

The Effectiveness of Asset Classes in Hedging Risk

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Over the past two decades, the interest in alternative assets as a portfolio component has grown tremendously. Traditionally, the most popular alternative assets consisted of real estate and foreign equities, however, commodities have garnered most of the recent interest. Thus, much of the growth in alternative asset investment can be attributed to the growth in commodity investment. For example, investment in commodity-based, exchange-traded products reached an astounding \$125.8 billion in May 2010; see Carpenter [2010]. The popularity of commodities is partially predicated on the view that they help to “diversify” or “hedge” investment portfolios against the financial destruction that typically coincides with periods of high inflation, financial emergencies, and political turmoil. The recent phenomenal growth in commodity investments can be largely attributed to two primary factors: 1) the perceived risk of hyperinflation and crisis events has become more prominent in recent years, and 2) commodity-based investment products have become more readily available to investors. In this research, we evaluate the diversification potential of commodities, relative to other asset classes, in hedging security market risk.

Numerous studies have evaluated the investment performance and diversification benefits associated with alternative asset classes such as commodities, real estate, and

foreign equities. In spite of the extensive past research, we believe several issues warrant additional investigation. First, when evaluating the merits of alternative assets, previous studies have generally focused on a limited set of assets over a relatively short time period. By limiting the sample period and number of asset classes, it is difficult to determine the relative, long-term hedging potential that alternative assets offer investors. In contrast, we consider several classes of alternative assets over a sample period of 41 years. Thus, we offer robust evidence regarding the hedging potential of the most prominent asset classes relative to one another. Second, we consider two separate dimensions of risk hedging: 1) hedging of general fluctuations in monthly returns, and 2) hedging of extreme return movements. Previous research is generally limited to the first dimension. But given recent market experience, hedging extreme events has likely become the more crucial consideration for investors. Third, the degree to which the hedging potential of commodities varies across commodity type remains unclear. Most previous research evaluates the investment benefits of commodities via a broad commodity index. Our research considers a general commodity index, along with each of its five primary components. Recent research makes a compelling argument that commodities should not be considered as a single asset class. Fourth, we consider the

diversification potential of alternative assets for both equity and fixed-income portfolios versus prior research that focuses on the implications for equity investors. Finally, one of the most common justifications for adding alternative assets to a portfolio is to hedge against the adverse effects of higher inflation, yet studies routinely ignore the influence that the inflationary environment has on the direct diversification benefits of alternative assets. In contrast, we use an *ex ante* measure to identify shifts in inflationary pressures, which makes our findings more relevant for investment practice.

RELATED RESEARCH

Alternative assets are frequently advocated for the diversification benefits that they offer investors. Real estate and international equities have historically dominated the alternative asset landscape due to their relatively well-developed secondary markets. Investment funds that specialize in real estate investment trusts (REITs) and foreign equities have existed for many years and provide investors with a low-cost method of gaining an exposure to these asset classes. The recent expansion in the variety of exchange-traded funds (ETFs) and exchange-traded notes (ETNs) has greatly increased the offerings in alternative asset classes but, of equal importance, has also provided investors with low-cost, easy access to a variety of commodities. As a result, gaining a commodity exposure has gone from being a relatively costly and difficult process to being relatively simple and low cost.

The investment benefits of real estate have been expounded by numerous researchers for many years; see Fogler [1984], Goetzmann and Ibbotson [1990], Firstenberg, Ross, and Zisler [1988], Hudson-Wilson, Fabozzi, and Gordon [2003], Chen et al. [2005], and Lee and Stevenson [2005].¹ Goetzmann and Ibbotson [1990] found a relatively low positive correlation between commercial real estate and equities, and further, they reported a negative correlation between equities and residential and farm real estate. The authors also reported a negative relationship between real estate and long-term government bonds. Hudson-Wilson, Fabozzi, and Gordon [2003], Chen et al. [2005], and Lee and Stevenson [2005] extended the research by examining the benefits associated with adding real estate to mixed-asset portfolios. They reported evidence supporting the contention

that adding real estate reduces portfolio volatility and produces an improved risk–return trade-off. Furthermore, the evidence indicates that real estate offers fairly consistent diversification to a portfolio, and the benefits increase as the investment horizon expands.² In general, however, the evidence indicates that the benefits of supplementing a portfolio with real estate accrue primarily from risk reduction, rather than from return enhancement. Finally, Fei, Ding, and Deng [2010] reported evidence suggesting that the correlation of REITs with equities is inversely related to REIT performance, thus implying that the diversification benefits of real estate diminish during adverse market environments.³

As with other types of alternative assets, real estate is frequently advocated for its inflation-hedging capabilities. The empirical evidence, however, is somewhat mixed regarding real estate's efficacy in fulfilling this role. Bond and Seiler [1998] found evidence supporting the claim that during the period from 1969 to 1994 real estate provided an effective inflation hedge. Chatrath and Liang [1998] found less support for real estate's inflation-hedging potential; they found some support for its ability to hedge inflation in the long run, but not in the short run.

The benefits of international diversification have been advocated since Solnik [1974] presented the case to U.S. pension plans. The actual diversification benefits of international investment have been questioned, however, as researchers find that the correlation structure of international equities differs significantly through time and increases when markets are volatile; see Michaud et al. [1996], Bekaert et al. [1998], Goetzmann, Li, and Rouwenhorst [2005], Chua, Kritzman, and Page [2009], and Leibowitz and Bova [2009]. Ang and Bekaert [2002] claimed that the increased correlation of global equities during bear markets has only a small influence on global asset allocation. They further argued that the diversification benefits offered by international equities are substantial.

Much of the early research on international diversification centered on developed markets. As correlations between developed markets have increased, the interest in emerging markets has grown. Despite their high stand-alone risk, emerging markets offer significant diversification benefits because of their historically low correlations with developed markets. Errunza, Hogan, and Hung [1999] reported evidence supporting the relative attractiveness of emerging markets. They reported

an average correlation between the S&P 500 and nine emerging markets of only 0.09 versus an average correlation between the S&P 500 and seven developed markets of 0.40. Eun and Lee [2010] found evidence suggesting a fairly rapid convergence in global equity market performance, which has negatively impacted the benefits of international investment. Goetzmann, Li, and Rowenhorst [2005] and Eun and Lee [2010] concluded that while emerging markets are becoming more integrated into global financial markets, they are more distinct from each other than developed markets and still provide considerable diversification benefits to global investors.

Over the past 30 years, numerous studies have evaluated the performance of commodity investments on a stand-alone basis (e.g., Ankrum and Hensel [1993], Erb and Harvey [2006], and Gorton and Rouwenhorst [2006]) and as a component of an investment portfolio (e.g., Bodie [1983], Jensen, Johnson, and Mercer [2000, 2002] and Conover et al. [2010]). In general, these studies support the contention that commodities represent an attractive investment.

Gorton and Rouwenhorst [2006] found that over the period 1959 through 2004 commodities exhibited performance comparable to stocks with very low correlations to both stocks and bonds. For example, the authors reported a correlation of 0.05 between the S&P 500 return and the return to an equally weighted commodity index. Similarly, the authors reported a correlation of -0.14 between monthly bond returns and the commodity index. Furthermore, they reported evidence suggesting that commodities perform well even in periods of poor stock performance. Based on this evidence, the authors concluded that commodities offer both diversification potential for investors and strong return performance.

Erb and Harvey [2006] examined a time period comparable to Gorton and Rouwenhorst and confirmed the favorable performance of commodities. Based on additional analysis, however, they found that the performance differs substantially across time, across specific commodity index, and across commodity type. They concluded that investors should be cautious about projecting the past performance of commodities into the future.

Conover et al. [2010] examined the benefits of adding commodity exposures of 5%, 10%, and 15% to equity portfolios. They found that adding commodities

to a portfolio serves to improve portfolio performance. They also found, however, that the benefits exhibit substantial temporal variation. Büyüksahin, Haigh, and Robe [2010] examined whether the diversification benefits provided by commodities have diminished due to increased integration of markets. The authors found no persistent increase in co-movements between the returns on passive commodity and equity investments during the period from 1991 to 2008. The authors did identify, however, substantial variation over time in the potential benefits that commodities bring to equity investors.

An issue that has been largely neglected by previous researchers is how the diversification benefits of commodities change during periods of extreme market moves. Past researchers have criticized the hedging potential of foreign equities and real estate because the correlations have been shown to increase significantly during periods of high market volatility; see Erb, Harvey, and Viskanta [1994], Longin [1996], Longin and Solnik [2001], and Fei, Ding, and Deng [2010]. Thus, the diversification benefits of foreign equities and real estate tend to diminish when they are most needed by investors (i.e., during periods of extreme price movements). Büyüksahin, Haigh, and Robe [2010] presented visual evidence suggesting that commodities may suffer from the same basic flaw.

SAMPLE AND ASSET CLASS PROXIES

We evaluate the investment benefits associated with adding alternative assets to portfolios of U.S. equities and U.S. bonds for the period from January 1970 through December 2010. In order to differentiate the hedging potential across the most prominent alternative assets, we consider monthly total returns on the following indices:

- *U.S. Equities*: Proxied by the value-weighted CRSP Index (VWCRSP) from the Center for Research in Security Prices. The index is composed of all stocks with primary listing on the NYSE, ASE, NASDAQ (since 1972), and ARCA (since 2006). Our results are similar if we use total returns on the S&P 500 Index, available from 1988.
- *U.S. Bonds*: Proxied by Barclays Capital U.S. Aggregate Bond Index (BOND), previously known as the Lehman Aggregate Bond Index. The index

“measures the investment grade, U.S. dollar, fixed-rate taxable bond market, including Treasuries, government-related and corporate securities, MBS (agency fixed-rate and hybrid ARM pass throughs), ABS and CMBS.” The index was created in 1986 with history backfilled to 1976. U.S. TIPS were removed from the index in 1998. The data are from Datastream.

- *U.S. Real Estate*: Proxied by the FTSE/NAREIT Index, which is a value-weighted index of all real estate investment trusts (REITs) that are actively traded on the NYSE and ASE.⁴ We also consider separately the NAREIT Mortgage index and NAREIT Hybrid index. Data are from Datastream.
- *Emerging Market Equities*: Proxied by the MSCI Emerging Markets Index (EMRG), which is a free float-adjusted market value-weighted index designed to measure equity market performance in the global emerging markets. The index includes large-, mid-, and small-cap equity securities in 21 markets classified as emerging. Data are from Datastream.
- *Foreign Developed Market Equities*: Proxied by the EAFE, which is a free float-adjusted market value-weighted index of equities from Europe, Australasia, and the Far East. The index is designed to measure the equity market performance of developed markets excluding the U.S. and Canada. Data are from Datastream.

As an indicator of commodity prices in general, we consider the S&P GSCI (GSCI), which is composed of five subcategories of commodity contracts and 24 individual commodities. Following previous research, we use total return (fully collateralized return) when examining the performance of the commodity indices.

Erb and Harvey [2006] argued persuasively that the evidence indicates that commodities should not be treated as a single asset class. Specifically, the authors show that the correlation of commodities across commodity type is generally insignificant. For example, they find that the average correlation across individual commodities is only 0.09. Based on this evidence, in addition to the GSCI composite index, we consider five subcategories of commodities. All GSCI data are from Datastream.

- *GSCI Composite*: A production-weighted commodity futures index that consists of five subcategories of futures contracts and 24 individual futures contracts.
- *GSCI Energy*: A production-weighted index that includes six energy contracts (e.g., heating and crude oil).
- *GSCI Livestock*: A production-weighted index that includes three contracts on livestock (e.g., live cattle and lean hogs).
- *GSCI Agriculture*: A production-weighted index that includes eight agricultural futures contracts (e.g., wheat and coffee).
- *GSCI Metals*: A production-weighted index that includes five futures contracts on industrial metals (e.g., copper and aluminum).
- *GSCI Precious Metals*: A production-weighted index that includes futures contracts on two precious metals (gold and silver).

Given the unique treatment of gold as a commodity, we also consider separately the hedging properties of gold using total returns on the S&P GSCI Gold Index from Datastream. Finally, we include a three-month T-bill index (obtained from the Federal Reserve website) as an indicator of the returns to money market securities.

SUMMARY STATISTICS FOR ASSET CLASSES

Exhibit 1 reports summary statistics for the 15 different asset classes considered in the analysis. For the full period, the highest return was earned by emerging markets (EMRG) with a monthly return of 1.35%. It should be noted, however, that the emerging markets index has only been available since 1988. Interestingly, the next three top returns are from commodity indices, with Energy returning 1.15% and the Composite and Metals indices each at 0.98%. The returns to U.S. equities, developed foreign equities (EAFE), and general real estate (NAREIT) are very similar, yet somewhat lower than the top four returning asset classes.

The standard deviations indicate that the top-performing asset classes are characterized by considerable volatility, with the monthly standard deviations exceeding 5% for each of those four classes. Energy, with a 9.25% standard deviation, has the highest volatility of the alternative investments. In addition, as indicated by the Bottom 5% column 1 of every 20 monthly

EXHIBIT 1

Asset Class Summary Statistics, 1970–2010

Asset Class	Start Date	Mean Monthly Return (%)	Standard Deviation	Coefficient of Variation	Bottom 5%	Top 5%
U.S. Equities: Value-Weighted CRSP (VWCRSP)	1970	0.91	4.54	4.99	−7.35	7.65
Foreign Equities						
Developed Markets (EAFE)	1970	0.89	4.98	5.60	−7.68	8.89
Emerging Markets (EMRG)	1988	1.35	6.98	5.17	−10.64	11.58
S&P GSCI						
Composite	1970	0.98	5.78	5.90	−8.85	9.60
Precious Metals	1973	0.86	6.63	7.71	−7.94	10.64
Metals	1977	0.98	7.06	7.20	−8.53	12.18
Energy	1983	1.15	9.25	8.04	−13.15	17.15
Livestock	1970	0.77	5.18	6.73	−7.44	8.37
Agriculture	1970	0.58	5.97	10.29	−8.54	11.23
Gold	1978	0.68	5.65	8.31	−6.46	9.82
Real Estate Equities-NAREIT	1972	0.90	5.20	5.78	−6.93	7.94
NAREIT-Mortgage	1972	0.59	6.01	10.19	−10.49	8.92
NAREIT-Hybrid	1972	0.70	7.13	10.19	−12.68	11.23
U.S. Aggregate Bonds (BOND)	1976	0.68	1.64	2.41	−1.82	3.05
T-bills (Three Month)	1970	0.50	0.30	0.60	0.03	1.02

energy returns is less than −13.15%, which indicates that extreme negative returns are relatively commonplace with this asset class. There is also a relatively high incidence of extremely negative returns for EMRG and mortgage REITs.

The coefficient of variation indicates that for the entire period, the equity indices, including general REITs, had comparable performance with U.S. equities performing best and REITs the worst. Interestingly, the commodity composite compares favorably with the equity indices (U.S. equities, EAFE, and NAREIT). For each of these major asset classes, the general comparability of the coefficient of variation indicates that each asset class served as a viable stand-alone investment over the full sample period. The generally favorable performance of commodities supports the findings of numerous previous researchers (e.g., Gorton and Rouwenhorst [2006]). Each of the separate commodities, however, is far inferior to the equity indices on a risk–return basis.

CONSISTENCY OF PERFORMANCE ACROSS TIME

Exhibit 2 presents summary statistics for the first and second halves of the sample period. It should be noted

that the second half of the sample period (1990–2010) aligns fairly closely with the introduction of trading on the GSCI and with major structural changes in the REIT market. A contract on the GSCI was first offered on the CME in July 1992. Erb and Harvey [2006] argued that returns to the GSCI prior to the July 1992 date are only hypothetical. Lee [2010] identified several significant changes in the REIT industry that were concentrated in the late 1980s and early 1990s. Chan, Leung, and Wang [1998] noted that these changes facilitated institutional holdings of REITs and resulted in increased institutional holdings of REITs from approximately 13% in the 1986–1992 period to 30% by 1995.

The data reported in Exhibit 2 indicate that the returns for nearly all the assets diminished in the second half of the sample. The only exceptions were for the NAREIT and mortgage NAREIT. The improved performance for the REIT indices is consistent with the conjecture that the structural changes to the REIT industry, which occurred in the late 1980s and early 1990s, improved REIT performance.⁵ The decline for commodities and the foreign equity indices (emerging and EAFE) was especially pronounced. In particular, the commodity composite returns dropped by 57%, while the EAFE and emerging markets (EMRG) dropped by 59% and 52%, respectively. In contrast, the performance

EXHIBIT 2

Asset Class Summary Statistics: Subperiods

Asset Class	1970–1990			1990–2010		
	Mean (%)	Standard Deviation (%)	Coefficient of Variation	Mean (%)	Standard Deviation (%)	Coefficient of Variation
U.S. Equities: VWCSP	0.97	4.72	4.87	0.80	4.38	5.49
Foreign Equities						
Developed (EAFE)	1.18	5.08	4.31	0.48	5.11	10.66
Emerging (EMRG)	2.32	7.51	3.24	1.12	6.97	6.21
S&P GSCI						
Composite	1.42	5.40	3.81	0.61	6.28	10.30
Precious Metals	1.03	8.42	8.20	0.66	4.40	6.68
Metals	1.41	8.56	6.07	0.81	5.88	7.22
Energy	2.16	9.96	4.61	0.92	9.46	10.28
Livestock	1.51	6.04	4.00	0.10	3.95	40.84
Agriculture	0.99	6.48	6.54	0.10	5.29	53.62
Gold	0.75	7.25	9.64	0.60	4.31	7.21
Real Estate-NAREIT	0.72	4.95	6.87	0.94	5.39	5.71
NAREIT-Mortgage	0.40	5.85	14.75	0.66	6.10	9.27
NAREIT-Hybrid	0.65	6.17	9.51	0.59	7.82	13.18
U.S. Bonds (BOND)	0.84	2.16	2.57	0.57	1.10	1.93
T-bills (Three Month)	0.68	0.28	0.41	0.32	0.18	0.57

of the U.S. equity market was only 17.5% lower than in the prior period. The inferior performance for the commodity indices during the later period, relative to its early history, corresponds with the evidence reported by Erb and Harvey [2006].

ASSET CLASS DIVERSIFICATION POTENTIAL

Exhibit 3 reports correlations of U.S. equities (Panel A) and debt (Panel B) with each of the alternative asset classes. The correlations are reported for the full sample period and separately for each subperiod. The evidence in Panel A indicates that U.S. equities have a high and consistent correlation with foreign equities, of both developed markets (EAFE) and developing markets (EMRG). Surprisingly, for the full period, U.S. equities actually exhibit a higher correlation with EMRG relative to EAFE. Furthermore, the evidence across subperiods indicates that the correlation between foreign equities and U.S. equities increased dramatically between the first and second halves of the sample period, increasing from 0.48 to 0.73 for EAFE and from 0.29 to 0.69 for EMRG. Caution must be used in evaluating the correlations for EMRG because the return data began in 1988. Surprisingly, in the later period, the correlation between U.S. equities and the emerging markets (0.69)

was very similar to the correlation that U.S. equities had with developed foreign equities (0.73). Both values suggest that the diversification benefits of foreign equities for U.S. equity investors have subsided drastically over time and are currently relatively meager when compared to other alternative asset classes. The dramatic temporal increase in correlations between the first and second periods corresponds with the evidence of Eun and Lee [2010], which identifies a fairly rapid convergence in global equity market performance.

Relative to foreign equities, the correlation between U.S. equities and commodities signals a much more promising level of diversification potential. In particular, for the full period, U.S. equities have an insignificant correlation with the S&P GSCI Composite and have significant correlations with only two of the component indices, Metals and Livestock. The correlation with the industrial metals index (Metals) is relatively high and consistent across the subperiods, suggesting that metals offer far less diversification potential than the average commodity. Given that industrial metals are crucial to industrial production, this relatively high correlation is not terribly surprising. The evidence in Panel A also indicates that the correlation between U.S. equities and commodities has increased considerably over time with especially prominent increases occurring for Energy,

EXHIBIT 3

Asset Class Correlations with U.S. Stocks and U.S. Bonds

Asset Class	1970–2010	1970–1990	1990–2010
<i>Panel A. Correlations with U.S. Stocks (VWCRSP)</i>			
Foreign Equities			
Developed Markets (EAFE)	0.61***	0.48***	0.73***
Emerging Markets (EMRG)	0.66***	0.29*	0.69***
S&P GSCI			
Composite	0.07	−0.06	0.13**
Precious Metals	0.04	0.06	−0.02
Metals	0.27***	0.18**	0.35***
Energy	0.05	−0.14	0.06
Livestock	0.08*	0.09	0.08
Agriculture	0.07	−0.07	0.26***
Gold	0.01	0.04	−0.06
Real Estate-NAREIT	0.58***	0.64***	0.55***
NAREIT-Mortgage	0.46***	0.55***	0.37***
NAREIT-Hybrid	0.49***	0.56***	0.45***
U.S. Aggregate Bonds (BOND)	0.24***	0.34***	0.15**
T-bills (Three Month)	0.02	−0.02	0.04
<i>Panel B. Correlations with U.S. Bonds (BOND)</i>			
Foreign Equities			
Developed Markets (EAFE)	0.16***	0.21***	0.11*
Emerging Markets (EMRG)	0.01	0.07	0.01
S&P GSCI			
Composite	−0.02	−0.08	0.00
Precious Metals	−0.03	−0.10	0.12*
Metals	−0.05	−0.02	−0.10
Energy	−0.06	−0.21**	0.00
Livestock	0.03	0.02	0.02
Agriculture	−0.01	−0.04	0.04
Gold	0.02	−0.04	0.14**
Real Estate-NAREIT	0.25***	0.39***	0.17***
NAREIT-Mortgage	0.34***	0.50***	0.25***
NAREIT-Hybrid	0.23***	0.34***	0.20***
T-bills (Three Month)	0.30***	0.40***	0.16***

Notes: ***significant at the 1% level, **significant at the 5% level, and *significant at the 10% level.

Metals, and Agriculture. Whereas the Composite had an insignificant relationship with equities in the earlier period, the correlation was significant in the later period, but at 0.13 the correlation value remains quite low. The marked increase in correlation is consistent with the evidence reported by Tang and Xiong [2011] who noted that increased recognition of the potential diversification benefits of commodities has led to a substantial increase in commodity investments. They argued that this increased investor participation has led to a process

of financialization among commodity markets, which has caused greater intra-commodity correlation and induced greater correlation between commodities and other financial assets. In contrast, Büyüksahin, Haigh, and Robe [2010] argued that there has not been a persistent increase in correlation over the past 17 years.

For the full period, the correlation that real estate has with U.S. equities is similar to the correlation of U.S. equities and foreign equities. Unlike foreign equities, however, the correlation between U.S. equities and real estate has fallen between the first and second halves of the sample period. Thus, it appears that the diversification potential of real estate has increased, and relative to foreign equities, real estate now appears to offer U.S. equity investors slightly greater diversification benefits.

The conventional wisdom that calls for investors to allocate their portfolio across equities and debt is confirmed by the relatively low correlation observed between U.S. equities and U.S. bonds (0.24). Furthermore, the correlation is substantially lower in the later period, which suggests that the diversification benefits have expanded. Finally, as expected, the correlation of T-bills (the risk-free proxy) is trivial for the full period and each subperiod.

Panel B of Exhibit 3 indicates that, relative to equity portfolios, alternative assets offer far greater diversification benefits for fixed-income portfolios. The correlations reported for commodities and emerging market equities (EMRG) suggest that these asset classes offer the greatest diversification potential. In contrast, real estate and developed markets (EAFE) appear to offer the least potential, although their diversification potential appears to have increased over time. Consistent with expectations, T-bill returns are significantly correlated with U.S. bonds, however, the correlation in the later period is only 0.16.

HEDGING EXTREME SECURITY RETURNS

In Exhibit 4, we gauge the relative potential of each asset class in hedging two dimensions of equity market risk: general equity market moves and market shocks. We do this by evaluating the general relationship between U.S. equities and each asset class, while also considering the performance during extreme moves in the equity market. The investigation is executed by esti-

EXHIBIT 4

Regressions with Extreme Movements: Equity (5% Extreme Movements)

Asset Class	Intercept	VWCRSP	Bott5%	Top5%
EAFE	0.52	0.58	-3.16	0.16
<i>t</i> -statistic	2.74	10.05	-2.75	0.14
Emerging Markets	0.73	0.97	-3.94	-0.81
<i>t</i> -statistic	1.93	9.14	-2.19	-0.50
S&P GSCI				
Composite	1.10	0.10	-1.65	-2.56
<i>t</i> -statistic	4.15	1.20	-0.70	-1.99
Precious Metals	0.85	0.10	0.31	-1.66
<i>t</i> -statistic	2.46	1.09	0.16	-1.19
Energy	1.57	0.03	-5.04	-3.92
<i>t</i> -statistic	2.96	0.20	-1.28	-1.65
Metals	0.47	0.49	1.80	-0.95
<i>t</i> -statistic	1.39	4.54	0.49	-0.61
Livestock	0.87	0.08	-1.81	-1.39
<i>t</i> -statistic	3.47	1.12	-1.27	-1.34
Agriculture	0.39	0.15	-0.44	1.64
<i>t</i> -statistic	1.32	1.67	-0.33	0.73
Gold	0.57	0.10	2.06	-1.68
<i>t</i> -statistic	1.89	1.08	1.14	-1.24
NAREIT	0.56	0.59	-3.55	-0.49
<i>t</i> -statistic	2.91	9.35	-2.04	-0.29
NAREIT-mortgage	0.06	0.64	0.17	-1.14
<i>t</i> -statistic	0.20	7.62	0.11	-0.58
NAREIT-hybrid	0.25	0.68	-3.50	0.20
<i>t</i> -statistic	0.81	7.32	-1.57	0.09
U.S. Bonds	0.52	0.12	1.08	-0.11
<i>t</i> -statistic	5.93	3.95	2.42	-0.25
T-bills (Three Month)	0.50	-0.00	-0.05	0.00
<i>t</i> -statistic	25.95	-0.01	-0.58	0.01

Notes: Estimation results for the following model: $\text{Asset Class Ret}_t = a + b_1 \times \text{VWCRSP}_t + b_2 \times \text{Bott5\%} + b_3 \times \text{Top5\%} + e_t$, where Bott5\% (Top5\%) is a dummy variable that equals one for the top and bottom 5% of VWCRSP returns.

mating the following regressions with alternative combinations of dependent and independent variables.

Model 1: $\text{Asset Class Ret}_t = a + b_1 \times \text{Equity (Bond)}$
 $\text{Ret}_t + b_2 \times \text{Bott5\%} + b_3 \times \text{Top5\%} + e_t$

where Asset Class Ret_t is the monthly return to the respective asset index, Equity (Bond) Ret_t is the monthly return to the U.S. equity (Bond) index in month t , Bott5% is a zero/one dummy variable that equals one when the observation (stock or bond market) is in the bottom 5% of values, and Top5% is a zero/one dummy variable that equals one when the observation (stock or

bond market) is in the top 5% of values. To control for potential problems with the data (e.g., heteroskedasticity and autocorrelation in the errors), t -statistics are based on Newey–West-adjusted standard errors.

The data reported previously in Exhibit 1 indicate that the incidence of extreme U.S. equity market moves is fairly high: 1 in 20 monthly returns is less than -7.35%. A drop of such magnitude would cause considerable concern for most investors. In interpreting the results reported in Exhibit 4, the general relationship between U.S. equities and each asset class is reflected in the coefficient on VWCRSP (the asset class beta), whereas the unusual return performance during extreme market moves is identified by the coefficients on the Bott5% and Top5% dummies.

The evidence in Exhibit 4 highlights the diversification flaws associated with foreign equities, both developed markets (EAFE) and emerging markets (EMRG). Both foreign indices are very closely related to U.S. equities as evidenced by the respective coefficients on VWCRSP (asset class betas), which are economically large (0.58 and 0.97) and highly statistically significant. Thus, on average, a 1% move in U.S. equity returns corresponds with a 0.58% move in the EAFE and a 0.97% move in EMRG. This result indicates that the diversification potential of these asset classes is greatly limited during normal market conditions. Worse yet, the coefficients on Bott5% indicate that the indices' returns are extraordinarily bad when equities do their worst. Specifically, the EAFE's return is 3.16% lower than expected when U.S. equities are performing poorly, while the EMRG's return is 3.94% lower. Thus, foreign equities provide U.S. equity investors the least protection during periods when protection is most valued by investors. The insignificant coefficient on the Top5% dummy, relative to the highly significant coefficient on Bott5%, suggests that equity market contagion effects are limited to negative market events.

Exhibit 4 offers additional support for the diversification potential that most commodity types offer equity investors. The minimal relation between commodities and U.S. equities is confirmed by the extremely small asset-class betas. The relatively limited diversification potential of industrial metals is apparent, however, as Metals are shown to have a strong, significant relation with U.S. equities (0.49). Importantly, for hedging negative market shocks, none of the commodities has a significant Bott5% coefficient, which indicates that when equity markets

experience extreme adversity, commodity performance does not deviate significantly from its normal level. This finding supports the general ability of commodities to hedge events that have the most adverse impact on U.S. equities.

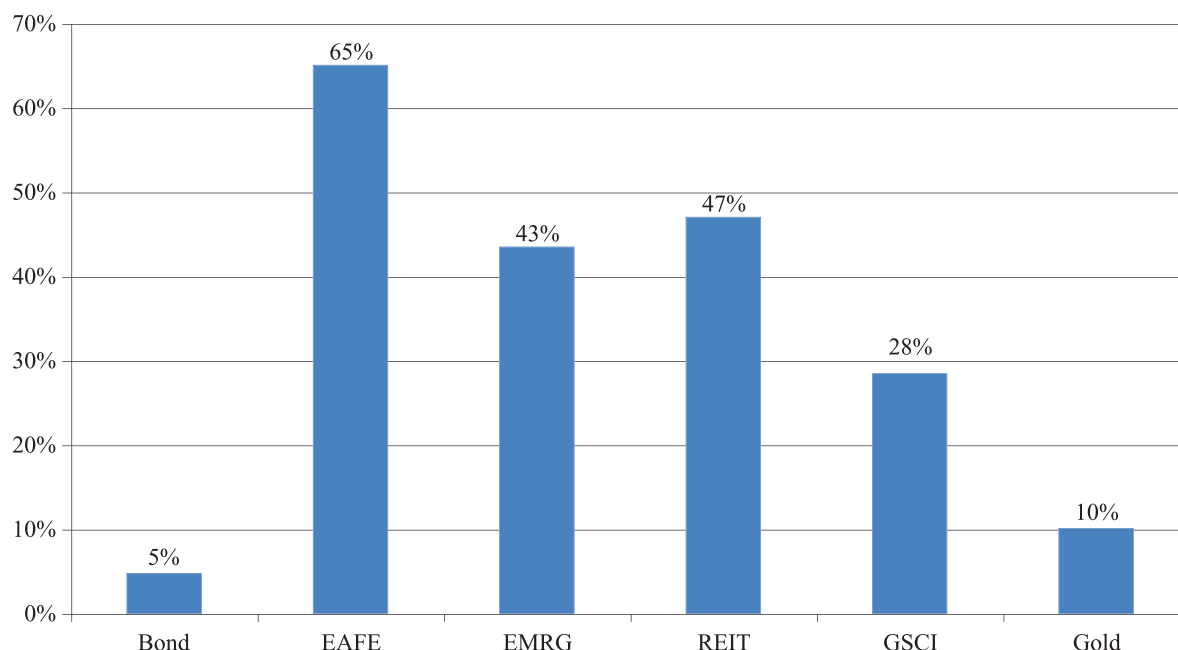
Surprisingly, the coefficients on Bott5% and Top5% are extremely large for Composite, Energy, Livestock, and Gold. A common critique of the GSCI Composite is its heavy reliance on energy contracts, which is reflected by the similarity in coefficients across Composite and Energy. The dummy variable coefficients (Bott5% and Top5%) indicate that, on average, extreme equity market moves, both positive and negative, are associated with unusual extreme negative moves in energy prices, and to a lesser extent livestock prices. This should cause some concern for investors looking for a somewhat consistent hedge against extreme drops in equity prices, because, on average, energy prices would compound the investor's loss during a devastating equity market event. In contrast, on average, precious metals (particularly gold), agriculture contracts, and metals have offered a counterbalance to the extreme equity market moves.

The real estate results reported in Exhibit 4 reinforce the relatively poor hedging potential real estate offers equity investors. Each of the real estate indices has a significant and relatively strong relation with equity returns as evidenced by the coefficient on VWCRSP, which ranges from 0.59 to 0.68. Furthermore, when U.S. equities experience a negative market shock, the NAREIT and hybrid NAREIT experience extraordinarily poor returns (3.55% and 3.50% below expectations, respectively). Thus, during periods of equity market turmoil, real estate holdings would likely compound an investor's problems instead of alleviating them.

Exhibit 4 reinforces the hedging potential for U.S. equity investors in holding U.S. bonds. The relation between U.S. equities and bonds is significant, but, at 0.12, the relation is relatively weak. The weak positive relation supports a fairly strong degree of diversification potential during normal market conditions. More importantly, the large, significant coefficient on Bott5% (1.08) indicates that U.S. bonds show extremely strong performance when U.S. equities are performing their

EXHIBIT 5

Percentage of Months in Which Equity and Other Asset Classes Simultaneously Experience Extreme Negative Returns



Notes: The exhibit shows the percentage of months over the 1970–2010 (or available) period in which the equity index experiences returns in the bottom 5% of the sample and other asset classes simultaneously experience returns in their bottom 5%.

worst. Interestingly, not a single additional asset class offers a comparable level and consistency of hedging for extreme adverse equity market events. Thus, we find strong support for the contention that bonds provide strong diversification potential during normal market conditions. More importantly, however, the evidence suggests that bonds offer equity investors protection against extreme negative market shocks. This finding is consistent with the evidence reported by Gulko [2002] that equities and bonds tend to decouple during market crashes. Finally, the steady performance of T-bills is apparent by the values reported in the final row of the exhibit.

Exhibit 5 clearly depicts the relative efficacy of each of the major asset classes in hedging extreme drops in U.S. equities. Relative to the other assets, U.S. bonds, gold, and commodities show superior ability in mitigating the harm caused by an extreme reduction in U.S. equities. When equities fall dramatically, each of the three assets shows a less than 30% chance of experiencing a comparable reduction in value. U.S. bonds and gold are especially effective in this regard because their respective chances of experiencing a comparable plunge in value are only 1 in 20 and 1 in 10. In contrast, foreign equities and real estate each have over a 40% chance of experiencing a negative market shock when U.S. equities tumble. Finally, with a 65% value, developed market equities (EAFE) show the least potential to hedge an extreme drop in U.S. equities.

Exhibit 6 reports evidence on the potential of the various asset classes in hedging extreme moves in bond returns. The summary statistics, reported previously in Exhibit 1, suggest that extreme moves in U.S. bond returns, relative to equities, are of much less concern. In particular, the value identifying the lowest 5% of bond returns is -1.82% , which is one-fourth the magnitude of the comparable value for U.S. equities.

The evidence in Exhibit 6 indicates that foreign developed equities (EAFE) tend to move fairly strongly with U.S. bonds (0.52), suggesting they offer relatively little diversification benefit compared to other assets. In contrast, the relation with emerging markets is negative, but the extremely large negative coefficient on Bott5% suggests that EMRG offers investors limited ability to hedge adverse shocks to the U.S. bond market. Commodities, however, appear to provide considerable diversification potential during normal market conditions because none of the indices has a significant relation with

U.S. bonds. It is somewhat disconcerting for bond investors, however, that each of the commodity indices has a large negative coefficient on Bott5%, which suggests that, on average, extremely poor commodity returns often correspond with adverse bond market shocks.

The real estate indices are very strongly related to U.S. bond returns as evidenced by the coefficients on BOND, which are 0.83, 1.30, and 1.18. Thus, U.S. bonds have a very high sensitivity to the factors that move real estate prices. This result suggests that REITs offer little diversification potential for bond investors.

Finally, the advantage of including T-bills in a bond portfolio is made apparent by the output reported at the bottom of Exhibit 6. Although the relationship between

EXHIBIT 6

Regressions with Extreme Movements: Bond (5% Extreme Movements)

Asset Class	Intercept	Bond	Bott5%	Top5%
EAFE	0.67	0.52	-0.78	-1.12
<i>t</i> -statistic	2.28	2.43	-0.53	-0.62
Emerging Markets	1.82	-0.56	-12.91	4.06
<i>t</i> -statistic	3.72	-1.43	-2.23	1.25
S&P GSCI				
Composite	1.01	-0.01	-1.94	-2.66
<i>t</i> -statistic	2.86	-0.02	-1.14	-1.68
Precious Metals	1.05	-0.42	-2.54	1.58
<i>t</i> -statistic	3.08	-1.64	-1.25	0.82
Energy	1.50	0.05	-2.13	-8.73
<i>t</i> -statistic	2.21	0.10	-0.59	-2.99
Metals	1.44	-0.28	-3.36	-2.03
<i>t</i> -statistic	3.43	-0.88	-1.51	-0.85
Livestock	0.63	0.18	-0.57	-1.79
<i>t</i> -statistic	2.36	0.93	-0.46	-1.45
Agriculture	0.33	-0.22	1.63	-1.28
<i>t</i> -statistic	1.08	-0.99	1.18	-0.81
Gold	0.82	-0.15	-1.93	1.19
<i>t</i> -statistic	2.27	-0.63	-0.94	0.63
NAREIT	0.63	0.83	-0.60	-1.82
<i>t</i> -statistic	2.28	4.63	-0.31	-1.05
NAREIT-mortgage	-0.06	1.30	0.37	-1.10
<i>t</i> -statistic	-0.20	5.98	0.23	-0.79
NAREIT-hybrid	0.04	1.18	1.62	-1.38
<i>t</i> -statistic	0.09	4.79	0.87	-0.60
T-bills (Three Month)	0.41	0.07	0.42	0.23
<i>t</i> -statistic	21.16	4.36	4.28	1.89

Notes: Estimation results for the following model: $\text{Asset Class Ret}_i = a + b_1 \times \text{BOND}_i + b_2 \times \text{Bott5\%} + b_3 \times \text{Top5\%} + e_i$ where Bott5% (Top5%) is a dummy variable that equals one for the top and bottom 5% of the U.S. Aggregate Bond Index (BOND).

U.S. bonds and T-bills is significant at 0.07, the association is economically weak. Thus, the weak relation implies that T-bills offer general diversification potential in a bond portfolio. More importantly, however, extreme moves in bond returns (both positive and negative) correspond with unusually strong positive returns for T-bills. This result supports the contention that T-bills tend to prosper as an asset class during periods of extreme bond market uncertainty, which is a very favorable characteristic for a fixed-income investor wishing to hedge extreme market moves.

Exhibit 7 reports the correspondence of negative shocks to the U.S. bond market and each of the other major asset classes. The results indicate that there is a relatively low incidence of extreme negative events that simultaneously impact bonds and any of the other asset classes. In fact, surprisingly, gold has the highest incidence and that is only 15%. Commodities (GSCI), emerging market equities (EMRG), and U.S. equities (VWCRSP) show especially strong potential in mit-

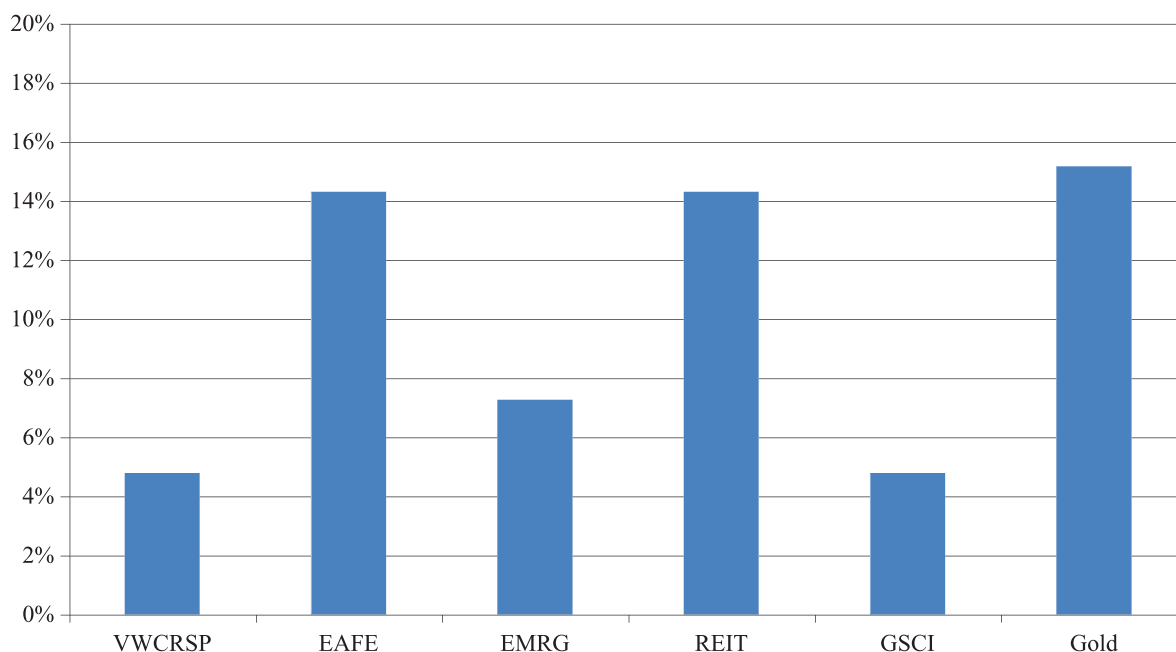
igating the effects of extreme adverse moves in U.S. bonds.

INFLATIONARY ENVIRONMENTS

Following Jensen and Moorman [2010], we categorize Federal Reserve monetary policy into two broad classifications: inflationary and noninflationary. During inflationary periods, Fed actions are defined by rate-increasing activities with regard to either the Fed policy rate (discount rate) or the general target rate (federal funds rate). In contrast, noninflationary periods correspond with Fed actions defined by rate decreases for both the policy rate and the target rate. Thus, inflationary environments correspond with generally restrictive Fed policy actions, while noninflationary periods correspond with expansive policy actions. In order to make the findings more relevant for investment professionals, we define the inflationary environments on an ex ante basis (i.e., the environments are established based on rate

EXHIBIT 7

Percentage of Months in Which Bonds and Other Asset Classes Simultaneously Experience Extreme Negative Returns



Notes: The exhibit shows the percentage of months over the 1970–2010 (or available) period in which the aggregate bond index experiences returns in the bottom 5% of the sample and other asset classes simultaneously experience returns in their bottom 5%.

changes that occurred previously). Thus, the approach would allow investors to make monthly investment allocation decisions using information revealed in the prior month; see Jensen and Moorman [2010] for a thorough discussion of the two alternative environments.

Exhibit 8 reports data regarding the inflationary environments and confirms the efficacy of the classification approach in differentiating inflationary pressures and the availability of money/reserves. The evidence clearly indicates that restrictive Fed policy actions are associated with a reduced availability of funds and greater inflation. Specifically, the increase in all three monetary/reserve aggregates is substantially smaller during restrictive (inflationary) periods and the rate of inflation is substantially greater.⁶ This result is consistent with the contention that Fed actions that signal increased stringency are initiated when the Fed forecasts greater inflationary pressures. In contrast, an easy money policy (rate-reducing period) is consistent with lower inflationary pressures. Such a policy increases the availability of funds for financial market participants. This view is supported by the significantly lower rate of inflation and substantially greater increase in reserves and monetary aggregates during noninflationary environments. Overall, the evidence in Exhibit 8 indicates that Fed policy shifts provide market participants with an indicator variable that can be used on an ex ante basis

to make portfolio allocation decisions in response to future inflationary pressures.

Exhibit 9 reports evidence regarding the diversification benefits of the asset classes for equity investors (Panel A) and for debt investors (Panel B) across alternative inflationary/monetary environments. The Panel A results imply that foreign equities provide relatively little diversification potential regardless of whether the inflationary pressures are elevated, however, the correlations are somewhat higher during noninflationary periods. The diversification potential of U.S. bonds remains fairly consistent across the two environments, but also appears slightly better during inflationary periods.

Commodities appear to offer equity investors especially strong diversification benefits during inflationary periods, which is consistent with their advocacy as an inflation hedge. Although the Composite has a trivial correlation with U.S. equities during inflationary periods (0.04), the correlation is statistically significant when inflationary pressures are low (0.21). This pattern prevails across all the commodities with the exception of Livestock and Precious Metals. Energy exhibits an especially prominent pattern, which is consistent with the view that energy prices play an instrumental role in promoting inflationary pressures. Thus, given the negative influence that inflation has on security prices, energy might be expected to serve as a more effective hedge during

periods of elevated inflationary pressures. This is consistent with Halpern and Warsager [1998], who advocated energy futures as an inflation hedge. Finally, the evidence is consistent with the claim that, regardless of inflationary pressures, precious metals offer consistent diversification benefits.

Real estate provides relatively little diversification benefit irrespective of the inflationary environment, however, mortgage REITS appear to offer more potential when inflationary pressures are low. Given that the NAREIT includes a variety of real estate types, it is possible that certain types of real estate may serve as a better diversifier during periods of elevated inflation. For example, apartment and retail-based real estate investments are commonly proposed as offering above-average inflation protection; see Hudson-Wilson et al. [2005].

EXHIBIT 8

Inflation Rate and Change in Monetary/Reserve Aggregates Across Inflationary Environments, 1970–2010

	All	Inflationary	Noninflationary	Comparison <i>t</i> -test
Inflation Rate (%)	0.50	0.43	0.23	−0.20*** (4.81)
Δ in Total Reserves (%)	1.27	0.08	3.60*	3.52* (1.73)
Δ in Nonborrowed Reserves (%)	1.54	0.22	4.13	3.91 (1.04)
Δ in Adjusted Monetary Base (%)	0.73	0.50	1.17	0.67** (2.02)

Notes: This exhibit shows the percentage change in funding aggregates across different inflationary conditions. Changes in funding aggregates are taken from monthly observations in total reserves, nonborrowed reserves, and adjusted monetary base. Monthly changes are from January 1970 through December 2010. Changes in funding aggregates are measured in month $t + 1$ based on monetary conditions determined in month t . Newey–West t -statistics are reported in italics. ***, **, * indicate that the percentage change in aggregates differs significantly across inflationary periods at the 1%, 5%, and 10% levels, respectively.

EXHIBIT 9

Asset Class Correlations with U.S. Stocks and U.S. Bonds Across Inflationary Environments

Asset Class	1970–2010	Inflationary Period	Noninflationary
<i>Panel A. Correlations with U.S. Stocks (VWCRSP)</i>			
Foreign Equities			
Developed Markets (EAFE)	0.61***	0.57***	0.68***
Emerging Markets (EMRG)	0.66***	0.58***	0.76***
S&P GSCI			
Composite	0.07	0.04	0.21**
Precious Metals	0.04	0.05	0.02
Metals	0.27***	0.20***	0.45***
Energy	0.05	−0.05	0.23***
Livestock	0.08*	0.10*	0.06
Agriculture	0.07	0.07	0.14*
Gold	0.01	0.01	0.02
Real Estate-NAREIT	0.58***	0.58***	0.57***
NAREIT-Mortgage	0.46***	0.52***	0.33***
NAREIT-Hybrid	0.49***	0.50***	0.47***
U.S. Bonds (BOND)	0.24***	0.21***	0.27***
T-bills (Three Month)	0.02	−0.03	0.17**
<i>Panel B. Correlations with U.S. Bonds (BOND)</i>			
Foreign Equities			
Developed Markets (EAFE)	0.16***	0.10*	0.24***
Emerging Markets (EMRG)	0.01	−0.01	0.03
S&P GSCI			
Composite	−0.02	−0.01	0.00
Precious Metals	−0.03	−0.14**	0.15*
Metals	−0.05	−0.06	−0.01
Energy	−0.06	−0.05	−0.03
Livestock	0.03	0.04	0.04
Agriculture	−0.01	−0.01	0.04
Gold	0.02	−0.07	0.19**
Real Estate-NAREIT	0.25***	0.25***	0.20**
NAREIT-Mortgage	0.34***	0.34***	0.31***
NAREIT-Hybrid	0.23***	0.17***	0.31***
T-bills (Three Month)	0.30***	0.24***	0.48***

CONCLUSION

We evaluate the effectiveness of several different asset classes in hedging variation in security prices over the last 40 years. Specifically, we consider developed equities, emerging equities, commodities, and real estate during the period from 1970 through 2010. Hedging potential is examined relative to both general variation in prices and extreme price adjustments. Furthermore, the hedging potential of the various asset classes is considered with respect to both U.S. equities and U.S. bonds.

Our findings generally support the diversification efficacy of commodity investments, because commodities show relatively strong return performance and rather low correlation with both equities and bonds. There are, however, a few caveats to the general diversification benefits offered by commodities. First, relative to the other commodity types, the general diversification potential of industrial metals (Metals) appears to be much more limited (i.e., Metals have a much higher correlation with U.S. equities). Thus, equity investors may want to rely more heavily on other types of commodities when structuring a commodity investment that is designed to hedge against general equity market declines. The enormous expansion in commodity ETFs makes creation of a customized commodity exposure more feasible. Second, commodities serve as much more effective hedges during periods when inflationary pressures are relatively elevated. Energy and precious metals are particularly effective in hedging equity market moves during periods when inflationary pressures are elevated. Furthermore, of the various commodity types, precious metals offers the most consistent diversification potential across inflationary periods. Third, when equity prices plunge, the move in commodity prices is statistically insignificant, supporting the ability of commodities to hedge extreme price moves. It is somewhat disconcerting, however, to observe the huge average negative move in commodity prices, particularly in energy prices, that accompanies a negative equity market shock. Thus, while not

statistically significant, on average, a position in energy would have compounded the adverse effects of a negative market shock, but precious metals (especially gold) would have alleviated the shock.

We find strong support for the risk reduction attributes of bonds for U.S. equity investors. The general diversification potential of bonds is indicated by the low correlation between U.S. equities and U.S. bonds. In addition, when U.S. equities plummet, U.S. bonds experience above-average performance, suggesting that bonds are effective in hedging adverse equity market shocks. Extreme drops in U.S. equities are accompanied by extreme bond market reductions in only 5%

of cases, which is far lower than any other major asset class. Finally, the hedging attributes of bonds are shown to be consistent across time and across inflationary environments.

Relative to commodities and bonds, the characteristics of developed market equities, emerging market equities, and real estate suggest that these asset classes provide inferior hedging potential for U.S. investors. Developed market equities, emerging market equities, and real estate show relatively strong sensitivity to movements in U.S. securities, which implies that these three asset classes have limited diversification potential. More importantly, each of these three asset classes performs particularly poorly during extreme adverse movements in U.S. equities. Thus, the three asset classes provide limited diversification for general market fluctuations, and their diversification attributes diminish during periods when hedging is most valued.

ENDNOTES

¹In addition, Eichholtz [1996], Mull and Soenen [1997], and Quan and Titman [1997] offered evidence supporting the benefits of real estate investment from an international perspective.

²In spite of the identified diversification benefits that real estate offers, Garay and Stevenson [2009] noted that institutional investors typically limit their real estate allocation to between 5% and 10% of their total portfolio.

³Clayton et al. [2009] noted that real estate was ineffective in hedging the financial crisis of 2008 and 2009. The authors argued, however, that this observation does not negate the benefits of real estate investment because diversification is intended to hedge against idiosyncratic asset class-specific risks, not risks that are common to all asset classes.

⁴Georgiev, Gupta, and Kunkel [2003] found evidence suggesting that direct real estate investment provides greater benefits than investment in REITs. The superior benefits of direct real estate may be overstated, however, because of data-smoothing issues inherent in direct real estate indices. The direct real estate indices may reflect biased results due to infrequent trading and appraisal-based valuation methods, which serve to understate the actual volatility of real estate as an asset class. Therefore, to avoid potential biases, we follow the majority of real estate research and evaluate real estate returns via REIT indices.

⁵See Lee [2010] for a thorough discussion of the structural changes that have occurred in the REIT industry.

⁶The insignificant difference in nonborrowed reserves is attributed to the extraordinarily large increase in reserves

that coincided with the 2008 financial crises. When the post-2008 period is eliminated, the aggregate differences are all significant at the 1% level.

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