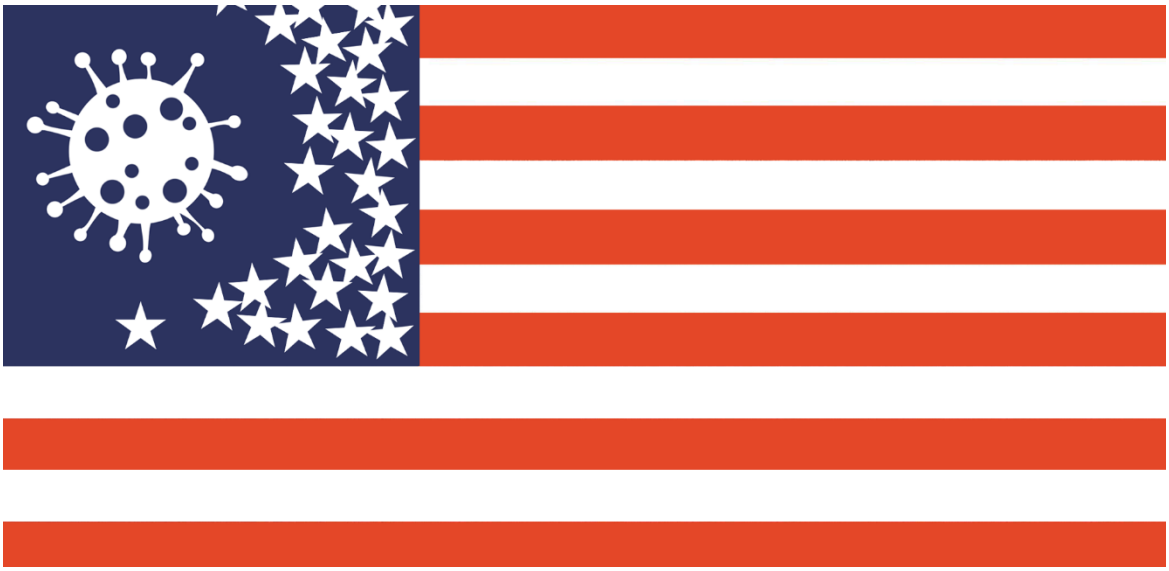
HiddenLevers 2020 Model Performance Review



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HiddenLevers Stress Testing Model Performance Review

HiddenLevers' model projected direction and magnitude of impact in 95% of cases studied across scenarios ranging from Oct 1987 through March 2020.

In the 2020 COVID19 crash, the model projected performance within 5% of actual results for 15 of 16 securities across travel, hospitality, energy, tech, and other sectors.

This review builds on a securities list first published in a 2015 review, preventing selection bias for 2020 scenario or other past scenarios.

HiddenLevers' Model Performance: HiddenLevers tested its model using a range of stocks, ETFs, and mutual funds across five different scenarios. The model correctly projected the direction and magnitude of returns in 95% of the 83 directly comparable cases studied, while also falling within 5% of actual historical returns in 75% of cases studied.

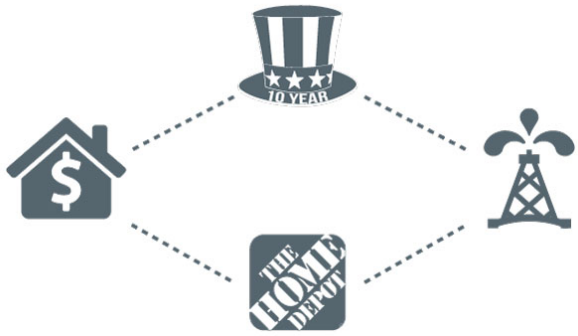
HL vs. traditional models – What's the difference? Monte Carlo and Value at Risk are two widely used models, yet neither accounts for tail risk or scenarios in which traditional relationships in the economy break down. HiddenLevers provides scenario-based portfolio stress testing, which can account for a wider range of risk factors than traditional models.

HL model shines in complex, divergent scenarios: The COVID19 crash was among the fastest in market history, with a particularly severe impact on the hospitality, travel, and energy industries. Monte Carlo and VaR models don't measure the impact of oil prices, airline travel, or other indicators, rendering them incapable of making meaningful projections in this environment. HiddenLevers' model captured these nuances, projecting direction and magnitude correctly for a wide range of securities across stocks, ETFs, and mutual funds.

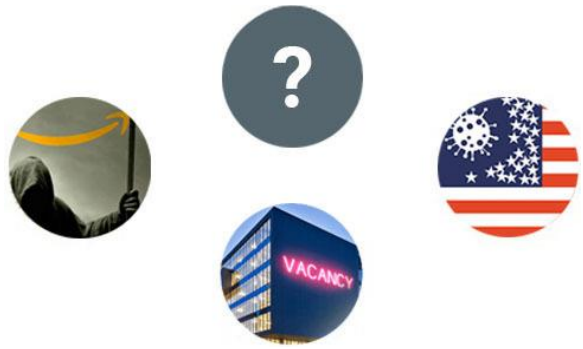
1. MODEL COMPARISON

HiddenLevers uses a scenario-based approach which relies on correlations between dozens of levers (economic indicators) and assets, while competing models like Monte Carlo and VaR often rely only on expected return and standard deviation for different asset classes. A brief overview of the HiddenLevers model and a comparison to traditional models is provided below.

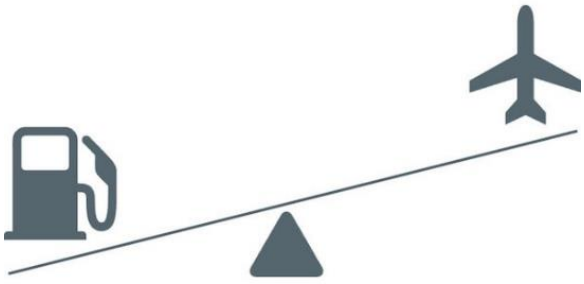
1.1 HiddenLevers Model Overview



1. Find the Connections
HiddenLevers uses big data to measure millions of relationships between the economy and investments. Interest rates affect home sales and oil prices, which impact the price of Home Depot stock. We uncover these links for 35,000+ investments.



2. Ask the Big What-ifs
HiddenLevers creates scenarios to model recessions, crises, and other economic events, using historical research and analysis on how economic indicators are correlated. A scenario is defined from this research as a series of up-or-down movements in the levers.



3. Model the Impacts
In a stress test, investment performance is projected using the relationships measured in step 1, applied to the scenario assumptions in step 2. If a scenario forecasts oil to rise, and Exxon is correlated with oil, then Exxon will rise in that scenario.

1.2 Comparison to Monte Carlo and VaR

Since the HiddenLevers model measures the relationship between a wide range of levers and each individual asset, it is capable of projecting the potential impact of these forces on a portfolio.

Monte Carlo: Monte Carlo-style models generally use the expected return and standard deviation of an asset class to engage in a large number of probabilistic projections of an asset's returns. The advantage of this simple approach is that it relies on very few inputs and can be used to quickly create a range of projected "paths" that an asset's returns might take over time. The disadvantage of this approach is that Monte Carlo has no concept of oil prices or any other economic factor, and cannot take economic shocks into account in any meaningful way. Monte Carlo models will typically produce results showing a 95% confidence interval around projected returns, but will fail to take into account macro-economic tail risks entirely.

Value at Risk: Value at risk models attempt to estimate the potential downside risk to a portfolio by calculating each individual asset's potential loss range over a specified timeframe. Most value at risk models calculate the potential losses for a particular asset in a probabilistic manner similar to Monte Carlo, with no macro-economic input, and with a fixed view of potential downside from a standard deviation perspective. The advantage of VaR models is that they can be used to generate a single potential loss number for a portfolio (hence the name). The disadvantages were seen in 2008, when a tail-risk event like the financial crisis shocked individual securities beyond a traditional 2 or 3 standard deviation cut-off.

Conditional VaR models help to quantify tail-risk in a portfolio, but generally do not attempt to account for differences in various economic outcomes. For instance, falling interest rates and oil prices may be beneficial to certain portfolio holdings, and harmful to others – but which ones? An economic scenario like the COVID19 pandemic impacts different industries in very different ways - HiddenLevers attempts to answer these questions, while most traditional models do not.

2. 2020 COVID19 PANDEMIC SCENARIO

HIDDENLEVERS SUCCESSFULLY MODELED THE 2020 COVID19 CRASH AND SUBSEQUENT RECOVERY, PRODUCING MEANINGFUL RESULTS FOR ALL SIXTEEN SECURITIES STUDIED DURING ONE OF THE MOST RAPID CORRECTIONS IN MARKET HISTORY.

2.1 2020 COVID19 Pandemic Scenario Background

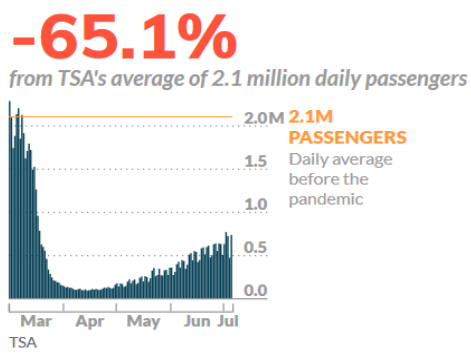


Figure 1: Trends in 2020 Airline Traffic

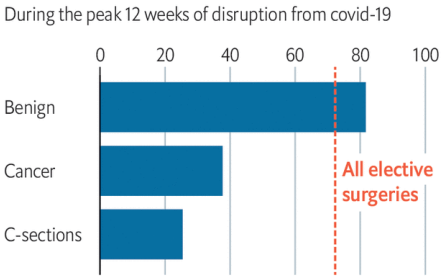


Figure 2: March-May 2020 Elective Surgery decline

The sharp decline in US markets beginning Feb 19th, 2020 posed numerous challenges for stress testing models. The market crashed due to the economic shock of a shutdown of the US economy to combat the COVID19 pandemic. This led to a 95% reduction in air travel peak-to-trough, a nearly 50% decline in gasoline consumption, and substantial impacts to in-person retail, hospitality, entertainment, and health care. Meanwhile many technology stocks were less impacted, as the new work-from-home paradigm increased their sales.

Traditional factor models, Monte Carlo and VaR models generally do not include any analysis of economic indicators like air travel, and many do not include oil prices or other macro factors at all. As a result, these models would likely understate the impact of the crisis on hard-hit sectors, lumping all equities together in terms of performance.

2.2 How the Model Copes with A Novel Crisis

Since HiddenLevers separates the impact of each variable in its model, it is more robust to unexpected environments in which usually minor variables might take a star turn, or in which factors might move in opposing directions. The HiddenLevers model has taken a novel approach to solve problems frequently found in multivariate regression models, resulting in a model that can better handle these issues.

Coefficient results (e.g. oil beta, air traffic beta, retail sales beta) from initial regressions are combined in an estimation model that uses the correlation between the independent variables to scale their relative impacts. This model approach is particular to HiddenLevers, and the approach has met with considerable success in real life conditions. By breaking apart the estimation of the variables, and recombining and scaling the results in the estimation process, HiddenLevers has created a model that is more robust to unexpected economic environments that are dissimilar to the historical data used for the regressions.

The model also utilizes an approach similar to principle-components analysis, wherein the most important factor impacting a particular security is modeled as the “principle” factor, with other factors treated as secondary. This enables the model to better handle scenarios like COVID19, where a 95% drop in air travel can become the principle factor for certain securities, enabling better forecasting of the resulting shock.

2.3 Stress Test Inputs and Results Summary

HiddenLevers stress testing functionality is capable of running historical timeframes, in which the model replays the economic conditions occurring over a specific set of dates:

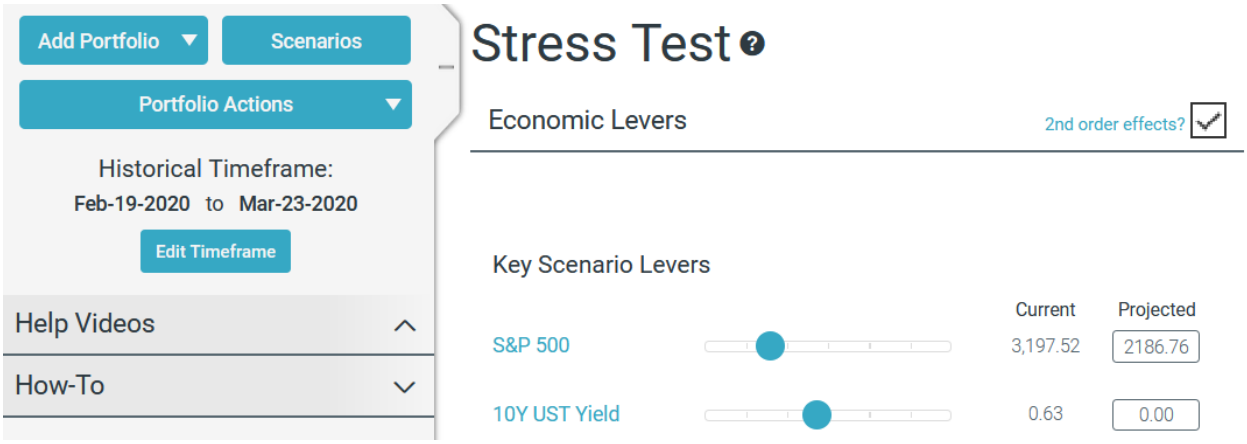


Figure 3: This HiddenLevers screenshot shows the 2020 COVID19 historical timeframe of February 19th, 2020 to March 23rd, 2020

As seen in the screenshot above, the 2020 COVID19 Pandemic scenario models the impact of economic changes that occurred from **February 19th, 2020 to March 23rd, 2020**.

The economic factor changes in the economy start from current levels, and replay the percentage change impacting economic lever. The model uses these factor changes to project how securities would react if the same conditions occurred again today. By comparing the model projections with actual historical performance, the model's accuracy can also be measured. **Since the model is forward looking, the projections end at a different point, but the percentage changes in factors are identical to that which occurred over the historical time period, enabling a comparison of model performance and actual performance.**

In total 16 different securities were modeled, including equity funds and ETFs, fixed income funds and ETFs, energy companies, hospitality and travel companies, and large-cap technology, financial, and industrial firms:

Security Type	Symbol	Name
Hospitality, Travel, and Energy Stocks	MAR	Marriott International Inc
	LUV	Southwest Airlines
	BA	Boeing Co
	XOM	Exxon Mobil Corporation
	OXY	Occidental Petroleum Corporation
	RDS-A	Royal Dutch Shell PLC ADR Class A
US Large Cap Stocks	IBM	IBM
	BAC	Bank of America
	GOOG	Alphabet Inc
	MSFT	Microsoft
Equity ETFs and Funds	FCNTX	Fidelity Contrafund Fund
	IWM	iShares Russell 2000
Fixed Income ETFs and Funds	AGG	PIMCO Total Return Fund I
	PTTRX	SPDR Barclays Capital High Yield Bond ETF
	JNK	SPDR Barclays Capital High Yield Bond ETF
	EMB	iShares TR JPMorgan USD Emerging Markets Bond ETF

Table 1: A table showing the 16 securities modeled in the 2020 COVID19 scenario

In 100% of these stress tests, the HiddenLevers model correctly projected the direction and magnitude of security performance, **and in all but one case, the model projected return fell within 5% of the actual historical performance.** The stress results for each subgroup of securities is discussed in detail below.

2.4 Results: US Hospitality, Travel, and Energy Stocks

The table below shows model projections in comparison with actual performance for six companies particularly impacted in the Q1 2020 crash – these companies all derive a majority of their revenue from lodging, air travel, liquid fuel sales, or supporting industries.

		Actual Performance (%)	HL Projected Performance (%)	Difference
XOM	Exxon Mobil	-47	-42	-5
OXY	Occidental Petroleum	-76.5	-71.6	-4.9
RDS-A	Royal Dutch Shell	-46.6	-51.3	4.7
LUV	Southwest Airlines	-40.7	-27	-13.7
MAR	Marriot International	-52.3	-52.6	0.3
GOOG	Alphabet Inc	-33.7	-34.2	0.5
MSFT	Microsoft	-33.79	-33	-0.79
BA	Boeing	-68.8	-64.4	-4.4

Table 2: A table displaying the 8 Hospitality, Travel, and Energy securities used in the 2020 COVID19 scenario

In 7 of the 8 comparisons above, the HiddenLevers model provided results within 5% of the actual historical performance, and the direction and magnitude of the model projections was accurate in 100% of these cases.

With respect to energy companies, the model handled the combined impact of falling equity markets and falling oil prices well, providing results within 5% of actual performance even for Occidental Petroleum, whose stock fell over 75% during the period.

Among travel related companies, the projection for Boeing also fell within 5% of actual performance – here the model combined the negative impacts of a falling S&P 500, a crash in air travel, and a drop in defense spending to accurately project Boeing's performance. With Southwest Airlines, the model projected substantial losses in both cases, but underestimated the crisis impact relative to actual performance. For Southwest, the model over-estimated the positive influence of falling oil prices on LUV, causing it to produce an overly bullish projection.

For Marriott the model was quite precise, with a model projection error of only 0.3% relative to an actual historical drop of 52.3% during the period. How did the HiddenLevers model manage to nail its projection of Marriott's performance using only the economic lever changes as inputs?

Figure 4: Marriot vs Consumer Confidence from 2010 to 2020

HiddenLevers identified a key factor strongly correlated with Marriott's performance: consumer confidence.

The model combined the negative impacts of a falling S&P 500, falling air travel, and falling US consumer confidence to produce a highly accurate projection for Marriott in this scenario. While models can never be completely accurate, this example shows how HiddenLevers' use of a broader range of economic factors can improve projection accuracy beyond traditional models.

2.5 Results: Other US Large-Cap Stocks

		Actual Performance (%)	HL Projected Performance (%)	Difference
IBM	IBM	-37.4	-35.5	-1.9
BAC	Bank of America	-46.91	-46.3	-0.61
GOOG	Alphabet Inc	-33.7	-34.2	0.5
MSFT	Microsoft	-33.79	-33	-0.79

Table 3: The 4 US Large-Cap securities used in the 2020 COVID19 scenario

HiddenLevers' stress testing model produced extremely accurate results for major US technology and financial stocks in a replay of the Feb-Mar 2020 downturn. 3 of 4 securities showed model projection errors of less than 100 basis points – very small errors given that the actual performance downside was between 33% and 47% for all of these companies.

2.6 Results: Equity ETFs and Mutual Funds

		Actual Performance (%)	HL Projected Performance (%)	Difference
IWM	iShares Russell 2000 Index	-40.37	-39.9	-0.47
FCNTX	Fidelity Contrafund Fund	-29.4	-33.2	3.8

Table 4: The two Equity ETFs used in the 2020 COVID19 scenario

Both IWM and FCNTX showed good model projection results in the stress test, with both showing a difference versus actual performance of less than 4%. As an equity index ETF, IWM would be expected to show accurate results, since its broad portfolio ensures that idiosyncratic single-stock behavior is less likely to influence overall results. FCNTX outperformed relative to the model's projection, likely due to large holdings like AMZN (its top holding) which benefitted as a result of the move to online shopping during the pandemic.

2.7 Results: Fixed Income ETFs and Mutual Funds

		Actual Performance (%)	HL Projected Performance (%)	Difference
AGG	iShares Core US Aggregate Bond ETF	-1.37	-2.7	1.33
PTTRX	PIMCO Total Return Fund Inst. Class	-2.6	-2.7	0.1
JNK	SPDR Barclays Capital High Yield BND ET	-22.7	-25.9	3.2
EMB	iShares TR / JPMorgan USD Emerging Markets	-21.27	-16.7	-4.57

Table 5: The four Fixed Income ETFs used in the 2020 COVID19 scenario

All four fixed income ETFs and funds showed good model projection accuracy, with all projections within 5% of actual performance, and in the case of PTTRX only drifting by 0.1%. The high-yield bond spread and VIX levers are essential in helping to model high yield bond funds, since they are exposed to credit risk to an extent not sufficiently captured via S&P 500 beta alone. Investment grade bond funds like AGG and PTTRX tend to fluctuate mainly with respect to interest rate risk – here the HiddenLevers model uses a duration + convexity-based model, which performed well in this instance.

2.8 Modeling the Recovery: March 23 – July 31 2020

Stress testing models must be capable of handling both downside and upside scenarios to prove useful to investors across investment environments. HiddenLevers modeled the performance of the same sixteen securities during the recovery from the COVID crash – by July 31st the S&P 500 had moved decisively into positive territory for the year.

The full results produced by the model for the COVID Pandemic recovery scenario can be seen in the table below. The model correctly projected direction in 100% of cases, and in 75% of these stress tests the HiddenLevers model projected return fell within 5% of the actual historical performance**.** HiddenLevers' model performance was particularly strong with fixed income funds and ETFs, with accurate projections for both investment grade and riskier bond funds, even as funds like EMB and JNK rose over 25% during the period studied.

	March 23 – July 31 2020		
	Actual Performance (%)	**HL Projected Performance (%)**	**Difference**
IBM	34	39	**-5**
BAC	38.6	38.7	**-0.1**
AGG	6.98	7.2	**-0.22**
IWM	50.6	55.6	**-5**
FCNTX	52.3	56.5	**-4.2**
PTTRX	8.2	6.6	**1.6**
JNK	28	27.9	**0.1**
EMB	25.6	24.6	**1**
XOM	31	56.2	-25.2
OXY	76	98.7	-22.7
RDS-A	51.5	70.2	-18.7
LUV	-8.42	-8.7	**0.28**
MAR	19.5	23	**-3.5**
GOOG	40.4	58.6	-18.2
MSFT	51.2	51.7	**-0.5**
BA	49.6	52.9	**-3.3**

Table 6: HiddenLevers model vs historical performance for COVID recovery scenario

The main source of error for the model in this recovery was in the projection of energy stocks' recovery. Oil prices rose roughly 70% over the period, but Exxon, Occidental, and Shell did not match those returns, in part because oil's dramatic return only brought it back to $40/barrel – still a challenging price for sustained profitability.

3. 2014 OIL DECLINE SCENARIO

Section 3 details HiddenLevers' performance in the 2014 oil price decline, using the same 16 securities reviewed in section 2. This analysis was originally published in early 2015, and has been updated with additional securities, while keeping the original results for the 11 securities analyzed at that time.

HIDDENLEVERS SUCCESSFULLY MODELED THE 2014 OIL PRICE DECLINE, PRODUCING MEANINGFUL RESULTS FOR 95% OF SECURITIES STUDIED DESPITE A BREAKDOWN IN MARKET CORRELATIONS.

3.1 Oil Price Decline Scenario Background

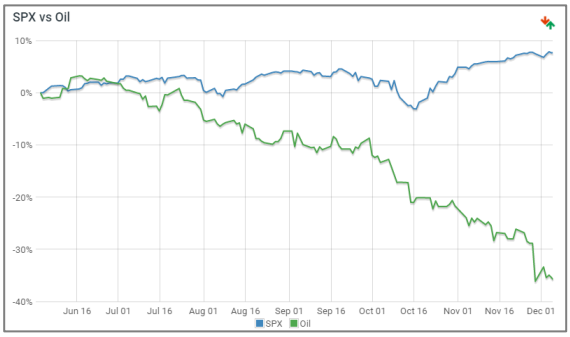


Figure 4: S&P 500 – Oil Relationship from June to December 2014

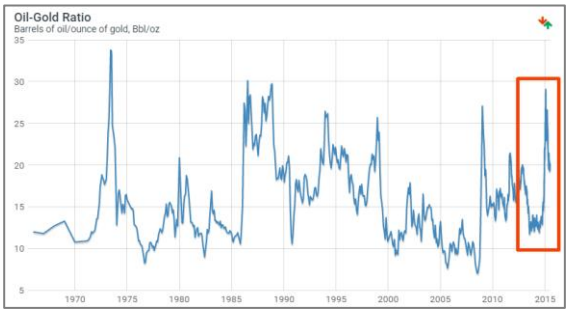


Figure 5: The Oil-Gold Ratio, with 2014 spike highlighted

The decline in oil prices beginning mid-June 2014 poses a number of challenges for stress testing models. The general correlation between the S&P and oil over the previous five years broke down rapidly, and relationships between other commodities broke down as well. Copper did not fall as fast as oil, while steel and uranium prices rose, and gold was volatile but almost flat over the period.

Traditional multiple regression models attempt to measure the impact of all variables simultaneously. This approach could provide inaccurate projections when the historical correlation between variables breaks down. It might even project a RISE in oil stocks in this scenario (due to the impact of the S&P and other variables), when in fact virtually all fell.

Meanwhile, Monte Carlo and VaR models usually don't include oil prices in their models at all. Because of this, they might project a happy ending for all equities, given the 8% rise in the S&P over the timeframe.

3.2 Model Results: June 1 2014 – Dec 1 2014 Oil Decline

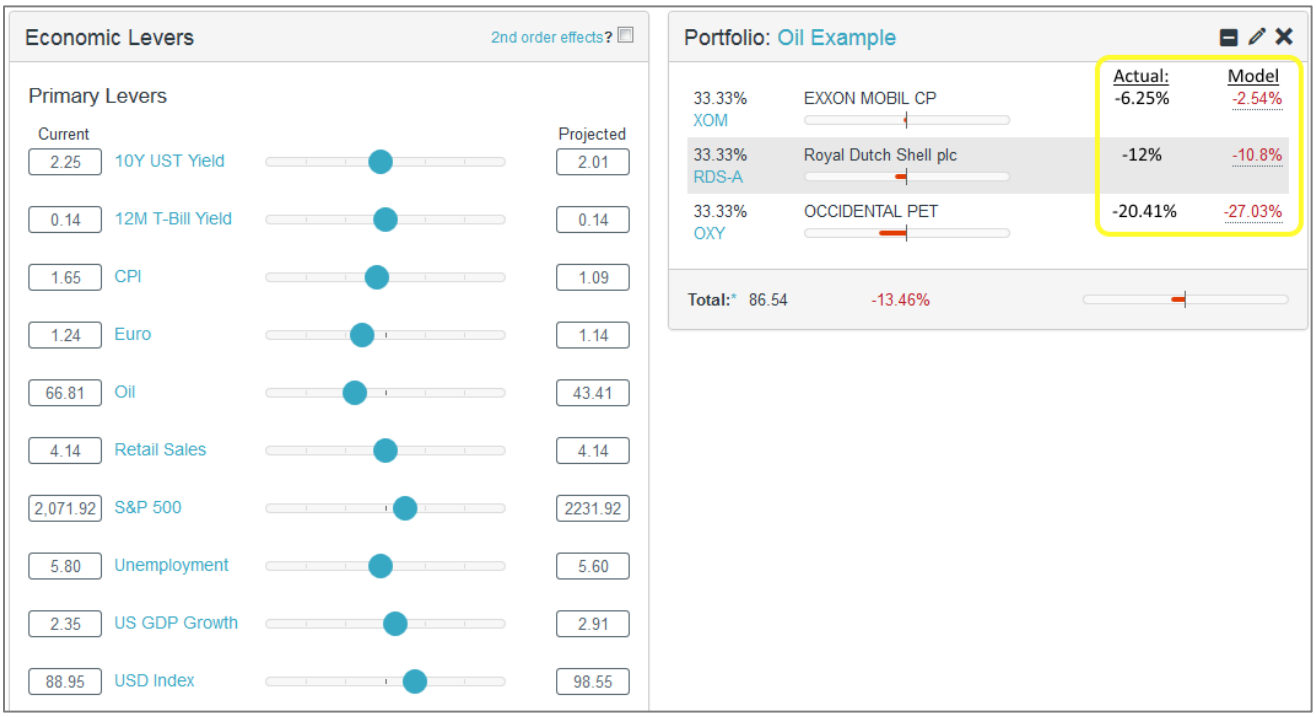
As described in Section 2.2, HiddenLevers separates the impact of each variable in its model, enabling more effective modeling in unexpected environments in which variables move in opposing directions.

The chief divergence in 2014 was a breakdown in the correlation between oil prices and equity prices – the S&P and oil had moved together over the previous five years, but starting in mid-2014 oil prices dropped by 50% while stock markets continued to rise. Since HiddenLevers breaks apart the process of estimating each variable's impact from projecting investment performance, it was able to handle this divergence.

In this scenario, the HiddenLevers model provided results with the correct direction and magnitude in 95% of cases studied, and provided projections within 5% of the actual historical performance in 75% of cases studied. Results for different subgroups of securities follow.

3.3 Results for Major Oil Producers

Here are examples of the performance of three different oil companies (XOM, RDS-A, OXY) during the recent environment, compared with actual performance June - Dec. 1st 2014.



In the HiddenLevers screenshot above, the economic levers at left have been set to represent the same percentage moves for each indicator as occurred in the actual economy over the six months ending 12/1/14. Since the model is forward looking, the projections end at a different point, but the percentage changes are identical to that which occurred over the historical time period, enabling a comparison of model performance and actual performance.

As shown above, the HiddenLevers model provides a very close estimate for the performance of Royal Dutch Shell, and produces an error of less than 4% for Exxon Mobil, and around 6.5% for Occidental Petroleum. The model is correct in order of magnitude and direction for all three oil companies.

3.4 Results for Large Caps, ETFs, and Mutual Funds

The screenshot below shows model projections for the 13 remaining securities used in all historical scenarios studied, with actual results provided for comparison:

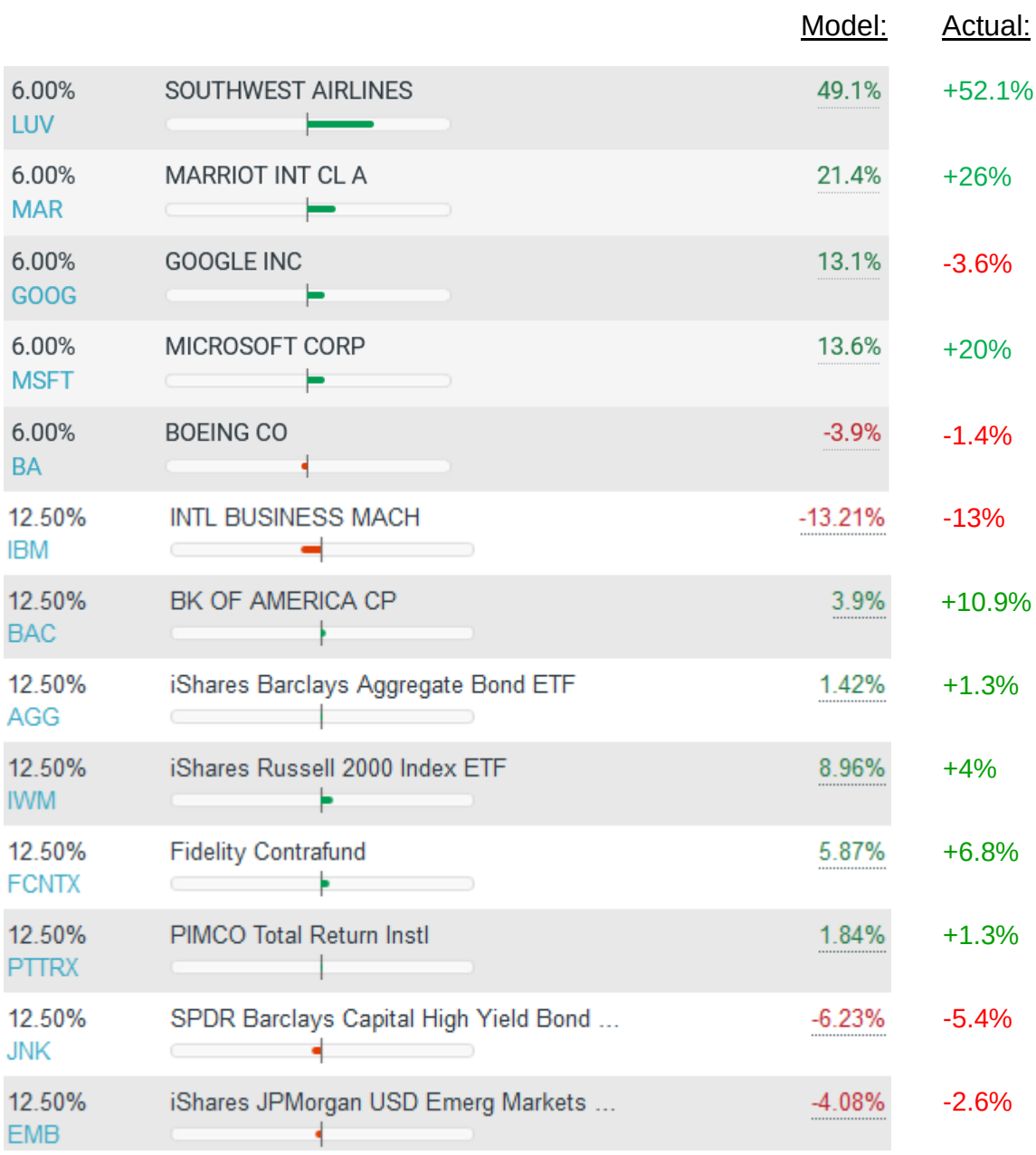


Figure 7: Screenshot showing Actual vs HL Projected Performance of 2014 Oil Price Decline Scenario

In 10 of 13 comparisons above, HiddenLevers provided results within 5% of the actual performance, and the direction and magnitude of the model projections was accurate in all but one of these cases. Google stands out as the only stock which dropped while the model projected a 13.6% increase. This appears to be an instance of idiosyncratic risk – GOOG performance may have been influenced by company specific factors unrelated to any macroeconomic factor.

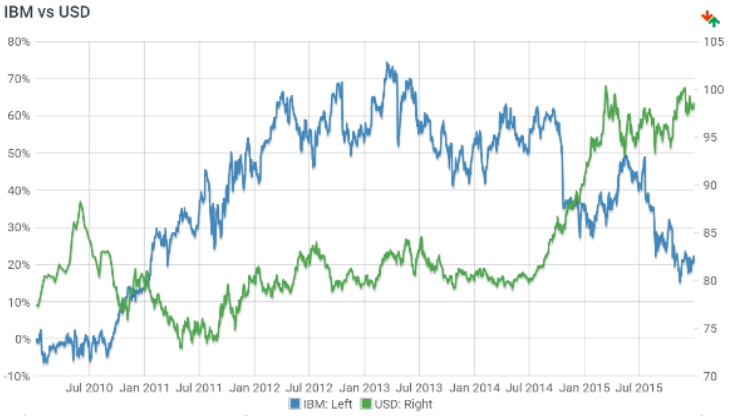


Figure 8: The inverse correlation between IBM and USD, 2010 - 2015

The model did a particularly good job with Southwest Airlines (LUV) and IBM. With LUV, the model was able to combine the positive impact of falling oil prices and a rising S&P 500 to project an upward move of roughly 50%, in line with the actual historical results.

How did HiddenLevers nail the projection on IBM? One economic headwind that IBM faced in 2014 was a strong rise in the value of the dollar (IBM does a significant percentage of business overseas).

While this was not the only factor in IBM's decline, the HiddenLevers model was able to use this inverse correlation to project weakness in IBM despite the rising S&P 500, and as a result provided an accurate model of IBM's actual results.

3.5 Results for High Yield and other Bond Funds

HiddenLevers uses US high yield bond spreads (to treasuries) as an economic lever to gauge risk in bond markets, improving the model's ability to account for rising credit risk. The oil price decline in 2014 resulted in a substantial spike in credit spreads, and since HiddenLevers measures the correlation between bond funds and spreads, it was able to project the negative impact to high yield bond funds like JNK and emerging market bond funds like EMB, while still correctly projecting positive returns for investment grade bond funds like AGG and PTTRX.

4. HISTORICAL SCENARIO RESULTS

HIDDENLEVERS MEASURED MODEL PROJECTIONS AGAINST REAL HISTORICAL RESULTS – THE MODEL ACCURATELY PROJECTED RESULTS IN 75% OF THE 67 CASES STUDIED.

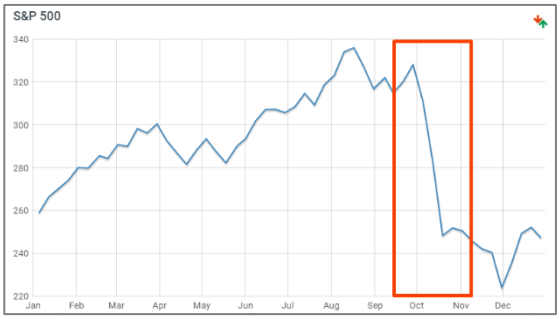
4.1 Historical Comparison Approach

HiddenLevers has backtested its model against historical scenarios in order to assess and improve model accuracy. HiddenLevers uses the real-life percentage change in the economic levers over a past time period in order to create a historical scenario. The historical scenario can then be executed against a portfolio of investments, with the actual performance of each investment over the historical time period compared against the model projection.

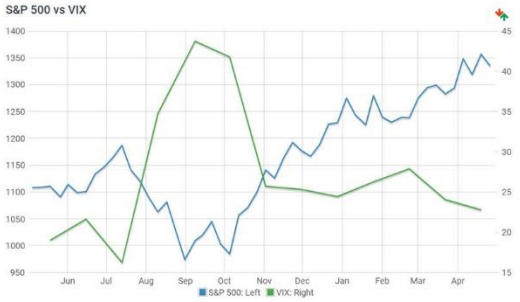
HiddenLevers historical scenarios essentially simulate what would happen if a historical event were to replay again today, with today's relationships between each security and lever. When comparing actual and model results, it is important to note that the business of certain companies may have changed significantly over time, and the compositions of funds may have changed as well. Nonetheless, this form of back-testing is valuable as it enables us to gauge the model's performance against real-life events.

4.1 Definitions of Historical Scenarios

Five historical scenarios were studied, using the timeframes specified below:



1987 Market Crash:
Covers September 28 – October 19, 1987, including the 20%+ one-day crash on October 19th, 1987.



1998 Russia Default:

Covers July 13 1998 – August 31 1998, a timeframe encompassing the Russian sovereign default and the losses which caused the LTCM hedge fund failure.

2008-2009 Financial Crisis:

Covers the core period of the financial crisis from just prior to Lehman Brothers' collapse to the market lows (September 1st 2008 – March 9th 2009).

2014 Oil Price Decline:

Covers the six months from June 1st to December 1st 2014, a period in which oil prices dropped nearly 50% while the S&P 500 rose 8%.

2020 COVID19 Pandemic:

The crash covers the roughly one-month period from February 19th – March 23rd, 2020, when the global pandemic caused the S&P 500 to drop 33% over just 23 trading days, with the VIX index also hitting record levels prior to Federal Reserve promises of unlimited intervention.

The recovery covers the subsequent period from March 23rd, 2020 – July 31st, 2020, a period in which the market rallied from the lows to be positive for 2020.

4.2 Model vs. Historical Results Comparison

The following tables and screenshots show the performance of 16 representative securities, comparing HiddenLevers model projections versus actual returns for the six different historical scenarios. Section 2 describes the comparative results for the 2020 COVID19 Pandemic Scenario in greater detail, and Section 3 includes an update to previously published analysis on the 2014 Oil Price decline scenario.

(Green highlighting indicates that model projection was within 5% of actual result)

	Feb 19 – Mar 23 2020			Mar 23 – July 31 2020		
	Actual Performance (%)	HL Projected Performance (%)	Difference	Actual Performance (%)	HL Projected Performance (%)	Difference
IBM	-37.4	-35.5	**-1.9**	34	39	**-5**
BAC	-46.91	-46.3	**-0.61**	38.6	38.7	**-0.1**
AGG	-1.37	-2.7	**1.33**	6.98	7.2	**-0.22**
IWM	-40.37	-39.9	**-0.47**	50.6	55.6	**-5**
FCNTX	-29.4	-33.2	**3.8**	52.3	56.5	**-4.2**
PTTRX	-2.6	-2.7	**0.1**	8.2	6.6	**1.6**
JNK	-22.7	-25.9	**3.2**	28	27.9	**0.1**
EMB	-21.27	-16.7	**-4.57**	25.6	24.6	**1**
XOM	-47	-42	**-5**	31	56.2	-25.2
OXY	-76.5	-71.6	**-4.9**	76	98.7	-22.7
RDS-A	-46.6	-51.3	**4.7**	51.5	70.2	-18.7
LUV	-40.7	-27	-13.7	-8.42	-8.7	**0.28**
MAR	-52.3	-52.6	**0.3**	19.5	23	**-3.5**
GOOG	-33.7	-34.2	**0.5**	40.4	58.6	-18.2
MSFT	-33.79	-33	**-0.79**	51.2	51.7	**-0.5**
BA	-68.8	-64.4	**-4.4**	49.6	52.9	**-3.3**

Table 7: HiddenLevers model vs historical performance for Feb-Mar 2020 and Mar-July 2020 scenarios

	Jul 13 – Aug 31 1998			Sept 1 2008 – Mar 9 2009		
	Actual Performance (%)	HL Projected Performance (%)	Difference	Actual Performance (%)	HL Projected Performance (%)	Difference
IBM	-9.5	-6.3	-3.2	-31	-51.7	20.7
BAC	-33.2	-25.3	-7.9	-88	-83	-5
AGG	N/A	0.2		1.6	-1.4	3
IWM	N/A	-22.6		-53	-58	5
FCNTX	-18	-21	3	-38.8	-42.6	3.8
PTTRX	0.9	0.9	0	2.4	0	2.4
JNK	N/A			-33.7	-28.7	-5
EMB	N/A			-18.6	-20.7	2.1
XOM	-7.2	-18.3	11.1	-19	-61	42
OXY	-27.4	-31	**3.6**	-33.5	-87.3	53.8
RDS-A	N/A	-25.7		-35	-75.8	40.8
LUV	-12.7	-14.9	**2.2**	-66.7	-20.9	-45.8
MAR	-14	-24.6	10.6	-57.4	-71.3	13.9
GOOG	N/A	-22.1		-33.7	-45	11.3
MSFT	-18.4	-21.3	**2.9**	-42.8	-43.4	0.6
BA	-34.7	-37.8	**3.1**	-53.5	-49.1	-4.4

Table 8: HiddenLevers model vs historical performance for July-Aug 1998 and September 2008 – March 2009 scenarios

	Jun 1 – Dec 1 2014			Oct 2 – Oct 19 1987		
	Actual Performance (%)	HL Projected Performance (%)	Difference	Actual Performance (%)	HL Projected Performance (%)	Difference
IBM	-13	-13.2	0.2	-22.2	-25	2.8
BAC	10.9	3.9	7	-26.7	-35.7	9.03
AGG	1.3	1.4	-0.1	N/A	-1.2	
IWM	4	8.9	-4.9	N/A	-30.7	
FCNTX	6.8	5.9	0.9	-28.6	-27.4	-1.2
PTTRX	1.3	1.8	-0.5	-3.3	-0.9	-2.4
JNK	-5.4	-6.2	0.8	N/A	-18.4	
EMB	-2.6	4.1	1.5	N/A	-11.1	
XOM	-6.25	-2.54	-3.71	-33	-28	-5
OXY	-12	-10.8	-1.2	-32.5	-47.5	15
RDS-A	-20.41	-27	6.59	N/A	-36.8	
LUV	52.1	49.1	3	-31.1	-27.9	-3.2
MAR	26	21.4	4.6	N/A	-35.6	
GOOG	-3.6	13.1	-16.7	N/A	-22.2	
MSFT	20	13.6	6.4	-38	-21.3	-16.7
BA	-1.4	-3.9	2.5	-25.4	-28.5	3.1

Table 9: HiddenLevers model vs historical performance for June – Dec 2014 and Oct 1987 scenarios

The results in tables 6-8 include a range of large cap US equities (IBM, BAC, XOM, OXY, LUV, MAR, GOOG, MSFT, BA), one foreign large cap (RDS-A), investment grade bond funds and ETFs (AGG,PTTRX), two high yield ETFs (JNK, EMB), equities funds and ETFs (FCNTX, IWM). The diversity of securities and scenarios selected helps validate whether HiddenLevers' model can cope with a wide range of securities and macro-economic environments. Out of 96 possible comparisons (16 securities x 6 scenarios), 13 are excluded as the ETFs or stocks in question did not yet exist. 83 available comparisons are used in the analysis of the HiddenLevers model and its overall accuracy.

In 62 of 83 (75%) of comparable cases, the HiddenLevers model produced projections within five percentage points of the actual result. Most of the large-scale misses in projections occur with the financial crisis scenario, and in particular with modeling energy stocks during that crisis. Despite a 58% drop in oil prices from September 1 2008 to March 9 2009, Exxon Mobil (XOM) stock fell only 19%. RDS-A and OXY similarly outperformed oil prices substantially during the time-period. This did not occur in 2020, when oil company stocks crashed along with oil prices – and the HiddenLevers model was much more accurate with respect to these companies in the 2020 scenario as a result. Despite these challenges, even in these cases the HiddenLevers model did provide warning of significant downside risk exposure.

In 82 of 83 (99%) of comparable cases, HiddenLevers' model produced results where the directional projection of security performance matched the security's actual directional performance (the sole outlier case was GOOG in 2014, when it idiosyncratically lost 3.6% during a timeframe in which the S&P rose 8%). In 78 of 83 (94%) of comparable cases, HiddenLevers projected the magnitude of gain or loss within 20% of the actual result. All of the larger error cases here were with respect to large double-digit percentage moves in the securities, so that a 15-20% difference reflects less than half the security's actual percentage change.

5. CONCLUSION

HiddenLevers periodically assesses the accuracy of its model against historical scenarios, and has published herein results affirming the accuracy of the model across a wide range of scenarios, including the 2008 financial crisis and recent 2020 pandemic-related market crash and recovery. HiddenLevers' model projections fell within 5% of realized returns in 75% of directly comparable cases studied.

When assessing different stress testing methodologies, it's important to ask, "But what happens to this model when its assumptions break down?" Precisely this sort of test arose in late 2014, as oil prices diverged from equities prices, and again in 2020, when air travel crashed far more rapidly than at any other point in history. The HiddenLevers model proved capable of making accurate projections for these kind of scenarios, and accurately projected returns for a wide range of potential investments, including equity and fixed income funds, and a variety of large cap equities spread across sectors.

Users of HiddenLevers' model benefit from periodic model reviews published by HiddenLevers, as this places documentation of the model's accuracy in the public record. In preparing the 2020 model review, HiddenLevers utilized the same securities previously used in the 2015 model review, while adding new securities and stress testing the full set against all scenarios. Taking this approach ensures that HiddenLevers cannot select securities or scenarios that will produce overly optimistic results – the majority of securities reviewed for 2020 were selected in 2015. HiddenLevers continues to improve its model, adding new levers and refining projection capabilities as a result of user feedback and our internal model review process. Please reach out with questions, comments, and feedback to help us push the model forward!

THANK YOU.

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A. Addendum: Historical Stress Test Details

Figures 9-13 are screenshots of the HiddenLevers Live Stress Testing page, where portfolios can be stress tested against both historical and forward-looking scenarios. In order to perform the model review tests discussed in this white paper, historical stress tests were executed using the dates listed for each case.

When a user selects historical dates in Live Stress Testing, the model automatically calculates the percentage change of each economic lever over the historical timeframe, and applies this change to the lever in order to replay the impact of the historical event. When the timeframe is shorter than the frequency of the data (for instance, some of the scenario timeframes were less than one month, while levers like GDP move on a quarterly frequency), the levers' movements were manually calculated and prorated for the time period elapsed. Those levers were then individually adjusted to accurately account for how the economy changed over the historical period in question.

All lever projections can be seen on each screenshot, so that readers can easily see the full set of inputs used as part of this model review exercise.

Figure 9: Model Results for Timeframe February 19, 2020 – March 23, 2020

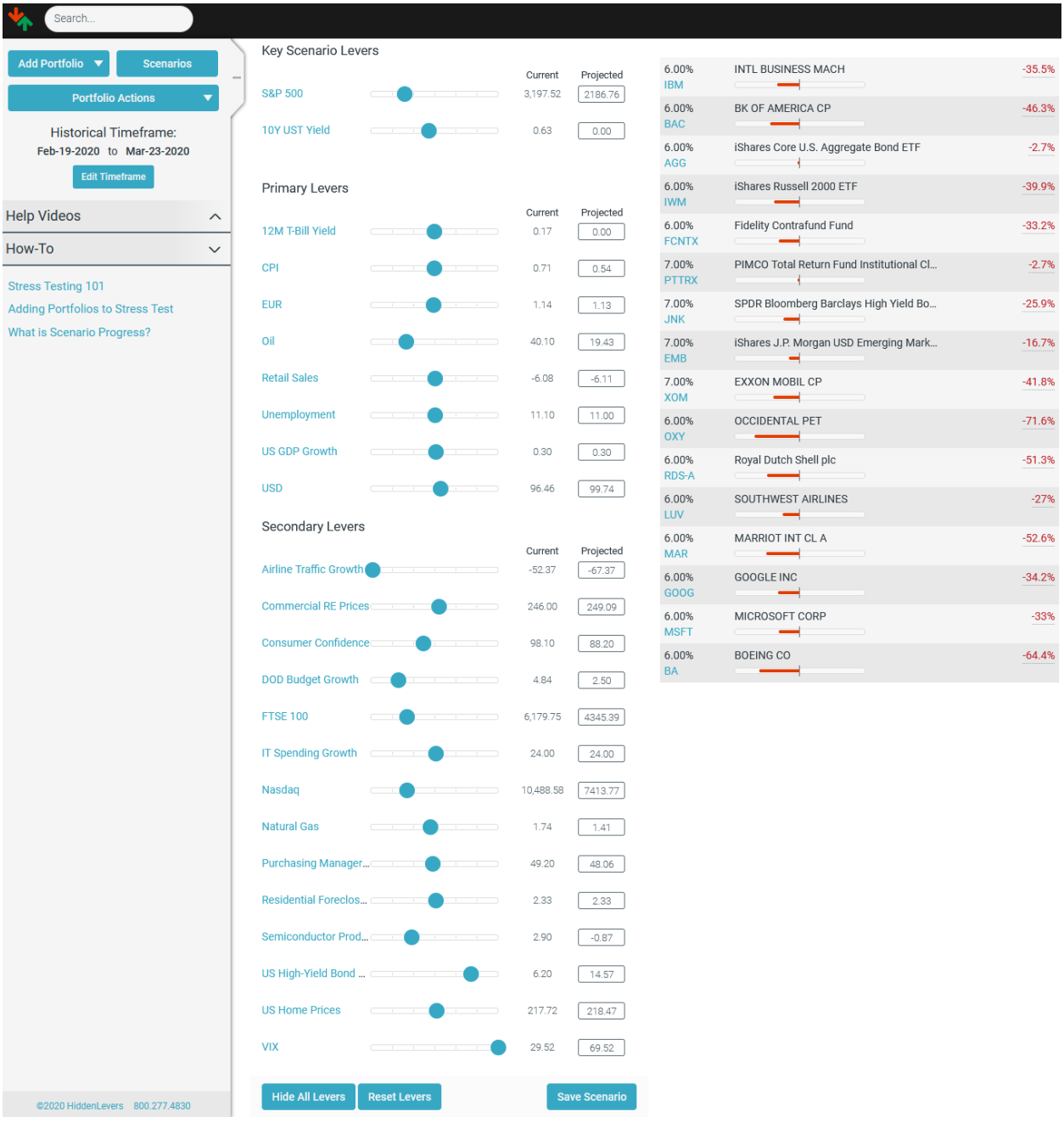

Figure 10: Model Results for Timeframe March 23, 2020 – July 31, 2020

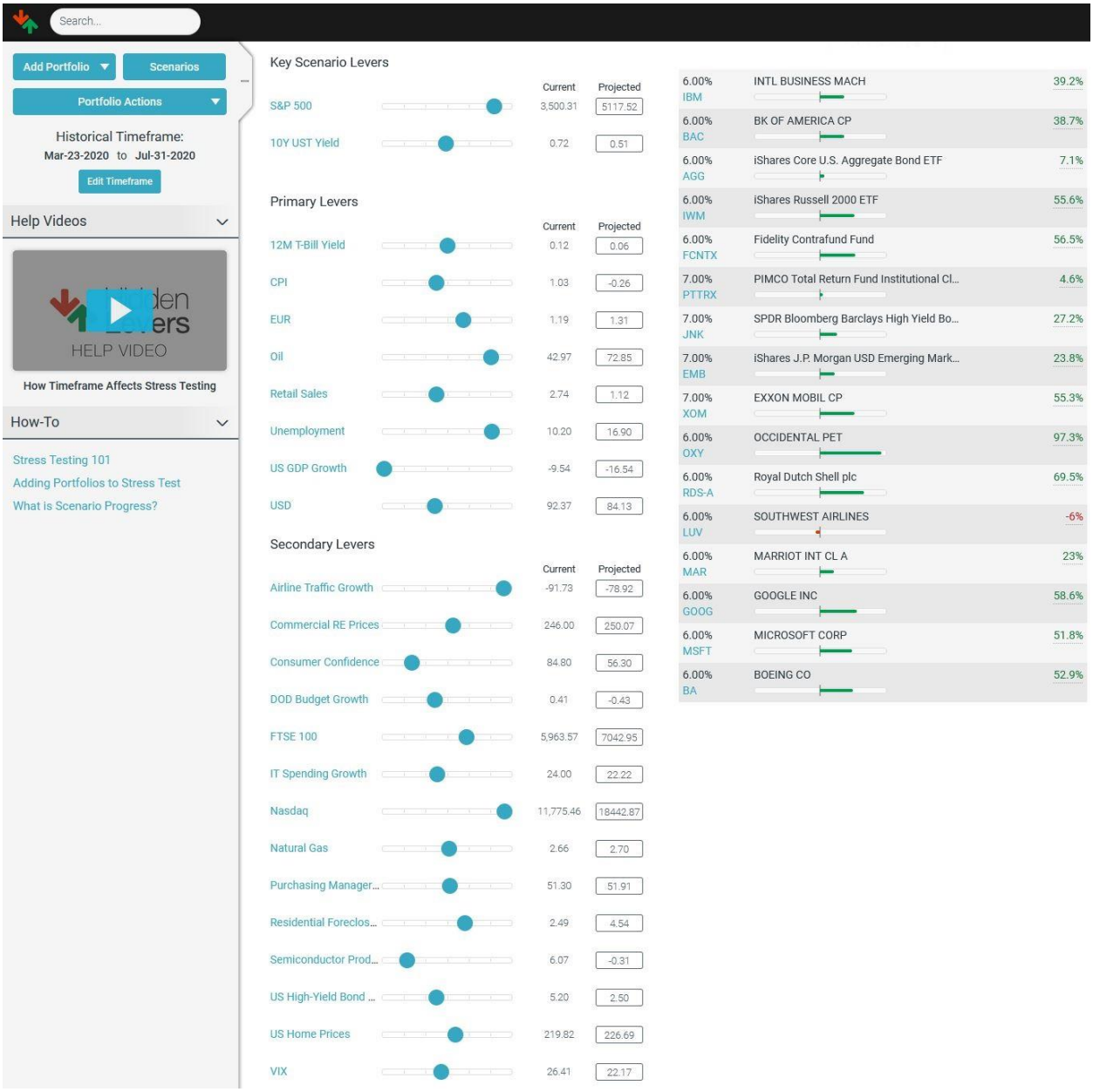

Figure 11: Model Results for Timeframe September 28, 1987 – October 19, 1987

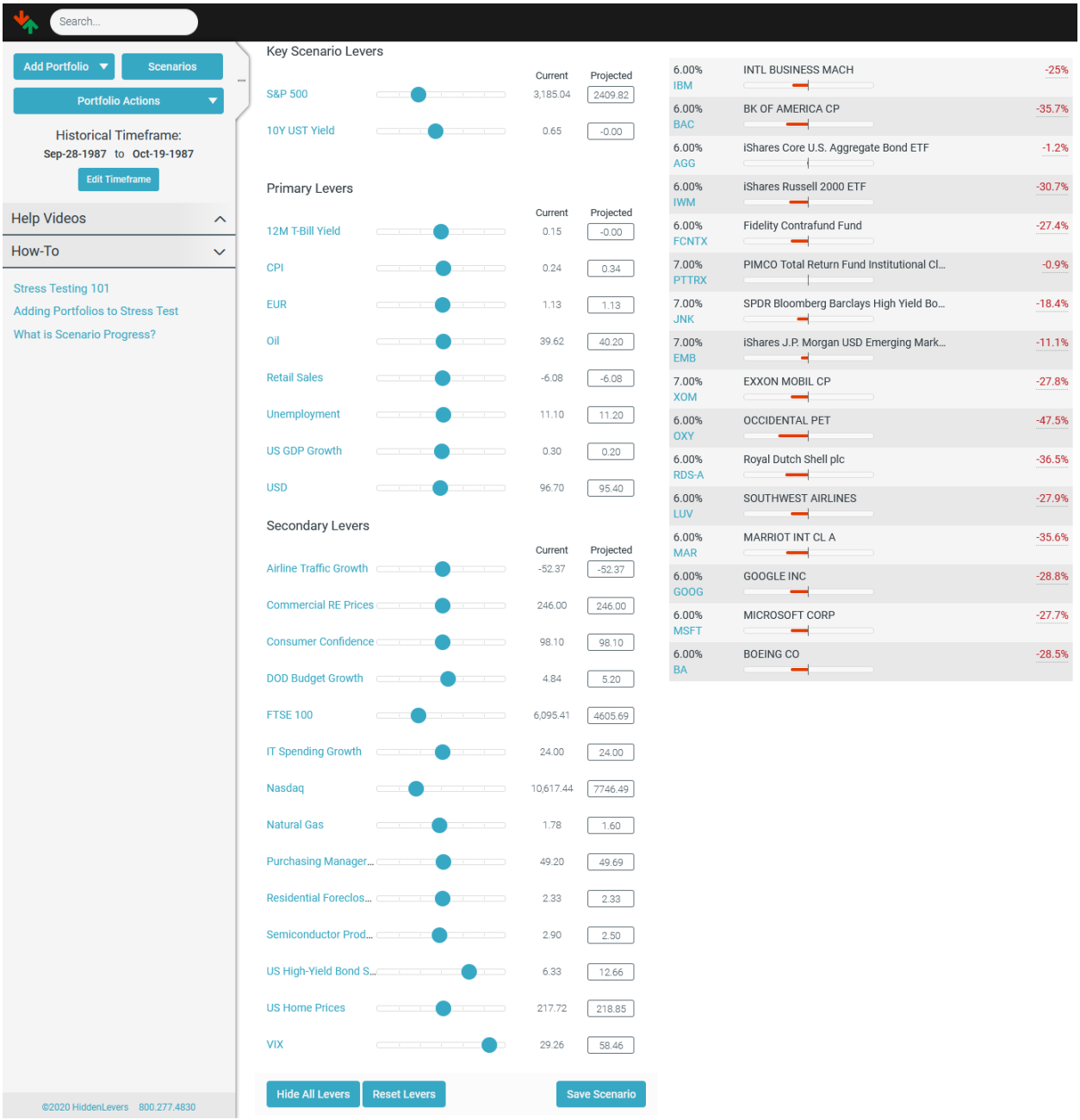

Figure 12: Model Results for Timeframe July 13, 1998 – August 31, 1998

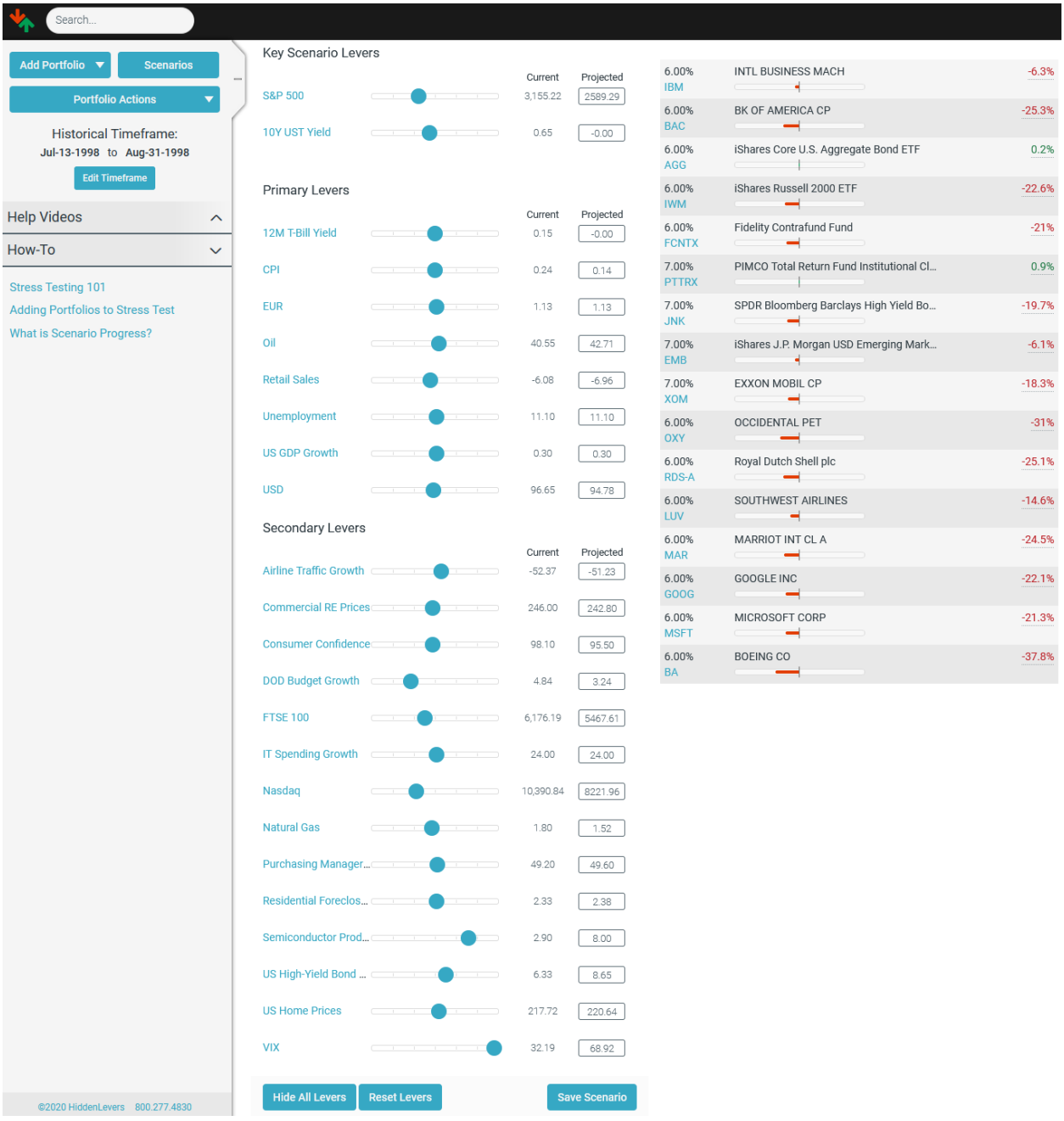

Figure 13: Model Results for Timeframe September 1 2008 – March 9, 2009