

OPTIMAL USE OF COMMODITIES WITHIN A TAA FRAMEWORK

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ABSTRACT

Commodities have a zero expected real return. After transactions costs, commodities are even more challenging, i.e., at just a 4bps transaction cost, only 36% of the months since Jan 1919 delivered a positive real return for a blended commodity index. This article argues that despite unusually high commodity transaction costs (for retail investors using ETFs or ETNs), if applied correctly, commodities offer a powerful source of outperformance during periods of accelerating inflation.

Commodities are examined within the context of a tactical asset allocation framework. It is shown that if commodities are used in the conventional fashion (i.e., selecting them based on trending or momentum) they are shockingly subtractive. In contrast, if added to the portfolio (outside of the TAA framework) whenever a backward-looking (no forecasting) measure of inflationary surprise exceeds some pre-determined level, the contribution can be several hundred basis points, even after the assumption of a 100bps one-way transaction cost. It is observed that this result applies equally to conventional non-TAA portfolios (i.e., traditional mean/variance balanced portfolios).

KEY TAKEAWAYS

- The inclusion of commodities within a TAA portfolio, accessed in the traditional fashion based on trending or momentum, subtracted 160bps at the 70th-percentile level, and 140bps at the 60th-percentile.
- Over the last 105 years, ultra-diversified commodities, natural gas, and oil have been the most effective inflation mitigants, whereas gold and TIPS bonds have been relatively ineffective.
- The most effective application of commodities, is to add them to a portfolio, but only when a backward-looking (no forecasting) metric of inflationary surprise exceeds some predetermined level.
- At the 60th-percentile level, a fully integrated TAA portfolio adding commodities temporarily based on inflationary surprise, outperformed a passive index benchmark (with the exact same average asset mix) by 370bps (and this result is after commodities were penalized with a 100bps one-way transaction cost).

KEYWORDS

- Commodities
- Tactical Asset Allocation
- Inflationary Surprise
- Client-Based Investment Objective
- Ex-post Optimization Bias

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1. INTRODUCTION

This article's primary objective is to: (i) determine if commodities should be used within a Tactical Asset Allocation (hereafter labeled "TAA") framework, (ii) if so, the proper structure for doing so, (iii) the expected incremental benefit, (iv) the causality underlying said benefit, and (v) pitfalls to consider. The secondary objective is to suggest what can be expected from a properly structured TAA solution relative to appropriate comparative passive index benchmarks.

To motivate these objectives, let me backup for a moment. Some TAA managers include commodities within their portfolios. The reasons they give for doing so include, commodities: (i) exhibit trending and momentum (although less than experienced by bonds or stocks), (ii) march to a different drummer than stocks or bonds (radically lower correlations during relevant environments), and most importantly (iii) are a powerful mitigant against inflationary surprise (Brown 2023c).

Some TAA managers exclude commodities. The reasons they give for doing so include, commodities: (i) have an expected zero return (unlike stocks from profits, bonds from interest, or real estate from rents), (ii) are costly to trade (buy or sell), (iii) deliver significantly lower and shorter-lived trending/momentum than stocks or bonds, and (iv) are subject to unusually severe reversal (far beyond what is experienced by stocks or bonds).

Those TAA managers who include commodities within their portfolios, treat commodities in a fashion similar to how they treat stocks and bonds. In other words, commodities are "always on," i.e., always available for inclusion if their relative trending/momentum justifies doing so. I accept all of the reasons given above by both sets of managers, i.e., those who include and those who exclude commodities . . . as factual and sufficiently accurate.

This would appear to leave us in an impossible position, a contradiction. But the argument underlying this article is that managers (whether TAA or traditional mean/variance balanced portfolios) are using commodities incorrectly. That they are attempting to either "include" them or "exclude" them, when in reality, they would be far more successful if instead they carved out an entirely separate and independent role for commodities, one that was conditional and transitory. In the case of TAA managers, the argument underlying this article is that commodities are incredibly contributive, but only if they are applied strictly outside of the traditional trending/momentum capturing framework that defines and/or underlies all TAA portfolios. And instead, only allocate to commodities if inflationary surprise has exceeded some pre-defined level. Moreover, I make the argument that this differentiated role for commodities applies equally (or more so) for traditional portfolios (Brown 2023c). Let us begin.

2. SETUP

The following analysis utilizes monthly total returns spanning the last 105 years (Jan 1919 - Oct 2023). Why the last 105 years? First, quality data exists back to Jan 1919, but deteriorates rapidly prior to that date. Second, it's important to include a greater range of environments, e.g., world and

civil wars, revolutions, pandemics, banking crisis, political crisis, depressions, economic growth/recession, rising/falling inflation, increasing/decreasing interest rates, expansionary/contractionary monetary policy, stimulative/restrictive fiscal policy, terrorism, and during extended periods of peace, prosperity, and technological advance (Brown 2024a). Forty-seven¹ unique/differentiated asset categories were utilized. Why these forty-seven? They were chosen for the following reasons: (i) quality data extended back to Jan 1919, (ii) duplications or near-duplications were eliminated, and (iii) in the case of commodities, only those where viable ETFs or ETNs are currently available were included (e.g., coffee, corn, and coal were excluded). All viable asset categories were included, no ex-post cherry picking.

The TAA portfolio was constructed as follows:

- Inflation-adjusted total return monthly index data utilized
- A trending score was calculated for each available asset category
- Said trending score was equal to the current index value divided by its 11-month average level (Brown 2018, Brown 2022b)
- The portfolio consisted of the nine asset categories (equal-weighted) with the highest trending scores
- Transaction costs² were imposed upon the portfolio (but only for the TAA portfolio and not for the comparative passive benchmarks which benefited from cost-free monthly rebalancing)
- This approach parallels previous publications (Brown 2018, Brown 2022b, Brown 2023a)

All analysis and results are expressed in inflation-adjusted terms (no exceptions). The hypothetical investor's objective is as follows:

- It's assumed that the portfolio serves investor needs arriving between five and ten years in the future
- As such, I assume the midpoint of this interval as the formal investment time period, i.e., 7.5 years
- The investor has specified that they wish to maximize the 99.6th-percentile outcome, i.e., pursue serious tail-risk mitigation
- In other words, the objective is to minimize left-hand tail events for a randomly selected 7.5-year investment period (strictly avoiding any forecast/prediction of what the next 7.5 years will bring)

Keep this stated investment objective in mind, I will refer back to it throughout this article. Side note . . . is this the "right" investment objective? Of course not, there is no "right," and the selection of a particular objective has no impact on this article's results. Nevertheless, an objective must be specified in order to draw any conclusions. Conclusions cannot be drawn from a report of simple

¹ These 47 asset categories include: 8 slices of U.S. stocks, 15 different foreign countries, 5 versions of U.S. Treasuries (maturities ranging from 90-Days to 30-Years), TIPS bonds, 6 additional versions of bonds (spanning investment grade, high yield, international governments, and global governments), and 12 commodities

² Transactions costs were specified at (in one direction, i.e., a buy or a sell) 1bps for all asset categories, other than 30-year U.S. Treasuries and government/corporate investment grade bonds which were set at 8.5bps, and commodities which were set at 100bps

traditional summary statistics spanning the 105 years examined herein (Asness et al 2014, Brown 2023b, Brown 2023d, Brown 2024b). Doing so would hide the powerful non-iid characteristics of investment market returns.

To evaluate the success or failure of the TAA portfolio, two comparative passive, fixed-weight benchmarks are shown. Both rebalance monthly at zero cost. The first of is labeled “*25/75 fixed-weight benchmark*” and is constructed with two objectives in mind: (i) approximate a 25/75 stock/bond split³ and (ii) incorporate the exact same asset class indices that were used by the applicable TAA portfolio (no more and no less) in as unbiased⁴ a fashion as is possible.

The second benchmark is labeled “*Benchmark with weights that match the TAA's average weights over time*” and is constructed with a single objective, i.e., utilize asset class index weights that exactly match the TAA portfolio’s average weights over the last 105 years. This construction technique neutralizes any advantage or disadvantage that would accrue if the TAA portfolio adopted a different risk (or allocation) level over time.

3. INITIAL RESULTS

Let us begin the analysis. To provide a baseline from which to iterate we start by including all available asset categories, i.e., the 47 indices⁵. By doing so, we include all commodities, fixed income, and equities. Our objective is to ask and answer the question, are commodities, credit, or international governments contributive . . . or is our hypothetical investor better off by leaving them out of their TAA portfolio? Exhibit 1 provides the results.

³ It is assumed that an approximate or effective 25/75 stock/bond split is consistent with an investment time horizon of 7.5 years

⁴ For example, equal weight is given to domestic and international . . . and equal weight is given to all available indices within an asset category (e.g., equal weight is given to all countries within the international stock allocation). The objective with this approach is to avoid selection bias and to perfectly reflect that exact same playing field that the TAA portfolio played

⁵ 23 stock: S&P 500, S&P Utilities, S&P Industrials, Dow Jones Industrials, Dow Jones Transportation, Kenneth R French shops industry sector, Kenneth R French energy industry sector, Kenneth R French small cap, Australia, Spain, France, Germany, Ireland, Italy, Japan, South Africa, Netherlands, New Zealand, Denmark, Sweden, India, Belgium, UK . . . 12 bond: 10-year Treasuries, 90-day Treasuries, 30-year Treasuries, 5-year Treasuries, 3-year Treasuries, TIPS bonds, Aggregate investment grade gov/corp bonds, Dow Jones Corporate Bond Return Index, USA Total Return AAA Corporate Bond Index, High yield bonds, All-world ex-US government bonds (GDP-weighted), International government bonds (GDP-weighted) . . . 12 commodity: Gold, Silver, Platinum, Palladium, Diversified precious metals, Gold mining companies, Oil, Base metals (zinc, copper, aluminum), Agriculture, Natural gas, Ultra diversified commodities

EXHIBIT 1

Equal-weighted TAA drawing from 47 unique stock, bond, and commodity indices

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	-3.9	-3.7	-3.1	-2.3	-1.9	-1.5	-0.4	0.2	1.5	3.0	4.6	5.4	6.1	6.9	7.7	8.9
25/75 fixed-weight benchmark	-7.0	-6.6	-6.3	-4.7	-3.5	-3.4	-2.6	-2.1	0.2	0.8	1.3	1.9	2.3	2.6	3.0	3.4
Benchmark with weights that match the TAA's average weights over time	-4.0	-3.5	-3.4	-3.0	-1.9	-1.4	0.3	0.8	2.1	2.9	3.5	4.0	4.5	5.1	5.5	5.9

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is allocated 10% to commodities and 90% to a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories (e.g., U.S. stocks or commodities) equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 47 asset categories are represented.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 100bps (one way, i.e., a "buy" or a "sell")

Let me offer several observations:

- Some readers may be discomforted by the lack of aggregate period (the last 105 years) summary statistics (means, standard deviations, correlations, and additional moments for more complex distributions than the simple log-normal). But I observe that asset class returns are not iid (and never have been) and to make such an other-worldly assumption is a disservice to our clients (Hurst et al 2017, Brown 2024b)
- The 25/75 passive benchmark is a disaster at all percentile outcomes from the 99.8th through the 50th . . . which may feel surprising to those who believed that a 25% allocation to stocks was appropriate for a 7.5-year investment time horizon
- One could reasonably conclude that (excluding the ability to predict the future, in whole or in part) a simple 25/75 stock/bond mix is a remarkably unhelpful solution for investment time periods of 7.5-years in length
- The equal-weighted TAA portfolio (with transaction costs reflected) is essentially a tossup relative to the average-weights benchmark (with zero transaction costs) . . . especially if one focuses in on the 99.6th-percentile outcome
- Perhaps the TAA portfolio and the average-weights benchmark reach equivalency at the 81st-percentile outcome

So, what're the next steps? This article's primary objective is to understand the proper role for commodities (if any). In pursuit of this objective, let's next rerun the results, but excluding any and all commodities . . . seeing if doing so makes a measurable difference. This will reduce the available universe to 35 unique stock and bond indices (domestic and international). As before, the TAA portfolio requires simple equal-weighting across the nine most strongly trending asset categories. Exhibit 2 provides the results.

EXHIBIT 2

Equal-weighted TAA drawing from 35 unique stock and bond indices (no commodities)

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	-4.3	-3.9	-3.6	-1.8	-0.5	0.4	2.3	3.5	5.0	5.7	6.3	7.0	7.7	8.3	9.0	9.7
25/75 fixed-weight benchmark	-7.9	-7.4	-7.1	-5.5	-3.9	-3.8	-3.1	-2.4	-0.5	0.5	1.3	1.8	2.2	2.7	3.1	3.6
Benchmark with weights that match the TAA's average weights over time	-5.7	-4.9	-4.6	-3.5	-2.7	-2.0	-0.2	0.1	1.5	2.4	3.4	4.1	4.7	5.3	5.9	6.4

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is represented by a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories (e.g., U.S. stocks or commodities) equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 35 asset categories are represented.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 22bps (one way, i.e., a "buy" or a "sell")

Let me offer a relevant side-commentary on the problem of ex-post optimization (i.e., backtesting). Moving from Exhibit 1 to Exhibit 2 first engages this issue . . . which will become more pronounced as this article proceeds. Ex-post optimization is impossible to avoid if one bases their conclusions on history (as do all mean/variance Markowitz balanced portfolios). The only way to avoid this peril, is to base one's conclusions on their forecasts/predictions of the future (which creates a far worse problem). Appreciate, we have engaged in backtesting (ex-post optimization) when we make the simple conclusion that a 75/25 portfolio is higher-return and higher-risk than a 25/75 portfolio. But such an observation doesn't then imply that our conclusion is wrong or misguided.

Instead, the problem with backtesting has to do with how we go about it. Backtesting, per se, is neither good nor bad . . . sort of like fast food or politics, sure both are problematic most of the time, but not out of necessity. Let me offer an analogy - witness interrogation. If abused, the witness will admit to anything (as will the data). Of course, such admissions are vacuous (as would be any such data analysis). But if properly handled, the witness will reveal tremendous substance. One of the abuser's key techniques is to hide their abuse deep inside the aggregate-period (the last 105 years in this article's case) summary statistics. This article avoids this problem by restricting its reporting to the relevant time periods (i.e., 7.5-year investment time horizons) . . . and not on a single one or the average, but instead on all of them via the numerous percentile outcomes reported herein (Brown 2024b). It's unfortunate that this hasn't become our industry's standard.

As before, let me offer several observations:

- Take special note that the two passive benchmarks have changed, they now reflect a smaller universe, 35 asset categories instead of 47 . . . this is so that they more fairly serve the role as "unbiased comparative benchmarks"
- A comparison of Exhibits 1 and 2 shows that the exclusion of commodities uniformly improved the results at percentile outcomes ranging from the 99th through the 50th

- For example, at the 80th-percentile, the exclusion of commodities improved returns by 270bps
- This result harmonizes with many investment manager’s negative commentary on the use of commodities, as mentioned in the Introduction
- As before, Exhibit 2 shows unusually poor results for the 25/75 passive benchmark
- These results suggest that (excluding the ability to forecast/predict the future) the 25/75 asset mix remains unusually inferior for 7.5-year investment time periods

The logical next step is to see what happens if we eliminate the more aggressive bonds (i.e., foreign exchange-, credit-, and inflation-risk standpoints). Perhaps international bonds, high yield, and TIPS bonds prove unhelpful and subtractive. If we preserve the prior equal-weight requirement (of those asset categories selected by the TAA portfolio) we find that only traditional U.S. Treasuries (not TIPS bonds) and investment grade government/corporate bonds remain contributive. For this reason, we restrict our iterative analysis to a smaller set, consisting of 29 instead of 35 stock/bond indices (eliminating six bond categories). The only bonds that remain attractive (contributive to the previously stated investment objective) are non-TIPS U.S. Treasuries and diversified investment grade U.S. bonds (Treasuries and corporates). This result should not surprise if one considers the 7.5-year investment time period, the power of Treasuries and domestic investment grade bonds to mitigate stock-risk, and perhaps more importantly, in a TAA context the ability of international stock segments to offer opportunity or shelter (from declines in U.S.-based assets). Exhibit 3 provides the results.

EXHIBIT 3

TAA drawing on 29 stock and bond indices (i.e., non-TIP U.S. Treasuries and Investment Grade U.S. Aggregate)

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	-3.4	-3.2	-2.6	-0.7	0.6	1.1	3.2	4.1	5.4	6.1	6.6	7.2	8.0	8.7	9.3	9.9
25/75 fixed-weight benchmark	-4.7	-4.4	-4.3	-2.8	-2.5	-2.4	-1.9	-1.5	-0.4	0.4	1.2	1.7	2.5	3.1	3.5	3.7
Benchmark with weights that match the TAA's average weights over time	-5.4	-4.6	-4.3	-3.3	-2.4	-1.8	-0.1	0.2	1.6	2.4	3.4	4.2	4.8	5.4	6.0	6.5

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is represented by a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories (e.g., U.S. stocks or commodities) equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 29 asset categories are represented.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 8.5bps (one way, i.e., a "buy" or a "sell")

I offer several observations:

- As with commodities before, eliminating “*peripheral*” bond categories, meaningfully improved investment results at percentile outcomes ranging from the 99.8th through the 50th
- For example, at the 80th-percentile, the exclusion of “*peripheral*” bonds improved returns by 40bps

- These results reflect a smaller universe of asset categories, 29 instead of 35, consisting of 23 stock and 6 bond indices
- This result harmonizes with many TAA manager’s observations that for investment time periods of 7.5 years (and longer), stocks are the engine that provides real returns (net of inflation), but U.S. Treasuries (for U.S.-based investors) provide the needed transitory/temporary risk mitigation
- As before, Exhibit 3 shows remarkably poor results for the 25/75 passive benchmark
- These results suggest that barring the ability to forecast the future, the 25/75 asset mix remains shockingly inferior for 7.5-year investment time horizons

The logical next step is to move away from the equal-weight restriction on the TAA portfolio. Why? Because commercial TAA portfolios don’t use equal-weighting schemes. I started the prior analysis with this restriction to prevent ex-post optimization bias (which unfolds the moment one moves away from equal-weighting). The next analysis utilizes limited non-equal weighting that seeks to maximize the investor’s previously stated investment objective . . . and in a fashion that is absolutely no different from simple mean/variance optimization (Markowitz) based on the last 105 years. Although, in this case, somewhat more honestly, since it avoids any consideration of the aggregate 105-year time period (instead, staying strictly focused on the distribution of 7.5-year investment intervals, i.e., 1,247 unique 7.5-year periods). Exhibit 4 provides the results.

EXHIBIT 4

Ex-post optimized, unvarying rules-based TAA drawing from a universe of 29 stock and bond indices

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	-0.3	-0.1	0.1	1.9	2.4	2.5	3.5	3.9	5.0	5.7	6.3	7.1	7.8	8.4	9.1	9.8
25/75 fixed-weight benchmark	-4.7	-4.4	-4.3	-2.8	-2.5	-2.4	-1.9	-1.5	-0.4	0.4	1.2	1.7	2.5	3.1	3.5	3.7
Benchmark with weights that match the TAA's average weights over time	-5.1	-4.3	-4.0	-3.0	-2.2	-1.5	0.0	0.3	1.5	2.2	3.2	3.9	4.5	5.1	5.7	6.2

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is represented by a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories (e.g., U.S. stocks or commodities) equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 29 asset categories are represented.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 8.5bps (one way, i.e., a "buy" or a "sell")

Here are several helpful observations:

- Least we be accused of data-mining or rules-mining, the basis underlying Exhibit 4 results deviates only very slightly from the prior simple equal-weighting scheme
- Showing limited non-equal weighting, better reflects how all commercially available TAA portfolios are managed today
- Specifically:

- The 23 stock indices are all equal-weighted (if selected) . . . as in the prior analysis
- If cash (90-Day U.S. Treasuries) is selected as one of the nine most strongly trending asset categories, then 100% of the portfolio is allocated to cash (with the other eight asset categories being knocked out of the portfolio)
- This approach is consistent with many commercial, true TAA portfolios today (a frightening number of managers falsely label their products “*tactical asset allocation*,” when in fact all they do is make tiny (inconsequential) “*1% moves*” at most once each quarter) . . . making such claims, is nothing for than deceptive marketing nonsense
- Longer maturity Treasuries and investment grade government/corporate U.S. bonds receive radically reduced weightings (relative to stocks) if selected
- Specifically, the weighting to Treasuries and investment grade government/corporates are multiplied by 0.09x before weighting-normalization (i.e., bringing the sum of the weights back to 100%)
- Doing so, significantly reduces allocations to Treasuries longer than 90-Days (and government/corporate bonds)
- Comparing Exhibits 3 and 4 emphasizes how left-hand tail mitigation (trimming the negative outcomes) benefits from unequal-weighting schemes (under-weighting bonds and overweighting cash)
- The unequal-weighting scheme trounces the equal-weighting scheme at percentile levels ranging from the 99.8th-percentile through the 94th-percentile
- For example, consider the 99.6th-percentile, which results in a 310bps improvement (unequal-weighting over equal-weighting)
- In a sense, this result should not be surprising, given the portfolio’s ability/propensity to revert to 100% to cash (90-Day U.S. Treasuries) when things “*go bad*” . . . doing so, goes a long way towards trimming left-hand tail risk

4. A DEEPER EXAMINATION OF COMMODITIES

Exhibits 1-4 strongly support a conclusion that commodities are subtractive, or at least within a TAA framework, and should therefore be excluded. But perhaps we’re being overly hasty and/or perhaps sloppy in our analysis and subsequent conclusions. To examine the possible inclusion of commodities with greater rigor, let’s start by evaluating the performance of the “*Benchmark with weights that match the TAA’s average weights over time*” drawn from Exhibit 4, both with and without commodities. Doing so, we step outside of the TAA framework, by considering a fixed-weight passive portfolio. In a sense, this subsequent analysis reflects the inclusion/exclusion of commodities within traditional mean/variance balanced portfolios. Exhibit 5 provides the results. The first row shows the results without commodities. Each subsequent row shows that same passive index portfolio, but with the inclusion of the identified commodity (far left-hand column).

EXHIBIT 5

TAA model's average weights to stocks and bonds and a permanent fixed-weight to commodities

Portfolio		Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels											
		99.8	99.6	99.1	97	96	91	85	80	75	60	55	50
Benchmark with weights that match the TAA's average weights over time		-5.1	-4.3	-3.4	-1.5	-0.5	0.4	1.5	2.2	3.2	5.1	5.7	6.2
Permanent 22.9% allocation to this commodity (with monthly rebalancing)	Gold	-3.6	-2.9	-2.2	-1.0	-0.8	0.5	2.3	2.8	3.3	4.8	5.1	5.5
	TIPS bonds	-4.8	-4.1	-3.5	-1.3	-0.7	0.2	1.2	2.3	3.0	4.5	5.1	5.6
	Silver	-4.5	-4.0	-3.7	-1.5	-0.5	1.2	2.0	2.5	3.1	4.8	5.3	5.7
	Platinum	-5.0	-4.4	-3.7	-1.2	-0.7	0.6	1.8	2.4	2.8	3.9	4.3	4.8
	Palladium	-5.8	-5.5	-4.6	-3.4	-2.5	-0.4	0.6	2.3	3.1	4.8	5.3	5.8
	Diversified precious metals	-4.2	-3.6	-3.3	-1.5	-0.8	0.6	1.8	2.5	3.0	4.7	5.1	5.5
	Gold mining stocks	-5.0	-4.2	-3.6	-2.1	-1.7	-0.4	1.3	1.9	2.5	4.5	5.2	5.8
	Oil	-2.4	-2.2	-1.7	-1.0	-0.8	0.4	2.1	2.9	3.5	4.8	5.1	5.6
	Wheat	-4.2	-4.0	-3.5	-1.8	-1.1	0.5	1.5	2.3	3.1	4.6	4.9	5.4
	Base metals	-5.4	-4.7	-3.8	-2.0	-1.0	0.9	1.3	1.8	2.4	4.1	4.6	5.0
	Farm commodities	-4.8	-4.5	-3.7	-2.1	-1.3	0.4	1.2	1.9	2.5	4.1	4.4	4.8
	Natural gas	-1.6	-1.4	-1.1	-0.1	0.1	0.8	2.0	2.6	3.2	5.2	5.6	6.3
	Ultra diversified commodities	-3.9	-3.4	-2.8	-0.7	-0.2	1.0	1.9	2.5	3.0	4.6	5.1	5.5
67% diversified commodities and 33% natural gas	-2.8	-2.2	-1.7	-0.4	0.1	1.1	2.2	2.8	3.4	4.7	5.2	5.6	

Based on data spanning Jan 1919 through Oct 2023

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

No transaction costs imposed

Several important observations can be drawn:

- Exhibit 5 assumes a fixed and permanent allocation of 22.9% to the identified commodity. This level was selected because, ex-post, it generated the greatest return at the 99.6th-percentile outcome (recall the previously stated client's investment objective) for the three most beneficial commodities
- Based on the assumed portfolio (the Exhibit 4 TAA portfolio's average weights over the last 105 years), precious metals such as palladium, platinum, base metals, and farm commodities are unusually poor risk-mitigants . . . they actually worsen the client's desired result

- In contrast, (in the context of fixed-weight allocations to commodities) natural gas, oil, and a commodity blend (66.7% ultra-diversified commodities and 33.3% natural gas) are intriguingly contributive
- Observe how at the 99.6th-percentile (the previously specified investment objective), the passive portfolio benefited 210bps by allocating to the commodity blend (66.7% ultra-diversified commodities and 33.3% natural gas)

In the Introduction, I observed that some TAA managers include commodities within their portfolios because they believe commodities to be a powerful mitigant against inflationary-surprise (despite their implementation costs and zero expected return). I concur. But using commodities to combat inflationary surprise, requires that they're only added in when such surprise has become extreme. To examine this issue, we must adopt an explicit measure. Rather than create a new measure, this article adopts one from prior publications (Brown 2023c).

With the objective of minimizing accusations of data-mining or rules-mining . . . I take an overly simplistic approach to the surprise metric. Specifically, I define inflationary surprise as the ratio of the current level of the CPI divided by its eleven-month average level (Brown 2023c). Moreover, I assume that an allocation to the designated commodity, only occurs when the then current level of inflationary surprise (absolutely no forecasting or prediction of the future) exceeds some pre-determined level. Exhibit 6 provides the results.

EXHIBIT 6

TAA model's average weights to stocks and bonds, but a conditional and temporary weight to commodities

Portfolio		Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels											
		99.8	99.6	99.1	97	96	91	85	80	75	60	55	50
Benchmark with weights that match the TAA's average weights over time		-5.1	-4.3	-3.4	-1.5	-0.5	0.4	1.5	2.2	3.2	5.1	5.7	6.2
On those rare months when commodities are used, the allocation is 71.55%	Gold	-2.7	-2.3	-1.5	-0.5	-0.3	1.0	2.7	3.5	4.1	5.8	6.4	6.9
	TIPS bonds	-3.7	-3.3	-2.3	-1.3	-1.0	0.2	2.3	3.1	3.6	5.4	5.9	6.3
	Silver	-5.5	-5.0	-4.1	-1.6	-1.2	0.6	1.7	2.4	3.2	5.3	6.0	6.5
	Platinum	-3.4	-3.0	-2.5	-1.5	-0.9	0.8	2.0	3.2	3.9	5.5	5.9	6.3
	Palladium	-6.4	-5.9	-4.7	-2.9	-2.6	-1.4	-0.6	0.3	1.5	4.3	5.0	5.7
	Diversified precious metals	-4.0	-3.3	-2.1	0.1	0.4	1.1	2.0	2.9	3.6	5.3	5.9	6.4
	Gold mining stocks	-7.5	-6.7	-5.8	-4.1	-3.8	-1.6	0.5	1.4	2.3	4.8	5.5	6.1
	Oil	-1.7	-1.7	-1.5	-0.7	-0.3	1.6	3.2	4.1	4.7	6.2	6.6	7.0
	Wheat	-8.8	-6.7	-6.2	0.0	0.2	1.5	2.4	3.2	3.8	5.4	5.8	6.2
	Base metals	-2.5	-2.2	-1.9	-0.2	0.1	1.7	2.7	3.3	3.8	5.4	5.8	6.2
	Farm commodities	-6.3	-6.0	-5.5	-2.0	-1.3	0.9	2.3	3.1	3.9	5.5	6.0	6.4
	Natural gas	-1.0	-0.7	-0.4	0.3	0.4	1.1	2.4	3.5	4.4	6.4	6.8	7.5
Ultra diversified commodities	-0.5	0.1	0.7	1.5	1.7	2.6	3.3	4.0	4.5	5.8	6.2	6.4	
67% diversified commodities and 33% natural gas	0.2	0.8	1.1	1.8	2.1	2.8	3.7	4.4	4.9	6.2	6.5	6.9	

Based on data spanning Jan 1919 through Oct 2023

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

No transaction costs imposed

Portfolio is allocated 71.55% to commodities whenever the current CPI is more than 2.06% above its 11-month average level (i.e., approximately 21.09% of the months)

These results are telling, let me offer several helpful observations:

- Exhibit 6 assumes that whenever the current level of the CPI index is more than 2.06% (proportionately) above its 11-month average level (this happens 21.09% of the months), 71.55% of the portfolio is allocated to the designated commodity
- These levels (both the size of the commodity allocation and the frequency with which it is applied) were selected because, ex-post, they generated the most beneficial result at the 99.6th-percentile outcome (recall the previously stated investment objective) for the three most contributive commodities
- Is ex-post optimization bias present herein . . . yes, absolutely . . . it's greatest at the 99.6th-percentile . . . but by the 50th-percentile has virtually vanished

- Appreciate that the high commodity allocation (71%) appeared during just 21% of the months (resulting in a 15% average allocation over time)
- Observe how palladium, gold mining stocks, wheat, and farm commodities are unusually poor risk mitigants (they do more harm than good)
- In contrast, natural gas, a mixed blend (66.7% ultra-diversified commodities and 33.3% natural gas), and ultra-diversified commodities are unusually helpful risk-mitigants
- A comparison of Exhibits 5 and 6 reveals the benefit of allocating to commodities only temporarily/opportunistically as based on the inflationary surprise metric (which entailed no forecasting or prediction, it's purely backward-looking)
- Consider two different percentile outcomes employing the diversified commodity blend (the last row) . . . at the 99.6th-percentile, conditional allocations resulted in a 300bps improvement, and at the 60th-percentile, a 150bps improvement was experienced

Exhibit 6 results are based on a 71.55% commodity allocation (when applied) for the reason described immediately above. But is this the right level? Of course not. The right level has to be determined commodity by commodity. Since the ability to mitigate inflation-risk varies so greatly from one commodity to the next. Exhibit 7 examines this issue for five commodities, showing the optimal allocation for a given commodity depending upon how frequently it is applied to the underlying stock/bond portfolio.

EXHIBIT 7

Tradeoff between size of commodity allocation and the frequency of use

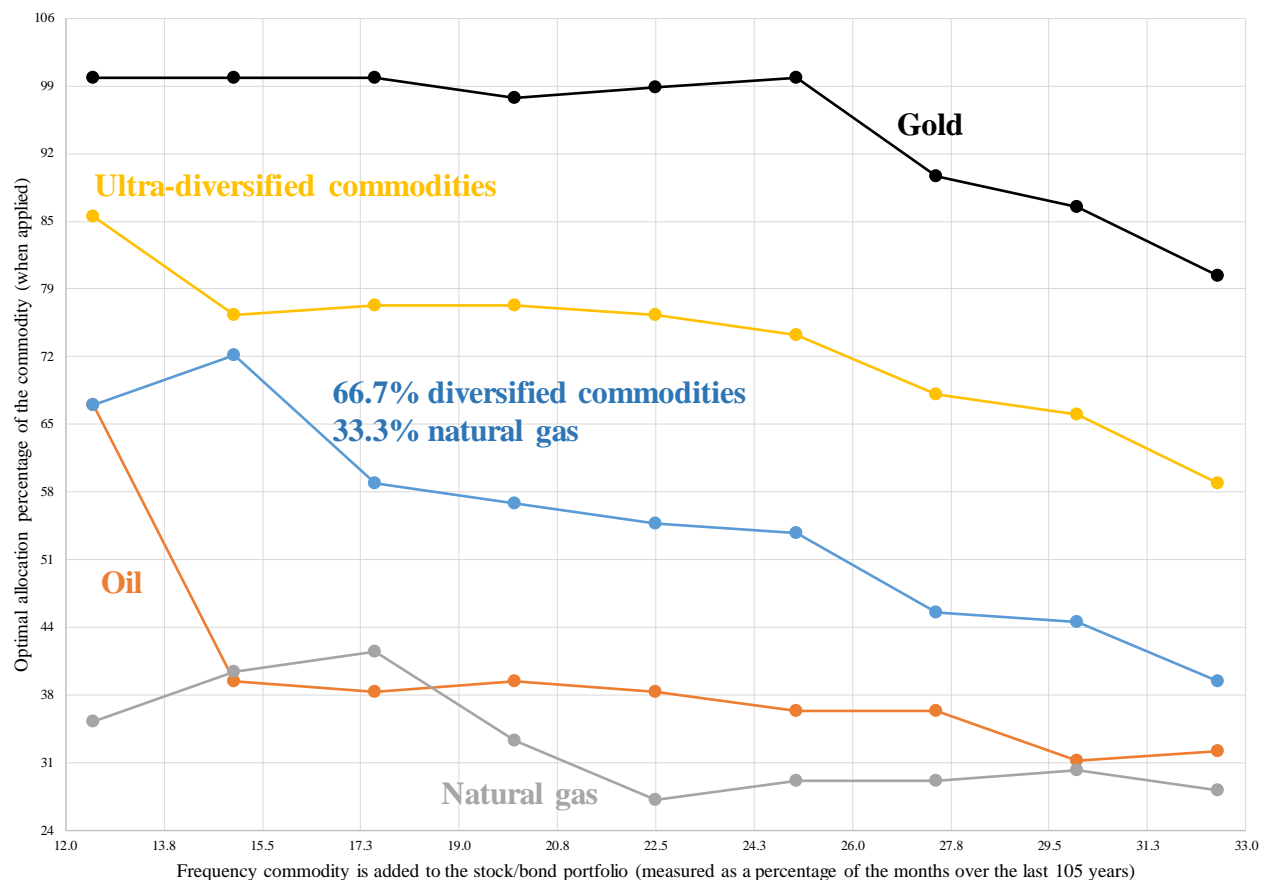


Exhibit 7 provides several interesting results:

- As the frequency with which commodities are added to the portfolio increases (this corresponds to lowering the level of inflationary surprise required before commodities are added), the optimal size of the commodity allocation decreases
- Why is this . . . (i) commodities have a zero expected return, unlike stocks (profits), bonds (interest), and real estate (rents) and (ii) commodity downturns are severe and long-lasting, imposing significant drag on the total portfolio
- It follows that (i) as one increases the frequency of use, so does the associated portfolio drag and (ii) at ever lower levels of inflationary surprise, the usefulness/effectiveness of commodities quickly declines . . . thus driving a lower optimal allocation (as Exhibit 7 reports)
- Some commodities are more effective at mitigating inflationary surprise (refer back to Exhibits 5 and 6) than others, e.g., natural gas versus gold or TIPS . . . thus significantly lower allocations are optimal (refer to Exhibit 7)
- Exhibits 5-7 are a report of the last 105 years . . . if oil's role in the global economy continues to decline (as it has), then its relevance as an inflationary surprise mitigant can be expected to diminish . . . for this reason, oil is excluded from further analysis

Exhibit 6 suggests a significant performance enhancement through the temporary/opportunistic allocation to commodities. Consider the 99.6th-percentile outcome comparing the pure stock/bond portfolio (first row) versus that same portfolio but "*protected*" by the commodity blend (last row), resulting in a 510bps improvement. Should this improvement be a surprise? No. Historically, stock and balanced portfolios experience strongly negative performance during periods of inflationary surprise. If one considers the median (the 50th-percentile), the net improvement falls to 70bps . . . nevertheless, a respectable improvement.

The analysis just presented (Exhibits 5-7) was based on a passive portfolio, one with weights that matched the TAA's average weightings over the last 105 years (Exhibit 4). One of this article's objectives, was to identify the proper role for commodities within a TAA framework (if any). To do so, we must next pursue the same analysis as appeared in Exhibits 5 and 6, but now using the prior TAA portfolio's monthly returns (drawn from Exhibit 4). This is an important incremental step. Why? Because the TAA portfolio was seeking to maximize the investor's outcome in inflation-adjusted terms. Perhaps, the TAA portfolio's monthly adaptation (shifting between the 29 different asset class indices) in real space, made the use of commodities as an inflation mitigant redundant and unnecessary, especially after the high 100bps (one directional) commodity trading costs. This is a critical comparison. Exhibit 8 provides the results.

EXHIBIT 8

Prior dynamically-weighted stock/bond TAA portfolio with conditional/temporary allocations to commodities

Portfolio		Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels											
		99.8	99.6	99.1	97	96	91	85	80	75	60	55	50
Prior dynamically-weighted stock/bond TAA portfolio		-0.3	-0.1	1.1	2.5	3.0	4.1	5.0	5.7	6.3	8.4	9.1	9.8
On those rare months when commodities are used, the allocation is 71.55%	Gold	-0.3	0.0	1.1	2.6	3.2	4.1	5.0	5.7	6.5	8.6	9.2	9.9
	TIPS bonds	-0.5	-0.2	0.9	2.6	3.0	3.9	4.7	5.3	6.0	8.2	8.7	9.3
	Silver	-1.3	-1.0	0.6	2.0	2.5	3.9	4.8	5.4	6.1	8.7	9.4	10.3
	Platinum	-0.2	0.6	1.6	2.8	3.2	4.1	4.8	5.5	6.3	8.1	8.8	9.5
	Palladium	-1.0	-0.2	0.9	1.6	2.0	3.1	4.0	4.6	5.2	7.6	8.5	9.2
	Diversified precious metals	-0.7	-0.2	1.3	2.3	3.1	4.0	4.8	5.4	6.2	8.6	9.2	9.9
	Gold mining stocks	-2.0	-1.8	-0.5	1.4	2.1	3.5	4.4	5.1	5.8	7.7	8.6	9.3
	Oil	2.3	2.9	3.1	3.5	3.8	4.6	5.4	6.0	6.6	8.8	9.5	10.5
	Wheat	1.3	1.6	1.8	3.2	3.6	4.7	5.3	6.0	6.7	8.5	9.2	9.9
	Base metals	-0.1	0.2	1.2	2.6	2.9	4.2	5.0	5.7	6.3	8.5	9.0	9.6
	Farm commodities	-0.3	0.0	0.7	2.0	2.4	3.9	5.0	5.4	6.2	7.9	8.5	9.4
	Natural gas	2.5	3.0	3.1	3.8	4.0	4.8	5.8	6.6	7.5	9.3	10.0	10.7
	Ultra diversified commodities	1.4	1.6	2.2	3.4	3.8	4.6	5.3	5.9	6.5	8.4	9.0	9.6
	67% diversified commodities and 33% natural gas	2.3	2.7	3.1	3.9	4.0	4.8	5.6	6.3	6.9	8.7	9.3	9.9

Based on data spanning Jan 1919 through Oct 2023

The "Prior dynamically-weighted stock/bond TAA portfolio" utilizes the results from the prior Exhibit 4

Results are based on monthly inflation-adjusted total returns

No transaction costs imposed on the trading of commodities

Portfolio is allocated 32.88% to commodities whenever the current CPI is more than 2.543% above its 11-month average level (i.e., approximately 15.26% of the months)

Several critical observations can be made:

- As before, both the frequency and size of the allocation to commodities was determined ex-post, serving to optimize the investor's stated objective
- This resulted in a smaller commodity allocation (32.88%) applied approximately 15.26% of the months . . . delivering an average 5% commodity allocation over the entire 105-year history
- The smaller less frequent commodity allocation is in alignment with expectations, i.e., the TAA portfolio's monthly adaptation (in real return space) should diminish the usefulness of commodities, as suggested earlier

- Further to this point, consider the 99.6th-percentile result . . . the benefit with and without shrank from the prior 510bps down to 280bps
- Similarly, at the 50th-percentile, the net benefit shrank from 70bps down to 10bps

5. INSERTING COMMODITIES BACK INTO THE TAA PORTFOLIO

The prior analysis (Exhibits 5-8) applied commodities to the passive benchmark portfolio and to the active TAA portfolio. This analysis was incremental and was intended to take small incremental steps so that varying effects could be identified (and unintended bias revealed). The logical next step is to fully integrate commodities back into the active TAA framework. This entails imposing transaction costs on the trading of commodities (previously stated as 100bps one-way, a buy or a sell). Appreciate that our assumption of commodity trading costs, severely handicaps the TAA portfolio relative to the two comparative benchmarks.

As before, I will progress slowly through three incremental steps. First, we'll add commodities back into the TAA portfolio (restricted to equal-weighting across its stock and bond selections) reported in Exhibit 3. Second, we'll relax the equal-weight restriction, and instead revert back to the ex-post optimized TAA portfolio shown in Exhibit 4. Third, we'll complete our analysis with a fully integrated TAA portfolio, one that selects its nine stock/bond sectors recognizing the opportunistic/temporary presence of commodities (as based on the measure of inflationary surprise, previously described). To simplify the analysis, I restrict the definition of commodities to the blended commodity index (the last row of Exhibit 8). Why this index? Because it was the best performing at the 99.6th-percentile in Exhibits 5, 6, and 8 (other than oil or natural gas, which are just too idiosyncratic all by themselves, and perhaps unduly backward-looking, as fossil fuels decline in relevancy).

Exhibit 9 provides the results for allowing the equal-weighted (for the nine stock and bond indices selected) portfolio to temporarily allocate to the blended commodity index, as based on the inflationary surprise metric. It also reflects transactions costs . . . for stocks, bonds, and commodities (e.g., 100bps for buying or selling a commodity position). The size and frequency of the commodity allocation is ex-post optimized.

EXHIBIT 9

TAA portfolio using equal-weight positions with blended commodity index added periodically/opportunistically

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	2.0	2.3	2.3	3.2	3.7	3.9	4.7	5.2	6.2	6.7	7.2	7.7	8.0	8.5	9.3	10.0
25/75 fixed-weight benchmark	-3.6	-3.4	-3.3	-2.6	-2.2	-2.1	-1.6	-1.1	0.3	0.7	1.3	1.6	2.0	2.4	2.8	3.1
Benchmark with weights that match the TAA's average weights over time	-4.6	-3.8	-3.5	-2.5	-1.6	-1.0	0.5	0.8	1.8	2.6	3.3	4.0	4.6	5.2	5.8	6.3

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is allocated 10% to the blended commodity index and 90% to a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories, equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 29 stock and bond asset categories are represented in addition to the blended commodity index.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 100bps (one way, i.e., a "buy" or a "sell")

Portfolio is allocated 54.4% to blended commodities whenever the current CPI is more than 2.543% above its 11-month average level (i.e., approximately 15.26% of the months)

The results are powerful and strongly suggest that commodities should be included within TAA portfolios, but only added independently from the traditional TAA process (i.e., based on trending/momentum). Here are several of the more important observations:

- Herein, 54.4% of the equal-weighted TAA portfolio is allocated to the commodity blend whenever inflationary surprise exceeded its 84.7th-percentile level . . . these two levels (size and frequency) were based on ex-post optimization relative to the investor's stated investment objective (as such, the average allocation to commodities is just 8%)
- Compare Exhibits 1 and 9 . . . with the later showing the improvement resulting from the temporary inclusion of the blended commodity index when inflationary surprise spikes upward (as opposed to allowing commodities to enter the TAA portfolio on an equal footing with the various stock or bond sectors) . . . at the 99.6th-, 80th-, and 50th-percentile levels, moving to an inflation surprise-based addition of commodities, improved results by 600bps, 370bps, and 110bps, respectively
- These benefits are what one would expect given the reasons given (see Introduction) for why some TAA managers exclude/include commodities from their portfolios
- Of equal import, consider Exhibit 9's comparative analysis, i.e., TAA versus its two passive benchmarks (recall that both rebalance monthly at zero transaction cost) . . . at the 99.6th-percentile, the TAA portfolio outperformed by either 570bps or 610bps

The next step of our analysis is to take a single small step towards greater realism, by relaxing the equal-weight requirement. We take this step by adopting the TAA portfolio previously reported in Exhibit 4 (one that restricted itself to 29 stock and bond indices) and adding in the commodity blend when inflationary surprise exceeded some predetermined extreme level. Exhibit 10 provides the results.

EXHIBIT 10

Prior optimized stock/bond TAA portfolio with blended commodity index added periodically and opportunistically

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	2.3	2.7	2.7	3.3	3.7	3.8	4.2	4.6	5.5	6.3	6.9	7.5	8.0	8.5	9.1	9.9
25/75 fixed-weight benchmark	-3.6	-3.4	-3.3	-2.6	-2.2	-2.1	-1.6	-1.1	0.3	0.7	1.3	1.6	2.0	2.4	2.8	3.1
Benchmark with weights that match the TAA's average weights over time	-4.4	-3.7	-3.3	-2.3	-1.5	-0.9	0.5	0.8	1.7	2.5	3.3	3.9	4.5	5.1	5.7	6.1

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is allocated 10% to the blended commodity index and 90% to a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories, equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 29 stock and bond asset categories are represented in addition to the blended commodity index.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 100bps (one way, i.e., a "buy" or a "sell")

Portfolio is allocated 48.3% to blended commodities whenever the current CPI is more than 2.543% above its 11-month average level (i.e., approximately 15.26% of the months)

Several interesting observations can be had:

- As before, the size and frequency of the blended commodity allocation was ex-post optimized at 48.3% whenever inflationary surprise exceeded its 84.7th-percentile level (as such, the average allocation to commodities is approximately 7%)
- Compare Exhibits 1 and 10 . . . with the later showing the improvement resulting from the inclusion of blended commodities (as based on inflationary surprise) within a non-equal-weighted TAA portfolio . . . at the 99.6th-, 80th-, and 50th-percentile levels . . . moving to inflation surprise-based addition of commodities . . . improved results by 640bps, 330bps, and 100bps, respectively
- Exhibit 10 shows how the TAA portfolio with blended commodities (when inflation surprises) outperformed the average-weights portfolio (bottom row) at the 99.6th-, 80th-, and 50th-percentiles by 640bps, 380bps, and 380bps, respectively
- These are meaningful results . . . especially given that the TAA portfolio is handicapped by transaction costs ranging from 1bps to 100bps
- Yes, these results were ex-post optimized, but only at the 99.6th-percentile and using ultra-simple rules . . . with these observations in mind, consider focusing in on the other percentile outcomes (which are significantly less subject to ex-post optimization bias)
- Exhibit 10 (particularly in light of the prior nine exhibits) demonstrates the benefits of including commodities within a TAA portfolio . . . although, suggests that such addition should be pursued outside the traditional trend/momentum TAA framework, and instead be based on some measure of inflationary surprise

Our final step is full integration, i.e., an optimized stock/bond TAA portfolio that pursues its objective with the recognition that commodities will be added whenever inflationary surprise exceeds some predetermined level. How is this next step different from before? Previously, the

stock/bond TAA portfolio was optimized with the assumption that commodities would never be added in.

6. A FULLY OPTIMIZED TAA PORTFOLIO WITH COMMODITIES

This next step is logical, i.e., it best reflects how an investment manager approaches the issue. Is this last step more susceptible to ex-post data mining? Yep. But I'd suggest, probably less so than the vast majority of mean/variance Markowitz optimizations. The only permitted variations in this last step are: (i) weight applied to cash, (ii) weight applied to Treasuries, (iii) weight applied to investment grade govt/corp bonds, (vi) weight applied to the commodity blend, and (v) at what level of inflationary surprise are commodities included within the larger portfolio. None of these determinants changed materially, other than the cash and commodity weightings, both of these changes feel logical and unexpected. Exhibit 11 provides the results.

EXHIBIT 11

Ex-post optimized TAA portfolio with blended commodity index added periodically and opportunistically

Portfolio	Geometric mean return during a randomly selected 7.5-year investment time period at varying percentile levels															
	99.8	99.6	99.5	98.5	97.5	97	94	92	85	80	75	70	65	60	55	50
TAA	2.0	2.9	2.9	3.8	4.3	4.4	4.9	5.2	5.9	6.5	7.1	7.6	8.2	8.9	9.5	10.0
25/75 fixed-weight benchmark	-3.6	-3.4	-3.3	-2.6	-2.2	-2.1	-1.6	-1.1	0.3	0.7	1.3	1.6	2.0	2.4	2.8	3.1
Benchmark with weights that match the TAA's average weights over time	-4.4	-3.6	-3.4	-2.3	-1.4	-0.9	0.4	0.7	1.8	2.6	3.4	4.0	4.5	5.2	5.7	6.1

Based on data spanning Jan 1919 through Oct 2023

The "25/75 fixed-weight benchmark" is allocated 10% to the blended commodity index and 90% to a portfolio consisting of 25% stocks and 75% bonds. Stocks (and bonds) are allocated 50% U.S. and 50% non-U.S. Within each of these categories, equal-weight is given to all available indices. All positions are rebalanced monthly assuming zero transaction costs. 29 stock and bond asset categories are represented in addition to the blended commodity index.

The "Benchmark with weights that match the TAA's average weights over time" utilizes monthly rebalancing back to the TAA portfolio's average long-term weights (1919-2023)

Results are based on monthly inflation-adjusted total returns

Transactions costs imposed on the TAA portfolio (only), ranging from 1bps to 100bps (one way, i.e., a "buy" or a "sell")

Portfolio is allocated 32.82% to blended commodities whenever the current CPI is more than 2.543% above its 11-month average level (i.e., approximately 15.26% of the months)

Exhibit 11 provides the bottom line. But with the qualification that like all historical simulations, is subject to data- and rules-mining. I've gone to extensive lengths to minimize these two perils. In the case of data-mining, by utilizing any and all available asset class indices that passed certain pre-specified tests (e.g., quality and non-duplication). In the case of rules-mining, by (i) focusing in on the distribution of all possible 7.5-year investment time periods and within that distribution, only optimizing the single 99.6th-percentile outcome (ii) severely limiting what rules can be changed (e.g., equal-weighting of stock indices is preserved unilaterally), and (iii) utilizing the last 105 years and not the last 40 years (which represent a single era, i.e., falling interest-, discount-, and inflation-rates).

Exhibit 11 reflects a 32.8% allocation to blended commodities during the 15% of the months when inflationary surprise was at its highest level. This resulted in an average commodity allocation of

just 5.0% over the 105 years examined herein. If this allocation seems low, keep in mind that after adjustment for inflation, the commodity blend delivered a positive return during just 51.8% of the months (the last 105 years). This result declines rapidly after the subtraction of transactions costs. If one assumes just 1, 2, 3, or 4bps, then the percentage of positive monthly returns falls to 47%, 42%, 39%, and 36%, respectively. As this exhibit demonstrates, commodities are an incredibly contributive portfolio ingredient, but they must be applied quite rarely and very selectively.

Let's begin our observations with a comparison of Exhibits 1 and 11. Doing so, shows how the right and the wrong inclusion of commodities within a TAA framework impacts the client's experience. I offer the contention that this comparison is not unique to TAA, but applies equally to all strategic or policy asset allocation portfolios. At the 99.6th-, 80th-, and 50th-percentiles, the fully optimized TAA portfolio (utilizing commodities, but only based on inflationary surprise) benefited by 660bps, 350bps, and 110bps, respectively.

Internal to Exhibit 11 is the comparison between the TAA portfolio and its two transaction-free passive index benchmarks. At the 99.6th- and 80th-percentile levels, the TAA portfolio outperformed (after transaction costs) by 630bps and 580bps versus the 25/75 portfolio . . . or by 650bps and 390bps versus the average-weights portfolio. Moreover, at every percentile level, the TAA portfolio delivered a higher return than either of the two passive benchmarks. In evaluating this result, keep in mind that such a result was never sought . . . and the optimization did not seek to achieve such an outcome. This final observation/qualification is highly relevant.

As before, trading into or out of the commodity blend, penalized the TAA portfolio by 100bps (whereas the passive index benchmarks rebalanced cost-free). As mentioned previously, the analysis herein is based on 1,247 unique 7.5-year investment time periods. Ex-post optimization bias is present at the 99.6th-percentile level (since that's the specific, unique level at which optimization was conducted), but the further one moves from the 99.6th-percentile level, the greater such bias converges on zero. At the 50th-percentile level, such bias is negligible.

Do these results feel too good. Sure. But that's because one (worried about such an outcome) has become embedded within our industry's 60-year history of traditional relatively passive balanced portfolios (Michaud 1989, Brown 2024b).

7. CONCLUSIONS

Stocks, bonds, and real estate deliver positive returns (net of inflation) as a result of profits, interest, and rent, respectively. Commodities are different, they offer no inherent positive return. Worse yet, trading commodities at the retail level (i.e., using ETFs or ETNs) entails significant transaction costs. At zero transaction costs, only 51.8% of the months (since Jan 1919) has the commodity blend delivered a positive return. If one assumes just 4bps of transaction costs (unrealistically low), this frequency falls to 36%.

Nevertheless, commodities are incredibly contributive if applied when a metric of inflationary surprise reaches a predetermined and infrequently seen high level. Within the context of a TAA portfolio structure, it was shown that a 32.8% allocation to the commodity blend during the 15% of the months when inflationary surprise was at its highest, added significant benefit.

Nevertheless, pitfalls remain, has one: (i) chosen the correct commodity definition, (ii) avoided forecasts or predictions of future commodity returns, (iii) adequately recognized the declining role for oil and coal in the future, (iv) adopted an appropriate definition of inflationary surprise, and (v) adequately incorporated the transaction costs associated with using commodity ETFs and/or ETNs.

The results herein, were based on a hypothetical client with a 7.5-year investment time horizon who sought to maximize the 99.6th-percentil outcome. Essentially a client focused on tail-risk mitigation. Within this context, the addition of commodities at the 99.6th-, 80th-, and 50th-percentile levels added 300bps, 80bps, and 20bps, respectively (comparing Exhibits 4 and 11). This attractive result was after penalizing the us of commodities with a 100bps one-way transaction cost, either a sell or a buy.

8. REFERENCES

Asness, Clifford, Andrea Frazzini, Ronen Israel, and Tobias Moskowitz. 2014. “Fact, Fiction, and Momentum Investing.” *The Journal of Portfolio Management Special 40th Anniversary Issue Edition: 1-19*

Brown, Rob. 2024a. “Ex-Post Cherry Picking.” *The Journal of Wealth Management*, July 2024, forthcoming

Brown, Rob. 2024b. “The Emperor's New Clothes - Balanced Portfolio Construction.” *The Journal of Investing*, June 2024, forthcoming

Brown, Rob. 2023a. “Risk-mitigated deep value - Bigger bang less buck.” *The Journal of Beta Investment Strategies*, 28 September 2023, DOI 10.3905/jbis.2023.1.046

Brown, Rob. 2023b. “Target Date Funds, Mis-sold and Misused.” *The Journal of Wealth Management*, 19 September 2023. DOI 10.3905/jwm.2023.1.222

Brown, Rob. 2023c. “Inflation Hedging Tools - What Works and What Doesn't.” *The Journal of Investing*, 29 July 2023, DOI 10.3905/joi.2023.1.278

Brown, Rob. 2023d. “Time to Retire the 4% Withdrawal Rule.” *The Journal of Investing*, July 2023, joi.2023.1.264; DOI: <https://doi.org/10.3905/joi.2023.1.264>

Brown, Rob. 2022b. “Winners Repeat, Losers Repeat.” *The Journal of Investing*, August 2022, 31 (5) 119-139; DOI: <https://doi.org/10.3905/joi.2022.1.226>

Brown, Rob. 2018. “Intelligent Rebalancing.” *The Journal of Investing*, Spring 2018, 27 (1) 31-42; DOI: <https://doi.org/10.3905/joi.2018.27.1.031>

Hurst, Brian, Yao Hua Ooi, and Lasse Heje Pedersen. 2017. “A Century of Evidence on Trend-Following Investing.” *The Journal of Portfolio Management* Vol. 44, Issue 1 (Fall): 1-15

Michaud, Richard. 1989. “The Markowitz Optimization Enigma: Is ‘Optimized’ Optimal?” *Financial Analysts Journal* Vol. 45, Issue 1 (Jan-Feb): 31-42