AD&Co’s own financial engineering models (OAS Subroutine) and applications (RiskProfiler, LoanKinetics, and the Kinetics platform) are fully equipped to accept unemployment scenarios.

### LDM v3.0 (NA LDM) and Prior Versions of LDM

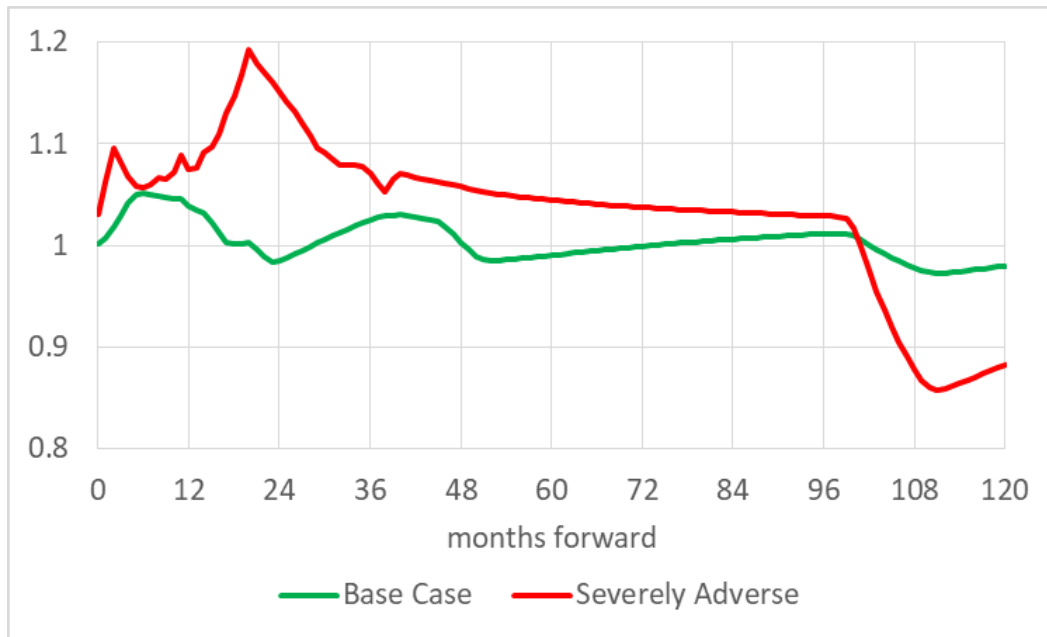
Unemployment is not an explicit factor in the Non-Agency LDM or any LDM prior to v3.0, but it is utilized in our CCAR process. In doing so, we avoid double-counting the stresses by first subtracting an unemployment component statistically explained by home prices (and, lately, interest rates). Therefore, only the differential unemployment, termed “unemployment residual,” affects the new delinquency (Current-to-Delinquent, or CtoD) transition with LDM. Figure A2, reproduced from our prior publications, illustrates where the unemployment residual term is factored into the well-known LDM structure. Figure A3 depicts CtoD dials for the 2024 CCAR scenarios.

**Figure A2. LoanDynamics Model with Unemployment Interference (v2.2 and prior)**



<sup>5</sup> See D. Swanson, “[New Feature in LDM 3.0](#),” *The Pipeline* 175 (March 2021).

Figure A3. CtoD Dials for the 2024 CCAR Scenarios



The green line in Figure A3 suggests that the Fed’s Base Case unemployment scenario is somewhat above the historical pattern and requires a slight CtoD acceleration. The red line depicts a modestly accelerated unemployment development for the Severely Adverse scenario—again, relative to the historical pattern (e.g., the last financial crisis). While the pattern of CtoD increase/decrease may seem noticeable, the associated increase in cumulative defaults and losses is rather moderate.

These dials are already implemented in AD&Co’s OAS Subroutine (and the financial engineering products using it). They are sent as files to LDM vendors for implementation.

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