

# The golden rule of investing\*

**Pim van Vliet**

Robeco Asset Management

[p.van.vliet@robeco.com](mailto:p.van.vliet@robeco.com)

**Harald Lohre**

Robeco Asset Management and Lancaster University Management School

[h.lohre@robeco.com](mailto:h.lohre@robeco.com)

June 23, 2023

## **Abstract**

While gold is a volatile asset, it is often considered a safe haven that offers protection during bear markets. We study this safe haven hypothesis by analyzing a strategic allocation to gold for a loss averse investor with a 1-year evaluation horizon. A modest allocation to gold indeed helps to reduce downside risk of traditional stock-bond allocations, yet such risk reduction comes at the cost of return. Conversely, low-volatility stocks are more effective in reducing losses without giving up returns. As a result, a stock-bond-gold allocation considerably benefits from embracing low-volatility stocks, and allows for increasing the equity allocation at the expense of bonds. Notably, the effectiveness of this defensive multi-asset portfolio increases with the investment horizon.

*Keywords:* strategic asset allocation, gold, defensive equities, low-volatility investing, loss aversion, downside risk

*JEL Classification:* G11, G12, G14

\* The authors thank Guido Baltussen, David Blitz, David Buckle, Colin Graham, Rupert Goodwin, Matthias Hanauer, Campbell Harvey, Iman Honarvar, Amar Soebhag, Larry Swedroe, Laurens Swinkels, Bart van Vliet, and participants at the London Quant Group's evening seminar and Robeco's quant research seminar in December 2022 for valuable comments and suggestions. The views expressed in this paper are not necessarily shared by Robeco or its subsidiaries.

Warren Buffet's first rule of investing is to never lose money, while his second rule is to never forget the first rule. This golden rule of investing is key for long-term capital protection and growth, and therefore managing downside risk should be at the very core of investing. Indeed, a safety first portfolio selection rule was already proposed by Roy (1952) seventy years ago. While government bonds are considered a key diversifier to mitigate the downside risk inherent in equity investing, they are not a panacea either. Following the tailwinds coming from a 3-decade long decline in interest rates, 2022 witnessed a regime shift in bond investing which saw central banks raising rates to fight inflation. As a result, government bonds gave very disappointing returns and failed to provide a safe haven amidst geopolitical crises and rapidly increasing inflation.

In times of extreme macroeconomic events including war, hyperinflation or major economic recessions, gold investing is widely regarded as a safe haven, coming with a 4,000+ year track record. The return on gold in USD was flat in 2022, not making up for the large equity and bond losses. Total gold value is estimated at 4.8 trillion USD as of 2022 which represents a significant part of total asset value.<sup>1</sup> Erb and Harvey (2013) critically examine six common arguments often brought forward to support gold investing including the safe haven argument. They reject these arguments, but do recognize that gold is an ultra-long inflation hedge.<sup>2</sup>

Early research on gold investing suggests a small but relevant role of gold in diversifying investors' asset allocation (Jaffe, 1989), with direct gold investments being more effective in reducing portfolio risk than investments in gold stocks (Chua, Sick and Woodward, 1990). Hillier, Draper and Faff (2006) confirm the investment role of gold vis-à-vis other precious metals. Interestingly, Daskalaki and Skiadopoulou (2011) document commodities to be spanned by stocks and bonds in a mean-variance setting but not for non-mean-variance utility functions.<sup>3</sup> Such evidence resonates with Baur and Lucey (2010) who see gold as a hedge against stocks on average but also as a safe haven in extreme stock market conditions. This characteristic relates to the positive skewness in gold returns that contrasts the negative skewness in other asset classes, see Lucey, Tully and Poti (2006). Yet, surveying the literature on the role of gold in a portfolio context, O'Connor et al (2015) note a focus on volatility as the risk metric of choice rather than higher moments of gold returns.

In fact, the empirical asset pricing literature typically opts for volatility as the relevant risk metric, measured based on nominal monthly returns. Since asset returns are not normally distributed it is though important to move beyond volatility and consider downside risk measures. In this vein, Markowitz (1959) follows up on Roy's safety first rule and discusses semi-variance as a better alternative to variance. Similarly, Kahneman and Tversky (1979) criticize mean-variance and popularize the concept of loss aversion; indeed, experimental evidence indicates that investors perceive loss probability as the main risk factor, see Holzmeister et al (2020). Importantly, Benartzi and Thaler (1995) argue that an annual investment horizon is more relevant to the majority of investors, and one

---

<sup>1</sup> Total value is estimated at 4.8 trillion USD by the global world council (2022), compared to 32 trillion USD for the S&P500 index as of end 2022. See Doeswijk, Lam, Swinkels (2014) for an extensive analysis of the composition of the global multi-asset market portfolio.

<sup>2</sup> Erb and Harvey illustrate the ultra-long inflation hedge with the fact that the real wage of a Roman centurion in the first century is pretty close to the wage of a US captain in the 21<sup>st</sup> century measured in gold. Besides the safe haven argument the other five arguments discussed are gold as (1) an inflation hedge, (2) a currency hedge, (3) an alternative asset with low real returns, (4) a return of gold standard, and (5) as 'underowned'. Since the end of the Erb and Harvey's sample, the return on gold was flat (from \$1663 per ounce in 2012 to \$1638 end of 2022), whereas equities went up more than 100% over this period.

<sup>3</sup> Daskalaki, Skiadopoulou, and Topaloglou (2017) arrive at a more favorable stance when they revisit the value-add of commodities in a stochastic dominance framework that encompasses a large variety of utility functions. The value-add of commodities turns out stronger for what the authors call second or third generation commodity indices (which consider long-short commodity style factors related to momentum or the commodity term structure). Such evidence favouring factor-based over index-based commodity investing resonates well with the findings of Blitz and de Groot (2014).

can thus rationalize the equity premium puzzle with loss aversion. Finally, when using a longer horizon it is important to account for inflation. In this vein, Neville et al (2021) show that gold offers high returns during periods of inflation, rendering gold more attractive from a real-return perspective.

We revisit the strategic role of gold in investment portfolios and focus on its marginal downside risk reduction benefits relative to bonds and equities. In addition to focusing on downside risk, our study differs from most of the extant works in terms of considering a longer horizon and accounting for inflation. Specifically, we resort to annual real returns and consult a wider range of downside risk measures. We take the perspective of a US investor who can strategically invest in equities, bonds, and gold.<sup>4</sup> Moreover, we focus on the strategic role of adopting a low-volatility style in the equity allocation to gauge its effectiveness in a multi-asset portfolio as well as its interplay with gold. Black, Jensen and Scholes (1972) found that low-risk stocks give high risk-adjusted returns, and Black (1993) argues that long-term investors could use this insight and reduce their bond allocation to achieve the same risk reduction. Therefore, we let bonds, gold and low-volatility stocks compete head-to-head in a multi-asset portfolio context to empirically examine their ability to serve investors' need for downside risk protection.

We start investigating the safe haven qualities of gold by replicating and extending an analysis of Erb and Harvey (2013). They reject the safe haven hypothesis based on the observation that gold and equities jointly go down 17% of the months. If gold was a genuine safe haven, this number should be close to zero. In the upper left chart of Figure 1, we extend Erb and Harvey's analysis using 10 additional years of monthly gold and equity market returns, and the outcome is similar: we find that equities and gold jointly go down in 17% of the considered months. Conversely, equities are down and gold is up 19% of the months, roughly resonating with a 50/50 chance for gold to show negative returns in a given negative equity month. Thus, gold is not a perfect safe haven when evaluated at a 1-month horizon.

Yet, most investors will scrutinize this matter over longer horizons, say 1-year or more. Therefore, we adapt this analysis in the right chart of Figure 1 to a 3-year horizon and consider real returns rather than nominal returns to correct for money illusion.<sup>5</sup> Through this long-term real return lens, equities give negative real returns only 14% of the time. Moreover, gold and equities went both down only 3% of the time. Hence, gold would have served as a safe haven in some 76% of the observed down markets in equities. Figure 1 clearly shows that this downside protection comes at a cost, since gold is down half of the times when equities are up.<sup>6</sup> Multi-asset investors searching for safe havens will have a natural preference for a low volatility style investment. The bottom two graphs show two important insights: First, low volatility investing comes with less negative real return observations that are considerably less severe. Second, gold seems particularly able to remedy in these events, especially relative to the case of an equity market investment.

The key findings of our empirical study starting in 1975 using 1-year real returns are summarized in Figure 2. A modest gold allocation in a traditional mix of equities and bonds reduces the risk of capital losses by around 10 percent across a wide range of equity-bond allocations. Still, adding gold also reduces the return leading to a small increase in the Sortino ratio, which measures the return per unit of downside volatility. Importantly, the downside risk can be reduced even more by adopting a low-

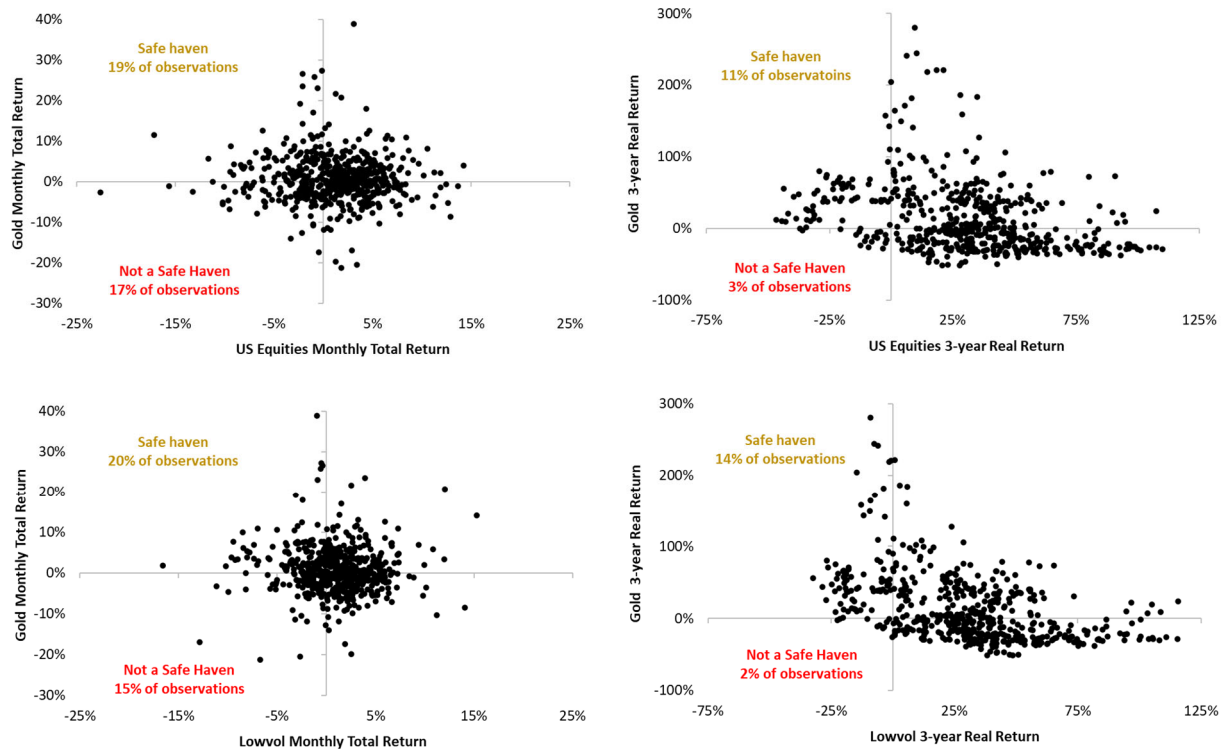
---

<sup>4</sup> Regarding different perspectives, see Baur and McDermott (2010) who investigate the safe haven qualities of gold in international equity markets or Reboredo (2013) who documents the hedging qualities of gold with respect to exchange rate movements.

<sup>5</sup> The difference between nominal and real returns is not significant on a monthly horizon, but this difference increases with the length of the investment horizon. By using nominal returns one would implicitly assume investors to suffer from money illusion (Shafir and Tversky, 1997). Money illusion is a serious bias affecting investors and can be linked to the low-beta anomaly (Cohen et al, 2005).

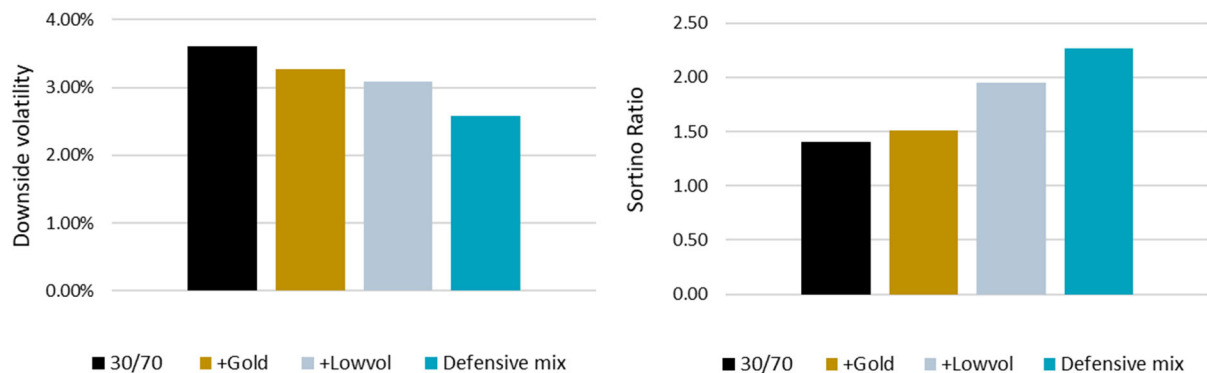
<sup>6</sup> Note that these 3-year returns contain overlapping returns by construction and represent around 20 independent observations given the sample size. To strike the right balance between investment horizon, rebalancing frequency, and statistical power our subsequent analyses are based on a 1-year horizon.

**Figure 1: Gold and Low-volatility, 1975-2022**



volatility style in the equity investment and letting this defensive equity allocation replace part of the bond allocation. This defensive equity allocation at the expense of bonds increases the return leading to a significantly higher return/risk ratio when compared to adding gold. Still, a defensive mix which augments the latter portfolio a modest allocation to gold has significantly lower downside risk than a traditional equity-bond portfolio, with higher returns leading to the largest increase in the Sortino ratio.<sup>7</sup> Thus, this defensive strategy is effective in adhering to the golden rule of investing, while still delivering long-term capital growth. In the rest of this paper, we consider a wide range of downside risk metrics and carry out different robustness test by (1) varying the investment horizon, (2) comparing different ways of getting gold exposure and (3) investigating the relevance of gold vis-à-vis oil.

**Figure 2: Four defensive portfolios**



<sup>7</sup> The +Gold portfolio allocates 10% to Gold, 23% to Equities, and 67% to Bonds. The +Lowvol portfolio is a 50/50 mix of Low Volatility Equities and Bonds. The Defensive mix portfolio allocates 10% to Gold and 45% to Low Volatility Equities and Bonds. See Exhibit 10 for the depicted statistics.

## 1. The role of gold in downside risk reduction

To gauge the effectiveness of gold in lowering total downside risk in a multi-asset portfolio context, we start our investigation in January 1975 when gold became truly tradeable. The return on gold is based on its spot price (Gold Bullion LBM \$/t oz), equities are the value-weighted US stock market (CRSP), and bonds are the 10-year government bonds (FRED).<sup>8</sup> Their annualized real return and risk figures are collected in Table 1.

**Table 1: Equities, bonds, and gold, 1975-2022**

1-year horizon	Equities	Bonds	Gold
Real return	8.0%	3.3%	1.5%
Downside volatility	7.9%	5.3%	11.3%
Sortino ratio	1.01	0.62	0.13
Loss probability	24.9%	34.6%	49.7%
Expected loss	-3.1%	-2.5%	-6.1%
Minimum return	-42.2%	-25.3%	-46.1%

The real returns for equities, bonds and gold are 8.0%, 3.3% and 1.5%, respectively. The risk of gold is high on a stand-alone basis, e.g., its downside volatility is 11.3% compared to 7.9% for equities and 5.3% for bonds. The downside volatility, or semi-deviation, is the second lower partial moment (LPM 2) which we compute based on real returns using a target threshold of 0.<sup>9</sup> The Sortino ratio, which measures the return per unit of downside volatility, is 1.01 for equities, 0.62 for bonds and only 0.13 for gold. Judging by the loss probability (LPM 1), expected loss (LPM 0), and minimum return, gold is riskier than both equities and bonds. Notably, bonds have a 34.6% probability of loss, which is lower than that of gold (49.7%), but higher than that of equities (24.9%).

To shed further light on the underlying dynamics, Figure 3 shows the annual correlations between equities, gold and bonds over a rolling 5-year period. While these correlations are around zero over the full sample period, they display significant time-variation. The gold-equity correlation shows less fluctuations than the bond-equity correlation. Following the start of the sample the bond-equity correlation is around 50% for a prolonged period of time. During the first two decades of the 21<sup>st</sup> century the correlation becomes significantly negative, only to go up sharply again around the 2020s. By contrast, the equity-gold correlation is more stable over time varying between +/-25%. The low and stable correlation of gold and equities is an attractive feature for investors.

To get a sense of the relevance of gold in a multi-asset context, we next consider a plain 50/50 equity-bond portfolio to which one sequentially adds 5 percent gold allocation increments up until one is fully invested in gold. Given an annual horizon, rebalancing to the respective target weights of a given balanced portfolio (e.g., 50/50) has two additional benefits compared to a monthly rebalanced portfolio. First, monthly rebalancing involves a significant amount of turnover, which is reduced at an annual rebalancing frequency. In addition, annual rebalancing gives positive exposure to factor and asset momentum (Ehsani and Linnainmaa, 2022). Since we use overlapping returns and thus rebalance 1/12 of the portfolio each month, rebalancing luck is also mitigated (Hoffstein and Faber, 2019).<sup>10</sup> Figure 4

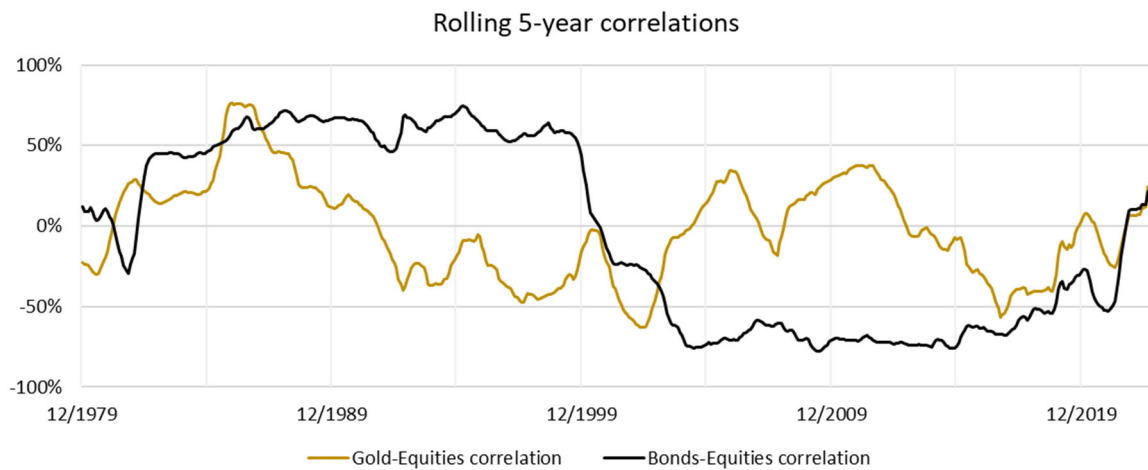
<sup>8</sup> The FRED 10-year yields are translated into bond returns as described by Swinkels (2019): [Data | Free Full-Text | Treasury Bond Return Data Starting in 1962 \(mdpi.com\)](#).

<sup>9</sup> This is equivalent to computing downside volatility based on total returns but using inflation as the target threshold.

<sup>10</sup> Appendix A shows that annual rebalancing enhances returns by +12bps relative to monthly rebalancing, of which 9bps are due to harvesting momentum effects and 3bps are due to transaction cost savings.

plots the average realized return versus downside volatility (also referred to as semi-deviation, again with inflation as the target threshold).<sup>11</sup> The 'nose' of the efficient frontier shows that the minimum risk portfolio is made up of 45/45/10 in equities, bonds, and gold, respectively. This portfolio brings down downside volatility to 3.7% relative to the original 50/50 stock-bond portfolio (3.9%). Allocating more than 20 percent to gold leads to higher risk and lower return portfolios which are clearly inefficient.

**Figure 3: Correlation of equities, bonds and gold over time**



**Figure 4: Return and downside volatility of equity-bond-gold allocations**

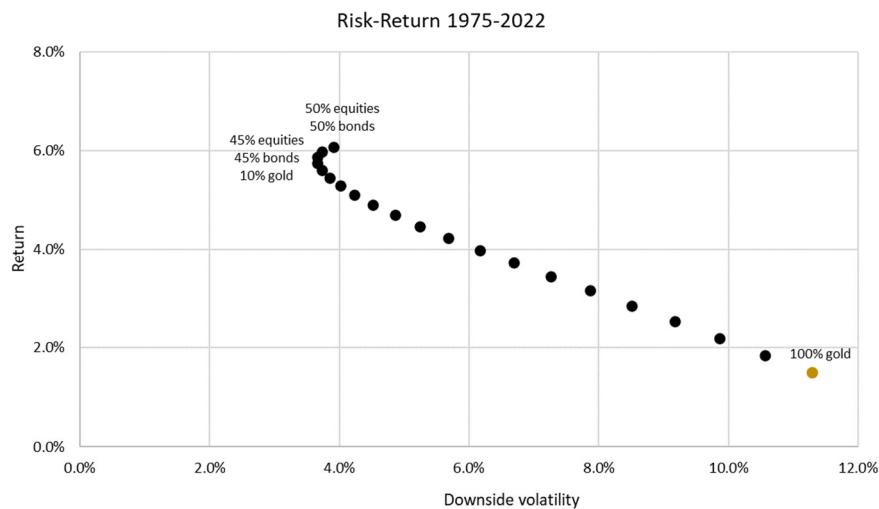


Table 2 shows the return, the three lower partial moments, Sortino ratio, as well as the minimum return across the different portfolio combinations (again using inflation as the threshold), where gold is added in 5 percent increments up to 50 percent (replacing the existing balanced mix in each step). Depending on the choice of risk measure, the optimal gold allocation varies between 10 and 20 percent. The 50/50

<sup>11</sup> Note that downside volatility is not the volatility of the negative return observations, but the square root of the average of the squared negative returns. To illustrate, suppose an asset has a return of -10% half of the considered months, and a return of +10% in all other months. Then, the volatility conditional on returns being negative is zero (no variation in downside returns), but the downside volatility is 7.1% (-10% is below the threshold of 0%).

equity-bond portfolio has a loss probability of 26.6% which a gold allocation can reduce to 22.4%. However, the obtained improvements in downside volatility are fairly modest and come at the cost of returns. Thus, there is only a slight upside in Sortino ratio relative to a traditional stock-bond allocation; it is highest for a 10 percent allocation to gold (1.61 versus 1.56 at 0% gold).

**Table 2: Adding gold to a 50/50 equity-bond portfolio, 1975-2022**

1-year horizon	0	5	10	15	20	25	30	35	40	45	50
Real return	6.1%	6.0%	5.9%	5.8%	5.6%	5.5%	5.3%	5.1%	4.9%	4.7%	4.5%
Downside volatility	3.9%	3.7%	<b>3.7%</b>	3.7%	3.7%	3.8%	4.0%	4.2%	4.5%	4.9%	5.2%
Sortino ratio	1.56	1.61	<b>1.61</b>	1.57	1.50	1.42	1.32	1.21	1.09	0.97	0.85
Loss probability	26.6%	24.3%	<b>22.4%</b>	22.6%	22.6%	22.0%	23.8%	26.8%	27.5%	29.7%	32.1%
Expected loss	-1.6%	-1.4%	-1.3%	<b>-1.3%</b>	-1.3%	-1.4%	-1.4%	-1.6%	-1.7%	-1.9%	-2.2%
Minimum return	-24.8%	-24.2%	-23.6%	-23.0%	<b>-22.4%</b>	-22.7%	-24.3%	-25.8%	-27.4%	-29.0%	-30.5%

While we have held the equity-bond combination fixed at 50/50 so far, Table 3 shows the downside volatility across a rich spectrum of equity-bond-gold allocations. The 50/50 column corresponds to the downside volatility row displayed in Table 2. This analysis allows to broadly gauge the downside risk diversification benefits of gold. The minimum downside volatility of 3.3% obtains when joining a 10 percent gold allocation to a 30/70 equity-bond portfolio. Note that this minimum risk portfolio is close to the classic risk parity portfolio that would equalize the risk contributions coming from the three asset classes.<sup>12</sup> Interestingly, the downside volatility of this ‘gilded mix’ is lower than that of the 30/70 equity-bond mix (3.6%) and lower than that of bonds (5.2%). Thus, adding 30 percent equities to bonds reduces downside volatility by 1.6 percentage points and further adding 10 percent gold reduces downside volatility by 0.3 percentage points. In other words, gold helps to reduce downside volatility by 10% relative to the fixed equity-bond mix, and this finding applies across the full range of stock-bond allocations, except for very stock-heavy allocations where the relative reduction is around 15%.

**Table 3: Downside volatility for a wide spectrum of equity-bond-gold allocations, 1975-2022**

Equities	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
Bonds	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	
Gold	0	0.053	0.048	0.045	0.041	0.039	0.037	0.036	0.036	0.037	0.039	0.042	0.045	0.048	0.052	0.056	0.061	0.065	0.070	0.075	0.079	
	5	0.048	0.044	0.041	0.038	0.036	0.034	0.033	0.033	0.034	0.035	0.037	0.040	0.043	0.046	0.050	0.054	0.058	0.062	0.067	0.071	0.076
	10	0.046	0.042	0.039	0.036	0.035	0.033	<b>0.033</b>	0.033	0.033	0.035	0.037	0.039	0.042	0.045	0.048	0.052	0.056	0.060	0.064	0.068	0.072
	15	0.045	0.042	0.039	0.037	0.035	0.034	0.033	0.033	0.034	0.035	0.037	0.039	0.041	0.044	0.047	0.050	0.054	0.057	0.061	0.065	0.069
	20	0.046	0.043	0.040	0.038	0.036	0.035	0.035	0.035	0.036	0.037	0.039	0.041	0.044	0.046	0.049	0.052	0.056	0.059	0.063	0.066	0.066
	25	0.047	0.044	0.042	0.040	0.039	0.037	0.036	0.037	0.037	0.038	0.040	0.042	0.044	0.046	0.049	0.051	0.054	0.057	0.061	0.064	0.064
	30	0.049	0.047	0.044	0.043	0.041	0.040	0.039	0.039	0.039	0.040	0.041	0.043	0.045	0.047	0.049	0.051	0.054	0.056	0.059	0.062	0.062
	35	0.051	0.049	0.047	0.046	0.044	0.043	0.042	0.042	0.042	0.042	0.043	0.044	0.046	0.047	0.049	0.051	0.053	0.056	0.058	0.060	0.060
	40	0.054	0.052	0.050	0.049	0.048	0.047	0.046	0.045	0.045	0.045	0.046	0.047	0.048	0.049	0.050	0.052	0.054	0.056	0.058	0.060	0.060
	45	0.057	0.056	0.054	0.053	0.051	0.050	0.050	0.049	0.049	0.048	0.049	0.049	0.049	0.050	0.051	0.052	0.053	0.055	0.056	0.058	0.060
	50	0.061	0.059	0.058	0.057	0.056	0.055	0.054	0.053	0.053	0.053	0.052	0.052	0.053	0.053	0.054	0.054	0.055	0.056	0.057	0.059	0.060
	55	0.065	0.064	0.062	0.061	0.060	0.059	0.059	0.058	0.057	0.057	0.057	0.057	0.057	0.057	0.058	0.058	0.058	0.059	0.060	0.060	0.061
	60	0.069	0.068	0.067	0.066	0.065	0.064	0.064	0.063	0.062	0.062	0.062	0.061	0.061	0.061	0.061	0.062	0.062	0.062	0.063	0.063	0.064
	65	0.074	0.073	0.072	0.071	0.070	0.070	0.069	0.068	0.068	0.067	0.067	0.067	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.067	0.067
	70	0.079	0.078	0.077	0.076	0.076	0.075	0.075	0.074	0.073	0.073	0.073	0.072	0.072	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071
	75	0.084	0.083	0.083	0.082	0.082	0.081	0.080	0.080	0.079	0.079	0.079	0.078	0.078	0.078	0.077	0.077	0.077	0.077	0.077	0.077	0.077
	80	0.089	0.089	0.088	0.088	0.087	0.087	0.087	0.086	0.086	0.085	0.085	0.085	0.084	0.084	0.084	0.084	0.083	0.083	0.083	0.083	0.083
	85	0.095	0.095	0.094	0.094	0.094	0.093	0.093	0.093	0.092	0.092	0.092	0.091	0.091	0.091	0.091	0.090	0.090	0.090	0.090	0.090	0.089
	90	0.101	0.101	0.100	0.100	0.100	0.100	0.099	0.099	0.099	0.099	0.098	0.098	0.098	0.098	0.098	0.097	0.097	0.097	0.097	0.097	0.097
	95	0.107	0.107	0.107	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
	100	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113

<sup>12</sup> The risk parity portfolio consists of 31% equities, 47% bonds and 22% gold based on the inverse of the downside 1-year volatility.



## 2. Defensive equity investing and gold

To follow the golden rule of investing in equities, there has been longstanding evidence for allocating to equity styles in order to avoid unrewarded risk and limit capital losses. In this regard, it is well-known that equity market risk is not priced in the cross-section of equities, and stocks with low (systematic) volatility outperform risky stocks, see Black, Jensen, and Scholes (1972) and Fama and French (1992). This lack of a positive risk/return relation within equity markets represents one of the largest anomalies in finance and prompted Black (1993) to advocate strategically allocating to low-risk stocks to improve the risk/return profile of a given balanced equity-bond portfolio, enabling investors to allocate more to defensive equities and less to bonds.<sup>13</sup>

To illustrate, Table 4 shows the risk and return characteristics of the equity market portfolio vis-à-vis a low-volatility investment, as well as five other equity factor styles. The equity styles are represented by the large cap (above median NYSE) value weighted returns portfolios of US stocks sorted on market capitalization (Size), book-to-price (Value), profitability (Prof), investment (Inv), 12-1 month return (Mom), and 36-months volatility (Vol).<sup>14</sup>

**Table 4: Equity factor portfolios, 1975-2022**

1-year horizon	Market	Size	Value	Prof	Inv	Mom	Vol
Real return	8.0%	9.4%	7.9%	9.2%	10.4%	10.3%	8.3%
Downside volatility	7.9%	9.5%	8.4%	6.7%	6.1%	8.1%	5.4%
Sortino ratio	0.95	0.93	0.87	1.28	1.60	1.20	1.42
Loss probability	24.9%	29.5%	25.6%	22.7%	22.0%	23.8%	24.2%
Expected loss	-3.1%	-4.2%	-3.5%	-2.6%	-2.1%	-3.1%	-1.9%
Minimum return	-42.2%	-45.5%	-36.3%	-34.4%	-40.0%	-40.5%	-26.7%

Low-volatility equity investing does indeed reduce risk compared to a classic equity market investment on all dimensions, whereas most remaining equity factor strategies have similar or higher risk than the market. Momentum offers high compounded real return, but also has high downside risk. Profitability and investments have somewhat more conservative characteristics compared with the size, value, and momentum factor portfolios. Unsurprisingly, low-volatility investing comes at very low downside risks, yet, it gives real return outcomes on par with the broad equity market (8.3% versus 8.0% for the market). Clearly, the defensiveness from low-volatility investing does not merely derive from an allocation effect but also from the benign relative return pattern of low volatility stocks that tends to play out in extreme market turmoil. As a result, low-volatility also has a high Sortino ratio of 1.42.<sup>15</sup>

In light of this evidence, we broaden our quest for a minimum risk portfolio by replacing the equity market with the defensive low-volatility equity style and investigate a wide range of possible combinations of low-volatility stocks, bonds, and gold in Table 5. From a downside risk perspective,

<sup>13</sup> There are several explanations of the low-risk anomaly, and Frazzini and Pedersen (2014) emphasize leverage constraints as dominant reason why low-risk stocks outperform high-risk stocks in terms of risk-adjusted returns. This leverage constraint is not binding for a multi-asset investor with a significant allocation to bonds.

<sup>14</sup> Double-sorted into portfolios. Equity factor portfolios are based on 2x3 double sorts with size and are taken from [www.robeco.com/~data-sets](http://www.robeco.com/~data-sets) and from [mba.tuck.dartmouth.edu/~ken.french/data\\_library](http://mba.tuck.dartmouth.edu/~ken.french/data_library).

<sup>15</sup> Note that a multi-factor defensive equity portfolio which integrates the main factors into one decile portfolio achieves a Sortino ratio of 2.28. In this vein, Blitz and Van Vliet (2018) advocate a conservative equity portfolio which contains the top 10 percent of stocks with below average volatility, high income and positive momentum. The authors demonstrate that this conservative portfolio gives above average returns at lower downside risk, a finding which is robust across US and international equity markets.



there is also a role for gold in the defensive equities and bond mix. A 10% gold allocation leads to the lowest downside volatility for a 50/50 equity-bond portfolio. Black's (1993) recommendation to allocate more to defensive equities at the expense of bonds is also apparent from Table 5, with the greenest area of optimal downside volatility shifting to the right relative to Table 3. The lowest downside volatility in Table 4 is 3.3% for a 30/70 equity-bond allocation together with 10 percent gold. This downside volatility can be further reduced to 2.6%, with a higher allocation to low-volatility stocks and a lower allocation to bonds. The defensive multi-asset portfolio thus consists of a 45/45/10 allocation to bonds, low-volatility stocks and gold, respectively.

**Table 5: Downside volatility of low-volatility-bond-gold allocations, 1975-2022**

Lowvol Bonds →	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	
Gold ↓	0	0.053	0.049	0.045	0.042	0.039	0.037	0.035	0.033	0.032	0.031	0.031	0.031	0.032	0.034	0.036	0.038	0.041	0.044	0.047	0.050	0.054
	5	0.048	0.044	0.041	0.038	0.035	0.032	0.030	0.029	0.028	0.027	0.027	0.028	0.029	0.030	0.032	0.035	0.037	0.040	0.043	0.047	0.050
	10	0.046	0.042	0.039	0.036	0.033	0.031	0.029	0.027	0.026	0.026	<b>0.026</b>	0.026	0.027	0.029	0.030	0.033	0.035	0.038	0.040	0.043	0.046
	15	0.045	0.042	0.039	0.036	0.033	0.031	0.029	0.028	0.027	0.026	0.026	0.026	0.027	0.028	0.030	0.031	0.034	0.036	0.038	0.041	0.044
	20	0.046	0.043	0.040	0.037	0.035	0.033	0.031	0.029	0.028	0.027	0.027	0.027	0.028	0.028	0.030	0.031	0.033	0.035	0.037	0.039	0.042
	25	0.047	0.044	0.042	0.039	0.037	0.035	0.033	0.032	0.030	0.029	0.029	0.029	0.029	0.030	0.031	0.033	0.034	0.036	0.038	0.040	0.042
	30	0.049	0.046	0.044	0.042	0.040	0.038	0.036	0.034	0.033	0.032	0.031	0.031	0.031	0.032	0.032	0.033	0.035	0.036	0.037	0.039	0.041
	35	0.051	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.037	0.035	0.035	0.034	0.034	0.034	0.034	0.035	0.036	0.037	0.038	0.039	0.041
	40	0.054	0.052	0.050	0.048	0.046	0.045	0.043	0.042	0.040	0.039	0.038	0.038	0.037	0.037	0.037	0.037	0.037	0.038	0.038	0.039	0.040
	45	0.057	0.055	0.054	0.052	0.050	0.049	0.047	0.046	0.045	0.044	0.043	0.042	0.041	0.041	0.041	0.040	0.040	0.041	0.041	0.041	0.042
	50	0.061	0.059	0.058	0.056	0.054	0.053	0.052	0.051	0.049	0.048	0.047	0.047	0.046	0.045	0.045	0.044	0.044	0.044	0.044	0.044	0.045
	55	0.065	0.063	0.062	0.061	0.059	0.058	0.057	0.055	0.054	0.053	0.052	0.052	0.051	0.050	0.050	0.049	0.049	0.049	0.048	0.048	0.048
	60	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.061	0.060	0.059	0.058	0.057	0.056	0.056	0.055	0.055	0.054	0.054	0.053	0.053	0.053
	65	0.074	0.073	0.072	0.071	0.069	0.068	0.067	0.066	0.066	0.065	0.064	0.063	0.062	0.062	0.061	0.060	0.059	0.059	0.059	0.059	0.058
	70	0.079	0.078	0.077	0.076	0.075	0.074	0.073	0.072	0.072	0.071	0.070	0.069	0.069	0.068	0.067	0.067	0.066	0.066	0.065	0.065	0.064
	75	0.084	0.083	0.082	0.082	0.081	0.080	0.079	0.079	0.078	0.077	0.077	0.076	0.075	0.074	0.074	0.073	0.073	0.073	0.072	0.072	0.071
	80	0.089	0.089	0.088	0.088	0.087	0.086	0.086	0.085	0.085	0.084	0.084	0.083	0.082	0.082	0.081	0.081	0.081	0.080	0.080	0.079	0.079
	85	0.095	0.095	0.094	0.094	0.093	0.093	0.092	0.092	0.091	0.091	0.091	0.090	0.090	0.089	0.089	0.089	0.088	0.088	0.087	0.087	0.087
	90	0.101	0.101	0.100	0.100	0.100	0.099	0.099	0.099	0.098	0.098	0.098	0.097	0.097	0.097	0.096	0.096	0.096	0.096	0.095	0.095	0.095
	95	0.107	0.107	0.107	0.106	0.106	0.106	0.106	0.106	0.106	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.104	0.104	0.104	0.104	0.104
	100	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113

Table 6 juxtaposes the different variants in one place, featuring the respective portfolios with the lowest downside volatility. We show the 30/70 equity-bond portfolio which is optimal from a high level equity-bond allocation perspective as well as the 50/50 low-volatility equity-bond portfolio. Thus, we can directly compare the impact of adding gold for these two different portfolios. Adding 10 percent gold to each of the defensive equity-bond mixes brings the downside volatility down by 0.3 and 0.5 percentage points, corresponding to a relative reduction of 10% to 20%.

**Table 6: Four defensive portfolios, 1975-2022**

1-year horizon	30 Equities 70 Bonds	27 Equities 63 Bonds 10 Gold	50 Lowvol 50 Bonds	45 Lowvol 45 Bonds 10 Gold
Real return	5.0%	4.9%	6.0%	5.8%
Downside volatility	3.6%	3.3%	3.1%	2.6%
Sortino ratio	1.40	1.51	1.95	2.27
Loss probability	24.3%	24.2%	26.1%	21.7%
Expected loss	-1.3%	-1.1%	-1.3%	-0.9%
Minimum return	-24.0%	-23.1%	-19.1%	-16.3%
Equity beta	0.37	0.32	0.41	0.36
Bond beta	0.77	0.67	0.71	0.62
Gold beta	-0.04	0.06	-0.08	0.03

The return goes down by 0.1% and 0.2%, and, as a result, the Sortino ratio goes up by 0.11 and 0.32, respectively. The loss probability stays the same or improves, as well as expected loss and minimum return figures. Thus, by shifting the equity portfolio towards low-volatility stocks and diversifying across bonds and gold, one can effectively minimize downside risk without giving up much return (if any). Henceforth, we will refer to the 45/45/10 portfolio as the defensive mix. Compared to the 30/70 portfolio the equity beta is on par, the bond beta reduces from 0.77 to 0.62 and the gold beta goes from -0.04 to 0.03

### 3. Robustness over investment horizons and through time

#### 3.1 Classic mean-variance setup

The results presented so far deviate in many important aspects from classic gold studies, namely in using real returns over an annual investment horizon to investigate the downside risk mitigation benefits of gold. The presented evidence suggests a low two-digit allocation to gold. In this section, we resort to the classic approach that would apply a 1-month horizon and use nominal returns. The upper row of Table 7 focuses on the corresponding outcome in terms of Sortino ratio. In the case of pure equity market investments (upper left chart), the maximum Sortino ratio emerges for a 5% gold allocation added to the 65/35 bond-equity mix. Hence, the relevance of gold is muted given the shorter investment horizon, but still meaningful in reducing downside risk. Yet, from a mean-variance perspective (lower left chart), even small gold allocations can hardly improve upon the various bond-equity mixes.

Switching the equity allocation to low volatility equity also sees a reduced relevance of gold. While the peculiar interaction of gold and low-volatility equity does not show on shorter investment horizons, we though note that the contribution of low volatility in boosting higher risk-adjusted returns is material relative to the naïve base case, not only from a Sortino perspective but also from a mean-variance perspective.

Table 7: Monthly nominal returns, Sharpe and Sortino Ratio, 1975-2022

Sortino   Monthly Equities		Equities																				
Bonds		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Gold	0	0.66	0.78	0.90	1.00	1.08	1.13	1.15	1.15	1.13	1.11	1.08	1.04	1.01	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.78
	5	0.68	0.80	0.91	1.01	1.09	1.14	1.16	1.16	1.15	1.12	1.09	1.06	1.03	0.99	0.96	0.93	0.90	0.87	0.85	0.82	0.80
	10	0.67	0.79	0.90	0.99	1.06	1.12	1.14	1.15	1.14	1.12	1.10	1.06	1.03	1.00	0.97	0.94	0.91	0.88	0.86	0.83	0.81
	15	0.66	0.76	0.86	0.95	1.02	1.07	1.10	1.11	1.11	1.10	1.08	1.05	1.03	1.00	0.97	0.94	0.92	0.89	0.87	0.84	0.82
	20	0.62	0.72	0.80	0.88	0.94	0.99	1.03	1.05	1.05	1.05	1.04	1.02	1.00	0.98	0.96	0.93	0.91	0.89	0.87	0.85	0.83
	25	0.58	0.66	0.73	0.80	0.86	0.90	0.94	0.96	0.98	0.98	0.98	0.97	0.96	0.95	0.93	0.91	0.89	0.87	0.86	0.84	0.82
	30	0.53	0.59	0.66	0.71	0.76	0.81	0.84	0.87	0.89	0.90	0.91	0.91	0.90	0.90	0.89	0.88	0.86	0.85	0.84	0.82	0.81
	35	0.47	0.53	0.58	0.63	0.67	0.71	0.74	0.77	0.79	0.81	0.82	0.83	0.83	0.83	0.83	0.82	0.81	0.80	0.80	0.79	0.79
	40	0.42	0.46	0.51	0.55	0.59	0.62	0.65	0.68	0.70	0.72	0.73	0.75	0.76	0.76	0.77	0.77	0.77	0.76	0.76	0.75	0.75
	45	0.37	0.40	0.44	0.47	0.51	0.54	0.56	0.59	0.61	0.63	0.65	0.67	0.68	0.69	0.70	0.70	0.71	0.71	0.71	0.71	0.71
	50	0.32	0.35	0.38	0.41	0.43	0.46	0.48	0.51	0.53	0.55	0.56	0.58	0.59	0.61	0.62	0.62	0.63	0.64	0.64	0.65	0.65
	55	0.28	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.50	0.51	0.53	0.54	0.55	0.56	0.57	0.58	0.58	0.59
	60	0.24	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.46	0.48	0.49	0.50	0.51	0.52	0.52
	65	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.33	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.45
	70	0.17	0.18	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39
	75	0.14	0.15	0.16	0.17	0.18	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.34	0.35
	80	0.12	0.12	0.13	0.14	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.23	0.24	0.25	0.25	0.26	0.27
	85	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.18	0.18	0.19
	90	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13
	95	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08
	100	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

Sortino   Monthly Lowvol		Lowvol																				
Bonds		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Gold	0	0.66	0.79	0.91	1.03	1.14	1.24	1.31	1.36	1.38	1.39	1.38	1.36	1.34	1.31	1.28	1.25	1.21	1.18	1.15	1.13	1.10
	5	0.68	0.80	0.92	1.04	1.15	1.25	1.32	1.37	1.40	1.41	1.40	1.39	1.36	1.33	1.30	1.27	1.24	1.21	1.18	1.15	1.12
	10	0.67	0.79	0.91	1.02	1.13	1.22	1.30	1.35	1.38	1.40	1.40	1.39	1.37	1.34	1.31	1.28	1.25	1.22	1.20	1.17	1.14
	15	0.66	0.76	0.87	0.98	1.07	1.16	1.23	1.29	1.33	1.35	1.36	1.35	1.34	1.32	1.30	1.28	1.25	1.23	1.20	1.17	1.15
	20	0.62	0.72	0.81	0.90	0.99	1.07	1.14	1.19	1.24	1.27	1.28	1.29	1.29	1.28	1.26	1.25	1.23	1.21	1.19	1.16	1.14
	25	0.58	0.66	0.74	0.82	0.89	0.96	1.02	1.08	1.12	1.16	1.18	1.20	1.20	1.20	1.20	1.19	1.18	1.17	1.15	1.14	1.12
	30	0.53	0.59	0.66	0.73	0.79	0.85	0.90	0.95	0.99	1.03	1.06	1.08	1.10	1.11	1.11	1.11	1.11	1.11	1.10	1.09	1.08
	35	0.47	0.53	0.58	0.64	0.69	0.74	0.79	0.83	0.87	0.90	0.93	0.96	0.98	1.00	1.01	1.02	1.02	1.03	1.03	1.02	1.02
	40	0.42	0.46	0.51	0.55	0.60	0.64	0.68	0.72	0.75	0.78	0.81	0.84	0.86	0.88	0.90	0.91	0.92	0.93	0.94	0.94	0.95
	45	0.37	0.40	0.44	0.47	0.51	0.55	0.58	0.62	0.65	0.67	0.70	0.73	0.75	0.77	0.79	0.81	0.82	0.83	0.84	0.85	0.86
	50	0.32	0.35	0.38	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.73	0.74	0.76	0.77
	55	0.28	0.30	0.33	0.35	0.37	0.40	0.42	0.44	0.47	0.49	0.51	0.53	0.55	0.57	0.58	0.60	0.62	0.63	0.65	0.66	0.67
	60	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.37	0.39	0.41	0.43	0.45	0.46	0.48	0.49	0.51	0.52	0.54	0.55	0.56	0.58
	65	0.20	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.46	0.47	0.49
	70	0.17	0.18	0.20	0.21	0.22	0.23	0.25	0.26	0.27	0.28	0.29	0.30	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.40
	75	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.35
	80	0.12	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.32
	85	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.18	0.18	0.19
	90	0.07	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13
	95	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08
	100	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

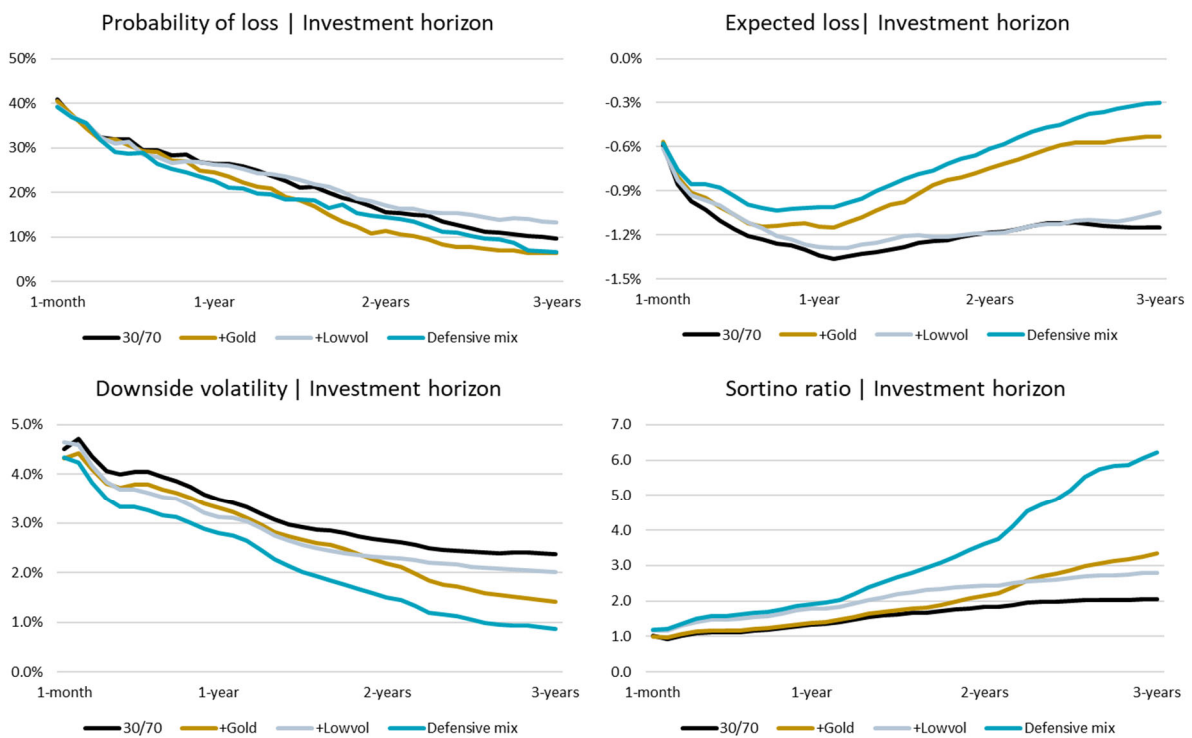
  

Sharpe   Monthly Equities		Equities																				
Bonds		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Gold	0	0.37	0.42	0.47	0.52	0.56	0.59	0.61	0.62	0.63	0.63	0.62	0.61	0.60	0.60	0.59	0.58	0.57	0.56	0.55	0.55	0.55
	5	0.37	0.42	0.48	0.52	0.56	0.59	0.61	0.63	0.63	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55
	10	0.37	0.42	0.47	0.51	0.55	0.58	0.60	0.62	0.63	0.63	0.62	0.61	0.60	0.59	0.58	0.57	0.56	0.55	0.55	0.55	0.55
	15	0.36	0.41	0.45	0.50	0.53	0.56	0.58	0.60	0.61	0.61	0.61	0.61	0.60	0.60	0.59	0.58	0.57	0.56	0.55	0.55	0.55
	20	0.35	0.39	0.43	0.47	0.50	0.53	0.55	0.57	0.58	0.59	0.59	0.59	0.58	0.58	0.57	0.57	0.56	0.55	0.55	0.55	0.55
	25	0.33	0.37	0.40	0.44	0.46	0.49	0.51	0.53	0.54	0.55	0.56	0.57	0.57	0.56	0.56	0.56	0.55	0.55	0.55	0.55	0.54
	30	0.31	0.34	0.37	0.40	0.43	0.45	0.47	0.49	0.50	0.51	0.52	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.55	0.55
	35	0.29	0.31	0.34	0.36	0.39	0.41	0.43	0.44	0.46	0.47	0.48	0.49	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	40	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.48	0.48	0.49	0.49	0.49	0.49
	45	0.24	0.26	0.28	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.45	0.46	0.46	0.46	0.46
	50	0.23	0.24	0.26	0.27	0.29	0															

### 3.2 Varying the investment horizon

All previous results are based on assuming a 12-month investment horizon. To demonstrate robustness of results across horizons, Figure 5 shows the downside risk statistics for a wide range of horizons ranging from 1-month up to 36-months. In line with results from Section 3.1, the downside risk reduction is more pronounced at larger investment horizons. The added value of replacing 30% equities and 20% bonds with 50% low-volatility is robust across all investment horizons. The downside volatility is similar up to a 9-month horizon, and consistently becomes smaller beyond this horizon. Since return is also higher, the Sortino ratio is consistently higher across all horizons and becomes more important at a longer horizon for which the gap with the 50/50 portfolio further widens for all three risk metrics. These findings are in line with Levhari and Levy (1977) who find that a longer investment horizon leads to higher risk-adjusted returns for low-risk equity portfolios. The added value of gold is also visible across all investment horizons. As a result, the increase in Sortino ratio is smaller for investment horizons shorter than 1-year and steadily becomes larger for horizons longer than 1-year.

Figure 5: Investment horizon analysis



### 3.3 Annual returns

Another simple way to look at risk and return is to look at calendar year returns which resonates with the annual lens that we have applied throughout this paper. The average return is 5.0% for the 30/70 equity-bond portfolio, compared to 6.2% for the 45/45/10 defensive mix portfolio. Figure 6 shows that the calendar year returns of the 30/70 portfolio were consistently negative in the late 1970s with four negative return years in a row. The defensive mix mitigated these losses and posted a positive return in 1979 and 1981. On the other hand, the defensive mix has more negative calendar year returns in the 1990s. In 1990, 1994 and 1999 the portfolio yielded a negative return, lower than that of the 30/70 portfolio. The 2000s and 2010s were characterized by a highly favorable period for 30/70 investors with hardly any negative calendar year return. More recently, the 30/70 portfolio yet suffered significant

losses in 2018, 2021 and especially 2022. Notwithstanding, the defensive portfolio was able to outperform and reduce losses in these years, similar to the earlier period before the 1990s.

**Figure 6: Calendar year returns, 1975-2022**

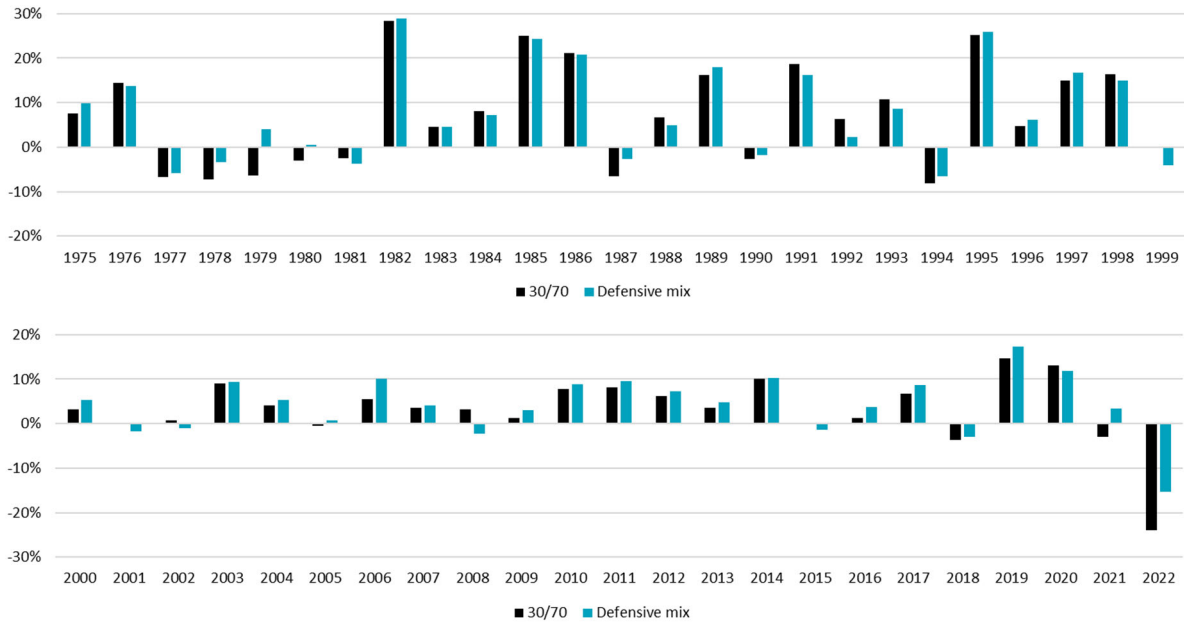
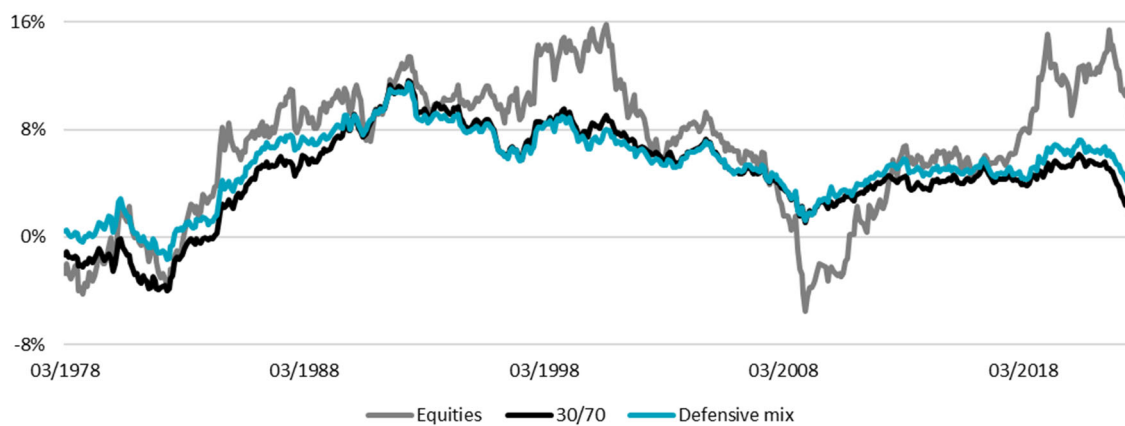


Figure 7 shows the rolling 10-year real returns of equities, the 30/70 equity-bond portfolio and the defensive mix. The latter strategy has the most stable 10-year annualized return with returns ranging between -2% and +12%. The 30/70 portfolio is more volatile ranging between -4% and +12%. The 30/70 portfolio lags the defensive mix 74 percent of the time. For equities the worst 10-year period gave a real annualized return of -6%, crucially driven by the 2000-2003 and 2008 equity bear markets. During the 1990s both low-volatility stocks and gold lagged bonds and equities, leading the 30/70 mix to outperform. Nonetheless, the average annualized return difference is 0.8 percent in favor of the defensive portfolio, but this outperformance is not stable over time. The annualized volatility of the return difference is 3.2 percent, which corresponds to an information ratio of 0.25 (t-stat of 1.75).

**Figure 7: Defensive investing: Rolling 10-year returns, 1975-2022**



### 3.4 Leverage and gold mining stocks

Instead of replacing equities and bonds with gold, one could also use futures on top of the original equity-bond exposure. Indeed, Appendix B shows that similar results obtain when gold futures are used. Given that the excess returns to gold are added on top of the equity returns in the futures overlay, the return outcome is slightly more attractive relative to the base case of a direct gold investment. Still, when leverage is used, one can theoretically lose more than 100% of the invested capital which is a clear violation of the golden rule of investing.

Against this backdrop, one might consider alternative routes to capture gold exposure by tilting the equity portfolio's stock selection accordingly. For instance, one could aim to minimize the tracking error of a given equity portfolio relative to a benchmark that would consider a specific gold allocation. Alternatively, one can avoid stocks that are negatively exposed to gold and/or emphasize stock holdings with positive gold exposure. Such analysis would typically identify only a small set of gold-sensitive stocks, with gold mining stocks being the most prominent representatives. Thus, to gauge the potential for improving downside risk protection by replacing gold with gold-sensitive stocks we investigate investing part of the equity portfolio in gold mining stocks. Specifically, Appendix B tests if gold mining stocks offer a better risk/return-profile than gold when aiming for a low-volatility equity portfolio. We ultimately conclude that adding gold is more effective in reducing the downside risk of a low-volatility equity portfolio than adding gold mining stocks.

### 3.5 What about the role of 'black gold'

In looking for a natural alternative to gold it seems straightforward to resort to oil instead. Oil is a major driving force of inflation and could thus serve as a hedge. Unlike gold, it is more challenging to hold a physical exposure to oil. We consider the role of oil in a multi asset portfolio with and without gold as a robustness analysis, and use the spot price of Brent oil. Indeed, repeating the stock-bond-allocation exercise from Section 2 we find that an oil allocation of 10% is similarly effective as a 10% gold allocation in reducing downside volatility. Clearly, this observation is not to say that such stock-bond-oil allocations span the previous stock-bond-gold allocations. In fact, Wang, Lucey and Huang (2022) evidence that gold serves as a hedge to oil price fluctuations half of the time; also, they document gold to possess safe haven power against extreme oil price movements. In short, their work suggests that oil and gold allocations work as complements in rounding out a multi-asset portfolio's downside risk, and this finding is confirmed by our subsequent analysis.

Table 7 documents oil to be a high risk asset on a stand-alone basis, showing even more severe risk statistics than gold and a low return of 0.7%. Yet, its equity and gold betas are low, together with a highly negative bond beta (-1.50), suggesting diversification benefits during periods of inflation and rising rates. Indeed, adding 10% oil to a fifty-fifty mix of bonds and low-volatility equities is similarly effective in reducing downside risk like adding 10% gold. But gold and oil allocations are not interchangeable: When considering a 10% allocation to both assets, gold and oil, to complement the fifty-fifty bond-low-volatility mix, we can witness the complementary nature of gold and oil in reducing downside risk, see the third column in Table 7. The resulting portfolio enjoys a further reduction in downside volatility, loss probability, expected loss and a high Sortino ratio of 2.05.

**Table 7: Oil added to the defensive mix, 1975-2022**

<b>1-year horizon</b>	<b>Oil</b>	<b>45 Lowvol 45 Bonds 10 Oil</b>	<b>40 Lowvol 40 Bonds 10 Oil 10 Gold</b>
Real return	0.7%	6.0%	5.8%
Downside volatility	17.1%	2.7%	2.6%
Sortino ratio	0.01	1.98	2.05
Loss probability	48.1%	21.3%	17.9%
Expected loss	-9.0%	-1.0%	-0.9%
Minimum return	-74.0%	-15.0%	-14.1%
Equity beta	0.23	0.39	0.34
Bond beta	-1.50	0.49	0.39
Gold beta	0.26	-0.05	0.06

#### 4. Conclusion

The golden rule of investing is to avoid capital losses. To this end, some conservative investors hold a part of their wealth in gold. Indeed, our empirical study corroborates that a portfolio's loss probability, its expected loss and downside volatility can be brought down with modest allocations to gold. However, hedging downside risk via gold investing comes at the cost of lower return. Conversely, including low-volatility stocks in the multi-asset portfolio increases its defensiveness considerably, without giving up returns. Notably, the effectiveness of the resulting defensive multi-asset portfolio increases with the investment horizon. While we have intentionally kept the empirical setup concise, it could readily be extended to consider additional asset classes and factors.<sup>16</sup> Notwithstanding, perfect safe havens are difficult to find, but a mix of defensive equities, bonds and a small allocation to gold can help to reduce capital losses.

---

<sup>16</sup> See Baltussen et al (2021). Factor premiums such as low-volatility also exist across markets, with evidence going back to the 19<sup>th</sup> century.

## References

- Asness, C. S., Moskowitz, T. J., & Pedersen, L. H. (2013). Value and momentum everywhere. *The Journal of Finance*, 68(3), 929-985.
- Baltussen, G., Swinkels, L., & Van Vliet, P. (2021). Global factor premiums. *Journal of Financial Economics*, 142(3), 1128-1154.
- Baur, D. G., & Lucey, B. M. (2010). Is gold a hedge or a safe haven? An analysis of stocks, bonds and gold. *The Financial Review*, 45, 217-229.
- Baur, D. G. & McDermott, T. K. (2010). Is gold a safe haven? International evidence. *Journal of Banking & Finance*, 34, 1886-1898.
- Benartzi, S., & Thaler, R. H. (1995). Myopic loss aversion and the equity premium puzzle. *The Quarterly Journal of Economics*, 110(1), 73-92.
- Black, F. (1993). Beta and return. *Journal of Portfolio Management*, 20(1), 8-18.
- Black, F., Jensen, M. C., & Scholes, M. (1972). The capital asset pricing model: Some empirical tests. *Studies in the Theory of Capital Markets*. Praeger Publishers Inc.
- Blitz, D. C., & de Groot, W. (2014). Strategic allocation to commodity factor premiums. *Journal of Alternative Investments*, 17 (2) 103-115.
- Blitz, D. C., & Van Vliet, P. (2008). Global tactical cross-asset allocation: Applying value and momentum across asset classes. *Journal of Portfolio Management*, 35(1), 23-38.
- Blitz, D. C., & van Vliet, P. (2018). The conservative formula: Quantitative investing made easy. *Journal of Portfolio Management*, 44(7), 24-38.
- Chua, J. H., Sick, G., & Woodward, R. S. (1990). Diversifying with gold stocks. *Financial Analysts Journal*, 46(4), 76-79.
- Cohen, R. B., Polk, C., & Vuolteenaho, T. (2005). Money illusion in the stock market: The Modigliani-Cohn hypothesis. *Quarterly Journal of Economics*, 120(2), 639-668.
- Daskalaki, C., & Skiadopoulos, G. (2011). Should investors include commodities in their portfolios after all? New evidence. *Journal of Banking & Finance*, 44, 250-269.
- Daskalaki, C., Skiadopoulos, G., & Topaloglou, N. (2017). Diversification benefits of commodities: A stochastic dominance efficiency approach. *Journal of Empirical Finance*, 44, 250-269.
- Doeswijk, R., Lam, T., & Swinkels, L. (2014). The global multi-asset market portfolio, 1959-2012. *Financial Analysts Journal*, 70(2), 26-41.
- Ehsani, S., & Linnainmaa, J. T. (2022). Factor momentum and the momentum factor. *Journal of Finance*, 77(3), 1877-1919.
- Erb, C. B., & Harvey, C. R. (2013). The golden dilemma. *Financial Analysts Journal*, 69(4), 10-42.
- Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *Journal of Finance*, 47(2), 427-465.
- Frazzini, A., & Pedersen, L. H. (2014). Betting against beta. *Journal of Financial Economics*, 111(1), 1-25.
- Hillier, D., Draper, P., & Faff, R. (2006). Do precious metals shine? An investment perspective. *Financial Analysts Journal*, 62(2), 98-106.
- Hoffstein, C., & Faber, N. (2019). Rebalance timing luck: The difference between hired and fired. *Journal of Index Investing*, 10(1), 27-36.



- Holzmeister, F., Huber, J., Kirchler, M., Lindner, F., Weitzel, U., & Zeisberger, S. (2020). What drives risk perception? A global survey with financial professionals and laypeople. *Management Science*, 66(9), 3977-4002.
- Jaffe, J. F. (1989). Gold and gold stocks as investments for institutional portfolios. *Financial Analysts Journal*, 45(2), 53-59.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica* 47 263–291.
- Levhari, D., & Levy, H. (1977). The capital asset pricing model and the investment horizon. *Review of Economics and Statistics*, 92-104.
- Lucey, B. M., Tully, E. & Poti, V. (2006). International portfolio formation, skewness and the role of gold, *Frontiers in Finance and Economics* 3, 49–68.
- Markowitz, H. M. (1959). *Portfolio Selection: Efficient Diversification of Investments*. New York: John Wiley & Sons.
- Neville, H., Draaisma, T., Funnell, B., Harvey, C. R., & Van Hemert, O. (2021). The best strategies for inflationary times. *Journal of Portfolio Management*, 47(8), 8-37.
- O'Connor, F. A., Lucey, B. M., Batten, J. A., & Baur, D. G. (2015). The financial economics of gold – A survey. *International Review of Financial Analysis*, 41, 186-205.
- Reboredo, J. C. (2013). Is gold a safe haven or a hedge for the US dollar? Implications for risk management. *Journal of Banking and Finance*, 37(8), 2665-2676.
- Roy, A. D. (1952). Safety first and the holding of assets. *Econometrica*, 20(3), 431-449.
- Shafir, E., Diamond, P., & Tversky, A. (1997). Money illusion. *Quarterly Journal of Economics*, 112(2), 341-374.
- Swinkels, L. (2019). Treasury bond return data starting in 1962. *Data*, 4(3), 91.
- Wang, X., Lucey, B. M., & Huang, S. (2022). Can gold hedge against oil price movements: Evidence from GARCH-EVT wavelet modelling. *Journal of Commodity Markets*, 27, 100226.

## Appendix A: Smart rebalancing to harvest asset class momentum

When the investment horizon is extended from one month to one year, the implicit rebalancing frequency is also one year. As a result, there is less turnover, leading to lower trading costs and higher gross returns because of an implicit increase in momentum factor exposure.

We first consider the transaction cost impact. When the 45/45/10 Low volatility-Bond-Gold allocation is rebalanced on a *monthly* basis, one faces a two-way turnover of 21% per annum. Assuming 20bps costs this amounts to a return drag of 0.04% per year. Rebalancing on an *annual* basis, turnover reduces to 6%, which implies a return drag of only 0.01%. This is a return difference of 0.03% per annum.

Next, we investigate the portfolio's momentum factor exposure. There is a rich body of evidence that momentum works across markets and asset classes, see Asness et al (2013) and Blitz and Van Vliet (2008). Monthly rebalancing is going against momentum by design because one sells recent winners and buys recent losers. To calculate the impact we create a momentum factor which goes 5% long the asset which had the highest return in the past 12-months and -5% short the asset which had the lowest 12-months return. We keep the cross-section very simple by only considering the four main assets used in this study: equities, bonds, gold and low volatility. The first column in Table A1 shows that this momentum factor has a positive and significant gross return of 0.46% per annum at a 1.08% volatility (t-stat 2.95). The fourth column shows the return difference between a monthly (column 2) and an annual (column 3) rebalancing frequency of the defensive portfolio which is 0.13% per annum (t-stat 2.13). As expected, the return difference has a positive beta to the momentum factor of 0.30. While the momentum factor involves high turnover (43% per annum), the annual rebalanced defensive mix implicitly builds positive momentum exposure by trading less.

**Table A1: Factor momentum effects: Annual versus monthly rebalancing, 1975-2022**

	1 Long/Short Momentum	Defensive mix Monthly	Defensive mix Annual	2 Difference Monthly/Annually
	<i>gross</i>	<i>gross</i>	<i>gross</i>	<i>net</i>
Average (simple nominal)	0.46%	9.37%	9.49%	0.12%
Stdev	1.08%	7.24%	7.33%	0.52%
Sharpe Ratio	0.43	1.29	1.30	0.26
t-stat	2.95	8.87	8.89	1.76
Beta L/S Momentum	1.00	0.89	1.18	0.30

## Appendix B: Alternative routes for capturing gold exposure

There are different ways to get exposure to gold. The main drawback of investing directly in gold is the lack of income. Unlike pure gold investments, gold mining stocks can generate income. While gold mining stocks are quite volatile, they can though bring a reduction in total portfolio risk. By virtue of their low correlation to other stocks, gold mining stocks are showing up in the MSCI minimum volatility index, whereas they are not included in the S&P low-volatility index.<sup>17</sup> Another way to get gold exposure is to invest in a gold future overlay on top of an existing portfolio, thus creating more than 100% exposure (leverage). Table B1 investigates how to best add gold to a low-volatility strategy: via direct investment (Panel A), via gold mining stocks (Panel B), or via gold futures (Panel C) in which the gold exposure is managed through a derivatives overlay.<sup>18</sup>

**Table B1: Low-volatility with gold, gold mining stocks and gold futures added, 1975-2022**

Gold allocation	0	5	10	15	20	25	...	100
<b>Panel A: Lowvol + Gold</b>								
Average real return	8.3%	8.1%	<b>7.9%</b>	7.7%	7.5%	7.3%	...	1.5%
Downside volatility	5.4%	5.0%	<b>4.6%</b>	4.4%	4.2%	4.0%	...	11.3%
Sortino Ratio	1.53	1.63	<b>1.70</b>	1.77	1.80	1.82	...	0.08
<b>Panel B: Lowvol + Gold Mining</b>								
Average real return	8.3%	8.2%	<b>8.1%</b>	8.0%	7.8%	7.6%	...	0.4%
Downside volatility	5.4%	5.2%	<b>5.1%</b>	5.1%	5.2%	5.4%	...	18.0%
Sortino Ratio	1.53	1.59	<b>1.60</b>	1.57	1.50	1.41	...	-0.01
<b>Panel C: Lowvol + Gold Futures</b>								
Average real return	8.3%	8.4%	<b>8.6%</b>	8.8%	8.9%	9.0%	...	10.7%
Downside volatility	5.4%	5.3%	<b>5.2%</b>	5.2%	5.2%	5.3%	...	8.7%
Sortino Ratio	1.53	1.61	<b>1.66</b>	1.69	1.70	1.70	...	1.52

We observe that adding gold to a low-volatility equity strategy is more effective than adding gold miners. A 10 percent allocation to gold (miners) lowers the downside volatility by 0.8 percentage points (0.3 percentage points), corresponding to a relative risk reduction of 14% (6%). The return goes down by 0.4% (0.2%), leading to a Sortino ratio of 1.70 (1.60). Furthermore, the highest Sortino ratio is obtained for 25 percent of gold and 10 percent of gold miners (1.82 versus 1.60). Panel C shows that adding gold futures gives higher returns and similar risk compared to adding gold miners in Panel B. The main advantage of adding gold futures is that the excess returns of gold are added, leading to higher long-term returns. Thus in order to further reduce the risk of a low-volatility equity strategy adding gold (or gold futures) is more efficient than adding gold miners.

<sup>17</sup> The most important difference between a low-volatility and a minimum volatility approach is that the latter may also select volatile stocks which have a low correlation with other stocks. See [etfdb.com](https://etfdb.com) for the holdings of the SPLV (S&P low-volatility index tracker) and USMV (MSCI minimum-volatility index tracker) funds: <https://etfdb.com/tool/etf-comparison/SPLV-USMV/#holdings>

<sup>18</sup> Note that there are also liquid gold tracking ETFs available for direct investment. For instance, the SPDS Gold Shares (ticker GLD) and iShares Gold Trust (ticker IAU) are the largest two as of 2023 ([etfdb.com/etfs/commodity/gold](https://etfdb.com/etfs/commodity/gold)). Since inception, their gross performance is on par with that of the spot price series, displaying a tracking error less than 1% to the gold spot price series over the 2005-2022 period. Hence, our baseline findings based on the spot price would not materially change if we were to consider gold ETF prices instead of spot prices starting 2005.