Efficient Use of Commodity Futures in Diversified Portfolios

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We provide evidence on the role of commodity futures in portfolios comprised of stocks, bonds, T-bills, and real estate. Over the period investigated (1973–1997), Markowitz optimization over a range of risk levels gives substantial weight to commodity futures, thereby enhancing the portfolios' returns. We find dramatically different results when we use a simple ex ante measure of monetary stringency to dichotomize the sample into expansive-versus-restrictive monetary-policy periods. In periods characterized by restrictive monetary policy, commodity futures are shown to have substantial weight in the efficient portfolios, with significant return enhancement at all levels of risk. In periods characterized by expansive monetary policy, commodity futures are shown to have little or no weight in the efficient portfolios, with no return enhancement at all levels of risk. © 2000 John Wiley & Sons, Inc. Jrl Fut Mark 20:489–506, 2000

INTRODUCTION

Portfolio theory establishes that investors can improve portfolio performance by diversifying across unique asset classes. Allocating funds to

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securities with imperfect correlation reduces portfolio risk without necessarily reducing expected return. Numerous studies examine the performance of portfolios composed of stocks, bonds, and cash equivalents, and demonstrate the advantages of adding asset classes to portfolios. We extend this prior work in three ways. First, we focus on the role of commodity futures in improving the performance of portfolios comprised of stocks, bonds, T-bills, and real estate. We examine commodity futures (rather than financial futures) because they represent a unique asset for diversification purposes. Unlike financial securities, making a direct investment in physical commodities generally is unrealistic, and characterized by prohibitively high transaction costs, insurance costs, and storage costs. In contrast, it is relatively easy to purchase and sell commodity futures contracts as a portfolio component.

We also extend prior work by investigating the influence of monetary policy on the performance of commodity futures and their role in efficient portfolios. Because the overall inflation rate is heavily dependent upon the prices of all physical commodities, indexes of commodity futures prices act as an inflation proxy. Thus, many argue that the economic rationale for including commodity futures as a portfolio component is their ability to hedge against changes in inflation. Because actual and expected inflation are important dimensions of monetary policy, we have the important implication that changes in monetary stringency may impact the role of commodity futures in portfolios. The advantage in our approach is that we use a simple ex ante proxy for monetary stringency that would have allowed an investor to reallocate portfolio weights over the period.

The third way we extend prior work is by lengthening the sample period under investigation to 25 years. This sample, from 1973 through 1997, is much longer than most previous studies. The longer sample period helps to ensure that our results are less sensitive to periods of unusual performance, which has plagued many previous studies. Furthermore, the longer sample period allows us to provide separate analyses across both expansive and restrictive monetary policy periods that are of sufficient length.

Over the full sample investigated (1973–1997), Markowitz optimization over a range of risk levels gives substantial weight to commodity futures. This allocation enhances the portfolios' returns. We find dramatically different results when we use a simple ex ante measure of monetary stringency to dichotomize the sample into expansive-versus-restrictive monetary-policy periods. In periods characterized by restrictive monetary policy, commodity futures are shown to have substantial weight

in the efficient portfolios, with significant return enhancement at all levels of risk. In periods characterized by expansive monetary policy, commodity futures are shown to have little or no weight in the efficient portfolios, with no return enhancement at all levels of risk.

In the following section of the paper, we present a brief overview of related research, and more formally motivate the examination. We then provide information on our data, followed by the presentation of methodology and results. The final section of the paper provides a summary and our conclusions.

RELATED RESEARCH

A number of studies have examined the performance of futures, with the results varying widely by study. Studies by Bodie (1983), Irwin and Brorsen (1985), Brorsen and Irwin (1985), and Irwin and Landa (1987) support the view that managed futures produce favorable or appropriate investment returns. In contrast, Elton, Gruber, and Rentzler (1987, 1990) found that managed futures were generally a poor investment on a portfolio basis. Several studies also reported mixed evidence, with the results depending on the type of futures investment and the period examined (see Edwards & Liew, 1999; Edwards & Park, 1996; Irwin, Krukemyer, & Zulauf, 1993; Schneeweis, Savanayana, & McCarthy, 1991). Irwin et al. (1987) noted that commodity pools provided attractive returns in the late 1970s, while Edwards and Park (1996) showed that managed futures generally performed poorly in the 1989 to 1992 period. Interestingly, Edwards and Liew (1999) found that passive commodity indexes were not substitutes for managed commodity funds in diversified portfolios during the 1982 to 1996 period. However, the authors note that it is unrealistic to believe that investors could replicate the holdings and necessary rebalancing of all managed futures pools to achieve the investment returns found in the study.

The attraction of commodity futures is based partially on the view that commodity prices tend to have low correlations with security returns (see the evidence of Bodie & Rosansky, 1980; Edwards & Park, 1996; Elton et al., 1987; Irwin & Brorsen, 1985; Irwin & Landa, 1987; Lee, Leuthold, & Cordier, 1985). Chance (1994) noted, however, that the correlation is marked by considerable instability. In particular, futures have exhibited both positive and negative correlation with stocks and bonds over time. This observation raises questions regarding the use of futures as a consistent diversification vehicle.

A second, and common, justification for including commodity futures in a portfolio is the view that they provide an inflation hedge (see supporting evidence in Bodie, 1983; Edwards & Park, 1996; Irwin & Landa, 1987).[1] As commodity prices increase during an inflationary period, long positions in commodity futures benefit, while security returns tend to be impacted adversely. Real estate and T-bills also are proposed frequently as inflation hedges (see Ankrim & Hensel, 1993; Fama & Schwert, 1977). We also include real estate and T-bills to examine the marginal inflation-hedging benefits commodity futures provide beyond those provided by real estate and T-bills.

This study relates closely to recent research that examined the relationship between the risk premiums attached to commodity futures and changes in business conditions. In particular, Bjornson and Carter (1997) and Bessembinder and Chan (1992) found evidence that the returns to futures were related significantly to changes in business conditions.[2] These two studies extended earlier works that related the returns on commodity futures to their level of systematic risk (see Carter, Rausser, & Schmitz, 1983; Dusak, 1973). Based on their evidence, Bjornson and Carter argue that a portfolio manager may choose to incorporate commodities into a portfolio if they are interested in establishing a hedge against inflation and high interest rates. This study extends Bjornson and Carter and other related studies by examining the performance of commodity futures in a portfolio setting.

Recent evidence suggests that monetary conditions are related to performance patterns in stock and bond returns (see Jensen & Johnson, 1995; Jensen, Johnson, & Mercer, 1997; Patelis, 1997; Thorbecke, 1997). In addition, Jensen et al. (1996) showed that changes in monetary conditions were related to changes in the default and term premia, and further, that these factors related to security returns differently depending upon the stringency of monetary policy. This evidence suggested that investors alter their inflation expectations and their required risk premiums with changes in monetary stringency. This link between inflation expectations, security returns, and monetary stringency suggests that monetary policy also may be linked to commodity futures returns.

The inconsistent performance of commodity futures identified by previous researchers, and hence their benefit as a diversification vehicle, may be related to changes in the stringency of monetary policy. Therefore,

[1]Elton, Gruber, and Rentzler (1987) found evidence refuting the effectiveness of futures as an inflation hedge. The differing results may be due to the observation that their study concentrated on a hyper-inflationary period (1979–1985) and employed monthly returns.

[2]These two studies focused on the risk premiums attached to agricultural commodities and did not directly examine the diversification benefits associated with futures.

in this study, we examine the role of commodity futures in diversified portfolios across different monetary environments. The objective is to determine whether an ex ante measure of monetary policy can be used to improve portfolio performance by changing allocation weights among stocks, bonds, T-bills, real estate, and commodity futures. The research by Jensen et al. (1996), Bjornson and Carter (1997), and Bessembinder and Chan (1992), suggests that the risk premia associated with futures, stocks, and bonds vary with changes in business and monetary conditions. Therefore, it is reasonable to ask whether the optimal allocation of commodity futures fluctuates with changes in monetary stringency.

SAMPLE AND DATA

We examined monthly returns for five alternative asset classes from January 1973 through December 1997. Previous studies frequently have examined futures investments over a period of ten years or less, leading to large discrepancies in the findings regarding the performance of futures (see Irwin, Krukemyer, & Zulauf, 1993). The use of a 25-year study period allowed us to generate more robust statistics, and therefore provide a better indication of the general performance of commodity futures. A short period of unusual performance would have had less impact on our results than on many of the findings previously reported.

Our focus was on general investment performance of alternative security classes, rather than the performance of various investment strategies. Thus, for each security class, we examined the composite index without considering the various possible sub-indexes. The return series employed in the study are:

Stock returns: Return on the value-weighted CRSP Index for the NYSE/AMEX/NASDAQ combined market, including dividends;

Corporate bond returns: Return on the Lehman Brothers corporate bond index;

T-bills: 30-day T-bill return from CRSP;

REIT: Return on the "All REIT" index developed by the National Association of Real Estate Investment Trusts (NAREIT). The index is market-weighted and includes equity, mortgage, and hybrid REITs;

Commodity futures: Goldman Sachs commodity total return index (GSCI). The total return index represents the return from a fully collateralized commodity futures investment and is designed to be comparable to an investment in stocks or bonds. The total return

equals the return to the futures contract plus the T-bill rate earned on the face value of the futures.[3] See Appendix I for a description of the composition and construction of the GSCI.

We used the NAREIT index in this analysis for two reasons. First, the index does not suffer from the smoothing and seasonal biases that tend to afflict appraisal-based indexes like the Russell–NCREIF index. Second, a REIT index provides the best indicator of the returns generated from an investment in a widely accessible investment vehicle. Direct real estate investments are less accessible, offer a much higher variability in performance, and provide less reliable return data.

The use of the Goldman Sachs commodity index (GSCI) represents a conservative approach to examining the performance of commodity futures, as the index approximates a passive buy-and-hold strategy. Several alternative means are available for investors to invest in commodity futures. For example, investors can invest in public futures funds, a private commodity pool operator, or directly with a commodity trading advisor. Previous researchers (see Edwards & Park, 1996; Irwin et al., 1993) found that these active futures investments exhibited superior performance to passive buy-and-hold strategies. Relying on the GSCI, however, had three benefits for our particular analysis. First, by relying on an index that approximates a buy-and-hold strategy, the performance of futures could be examined without the contamination of superior or inferior trading techniques. Second, relying on the GSCI avoids the biases associated with the databases that report futures returns. Edwards and Park (1996) provided a discussion of these database biases. Third, if futures contracts were shown to be an attractive portfolio component under this most conservative evaluation, there would be strong support for their consideration as a portfolio investment.

The use of the GSCI is consistent with our objective of examining the role of commodity futures as an investment alternative. The use of one of the other futures investment alternatives would combine the investment strategy with the monetary environment and make it difficult to determine whether a change in the monetary environment was responsible for the findings, or whether a change in investment strategy produced the result. In addition, it is likely that some investment managers rely on monetary policy in determining their futures investment strategies, thus making the separation of the influence of the monetary

[3]The JP Morgan commodity index also was examined, and the results were not materially different from those reported in the study. We report results from the GSCI since the index is available for one year more than the JP Morgan index.

TABLE I

Returns, Standard Deviations and Correlations for Alternative Investments

				Correlations				
Index	*Mean Monthly Return (%)*	*Standard Deviation*	*Coefficient of Variation*	*GSCI*	*Stocks*	*T-Bills*	*Corporate Bonds*	*REITs*
GSCI	1.049	5.243	4.998	1				
Stocks	1.104	4.519	4.093	−0.040	1			
T-bills	0.572	0.233	0.407	−0.017	−0.093	1		
Corp. Bonds	0.776	2.338	3.013	−0.126*	0.412*	0.033	1	
REITs	0.941	4.591	4.879	−0.037	0.662*	−0.080	0.427*	1

n = 300 months.
* Significant at the 5% level.

environment versus the trading strategy extremely difficult. Throughout this analysis, the merits of investing in commodity futures were assessed based on an examination of the GSCI.

METHODOLOGY AND RESULTS

Table I reports statistics calculated for the five asset classes over the entire study period. The results show that stocks experienced the highest return, approximately 13.2% annually, and T-bills the lowest, approximately 6.9% annually. The GSCI had a slightly lower return than stocks, and had a slightly higher variation. Thus, the coefficient of variation for futures is considerably worse than the coefficient of variation for the other asset classes. This evidence is consistent with previous studies, which found that the stand-alone performance of futures is inferior to other asset classes. The correlation results, however, suggest that commodity futures may provide an attractive diversification vehicle. Specifically, the correlation is negative between the GSCI and each of the other asset classes, and is significantly negative in the case of corporate bonds.

We examined the diversification potential of commodity futures by determining the improvement in the efficient set associated with introducing the GSCI to the investment mix. Figure 1 illustrates two alternative efficient frontiers: the first includes stocks, corporate bonds, real estate, and T-bills; the second adds futures as a fifth portfolio component. The efficient frontiers are constructed assuming there is no short-selling and no riskless borrowing or lending. The exhibit clearly demonstrates that commodity futures allow an investor to achieve a more favorable

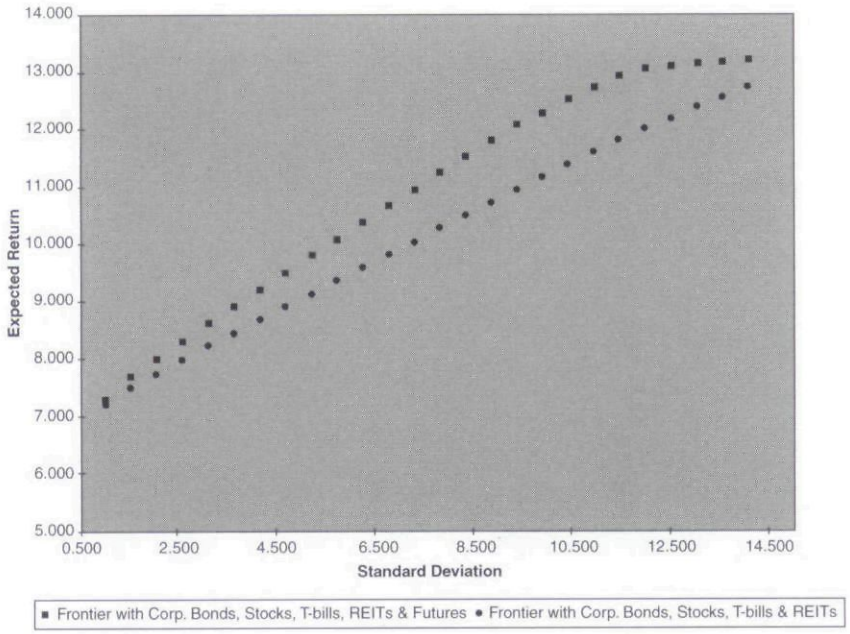

FIGURE 1
Efficient Frontiers.

portfolio over the full sample period. The benefits particularly are prominent at moderate levels of risk.

The evidence in Table I and Figure 1 suggests that the GSCI may not be attractive as a stand-alone asset on a risk/return basis. It does, however, appear to be beneficial as a portfolio component, suggesting that over the past 25 years investors could have enhanced their portfolio performance by including futures. This conclusion is generally consistent with the evidence reported in the more recent studies. In the remainder of the analysis, we address the relationship between monetary conditions and the performance of commodity futures, and reexamine their role across alternative monetary environments.

Monetary Conditions and the Role of Futures

In classifying the stringency of monetary policy, we used an ex ante measure that differentiates fundamentally different monetary environments. Following earlier studies, we classified all months as either falling in an expansive monetary environment or a restrictive monetary environment. These classifications were based on whether the most recent change in the discount rate was a decrease or an increase. A month was classified

TABLE II

Returns, Standard Deviations and Correlations

				Correlations				
Index	*Mean Monthly Return (%)*	*Standard Deviation*	*Coefficient of Variation*	*GSCI*	*Stocks*	*T-Bills*	*Corporate Bonds*	*REITs*
Panel A: Expansive Monetary Periods (n = 158 months)								
GSCI	0.335	4.321	12.899	1				
Stocks	1.735	3.934	2.267	−0.085	1			
T-bills	0.485	0.184	0.379	0.076	−0.020	1		
Corp. Bonds	0.978	2.008	2.053	−0.159*	0.504*	0.137	1	
REITs	1.884	4.059	2.154	−0.115	0.562*	−0.031	0.421*	1
Panel B: Restrictive Monetary Periods (n = 130 months)								
GSCI	1.993	6.167	3.094	1				
Stocks	0.357	5.167	14.473	0.016	1			
T-bills	0.671	0.246	0.367	−0.180*	−0.073	1		
Corp. Bonds	0.491	2.539	5.171	−0.080	0.327*	−0.026	1	
REITs	−0.188	4.976	NA	0.053	0.721*	0.020	0.392*	1

* Significant at the 5% level.

as expansive (restrictive) if the most recent previous change was a(n) decrease (increase). An important advantage of this measure is that it requires only past information, and therefore would have allowed an investor to reallocate portfolio weights over the period in an ex ante manner.

Jensen and Johnson (1995), Booth and Booth (1997), and Jensen, Johnson, and Mercer (1997, 1998) used this binary classification technique, showing that it serves well as a broad measure of monetary conditions. Further support is provided by Jensen, Mercer, and Johnson (1996), who showed that the federal funds premium, monetary aggregates, and various measures of banking activity differed significantly across the defined environments.[4]

Table II, panels A and B, report summary statistics for expansive and restrictive monetary periods, respectively. There are twelve months in which a discount rate change occurred that was in the opposite direction from the prior change (e.g., the first rate decrease following one or more increases). Since these twelve months necessarily include days in both expansive and restrictive monetary periods, they were excluded from the

[4]While this classification technique has been employed effectively to differentiate fundamentally different monetary conditions, we are not advocating this procedure as the best technique for identifying minor changes in the stringency of monetary policy. A more refined approach that adjusts more frequently would be required to accomplish that task [see Thorbecke (1997) and Patelis (1997) for examples]. Use of such measures, however, requires more frequent trading and more subjective evaluation.

sample. The total study period includes 300 months (25 years × 12) distributed as follows: 158 expansive-policy months, 130 restrictive-policy months, and 12 months that were excluded because they included days in both environments. Since a restrictive monetary environment was initiated in January 1973, February 1973 is the first month in the sample.

The mean returns and standard deviations reported in Table II show a substantial difference in the performance of each asset class between monetary environments. The mean returns for stocks, corporate bonds, and real estate are higher in expansive environments than in restrictive environments. This evidence is consistent with the evidence reported by Jensen et al. (1996) and Jensen et al. (1997, 1998). In contrast, the GSCI and T-bills have higher returns in restrictive policy environments.

The return differences especially were pronounced for stocks, real estate, and commodity futures. In expansive periods, stocks and real estate provided annual returns of approximately 21 and 23%, respectively. In restrictive periods, the corresponding annual returns are 4 and −2%, respectively. In contrast, the average annual return to the GSCI was approximately 4% during expansive periods and approximately 24% during restrictive periods. The return differences, in absolute terms, were much smaller for the other two asset classes. T-bills had an annual return that is approximately 2.2% higher in restrictive periods, whereas the annual return to corporate bonds was approximately 5.8% higher in expansive periods.[5]

The standard deviations presented in Table II show that the variation in returns was quite consistent across monetary environments, but that

[5]We examined the sensitivity of our results to two changes. First, we considered the impact that changes in the monetary regime had on our findings. Specifically, researchers have identified three distinct operating-policy regimes since 1970 (see Gilbert, 1985). The three periods are pre-October 1979, October 1979 to October 1982, and post-October 1982. These regimes were created because the Fed switched from interest rate to monetary-aggregate targeting in October 1979, and switched from targeting nonborrowed reserves to targeting borrowed reserves in October 1982. We performed three separate regressions that included a discount-rate-change dummy variable, along with an interaction dummy for the respective regimes. The results of the regressions indicated that futures return patterns were significantly stronger than average in the pre-1979 period, significantly weaker than average in the 1979–1982 period, and not significantly different from average in the post-1982 period. While these findings suggest that Fed operating procedures had an influence on the return patterns, generalizing from these results should be done with caution, given the relatively few observations in each of these regimes. Second, we consider the sensitivity of the results to changes in the composition of the GSCI. Specifically, there have been only six commodity futures contracts (silver, sugar, beans, corn, wheat, and cattle) that continuously have been a component of the GSCI from January 1973 through December 1997. Thus, over the 25-year period, an additional 19 commodities have been added to the index. To remove the influence of the added contracts, we created an equally weighted index composed of these six commodities and examined the returns associated with such an index. The mean monthly return for the index during expansive and restrictive periods was 0.2199 and 1.7038%, respectively, which is comparable to the return difference reported in Table II for the composite GSCI index over the same period.

TABLE III

Tests for Differences in Returns and Risk Across Monetary Environments

Index	*Difference in Mean Monthly Returns (%) (t-statistic)*	*Difference in Standard Deviation of Monthly Returns (F-statistic)*
GSCI	−1.6584	−1.8463
	(−2.59)*	(2.04)*
Stocks	1.3781	−1.2327
	(2.50)*	(1.72)*
T-bills	−0.1862	−0.0617
	(−7.13)*	(1.78)
Corporate Bonds	0.4866	−0.5311
	(1.78)	(1.60)*
REITs	2.0719	−0.9240
	(3.80)*	(1.51)*

* Significant at the 5% level.

they were higher for all five asset classes in restrictive monetary periods. This result is especially surprising for stocks, corporate bonds, and real estate, since these securities also experienced lower returns during restrictive monetary periods. The coefficients of variation show that on a stand-alone basis, the GSCI was quite inferior to the other asset classes during expansive monetary periods. In contrast, the risk/return trade-off for stocks, corporate bonds, and real estate during restrictive periods was substantially below the other asset classes. This evidence suggests that a portfolio consisting entirely of futures would have been a poor investment during expansive monetary periods, whereas a portfolio of common stock, corporate bonds, or real estate would have been a poor choice during restrictive periods.

The correlations reported in Table II suggest that the relationships between the monthly returns did not change substantially across the monetary periods. Commodity futures had a slightly lower correlation with stocks, corporate bonds, and real estate during expansive periods, while the correlation of futures with T-bills was lower during restrictive periods. The consistency of the correlations across monetary environments indicates that the patterns in correlations described by Chance (1994) cannot be entirely attributed to changes in monetary conditions.

Table III reports the results of statistical tests to determine whether the return and risk differences reported in Table II are statistically significant. A standard *t*-test is used in testing for the difference between mean monthly returns.[6] The results indicate that the return differences

[6]The *t*-tests were adjusted for differences in variance when appropriate.

for stocks, real estate, commodity futures, and T-bills are statistically significant. In the case of corporate bonds, the return difference is only marginally significant. The results of the *F*-tests indicate that the risk differences are statistically significant for all five asset classes. The risk differences suggest that restrictive monetary periods generally coincide with periods of increased economic uncertainty.

The results in Tables II and III are consistent with the view that expected and actual inflation play a more prominent role in security returns during restrictive monetary periods. Specifically, the two asset classes that perform well during restrictive monetary periods are T-bills and commodity futures, which are investments that generally are impacted less adversely by inflation. This finding is consistent with Bjornson and Carter (1997), who suggested that commodity returns tend to be higher during recessionary periods (which are characterized by lower interest rates and inflation), and are generally lower during expansionary periods (which are characterized by higher interest rates and inflation). In the case of T-bills, the 30-day T-bill is unlikely to be impacted adversely by changes in inflation expectations, and hence may serve as an effective investment when inflation becomes a more prominent concern for investors. The GSCI is more likely to increase in value during periods of unexpected inflation as increases in commodity prices are inflationary. In contrast, stocks and corporate bonds are more likely to be impacted adversely by increases in inflationary pressures.

Unexpectedly, real estate exhibits the strongest patterns across monetary periods, and its performance differs markedly from the performance of the other two proposed inflation hedges. The REIT index performs very poorly during restrictive monetary periods, and actually has a negative return. During expansive monetary conditions, however, the REIT index exhibits the best performance of the five securities. Direct real-estate investments could exhibit a different performance pattern, but as indicated previously, such investments have limited accessibility, low liquidity, and unreliable return data.

The strong performance patterns documented in Tables II and III are consistent with the existence of a systematic relationship between asset returns and monetary conditions. This relationship is supported by three aspects of the study. First, the study considers 25 years of return data, which is a much longer period of study than most previous research. Further, the period includes a variety of economic conditions and is divided almost equally into expansive and restrictive monetary periods. Second, there is a strong economic rationale, as discussed in the Related Research section, for the existence of the asset return patterns. Specifi-

TABLE IV

Optimal Portfolio Allocation Across Asset Classes

	Optimal Portfolio Weights (%)				
Portfolio Std. Dev.	*GSCI*	*Stocks*	*T-Bills*	*Corporate Bonds*	*REITs*
0.5	5.63	6.51	80.70	7.16	0.00
1.0	12.11	13.56	58.67	15.66	0.00
1.5	18.22	20.22	37.87	23.69	0.00
2.0	24.28	26.82	17.26	31.64	0.00
2.5	30.41	35.23	0.00	34.36	0.00
3.0	36.11	50.87	0.00	13.02	0.00
3.5	28.64	71.37	0.00	0.00	0.00
4.0	12.17	87.84	0.00	0.00	0.00

Portfolio weights were determined by constructing an optimal portfolio assuming no short-selling and no riskless borrowing or lending.

cally, we provide references to both theoretical and empirical research to motivate the analysis. Third, the asset return patterns are found to be both economically and statistically significant.

As with any study of security returns, the findings should be interpreted with caution. Specifically, while the evidence supports the existence of a systematic relationship between monetary conditions and asset returns, the findings do not prove that such a relationship exists. The lengthy study period reduces the influence of unusual observations, but their impact is not eliminated. Thus, there is always the possibility that the return patterns are coincidental rather than systematic.

EFFICIENT PORTFOLIO ALLOCATIONS

We next examine the optimal portfolio allocations for the five asset classes in order to determine the role that futures play in the optimal portfolio during the study period. We first examined the optimal portfolio composition without regard to the monetary environment. Table IV reports the asset weights for eight alternative portfolios that fall on the efficient frontier.[7] The weights were obtained by using monthly returns across the

[7]The efficient frontier is constructed assuming no short-selling and no riskless borrowing or lending. Short-selling is not considered for stocks and bonds due to the difficulty associated with such transactions. Entering short positions in futures contracts, however, is no more difficult than entering a long position in futures. In this analysis, short positions in futures were not considered due to the construction of the GSCI index. In particular, the index was constructed based on a strategy of rolling forward long positions in the various futures contracts and included the T-bill return (see Appendix I for a description of the construction of the GSCI). The poor performance of the GSCI during expansive monetary periods, however, suggests that short-selling futures may be advantageous during such periods.

entire 25-year study period. Eight increments of portfolio risk, measured as the standard deviation of monthly returns, were selected, and the weights associated with each of these standard deviations then were determined. As expected, very low-risk portfolios contain mostly T-bills, while very high-risk portfolios contain mostly stocks. Commodity futures play a prominent role in all of the portfolios, representing more than 10% of the portfolio in all cases except for the lowest-risk portfolio. For moderate risk levels, the optimal portfolio consists of significant investments in at least three of the five asset classes. For example, at the 2% portfolio risk level, there is an almost even distribution of weights across commodity futures, stocks, T-bills, and corporate bonds. At the 2.5% risk level, there is an almost even weighting in commodity futures, stocks, and corporate bonds.

For comparative purposes, we restricted the GSCI weight to zero at each of the eight standard deviations presented in Table IV. In every case, the portfolio return (not presented) was higher when the GSCI was included. The largest annual return difference, occurring at a standard deviation of 4%, was approximately 6%. The smallest annual return difference, occurring at a standard deviation of 0.5%, was approximately 0.2%. These findings further support the contention that futures should be considered a viable component of an investor's portfolio.

Table V follows the same format as Table IV, but contains the optimal portfolio allocations when considering monthly returns for each of the two monetary periods. The findings are consistent with the results reported in Tables II and III, and suggest that monetary conditions play an important role in determining the attractiveness of including the GSCI in a portfolio. During expansive monetary periods, commodity futures play no significant role in the efficient portfolios, as the highest weight applied to futures is only 2.51%. As expected, there are virtually no differences in returns when the GSCI weight is restricted to zero (results not reported). Again, T-bills play the most important role in the low-risk portfolios and no role in the high-risk portfolios. Common stock, corporate bonds, and real estate play prominent roles in most of the portfolios.

Table V also reports the weights for the efficient portfolios formed during restrictive monetary periods. The results suggest prominent roles for commodity futures and T-bills during restrictive policy periods. Furthermore, when the GSCI weight is restricted to zero (not reported), the efficient frontier collapses to only one portfolio, and it is 100% T-bills. Thus, the return advantage from including the GSCI in restrictive periods is quite substantial. Surprisingly, stocks, corporate bonds, and real estate offer no advantage as a portfolio component. Even though stocks, bonds,

TABLE V

Optimal Portfolio Allocation across Monetary Periods

		Optimal Portfolio Weights (%)				
Standard Deviation	*Monetary Environment*	*GSCI*	*Stocks*	*T-Bills*	*Corporate Bonds*	*REITs*
0.5	Expansive	0.34	5.15	83.69	3.63	7.21
	Restrictive	8.04	0.00	91.96	0.00	0.00
1.0	Expansive	0.89	10.42	64.89	8.98	14.82
	Restrictive	16.50	0.00	83.50	0.00	0.00
1.5	Expansive	1.43	15.49	46.82	14.13	22.14
	Restrictive	24.81	0.00	75.19	0.00	0.00
2.0	Expansive	1.97	20.61	28.56	19.33	29.53
	Restrictive	33.04	0.00	66.96	0.00	0.00
2.5	Expansive	2.51	25.72	10.33	24.52	36.91
	Restrictive	41.04	0.00	58.96	0.00	0.00
3.0	Expansive	0.60	32.31	0.00	21.68	45.41
	Restrictive	49.22	0.00	50.78	0.00	0.00
3.5	Expansive	0.00	41.63	0.00	2.04	56.33
	Restrictive	57.20	0.00	42.80	0.00	0.00
4.0	Expansive	0.00	3.38	0.00	0.00	96.62
	Restrictive	65.37	0.00	34.64	0.00	0.00

Portfolio weights were determined by constructing an optimal portfolio assuming no short-selling and no riskless borrowing or lending.

and real estate exhibit attractive correlations with commodity futures and T-bills, the diversification potential provided by stocks, bonds, and real estate does not offset their poor performance during restrictive monetary periods.

Overall, the results indicate that commodity futures could have provided a valuable addition to portfolios over the last 25 years. The low correlation that commodity futures have with other assets provides a substantial diversification opportunity, leading to them being heavily weighted in optimal portfolios. When the data are dichotomized by monetary stringency, it is clear that monetary conditions can be used easily to improve the allocation of commodity futures in portfolios. During expansive monetary periods, commodity futures offer no benefit as a portfolio component. In stark contrast, during restrictive periods, the optimal portfolios contain large commodity futures positions. This evidence is consistent with the contention that commodity futures provide an investment vehicle that allows investors to hedge against adverse inflationary/monetary conditions.[8] These same monetary conditions tend to be detrimental to stocks and corporate bonds.

[8]Historically, establishing a position that matched the performance of the GSCI reported here would

SUMMARY AND CONCLUSIONS

This study provides evidence on the use of passive buy-and-hold strategies in commodity futures. First, we examined the performance of commodity futures from 1973 through 1997 to assess their general attractiveness as a stand-alone investment, and as a portfolio component. In the overall study period, futures were shown to be a relatively poor stand-alone investment, since they have both lower returns and higher standard deviation than stocks. In a portfolio context, however, return/risk optimization (over a range of risk levels) gave substantial weight to commodity futures over the full sample. Such allocation significantly enhanced the portfolios' returns. This evidence supports the use of futures in traditional portfolios over the last 25 years.

Second, we examined monetary stringency's impact on the performance of the same commodity futures. Once we dichotomized the sample into expansive-versus-restrictive monetary environments (using only past information), we found dramatically different results for commodity futures both as a stand-alone investment and as a portfolio component. During restrictive policy periods, commodity futures exhibited strong return/risk performance as a stand-alone investment. Further, they were shown to have substantial weight in efficient portfolios across a wide range of risk levels, significantly enhancing the portfolios' returns. In contrast, during expansive policy periods, commodity futures had poor return/risk performance, and played virtually no role in efficient portfolios. Therefore, our evidence demonstrates the importance of using monetary stringency to guide the allocation of assets like commodity futures that are commonly viewed as inflation hedges.

APPENDIX I: CONSTRUCTION OF THE GOLDMAN SACHS COMMODITY INDEX (GSCI)

The source for the following information is *The GSCI Manual*, Goldman Sachs. Consistent with The GSCI Manual, "GSCI" is used throughout this description to describe the total return index. The GSCI is world-production weighted and the quantity of each commodity is determined by the average production of the commodity over the previous five years. The index includes all commodities offering sufficient liquidity and futures contract investability. Currently, the GSCI consists of 22 commod-

have been infeasible due to transaction costs and complexity. Specifically, the index is constructed based on a procedure of rolling over long positions in 22 different futures contracts (see Appendix I for a description). Since July 28, 1992, however, the Chicago Mercantile Exchange has offered a contract on the GSCI, thus making such a strategy easily accessible to investors.

ities from three broad categories, distributed as follows: four energy products, nine metals, and nine agricultural products. The GSCI returns are calculated based on the arithmetic average of returns to long positions in futures contracts that are nearest to expiration. At the beginning of the expiration month, futures contracts that are near to expiration are exchanged for contracts with the next applicable expiration date. Actively traded contracts, e.g., certain energy and industrial metals, have contracts that expire monthly, and thus, are rolled forward on a monthly basis. Agricultural and livestock futures are rolled forward on a less-frequent basis because the availability of these contracts is dependent on key points in the production cycle. The expiring contracts are rolled into the new contracts over a five-day roll period that occurs on the fifth through the ninth business days of the month. The rolls occur at a rate of 20% per day and are assumed to occur at the daily settlement price at the end of each of the five rolling-period days. The final GSCI return is calculated by adding the T-bill return to the return obtained from the long position in the futures contracts. This return represents a fully collateralized return, and thus is comparable to the returns earned from long positions in equities and bonds.

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