Real Assets and Inflation: Which Real Assets Hedge Inflation

Rajan Parajuli
School of Renewable Natural Resources
Louisiana State University
Baton Rouge, LA 70803
Email: rparaj1@lsu.edu

and

Sun Joseph Chang
School of Renewable Natural Resources
Louisiana State University
Baton Rouge, LA 70803
Email: xp2610@lsu.edu

Selected paper prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28

Real Assets and Inflation: Which Real Assets Hedge Inflation

Abstract

Inflation is considered as a leading macroeconomic indicator, which might create substantial distortions in financial statements, future earnings, and overall performance of securities in the financial market. An inflation-hedging ability of an asset offers protection against inflation, which eliminates or at least reduces the uncertainty about the future real returns. Real assets like real estate, timberland, and farmland have been regarded as good inflation hedges, whereas financial assets like common stocks and bonds are considered as perverse hedges against inflation. Using the generalized Capital Asset Pricing Model (CAPM) to account for inflation, this study evaluates the inflation-hedging ability of several real assets. Consistent with the findings of previous studies, this study concludes that private-equity assets offer hedges against inflation to some extent, but stocks are found to be inferior hedges against inflation.

JEL classification: G11

(Keywords: Real Assets, Inflation, CAPM, Private-equity assets, Public-equity assets)

Introduction

Inflation basically refers to a persistent rate at which the overall level of prices for goods and services rise over time. Inflation is considered as a leading macroeconomic indicator, which might create substantial distortions in financial statements, future earnings, and overall performance of securities in the financial market. Even though the United States has experienced sustained low inflation in recent years, a dramatic increase in the monetary supply to combat the global recession, continued rise in the demand for scarce raw materials in the emerging markets, and a growing level of imported inflation apparently indicated a resurgence of higher inflation in the near future (Anderson, 2011). Given that investors always prefer their investment returns with options to counter potential price inflation, a portfolio formed by including some inflation hedging securities in an attempt to manage inflation risk would be always a wise financial decision.

An inflation-hedging ability of an asset offers protection against inflation, which eliminates or at least reduces the uncertainty about the future real returns (Bodie, 1976). The inflation-hedging characteristics of an asset would be highly desirable, particularly for long-term institutional investors, such as pension funds, university endowments. Real assets like real estate, timberland, and farmland have been regarded as good inflation hedges, whereas financial assets like common stocks and bonds are considered as perverse hedges against inflation. The inflation hedging ability of an asset corresponds with the investment period: the longer the holding period, the more effective hedge against inflation (Lausti, 2004).

Real assets represent a broad array of investment strategies which include commodities, commodity-linked stocks, TIPS, and direct investments in real estate,

energy, farmland, timber and infrastructure. Real assets, in these days, have become a common alternative investment class especially for long-term institutional investors such as pension funds and university endowments. During the extended periods of high inflation, real assets offer investors protection against unanticipated variety of inflation and portfolio diversification benefits when needed most (O'Donnell, 2009). All real asset investments incur some common risks such as low correlation to paper assets, high sensitivity to macro-economic cycles, and manager selection risk, which augment some risk premiums to return series.

A number of previous empirical studies investigated the inflation-hedging ability of a wide array of assets including stocks, government bonds, and various real assets. A seminal work by Fama and Schwert (1977) revealed that during the period of 1953-1971, U.S. government bonds, treasury bills and private residential real estate were a complete hedge against expected inflation, whereas common stock returns were found negatively related to expected inflation, unanticipated inflation, and changes in expected inflation. The poor inflation-hedging ability of the equity market was further substantiated by several studies. Higher inflation may result in a drop in the money demand induced by lower growth in real activity, which simultaneously implies a drop in stock prices and hence a fall in stock returns (Fama, 1981; Stulz, 1986). Using interest rates as a proxy for expected inflation, Solnik (1983) also investigated the relation between stock returns and inflationary expectations for nine countries, and reported a significant negative relationship between the stock returns and inflationary expectations for every country in the study.

Following Fama and Schwert (1977), several studies analyzed the historical relationship between inflation and return on various real assets. Real assets not only provide hedges against inflation but also have become crucial vehicles for providing a new source of diversification in investors' portfolios. Hartzell et al. (1987) examined the ability of a well-diversified portfolio of private real estate to hedge against inflation, and found that commercial real estate offered a complete protection against both expected and unexpected inflation over the period of 1973-1983. Likewise, Washburn and Binkley (1993) and Washburn et al. (2005) assessed the historical relationship between inflation and forestry returns in the U.S. regions, and revealed that forests in the U.S. West and South were superior hedges against inflation. Further, Lausti (2004) evaluated the inflation hedging ability of forests in Finland over the period of 1973-2003, and reported that long-term forestry investments provided a hedge against the unexpected portion of inflation. Likewise, Wan et al. (2013) investigated the inflation hedging ability of private- and public-equity timberland assets in the U.S. over the period of 1987-2009, and revealed that private-equity timberland assets offer hedges against actual, expected and unexpected inflation, whereas public-equity timberland assets don't provide consistent hedges against inflation.

Employing the method of Fama and Schwert (1977) and Hertzell et al. (1987), this study also analyzes the inflation-returns relationship of a broad range of assets including commodities, timberlands, farmlands, real estate and financial assets. Using the Real Capital Asset Pricing Model (CAPM) with up-to-date historical data series, this study evaluates the hedging abilities of securities against both expected and unexpected inflation. Given that the price inflation is expected to rise in the near future, this study

provides important guidelines on the security selection and the formation of inflation-immune portfolios.

Methodology

Almost of all previous studies on the inflation-hedging topic considered the Fisher's (1930) hypothesis that nominal interest rate can be decomposed into an expected real return and an expected inflation rate (Fama and Schwert, 1977; Hertzell et al., 1987; Wan et al., 2013). By taking Fisher's hypothesis into account in order to derive the expected inflation, we employ the real CAPM developed by Lundgren (2005), which generalized the CAPM to account for inflation as:

$$R_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{mt} - R_{ft}\right) + \gamma_{ei}\pi_{et} + \gamma_{ui}\pi_{ut} + \varepsilon_{it} \qquad (1)$$

where, R_{it}, R_{ft} and R_{mt} refer to the realized rate of return on asset i at the time t, the nominal risk-free rate and return on market portfolio respectively. Likewise, π_{et} and π_{ut} denote the expected and unexpected inflation respectively. The terms, $R_{it} - R_{ft}$ and $R_{mt} - R_{ft}$ represent the realized excess return on asset i and the risk premium of the market portfolio. Parameter α_i represents the Jensen performance measure and β_i is an index of the asset's systematic risk (beta). Similarly, γ_{ei} and γ_{ui} measure the expected and unexpected inflation hedging ability of asset i respectively.

Since the expected inflation rate is not directly observable, a variety of econometric methods have been used to estimate the expected inflation. The most commonly used method to compute the expected inflation is the univariate time series Box-Jenkins/ARIMA estimates derived from risk-free rate proxied by the 1-month Treasury bill (Fama and Schwert, 1977; Washburn and Binkley, 1993). The predicted

risk-free from the ARIMA model is deducted from 3-month U.S. T-bills return to derive the series of expected inflation. Then, the unexpected inflation is obtained by subtracting the expected inflation from actual inflation (continuous change in CPI). The equation 1 is estimated by ordinary least square regression method to examine the inflation –hedging ability of various assets. If γ_{ei} and γ_{ui} >1, the asset i serves as a superior inflation hedge. Likewise if γ_{ei} and γ_{ui} < 0, the asset i is considered as an inferior inflation hedge, and the asset is classified as a partial inflation hedge if 0 <γ_{ei} and γ_{ui} <1. Assets which are insensitive to changes in inflation expectations have the values of γ_{ei} and γ_{ui} zero.

Data

We collect the quarterly series of the data from various sources such as WRDS, Bloomberg and Internet sources (Table 1). A continuous change in the U.S. Bureau of Labor Statistics consumer price index (CPI) i.e. ln (CPI_t/CPI_{t-1}) is commonly considered as the measure of inflation. Since both expected and unexpected inflation are not reported publicly, previous studies used the proxy variable for expected inflation, and expected inflation was subtracted from the total inflation to derive the unexpected inflation. Following the previous studies (Hartzell et al., 1987; Washburn and Binkley, 1993; Wan et al. 2013), we also obtain the autoregressive integrated moving average (ARIMA) time series estimates of the real risk-free rate of interest as an expected real rate, and then those estimates are deducted from 3-month U.S. Treasury-bill return series to derive a proxy for the expected inflation. The unexpected inflation is the difference between total inflation and expected inflation.

Table 1. Variables, their descriptions and data sources (1987Q1-2013Q4)

Index	Description	Source
Inflation rate	Contd. change in CPI	US Bureau of Labor Statistics
NCREIF Timberland	Private timberland index returns	NCREIF
NCREIF Farmland	Private farmland index returns	NCREIF
NCREIF Property	Private property index returns	NCREIF
SPGSCI	S&P global commodity index returns	Bloomberg
DJUBS	Dow Jones-UBS commodity index returns	Bloomberg
REITS	NAREIT US real estate index	FTSE NAREIT
TIPS5	5-year inflation indexed treasury bonds	Federal Reserve System
TIPS10	10-year inflation indexed treasury bonds	Federal Reserve System
Market return	Value-weighted returns on all stocks (VWRETD)	CRSP
Risk-free rate	1-month US T-bill return	Ibbotson Associates
3-month T-bill	3-month T-bill secondary market return	Federal Reserve System
Small-cap stocks	Russell 1000 index	Bloomberg
Large-cap stocks	S&P 500 index	Bloomberg

The nominal returns on private-equity timberland, farmland and property index returns are obtained from National Council of Real Estate Investment Fiduciaries (NCREIF). NCREIF is an association of institutional real estate professionals, which reports quarterly indices of real estate performance returns. Both NCREIF timberland and farmland indices are a quarterly national aggregate return series of a large pool of individual private timber and agricultural properties respectively. Likewise, NCREIF property index is a composite total rate of return measure of investment performance of a large pool of individual commercial real estate properties acquired in the private market. The quarterly data of public commodity indices, SPGSCI and DJUBS, are collected from Bloomberg. S&P GSCI is a tradable index in the commodity markets, which serves as a measure of commodity performance over the time. Likewise, the Dow Jones-UBS

Commodity Index is a single and diversified index of future contracts on physical commodities traded on U.S. exchanges. The total U.S. real estate index series (REITs) data are obtained from the FTSE NAREIT website. The series of value-weighted returns on NYSE, AMEX and NASDAQ stocks is used as a proxy for returns on market portfolio, which is obtained from Center for Research in Security Prices (CRSP), WRDS. The risk-free rate, proxied by 1-month U.S. T-bill return, is collected from Ibbotson Associates. The quarterly data range of all series but SPGCI, DJUBS, TIPS5, and TIPS10 is from 1987Q1 to 2013Q4. The SPGCI and DJUBS series start from 1991Q3, and the data for both TIPS5 and TIPS10 index series are from 2003Q1.

Results and Discussion

Table 2 presents the descriptive statistics of nominal asset returns and inflation rates over 1987 to 2013. The average quarterly inflation rate from 1987Q1 to 2013Q4 is 2.8%. The results show that the returns from private-equity assets clearly outperform the public-equity assets like S&P global commodity index and Dow Jones UBS commodity index. During the period of 1987-2013, the private-equity NCREIF timberland has the largest quarterly average nominal return of 3.1% with average volatility of 4.07%. On the other hand, the public-equity commodity indices, SPGCI and DJUBS offer the quarterly mean returns of 0.45% and 0.12% respectively. Illiquidity and appraisal smoothing bias are major arguments that the previous studies posit regarding the higher average return of private-equity assets (Scholtens and Spierdijk, 2010; Wan et al., 2013). On the other hand, financial assets like small-cap stocks and large-cap stocks have positive but very low average quarterly returns of 0.3 and 0.8%. Further, the value-weighted market return index and risk-free rate also offer the mean returns of 0.75% and 0.92% respectively.

Table 2. Summary statistics of the asset returns and inflation rates

Assets	No. of obs	Mean	Std. Dev.	Min	Max
NCREIF Timberland	108	0.0310	0.0407	-0.0654	0.2234
NCREIF Farmland	88	0.0293	0.0330	-0.0001	0.2278
NCREIF Property	108	0.0186	0.0230	-0.0829	0.0543
SPGSCI	90	0.0045	0.0385	-0.1927	0.0848
DJUBS	90	0.0012	0.0277	-0.1195	0.0512
REITS	108	0.0070	0.0321	-0.1516	0.0913
TIPS5	44	0.0076	0.0116	-0.0143	0.0269
TIPS10	44	0.0135	0.0094	-0.0076	0.0257
Small-cap stocks	108	0.0029	0.0020	0.0000	0.0072
Large-cap stocks	108	0.0084	0.0405	-0.1149	0.1081
Risk-free rate	108	0.0092	0.0289	-0.0824	0.0667
Market return	108	0.0075	0.0286	-0.0871	0.0661
Inflation rate	108	0.0280	0.0128	-0.0141	0.0602
Expected inflation	108	0.0319	0.0216	0.0000	0.0759
Unexpected inflation	108	-0.0039	0.0172	-0.0311	0.0381

The correlation between U.S. price inflation and the returns for several assets over the period of 1987-2013 is depicted in Figure 1. The private-equity assets have a higher positive correlation with inflation. The NCREIF property index is highly correlated with a value of 0.57, next being NCREIF timberland index with a value of 0.24. The public-equity commodity indices have positive but low correlation with the inflation rate. However, the financial assets represented by small-cap and large-cap stocks have negative correlation with inflation. The correlation coefficients between inflation and various asset returns clearly show that returns on both private-equity and public-equity real assets move with inflation, and could provide a protection against inflation. The stocks are not able to provide any hedges against inflation.

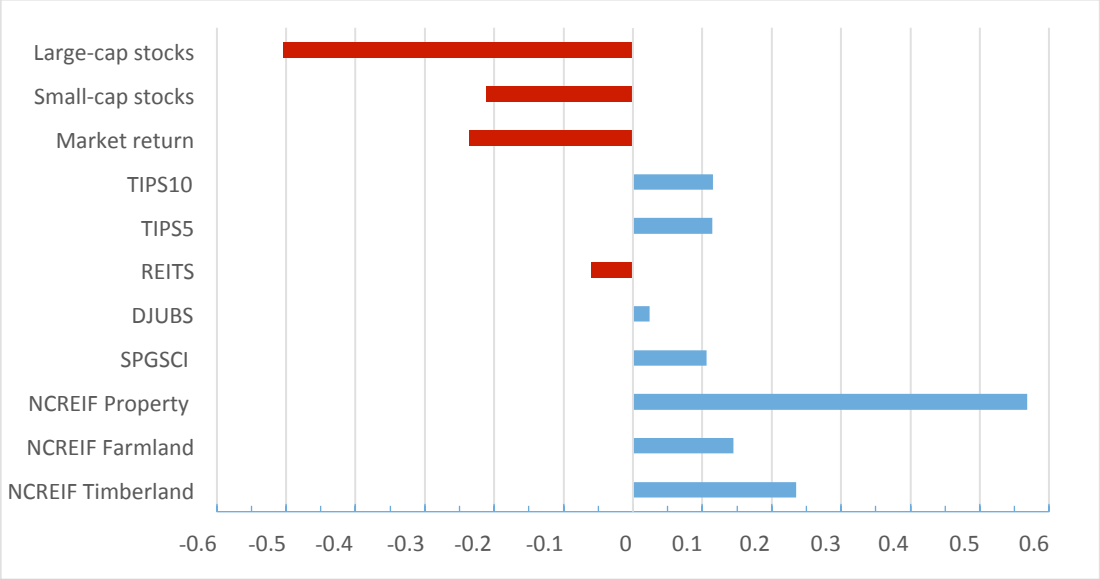

Figure 1: Correlation between inflation and assets

This study examines the hedging ability of various assets against expected and unexpected inflation by estimating ordinary time-series least square regression of equation 1. Among private-equity real assets, NCREIF timberland acts as a partial hedge against expected inflation as the coefficient of expected inflation is positive and statistically significant (Table 3). Likewise, NCREIF real estate property index serves as a partial hedge against both expected and unexpected inflation with statistically significant coefficient estimates. However, NCREIF farmland doesn't provide any protection against expected and unexpected inflation as both estimates are positive but statistically insignificant.

In case of public-equity real asset indices, both S&P and Dow Jones commodity indices do not offer the protection against expected and unexpected inflation (Table 3). All the coefficient estimates associated with inflation are positive but statistically insignificant. Similarly, the public-equity real estate index, REITs index also depicts no ability to protect the investment against inflation. However, both 5-year and 10-year

Treasury Inflation Protection Securities (TIPS) act as partial hedges against expected inflation, but they serves as inferior hedges against unanticipated inflation with negative and significant regression estimates.

Table 3. Inflation hedging ability of various assets: OLS regression (1987Q1-2013Q4)

Asset	α	β	Υ^e	Υ^u	R^2	DW
Private-equity Assets						
NCREIF Timberland	0.001 (0.009)	0.029 (0.13)	**0.882**** (0.29)	**0.447** (0.37)	0.12	2.09
NCREIF Farmland	0.021 (0.01)	0.173 (0.12)	**0.199** (0.34)	**0.563** (0.35)	0.06	2.06
NCREIF Property	0.007 (0.005)	0.103 (0.08)	**0.308 *** (0.17)	**0.383 *** (0.22)	0.04	0.41
Public-equity Assets						
SPGSCI	-0.009 (0.01)	0.429 (0.14)	**0.351** (0.38)	**0.539** (0.40)	0.10	2.02
DJUBS	-0.009 (0.007)	0.29 (0.10)	**0.241** (0.274)	**0.30** (0.29)	0.09	1.81
REITS	0.001 (0.006)	0.695 (0.09)	**0.002** (0.19)	**0.258** (0.24)	0.39	1.73
TIPS5	0.006** (0.002)	-0.086 (0.038)	**0.283**** (0.09)	**-0.274**** (0.09)	0.59	0.44
TIPS10	0.0121** (0.002)	-0.054 (0.04)	**0.176*** (0.09)	**-0.173*** (0.09)	0.36	0.26
Financial Assets						
Small-cap stocks	-0.001* (0.007)	0.983 (0.01)	**-0.012** (0.023)	**-0.006** (0.03)	0.99	1.46
Large-cap stocks	0.016** (0.008)	0.544 (0.121)	**-0.567**** (0.271)	**-0.982**** (0.342)	0.25	2.01

* and ** represent 10% and 5% significance levels.
Values in parenthesis are corresponding standard errors.

Table 3 also reports the inflation-hedging ability of financial assets represented by small-cap and large-cap stocks. Consistent with previous findings, stocks are found to be perverse hedges against inflation. Small-cap stocks proxied by Russell 1000 index have both negative but statistically insignificant inflation coefficients. The quarterly return on

S&P 500 index which represents the large-cap stocks have negative and statistically significant inflation coefficients.

Several past studies investigated the differences in performance of private-equity and public-equity assets (Riddiough et al., 2005; Scholtens and Spierdijk, 2010; Wan et al., 2013). Privately and publicly held real assets may differ substantially in terms of risk and return scenarios. While real estate and timberland are not traded frequently enough to construct a transaction-based index, most of the private-equity series such as NCREIF indices are based on appraisal values. For private real estate, appraisal-based portfolio indices are commonly used to estimate the return indices which might be influenced by appraisal smoothing (Riddiough et al., 2005). Another major difference between private and publicly held assets is liquidity (Scholtens and Spierdijk, 2010). Since most of the privately-held assets like timberland and farmland are not possible to sell immediately, they are relatively illiquid. The third factor could be the market efficiency. Public-equity assets may benefit from economies of scale and transparency revealed from analyst coverage, so they are more efficient than privately held assets.

Conclusions

Given that the U.S. Federal Reserve continues tapering the prevailing bond-purchase program, the overall U.S. price inflation in the near future is expected to rise. In that circumstance, this study assesses the inflation-hedging ability of private-equity and public-equity real assets using the up-to-date return data series. Real assets are considered as good inflation hedging securities, which move in line with the inflation. The correlation analysis shows that real assets particularly private-equity assets are positively

correlated with inflation, whereas stocks have negative correlation with inflation. Consistent with the previous findings, the private-equity real assets such as real estate and timberland are found to be good inflation hedges against inflation, and public-equity assets are less efficient to immune the investors' portfolio from the expected and unexpected inflation. Similarly, equity assets are found to be inferior hedges against the price inflation in the U.S.

Even though this study attempts to incorporate a wide range of real assets into the analysis, a number of real assets like gold, natural resources, natural gases are still missing. A broad comparative study by including all asset classes with up-to-date data series would provide a complete picture to investors. On the other hand, time-series regression with the limited sample size of 108 observations might not be statistically sufficient to derive valid inferences. Since the NCREIF timberland series is available from 1987, this study uses the quarterly data series from 1987 to derive a consistent comparison among the real assets.

References

Anderson, D. 2011. Hedging inflation with a real assets investment strategy. *Harris myCFO Investment Advisory Services, LLC*. http://www.harrismycfo.com/pdf/WS_PDF_5_harrismycfo_hedging_inflation_v1.pdf

Bodie, Z. 1976. Common stocks as a hedge against inflation. *The Journal of Finance*, 31(2): 459-470.

Fama, E.F. 1981. Stock returns, real activity, inflation and money. *American Economic Review*, 65: 545-564.

Fama, E.F., Schwert, G.W. 1977. Asset returns and inflation. *Journal of Financial Economics*, 6:115-146.

Fisher, I. 1930. The theory of interest as determined by impatience to spend income and opportunity to invest it. The Macmillan Company, New York. 566p.

Hartzell, D., Hekman, J.S., Miles, M.E. 1989. Real Estate Returns and Inflation. *AREUEA Journal*, 15:617-37.

Lausti, A. 2004. The inflation-hedging characteristics of forest ownership, private housing and stocks in Finland. *LTA* 4 (04):427– 451.

Lundgren, T. 2005. Assessing the investment performance of Swedish timberland: A capital asset pricing model approach. *Land Economics*, 81(3):353-362.

O'Donnell, E.J.2009. Real assets and inflation hedge investing. http://www.nepc.com/writable/research_articles/file/09_08_nepc_real_assets_investing.pdf.

Riddiough, T. J., Moriarty, M., Yeatman, P. J. 2005. Privately versus publicly held asset investment performance. *Real Estate Economics* 33 (1): 121-46.

Scholtens, B., Spierdijk, L. 2010. Does money grow on trees? The diversification properties of U.S. Timberland investments. *Land Economics*, 86(3): 514-529.

Solnik, B. 1983. The relation between stock prices and inflationary expectations: The international evidence. *The Journal of Finance*, 38: 35–48.

Stulz, R.N. 1986. Asset pricing and expected inflation. *The Journal of Finance*, 41(1): 209-223.

Wan, Y., Mei, B., Clutter, M.L., Siry, J.P. 2013. Assessing the inflation hedging ability of timberland assets in the United States. *Forest Science*, 59(1):93-104.

Washburn, C.L., Binkley, C.S. 1993. Do forest assets hedge inflation? *Land Economics*, 69(3): 215-224.

Washburn, C.L., D'Anieri, P., Aronow, M.E. 2005. Do forest assets continue to hedge inflation? *Hancock Timberland Investor*, 3rd quarter.