Commodities as an inflation hedge - Yes or no

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"Inflation Hedging Tools - What Works and What Doesn't"

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Author: Rob Brown, PhD, CFA

- 60/40 stock/bond portfolio over the 108.2 years (ending 11/30/2022)

- Returned an inflation-adjusted return of 8.6% during the 75% of the months during which inflationary surprise was at its lowest

- But . . . it lost -5.0% per annum during the 25% of the months when inflationary surprise was at its highest

Commodities, gold, oil . . . .

Are they useful hedges against inflation

If so . . . . when, to what degree, and in what dosage

- Based on returns spanning 1914 - today
- Important
  - Live
  - Spans all major asset classes
  - Covers numerous macroeconomic, capital market, and inflation/deflation regimes
- Show
  - Gold and TIPS . . . . Just don't work . . . . Which is as expected
  - What did work
    - Oil
    - Silver
    - Ultra-diversified commodities
  - BUT . . . . Success depends critically on
    - Hedging against the right level of "inflationary surprise" . . . . Not too much, not too little
    - Using the correct dosage of your chosen mitigant . . . . Got to use large enough dose
    - Even if you're "late to the party" . . . . You can still add value

Inflation . . . . what should you hedge against?

- Hedging against a high or a low level of inflation is pointless

- Investment markets are fantastic discounters of current day reality

- So . . . . there's little point in hedging against "what already is"

- What's to be done?

- Hedge against "inflationary surprise"

- That is interesting

- That is extremely beneficial

- If you use the right tool, definition of "inflationary surprise", apply the proper dosage

Is the "level" of inflation important . . . NOPE *!!!*

- Investment markets are far more affected by inflationary surprise than they are by high absolute levels of inflation

- Moreover, the affects are significantly more consistent across time for "surprise" versus absolute levels

- This leaves us with the necessity of identifying a crisp/clear definition of "inflationary surprise"

- This article defines inflationary surprise as the percentage the current CPI index lies above/below its average level over the last eleven months

Inflationary surprise, when and how severe

The 25% of the months with the highest level of inflationary surprise are shown, the remaining 75% are ignored

Level of inflationary surprise (percentage current price level is above its most recent 11-month average level)

Asset Categories Examined for Mitigation of Inflationary Surprise

Diversified

Reuters CRB Total Return Index (with GFD extension)

Thompson Jefferies CRB Core Commodity Total Return Index (with GFD extension)

Thomson Reuters Core Commodity CRB Index (with GFD extension)

Energy

West Texas Intermediate Oil Price (US$/Barrel) (with GFD Extension)

Base Metals

Aluminum Spot Price (USD/Ton) (with GFD Extension)

Zinc Special High Grade ($/Ton) (with GFD Extension)

High Grade Copper (US Cents/Pound) (with GFD Extension)

Diversified Base Metals (mimics the Invesco DB Base Metals ETF)

Agricultural

World Bank Agriculture Commodity Price Index

Precious Metals

Silver Cash Price (US$/Ounce) (with GFD Extension)

Gold Bullion Price-New York (US$/Ounce) (with GFD Extension)

Palladium (USD per Troy Ounce) (with GFD Extension)

Platinum Cash Price (US$/Ounce) (with GFD Extension)

Diversified Precious Metals (mimics the Aberdeen Physical Precious Metals Basket Shares ETF)

Bonds

GFD Indices USA Total Return T-Bill Index

USA 5-year Government Note Total Return Index

GFD Indices USA 10-year Government Bond Total Return Index

BofA Merrill Lynch US Inflation-Linked Treasury Total Return Index

GFD Indices USA Total Return AAA Corporate Bond Index

U.S. Bond Composite

GFD Indices All-World x/USA Countries Government Bond GDP-weighted Return Index

Global Bond Composite

Stocks

U.S. Stock Composite

International Stock Composite

Global Stock Composite

Blends

50% Silver and 50% Reuters CRB Total Return Index (with GFD extension)

50% Silver and 50% West Texas Intermediate Oil Price (US$/Barrel) (with GFD Extension)

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 Zinc Special High Grade ($/Ton) (with GFD Extension)

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 Diversified Base Metals (mimics the Invesco DB Base Metals ETF)

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 Silver Cash Price (US$/Ounce) (with GFD Extension)

 Gold Bullion Price-New York (US$/Ounce) (with GFD Extension)

 Palladium (USD per Troy Ounce) (with GFD Extension)

 Platinum Cash Price (US$/Ounce) (with GFD Extension)

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U.S. Bond Composite

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Global Bond Composite

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International Stock Composite

Global Stock Composite

Blends

50% Silver and 50% Reuters CRB Total Return Index (with GFD extension)

50% Silver and 50% West Texas Intermediate Oil Price (US$/Barrel) (with GFD Extension)

TIPS (Treasury Inflation-Protected Securities) Estimation Prior to 1997

Stepwise Regression Statistics

R Square	0.55
Adjusted R Square	0.54
F Statistic	73.0

Factor Loadings	Long/Short	t Statistic	P-value
10-year U.S. Treasury Bond	long	8.2	0.0000
Global Bond Composite (not currency hedged)	long	5.0	0.0000
Spot Platinum	long	3.9	0.0001
Consumer Price Index (all Urban Consumers, NSA)	long	3.1	0.0020
World Bank Agricultural Price Index	long	2.7	0.0077

The 60/40 portfolio

- 60/40 stock/bond portfolio over the 108.2 years (ending 11/30/2022)

- Returned an inflation-adjusted return of 8.6% during the 75% of the months during which inflationary surprise was at its lowest

- But . . . it lost -5.0% per annum during the 25% of the months when inflationary surprise was at its highest

- The article defines the portfolio's investment objective in a far more real world and realistic fashion

- "Success" is defined as earning at least 2.95% over and above the rate of inflation for a 10-year investment period

- The portfolio's explicit investment objective is to maximize the probability of realizing "success" (as defined above).

Where did "2.95%" come from?

- What is the basis or origin of the "2.95%" number?

- The 60/40 portfolio described above earned at least 2.95% over 10-year investment periods 75.0% of the time

- Essentially the use of a mitigant during times of extreme inflationary surprise is to raise the likelihood of success as far above 75.0% as possible

Should we focus on just those periods of "inflationary surprise"?

- Could this article restrict its analysis to just those isolated months when inflationary surprise exceeded some predetermined level?

- NOPE

- Adopting such an approach runs the risk (and even high likelihood) that the results would be misleading if the benefits of mitigation were all concentrated within a single standalone time period, as opposed to being uniformly distributed across all possible periods

Gold as a Mitigant Against Inflationary Surprise

Probability of success	Size of gold allocation (%)	Allocation to gold is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
77.6	20	85	1.78	6.05	3.40	3.27	2.64
77.6	20	90	1.73	6.00	3.47	3.32	2.47
76.9	20	95	1.69	6.00	3.56	3.23	2.36
76.8	20	80	1.75	6.07	3.48	3.17	2.59
76.0	10	90	1.69	5.96	3.53	3.13	2.34
75.9	20	75	1.77	6.04	3.42	3.13	2.56
75.0	0	na	1.65	5.96	3.61	2.95	1.73

TIPS Bonds as a Mitigant Against Inflationary Surprise

Probability of success	Size of TIPS allocation (%)	Allocation to TIPS is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
76.3	20	80	1.75	6.07	3.48	3.16	2.08
76.2	20	75	1.73	5.97	3.45	3.18	2.15
76.0	20	85	1.74	6.02	3.46	3.08	2.00
75.8	20	90	1.71	5.96	3.48	3.09	1.98
75.7	20	95	1.69	5.96	3.52	3.03	1.90
75.6	10	80	1.69	5.99	3.54	3.03	1.90
75.0	0	na	1.65	5.96	3.61	2.95	1.73

Diversified Commodities as a Mitigant Against Inflationary Surprise

Probability of success	Size of diversified commodities allocation (%)	Allocation to diversified commodities is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
78.6	20	75	1.87	5.91	3.16	3.42	2.75
78.6	20	80	1.84	6.00	3.26	3.44	2.64
77.8	20	85	1.82	6.02	3.31	3.30	2.52
77.8	20	90	1.75	5.98	3.41	3.35	2.45
77.4	25	96	1.76	5.96	3.38	3.25	2.55
77.3	20	95	1.77	5.96	3.37	3.29	2.47
75.0	0	na	1.65	5.96	3.61	2.95	1.73

Diversified commodities is defined to be the "Reuters CRB Total Return Index (with GFD extension)"

Mitigant	Probability of success	Size of mitigant allocation (%)	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
50% Silver and 50% Reuters CRB Total Return (not "core")	78.3	20	1.75	5.96	3.40	3.27	2.56
Silver	77.7	20	1.74	6.03	3.46	3.31	2.59
Diversified commodities (Reuters CRB)	77.3	20	1.77	5.96	3.37	3.29	2.47
Diversified commodities (Thompson Jefferies CRB Core)	77.3	20	1.77	5.96	3.37	3.29	2.47
Diversified commodities (Thomson Reuters)	77.1	20	1.75	5.96	3.40	3.28	2.38
50% silver and 50% oil	76.9	20	1.73	6.03	3.48	3.26	2.48
Diversified precious metals (GLTR)	76.9	20	1.71	6.00	3.51	3.25	2.43
Gold	76.9	20	1.69	6.00	3.56	3.23	2.36
West Texas Intermediate Oil Price	76.3	20	1.71	6.03	3.52	3.16	2.36
Copper	76.3	20	1.68	5.96	3.54	3.15	2.02
World Bank Agriculture Commodity Price Index	75.9	20	1.71	5.96	3.48	3.07	2.05
Zinc	75.7	20	1.69	5.96	3.51	3.07	1.92
TIPS bonds	75.7	20	1.69	5.96	3.52	3.03	1.90
Palladium	75.5	20	1.68	5.96	3.55	3.06	2.13
Diversified base metals (DBB)	75.2	20	1.67	5.96	3.56	3.00	1.90
International stock composite	75.2	20	1.64	5.91	3.61	2.99	1.79
Platinum	75.1	20	1.67	5.93	3.54	2.99	1.98
Global bond composite	75.1	20	1.66	5.96	3.59	2.95	1.74
International government bond composite	75.1	20	1.65	5.93	3.60	2.96	1.76
90-day US Treasury	75.0	20	1.66	5.96	3.59	2.95	1.73
US bond composite	75.0	10	1.65	5.96	3.60	2.95	1.70
5-year US Treasury	75.0	10	1.65	5.96	3.60	2.95	1.74
none	75.0	0	1.65	5.96	3.61	2.95	1.73
Global stock composite	75.0	10	1.64	5.96	3.62	2.95	1.73
Long-term AAA-rated corporate bonds	74.9	10	1.65	5.96	3.61	2.94	1.69
10-year US Treasury	74.9	10	1.65	5.96	3.61	2.94	1.70
Aluminum	74.9	10	1.64	5.96	3.62	2.93	1.79
US stock composite	74.9	10	1.64	5.96	3.63	2.93	1.69

Mitigant	Probability of success	Size of mitigant allocation (%)	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
50% Silver and 50% Reuters CRB Total Return (not "core")	78.3	20	1.75	5.96	3.40	3.27	2.56
Silver	77.7	20	1.74	6.03	3.46	3.31	2.59
Diversified commodities (Reuters CRB)	77.3	20	1.77	5.96	3.37	3.29	2.47
Diversified commodities (Thompson Jefferies CRB Core)	77.3	20	1.77	5.96	3.37	3.29	2.47
Diversified commodities (Thomson Reuters)	77.1	20	1.75	5.96	3.40	3.28	2.38
50% silver and 50% oil	76.9	20	1.73	6.03	3.48	3.26	2.48

- The use of gold and TIPS bonds prove to be relatively unattractive mitigants, ranking 8th and 13th from among the 27 possible candidates

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50% Silver and 50% Reuters CRB Total Return (not "core")	78.0	20	1.77	5.98	3.38	3.31	2.59
Palladium	77.8	20	1.76	5.96	3.38	3.30	2.55
Diversified commodities (Thompson Jefferies CRB Core)	77.8	20	1.75	5.98	3.41	3.35	2.45
Diversified commodities (Reuters CRB)	77.8	20	1.75	5.98	3.41	3.35	2.45
50% silver and 50% oil	77.7	20	1.77	6.03	3.41	3.26	2.65
Gold	77.6	20	1.73	6.00	3.47	3.32	2.47
Diversified precious metals (GLTR)	77.5	20	1.75	6.00	3.42	3.28	2.61
West Texas Intermediate Oil Price	77.1	20	1.74	6.01	3.45	3.18	2.54
Diversified commodities (Thomson Reuters)	77.1	20	1.71	5.96	3.47	3.21	2.36
Zinc	76.8	20	1.73	5.96	3.45	3.18	2.28
Platinum	76.7	20	1.74	5.96	3.42	3.14	2.38
World Bank Agriculture Commodity Price Index	76.5	20	1.72	5.96	3.46	3.17	2.14
Diversified base metals (DBB)	76.1	20	1.69	5.96	3.51	3.09	2.04
TIPS bonds	75.8	20	1.71	5.96	3.48	3.09	1.98
Copper	75.8	20	1.66	5.91	3.55	3.07	2.08
International stock composite	75.6	20	1.66	5.91	3.57	3.04	2.04
Aluminum	75.3	20	1.67	5.96	3.57	2.97	2.19
90-day US Treasury	75.1	20	1.66	5.95	3.58	2.99	1.90
Global bond composite	75.1	20	1.66	5.93	3.58	2.97	1.79
Global stock composite	75.1	10	1.64	5.96	3.63	2.96	1.75
International government bond composite	75.0	20	1.65	5.91	3.57	2.95	1.84
5-year US Treasury	75.0	10	1.65	5.96	3.61	2.94	1.71
none	75.0	0	1.65	5.96	3.61	2.95	1.73
US bond composite	74.9	10	1.65	5.93	3.60	2.92	1.68
Long-term AAA-rated corporate bonds	74.9	10	1.64	5.93	3.61	2.92	1.65
10-year US Treasury	74.9	10	1.64	5.93	3.62	2.90	1.66
US stock composite	74.8	10	1.63	5.96	3.66	2.93	1.60

Mitigant	Probability of success	Size of mitigant allocation (%)	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
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50% Silver and 50% Reuters CRB Total Return (not "core")	78.0	20	1.77	5.98	3.38	3.31	2.59
Palladium	77.8	20	1.76	5.96	3.38	3.30	2.55
Diversified commodities (Thompson Jefferies CRB Core)	77.8	20	1.75	5.98	3.41	3.35	2.45
Diversified commodities (Reuters CRB)	77.8	20	1.75	5.98	3.41	3.35	2.45
50% silver and 50% oil	77.7	20	1.77	6.03	3.41	3.26	2.65

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50% silver and 50% oil	86.0	30	2.01	6.23	3.10	3.94	3.54
West Texas Intermediate Oil Price	85.8	25	1.96	6.18	3.16	4.06	3.62
Silver	80.6	25	1.94	6.16	3.18	3.41	3.00
50% Silver and 50% Reuters CRB Total Return (not "core")	78.7	20	1.85	6.04	3.26	3.35	2.70
Zinc	78.2	20	1.81	5.96	3.29	3.31	2.63
Platinum	78.0	20	1.77	5.93	3.35	3.27	2.63
Diversified precious metals (GLTR)	77.9	20	1.81	6.04	3.34	3.25	2.65
Diversified commodities (Thompson Jefferies CRB Core)	77.8	20	1.82	6.02	3.31	3.30	2.52
Diversified commodities (Reuters CRB)	77.8	20	1.82	6.02	3.31	3.30	2.52
Gold	77.6	20	1.78	6.05	3.40	3.27	2.64
World Bank Agriculture Commodity Price Index	76.8	20	1.73	5.98	3.46	3.17	2.01
Diversified base metals (DBB)	76.5	20	1.76	5.99	3.41	3.15	2.36
Diversified commodities (Thomson Reuters)	76.3	20	1.76	6.00	3.42	3.15	2.26
TIPS bonds	76.0	20	1.74	6.02	3.46	3.08	2.00
Copper	75.8	20	1.74	5.97	3.42	3.11	2.26
Palladium	75.6	10	1.66	5.93	3.58	3.00	1.90
US stock composite	75.3	20	1.65	5.96	3.60	3.03	1.77
Global stock composite	75.3	20	1.64	5.91	3.61	2.99	1.84
International stock composite	75.1	20	1.62	5.85	3.62	2.96	1.90
Aluminum	75.0	20	1.71	6.05	3.54	2.94	2.31
90-day US Treasury	75.0	10	1.66	5.97	3.60	2.94	1.80
none	75.0	0	1.65	5.96	3.61	2.95	1.73
US bond composite	74.9	10	1.65	5.96	3.61	2.93	1.71
Long-term AAA-rated corporate bonds	74.9	10	1.65	5.96	3.62	2.88	1.67
Global bond composite	74.9	10	1.64	5.96	3.62	2.90	1.67
10-year US Treasury	74.8	10	1.64	5.96	3.63	2.92	1.67
International government bond composite	74.8	10	1.64	5.95	3.64	2.86	1.65
5-year US Treasury	74.7	10	1.65	5.96	3.62	2.92	1.71

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Zinc	78.2	20	1.81	5.96	3.29	3.31	2.63
Platinum	78.0	20	1.77	5.93	3.35	3.27	2.63
Diversified precious metals (GLTR)	77.9	20	1.81	6.04	3.34	3.25	2.65
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50% silver and 50% oil	87.3	30	1.89	6.14	3.24	3.98	3.60
West Texas Intermediate Oil Price	85.7	25	1.79	6.10	3.42	4.17	3.68
50% Silver and 50% Reuters CRB Total Return (not "core")	83.4	35	2.03	6.12	3.02	3.75	3.26
Silver	81.4	25	1.91	6.10	3.19	3.45	3.08
Diversified commodities (Thompson Jefferies CRB Core)	78.6	20	1.84	6.00	3.26	3.44	2.64
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Diversified precious metals (GLTR)	77.8	20	1.77	6.02	3.39	3.24	2.66
Platinum	77.4	20	1.81	6.02	3.33	3.33	2.59
World Bank Agriculture Commodity Price Index	76.8	20	1.77	6.02	3.41	3.29	2.13
Gold	76.8	20	1.75	6.07	3.48	3.17	2.59
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Global stock composite	75.2	20	1.65	5.92	3.59	2.99	1.79
90-day US Treasury	75.1	10	1.65	5.97	3.62	2.95	1.84
US stock composite	75.1	10	1.64	5.94	3.62	2.96	1.73
none	75.0	0	1.65	5.96	3.61	2.95	1.73
US bond composite	75.0	10	1.65	5.98	3.63	2.94	1.73
Global bond composite	75.0	10	1.64	5.97	3.63	2.94	1.71
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				Median	Standard deviation	25th percentile	20th percentile
50% silver and 50% oil	87.3	30	1.89	6.14	3.24	3.98	3.60
West Texas Intermediate Oil Price	85.7	25	1.79	6.10	3.42	4.17	3.68
50% Silver and 50% Reuters CRB Total Return (not "core")	83.4	35	2.03	6.12	3.02	3.75	3.26
Silver	81.4	25	1.91	6.10	3.19	3.45	3.08
Diversified commodities (Thompson Jefferies CRB Core)	78.6	20	1.84	6.00	3.26	3.44	2.64

Mitigant	Probability of success	Size of mitigant allocation (%)	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
West Texas Intermediate Oil Price	83.9	20	1.89	6.13	3.25	3.85	3.50
50% Silver and 50% Reuters CRB Total Return (not "core")	81.3	30	2.01	5.92	2.94	3.50	3.09
50% silver and 50% oil	80.4	20	1.90	6.05	3.18	3.44	2.99
Diversified commodities (Thompson Jefferies CRB Core)	78.6	20	1.87	5.91	3.16	3.42	2.75
Diversified commodities (Reuters CRB)	78.6	20	1.87	5.91	3.16	3.42	2.75
Silver	77.9	20	1.88	5.94	3.16	3.20	2.74
World Bank Agriculture Commodity Price Index	76.9	20	1.79	5.92	3.32	3.24	2.16
Platinum	76.8	20	1.82	5.84	3.21	3.15	2.54
Diversified commodities (Thomson Reuters)	76.5	20	1.80	5.84	3.25	3.13	2.26
Zinc	76.3	10	1.72	5.84	3.40	3.09	2.12
TIPS bonds	76.2	20	1.73	5.97	3.45	3.18	2.15
Gold	75.9	20	1.77	6.04	3.42	3.13	2.56
Diversified precious metals (GLTR)	75.8	20	1.78	5.91	3.32	3.06	2.60
Diversified base metals (DBB)	75.7	20	1.74	5.88	3.38	3.02	2.29
Copper	75.3	10	1.66	5.90	3.56	3.04	1.97
Global stock composite	75.2	20	1.66	5.95	3.59	2.98	1.81
US stock composite	75.1	20	1.67	5.99	3.59	3.01	1.82
US bond composite	75.1	10	1.64	5.94	3.62	2.96	1.77
none	75.0	0	1.65	5.96	3.61	2.95	1.73
90-day US Treasury	75.0	10	1.65	5.93	3.61	2.92	1.81
International stock composite	75.0	10	1.64	5.91	3.60	2.94	1.74
Global bond composite	75.0	10	1.63	5.93	3.64	2.93	1.74
10-year US Treasury	75.0	10	1.62	5.93	3.66	2.94	1.72
Long-term AAA-rated corporate bonds	74.9	10	1.63	5.94	3.64	2.93	1.72
5-year US Treasury	74.9	10	1.63	5.93	3.64	2.91	1.77
International government bond composite	74.9	10	1.62	5.93	3.66	2.90	1.70
Aluminum	74.8	20	1.74	6.03	3.46	2.90	2.34
Palladium	74.6	10	1.70	5.93	3.50	2.92	1.91

Mitigant	Probability of success	Size of mitigant allocation (%)	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
West Texas Intermediate Oil Price	83.9	20	1.89	6.13	3.25	3.85	3.50
50% Silver and 50% Reuters CRB Total Return (not "core")	81.3	30	2.01	5.92	2.94	3.50	3.09
50% silver and 50% oil	80.4	20	1.90	6.05	3.18	3.44	2.99
Diversified commodities (Thompson Jefferies CRB Core)	78.6	20	1.87	5.91	3.16	3.42	2.75

- Let's focus in on the best mitigant

- Oil

Oil as a Mitigant Against Inflationary Surprise

Probability of success	Size of oil allocation (%)	Allocation to oil is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
85.8	25	85	1.96	6.18	3.16	4.06	3.62
85.7	25	80	1.79	6.10	3.42	4.17	3.68
84.2	20	85	1.90	6.09	3.21	3.73	3.38
84.1	20	80	1.77	6.04	3.42	3.84	3.54
83.9	20	75	1.89	6.13	3.25	3.85	3.50
77.9	10	80	1.72	5.96	3.47	3.30	2.60
75.0	0	na	1.65	5.96	3.61	2.95	1.73

Silver

- Let's focus in on the second best mitigant

- Silver

Silver as a Mitigant Against Inflationary Surprise

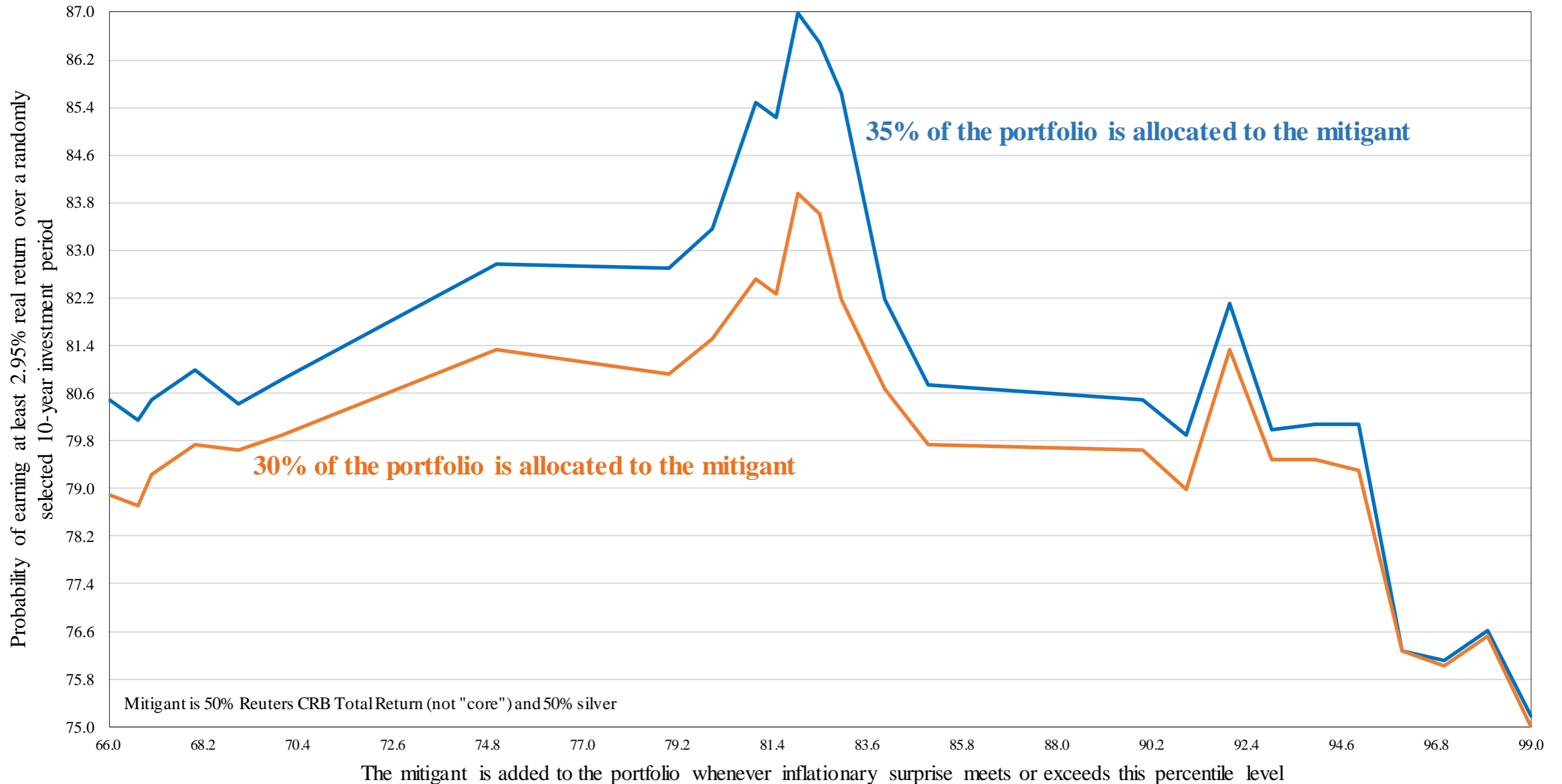| Probability of success	Size of silver allocation (%)	Allocation to silver is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
81.4	25	80	1.91	6.10	3.19	3.45	3.08
80.6	25	85	1.94	6.16	3.18	3.41	3.00
80.0	20	80	1.86	6.04	3.25	3.36	2.94
79.0	20	85	1.88	6.09	3.25	3.34	2.82
78.3	20	90	1.77	6.01	3.40	3.29	2.70
77.9	20	75	1.88	5.94	3.16	3.20	2.74
75.0	0	na	1.65	5.96	3.61	2.95	1.73

Probability of success	Size of oil/silver allocation (%)	Allocation to oil/silver is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
87.3	30	80	1.89	6.14	3.24	3.98	3.60
86.0	30	85	2.01	6.23	3.10	3.94	3.54
85.8	25	80	1.86	6.09	3.27	3.76	3.40
82.4	20	80	1.83	6.05	3.31	3.50	3.07
81.4	20	85	1.90	6.10	3.22	3.50	3.04
80.4	20	75	1.90	6.05	3.18	3.44	2.99
75.0	0	na	1.65	5.96	3.61	2.95	1.73

50% Diversified Commodities (Reuters CRB) and 50% Silver

Probability of success	Size of mitigant allocation (%)	Allocation to mitigant is made when Inflationary Surprise is at or above this percentile level	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
				Median	Standard deviation	25th percentile	20th percentile
83.4	35	80	2.03	6.12	3.02	3.75	3.26
83.0	33	80	2.01	6.10	3.04	3.67	3.23
81.5	30	80	1.97	6.08	3.08	3.63	3.17
81.3	30	75	2.01	5.92	2.94	3.50	3.09
80.2	25	80	1.91	6.03	3.16	3.51	3.01
80.1	25	75	1.95	5.91	3.03	3.39	2.98
75.0	0	na	1.65	5.96	3.61	2.95	1.73

- Before drawing conclusions

- Let's first evaluate the mitigant defined by a 50/50 blend consisting of diversified commodities and silver across the full range of possible inflationary surprise breach points, i.e., different levels at which it would be applied

- The following provides the results for both a 30% allocation to the mitigant in addition to a 35% allocation

Dosage Size and Frequency of Application Have a Major Impact on the Net Benefit

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Probability of earning at least 2.95% real return over a randomly selected 10-year investment period (y-axis)

35% of the portfolio is allocated to the mitigant

30% of the portfolio is allocated to the mitigant

Mitigant is 50% Reuters CRB Total Return (not "core") and 50% silver

The mitigant is added to the portfolio whenever inflationary surprise meets or exceeds this percentile level

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- A larger allocation to the mitigant is clearly and universally beneficial, as defined by the probability of success

- Applying the mitigant too frequently results in rapid decline in the benefit, as shown by the left-hand side of this exhibit

- Since 1914, the optimal level of application is associated with applying this mitigant whenever inflationary surprise meets or exceeds its 82nd-percentile value

- If such a criteria had been applied during the recent episode of rapidly increasing inflation, this mitigant would have been added at market-close on 4/30/2021 and would have been removed at market-close on 10/31/2022.

Impact of Applying the Inflationary Surprise Mitigant Either Early or Late

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Number of months that the mitigant is applied either EARLY or LATE	Probability of success	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
			Median	Standard deviation	25th percentile	20th percentile
8 early	90.6	2.30	6.28	2.73	4.18	3.89
6 early	90.6	2.30	6.51	2.83	4.51	4.10
4 early	89.8	2.28	6.29	2.76	4.31	4.02
5 early	88.8	2.28	6.54	2.87	4.36	4.03
1 early	87.7	2.17	6.31	2.91	4.08	3.56
2 early	87.6	2.07	6.10	2.95	3.97	3.62
1 late	87.4	2.01	5.98	2.97	3.85	3.58
3 early	87.4	2.21	6.27	2.84	4.14	3.78
7 early	87.4	2.13	6.31	2.96	3.99	3.52
0	83.4	2.03	6.12	3.02	3.75	3.26
2 late	82.1	1.96	6.03	3.08	3.49	3.10
3 late	80.9	1.87	5.94	3.18	3.38	3.02
6 late	80.4	1.79	6.19	3.45	3.52	2.99
5 late	80.2	1.81	5.93	3.28	3.32	2.96
4 late	79.9	1.71	5.73	3.34	3.28	2.94
7 late	78.5	1.75	6.02	3.44	3.31	2.76
8 late	76.3	1.76	6.09	3.45	3.10	2.55
no mitigant used	75.0	1.65	5.96	3.61	2.95	1.73

Mitigant is 50% Reuters CRB Total Return (not "core") and 50% silver

The allocation to the mitigant is 35% of the portfolio (for those months to which it is utilized)

The mitigant is applied only when the level of Inflationary Surprise is at or above its 80th-Percentile

EXAMPLE: If the mitigant is applied "1 month early", then it is added to the portfolio 1 month earlier than it should have been and is also removed from the portfolio 1 month earlier then it otherwise would have

Mitigant is 50% Reuters CRB Total Return (not "core") and 50% silver

The allocation to the mitigant is 35% of the portfolio (for those months to which it is utilized)

The mitigant is applied only when the level of Inflationary Surprise is at or above its 80th-Percentile

EXAMPLE: If the mitigant is applied "1 month early", then it is added to the portfolio 1 month earlier than it should have been and is also removed from the portfolio 1 month earlier then it otherwise would have

Impact of Applying the Inflationary Surprise Mitigant Either Early or Late

Number of months that the mitigant is applied either EARLY or LATE	Probability of success	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
			Median	Standard deviation	25th percentile	20th percentile
8 early	90.6	2.30	6.28	2.73	4.18	3.89
6 early	90.6	2.30	6.51	2.83	4.51	4.10
4 early	89.8	2.28	6.29	2.76	4.31	4.02
5 early	88.8	2.28	6.54	2.87	4.36	4.03
1 early	87.7	2.17	6.31	2.91	4.08	3.56
2 early	87.6	2.07	6.10	2.95	3.97	3.62
1 late	87.4	2.01	5.98	2.97	3.85	3.58
3 early	87.4	2.21	6.27	2.84	4.14	3.78
7 early	87.4	2.13	6.31	2.96	3.99	3.52

Impact of Applying the Inflationary Surprise Mitigant Either Early or Late

Number of months that the mitigant is applied either EARLY or LATE	Probability of success	Return per unit of risk (median ÷ standard deviation)	Statistics for 10-year geometric mean REAL returns (all in %)			
			Median	Standard deviation	25th percentile	20th percentile
0	83.4	2.03	6.12	3.02	3.75	3.26
2 late	82.1	1.96	6.03	3.08	3.49	3.10
3 late	80.9	1.87	5.94	3.18	3.38	3.02
6 late	80.4	1.79	6.19	3.45	3.52	2.99
5 late	80.2	1.81	5.93	3.28	3.32	2.96
4 late	79.9	1.71	5.73	3.34	3.28	2.94
7 late	78.5	1.75	6.02	3.44	3.31	2.76
8 late	76.3	1.76	6.09	3.45	3.10	2.55
no mitigant used	75.0	1.65	5.96	3.61	2.95	1.73

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- It was shown that both gold and TIPS are remarkably poor mitigants

- Easily dominated by others such as oil, silver, diversified commodities, and even diversified precious metals

- This observation should not be surprising

- Gold is driven in part by three other aspects (unrelated to inflationary surprise)

  - Gold has almost no industrial applications

  - Gold is frequently driven by extreme event-risk (whether national or international)

  - Gold's price movements are often driven by central bank and/or national treasury policy decisions unrelated to inflationary developments. In contrast, TIPS bonds carry a high level of interest rate risk. For example, the highly popular TIPS bond ETF (symbol TIP) carries an interest rate duration of approximately 7 years.

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- It was shown that both gold and TIPS are remarkably poor mitigants

- Easily dominated by others such as oil, silver, diversified commodities, and even diversified precious metals

- This observation should not be surprising

- TIPS face analogous challenges
  - TIPS bonds carry a high level of interest rate risk
  - For example, the highly popular TIPS bond ETF (symbol TIP) carries an interest rate duration of approximately 7 years.

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Relationship between GDP growth and stock market returns

Friday

January 27th

11:00 a.m. EASTERN

Important Disclosures

All data and statistics were provided by Global Financial Data, Inc. and NDR, Inc. (unless otherwise indicated in the exhibit)

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