

C A M B R I D G E A S S O C I A T E S L L C

U.S. TIPS: EVOLUTION, VALUATION AND IMPLEMENTATION

2002

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ABSTRACT

1. Over the last 12 months, Treasury Inflation Protected Securities (TIPS) have graduated from being an arcane fixed income instrument to a mainstream asset class. The global inflation indexed bond market has reached \$343 billion, greater than that of emerging markets debt (\$188 billion), and approaching that of global high-yield bonds (\$545 billion) and emerging markets equity (\$505 billion). Liquidity has improved significantly, as bid-ask spreads in the United States are currently approximately three basis points (bps), compared to 20 bps for high-grade corporate bonds, and there are now eight primary dealers actively participating in the market. As the market has matured and the Treasury has actively promoted the TIPS program, institutional demand for TIPS has increased.
2. As demand for TIPS has grown, the real yield on TIPS has fallen from highs of approximately 4.0% in the summer of 2000 to 2.3% as of October 31, 2002. Institutions with moderate total-return targets may find that TIPS' low volatility, low correlation to other asset classes, and inflation-hedging characteristics justify a permanent policy allocation even with yields as low as 2.3%. However, other institutions view TIPS as a tactical investment and compare TIPS valuations to those of nominal bonds, cash, and inflation-hedging assets. Based on a simple comparison of TIPS to a small selection of other asset classes, we find that TIPS are attractively priced relative to nominal bonds and cash, but are expensive relative to REITs.
3. The maturation of the TIPS market also has important implications for implementation of TIPS programs. For example, until about a year ago, an investor that wished to optimize the value of TIPS' deflation-hedging characteristics could have done so by rolling their TIPS forward at auction without incurring any significant cost. Since the best TIPS for hedging deflation would have no inflation accrual, trade at par, and have a long duration, we recommended that investors routinely trade in their old bonds for the most recently issued one of similar duration in order to reset the inflation accrual back to zero. In the past, the lack of demand at auction time and a positively sloped real yield curve enabled investors to roll into the most recent bond while picking up a yield premium. However, investors must now be more vigilant in evaluating the yield differential between the old and new bonds to determine if any loss in yield is worth the increased deflation hedging properties of the new bonds.
4. In contrast to deflation-hedging portfolios, the ideal inflation-hedging TIPS portfolio would have a low real duration to limit the exposure of these bonds to a rise in real rates, should that occur at the same time as a burst of unexpected inflation. Since one cannot predict with accuracy what will happen to real interest rates during inflation, sensitivity to real interest rates should be kept to a minimum. However, in an upward-sloping real yield curve environment yield must be sacrificed in

order to obtain the shorter the duration. As of the end of October, the ten-year TIPS offers an 86-bp yield advantage over the five-year TIPS, requiring investors to evaluate whether the lower real rate sensitivity is worth the yield disadvantage.

5. Given that inflation- and deflation-hedging objectives imply contradictory portfolio construction, how should one implement a TIPS allocation? If TIPS are used as a substitute for nominal bonds, a long duration portfolio may be desirable to maintain some deflation hedging characteristics. If the allocation is a pure inflation hedge or cash substitute, shorter maturity TIPS are most appropriate. Most institutions desire both inflation- and deflation-hedging characteristics of TIPS, which would best be served today through the current ten-year TIPS (maturing July 2012 with a coupon rate of 3.0%). This issue offers both sufficiently long duration and low inflation accruals to act as a deflation hedge, and may also serve as a reasonable inflation hedge. For institutions interested in a pure inflation hedge, the five-year TIPS maturing July 2007 with a coupon rate of 3.375%, may be the best option, as it has less sensitivity to a rise in real rates.
6. Investors considering hiring a manager to implement their TIPS allocation should consider that active managers, unless otherwise instructed, are likely to own a portfolio that is relatively close to the index in order to reduce index and peer tracking error. Given that an indexed portfolio would have a duration of 9.8 years and significant inflation accruals, this option would be sub-optimal for institutions with specific inflation- or deflation-hedging objectives. Investors should also pay close attention to the yield enhancement strategies employed by active managers, such as buying short-term corporate paper, as these investments would fall in value during extreme deflation when corporate spreads and default rates rise, defeating the purpose of the hedge. Finally, the cost of active management, typically 20 bps, seems high for a maturing asset class with only ten outstanding issues.

SUMMARY

Introduction

This year marked a milestone in the evolution of the Treasury Inflation-Protected Securities (TIPS) market in the United States. Just two years ago, many investors believed TIPS to be a fixed income breed that would soon be extinct, as government budget surpluses resulted in significantly reduced bond issuance and auction rates for TIPS near a real yield of 4% made them a relatively expensive source of funds for the government. Today, the government is operating with a \$160 billion to \$170 billion deficit and real yields at auction are approaching 2.0%. Furthermore, the Treasury has repeatedly stated that it is supportive of the TIPS program and has been actively working to promote the growth of the TIPS market. These circumstances clearly indicate that TIPS are graduating from being an arcane fixed income instrument to a mainstream asset class.

The recent increase in demand for TIPS and the maturing of the TIPS market have implications for valuations and implementation. While TIPS were very compelling when real yields were near 4%, are they still attractively priced at yields just north of 2.0%? Are TIPS attractive relative to other asset classes, such as nominal bonds, cash, and inflation-hedging assets? Finally, the increasing efficiency of the TIPS market makes the issue of implementation somewhat more complicated as in-house management of a passive TIPS portfolio becomes more time consuming to properly execute.

The TIPS Market Today

The increased size, liquidity, and institutional penetration of TIPS point to a healthy and maturing market. The following list highlights the significant developments in the TIPS market since they were first issued in 1997.

- The total market capitalization for global inflation-indexed (I/I) bonds has more than doubled over the last five years, reaching \$343 billion (Exhibit 1). The U.S. market accounted for 65% of that growth, as it expanded from two TIPS issues with a market cap of \$33 billion to ten issues with a market cap of \$162 billion. TIPS account for nearly 10% of the outstanding U.S. Treasury market, up from 0.25% in January 1997.
- The total market for global I/I bonds has grown large enough to be considered generally appropriate for institutions to make meaningful long-term allocations. For example, its \$343 billion market cap is fast approaching that of global high-yield bonds (\$545 billion) and emerging markets equity (\$505 billion), and has already eclipsed that of emerging markets debt (\$188 billion) (Exhibit 2).

- U.S. TIPS assets under management have increased sharply since they were first introduced. By December of 1997, there were approximately \$145 million in dedicated TIPS accounts¹ increasing to over \$20 billion today (Exhibit 3). Retail participation also seems to be on the rise, as Vanguard's and PIMCO's dedicated mutual funds have increased in size by 200% in the year 2002 through September 30.
- Surveys of the largest endowed institutions indicate that they are incorporating TIPS in their portfolios, regularly carving out either tactical or strategic allocations to TIPS, with some as high as 10%.
- Liquidity has improved substantially, as the bid-ask spread in the United States is currently approximately three bps, compared to the high-grade corporate bond spread of approximately 20 bps. In addition, there are now eight primary dealers actively participating in the market, with Barclays Capital as the dominant player.

A Valuation Framework for TIPS

While institutions with moderate total-return targets may find that TIPS' low volatility, low correlation to other asset classes, and inflation-hedging characteristics justify a permanent policy allocation even with yields as low as 2.3%, other institutions view TIPS as a tactical investment. In the past, when TIPS yielded over 3.5% and break-even inflation levels relative to nominal Treasury bonds of comparable maturity were near 1.5%, Cambridge Associates recommended TIPS as an attractive diversifier, inflation hedge, and nominal bond substitute. Today, with yields near 2.0%, we revisit that recommendation and provide a framework for valuing TIPS relative to selected other asset classes. In short, TIPS seem attractive relative to nominal Treasuries and cash, but are expensive relative to equity REITs. Of course, each of these asset classes has different characteristics and their advantages and limitations relative to TIPS should be considered before any substitute allocation is made.

Are TIPS an Attractive Substitute for Nominal Bonds?

Our framework for valuing inflation-linked bonds relative to nominal bonds is based on implied break-even inflation rates and the asymmetric distribution of relative returns.

Break-even Inflation. The notion of break-even inflation is based on the equation stated by the economist Paul Fisher, which states that a nominal bond yield is comprised of three components as follows:

¹ Figures based on 15 recognized managers of TIPS. See Exhibit 3.

Nominal Interest Rate = Real Interest Rate + Inflation Expectations + Inflation Risk Premium.

The break-even inflation rate is the level of inflation an investor could experience over the life of a bond and remain indifferent between holding a nominal bond and inflation-linked bond. Break-even inflation rates can be approximated in a simplified manner, by subtracting the nominal yield from the real yield of two bonds of equal maturity and credit quality.²

Presently, the implied break-even inflation rates between TIPS and nominal Treasuries of equal maturity are within normal historical bounds. In fact, as of October 31, 2002, they are on the low end of recent history, with the ten-year break-even rate at 1.60% and the five-year at 1.2% (Exhibit 4). The current break-even rate is low both relative to consensus economist expectations and to historical inflation. While economists' inflation predictions tend to have very low predictive power, the Bloomberg News September 27, 2002 Quarterly U.S. CPI poll for 2003 inflation indicated economists expected 2.2% inflation over the next year—well above the break-even inflation rates for the five-year and ten-year TIPS. From an historical perspective, there have been few ten-year periods in which inflation has been less than 1.60% (see Exhibit 5). Inflation has averaged less than 1.60% annually in only 23% of ten-year rolling periods since the period ended 1923, and only 9% since the period ended 1941. However, even if inflation were below 1.60% over the next ten years, the underperformance would be limited to the difference between implied and realized inflation. For example, if actual inflation over the period is 1% and the break-even inflation rate is 1.5%, the yield loss relative to nominal bonds would be 0.5%. Based on these factors, TIPS look cheap relative to nominal bonds.

Maximum Underperformance is Less Than Potential Outperformance

The second advantage of TIPS over nominal bonds is that the Treasury guarantees that an investor will receive, at minimum, par value of the bond back at maturity. The result of this principal protection is that TIPS have larger potential outperformance during inflation than their potential underperformance during deflation.³ Simply stated, the principal guarantee combined with the Fisher Equation implies that the maximum underperformance one can expect from TIPS relative to nominal bonds is the break-even inflation rate plus any accrued inflation and the premium paid over par. While this is only completely true of zero-coupon TIPS, the difference is not substantial for coupon bearing TIPS.⁴

² Due to the semi-annual nature of the coupon, reinvestment risk of coupons, variable inflation-linked coupon stream, and indexation lags, the exact calculation is more complex. However, simple subtraction offers a good comparative estimate.

³ This topic is explored extensively in the previous Cambridge Associates paper, *TIPS: Fixed Income Substitute?*

⁴ In a deflationary scenario, coupons are accrued on a deflating notional amount. Using the CPI-U time series from 1929 to 1939, the extra loss due to the coupon effect would be approximately 67 bps over the break-even inflation rate.

Exhibit 6 charts the difference in the internal rates of return (IRRs) for two bonds, a ten-year conventional Treasury, and a hypothetical ten-year TIPS purchased at par with no inflation accruals held to maturity. As the chart demonstrates, when the inflation level equals the yield differential at purchase, the return for all bonds is equal, hence the expression "break-even" inflation. During periods of significant inflation, TIPS outperformance is notable. For example, if inflation totaled 10% over the investment horizon, TIPS would have an IRR nine percentage points greater than that of nominal Treasury bonds. In contrast, were deflation to be 10% over the investment horizon, TIPS would underperform by 2.45 percentage points. Finally, it is worth noting that TIPS inflation accrual and premium paid to par slightly impact performance during deflation. The 3% July of 2012 trades at a 4.6% premium and has a 0.5% inflation accrual. Were one to experience 10% deflation, it would underperform the theoretical par bond by 19 bps.

Based on both the break-even inflation rate priced into the bond market and the asymmetric distribution of relative returns, we believe TIPS are attractive relative to nominal bonds.

Valuing TIPS Relative to Other Asset Classes

While valuing TIPS relative to nominal Treasuries is relatively straightforward, it is more difficult to value TIPS relative to other asset classes. First, we look at equity REITs because they have reasonable valuation data and similar inflation-hedging characteristics to TIPS. While real estate has higher volatility, less liquidity, and does not contain an embedded principal guarantee, it is often discussed as a substitute for TIPS in an "inflation-hedging" portfolio. Finally, we value TIPS relative to another close substitute, cash, which historically has provided inflation protection similar to that of TIPS.

Real Estate. Real estate, while far from a perfect proxy for TIPS, does have similar inflation-sensitive income and principal-appreciation characteristics. While real estate replacement costs and rents should track increases in inflation reasonably well over long periods, other forces, most notably supply and demand imbalances, may create considerable variability around this long-term relationship. (See Exhibit 7.) Assuming that REIT prices and dividends keep pace with inflation, the yield component of REITs could be compared to the real yield of TIPS.

As of November 1, 2002, the current mean yield of the NAREIT Index is 7.5%, or 5.1 percentage points greater than the yield on ten-year TIPS. However, the debt outstanding of the NAREIT Index as a percentage of capitalization is 46.3%, implying a leverage ratio of 1.86 times (see Exhibit 8). In an attempt to compare apples to apples, if one leverages a ten-year TIPS 1.86 times and assumes a real cost of funds of 1.5% (approximately equal to our long-term real T-bill return estimate), the leverage-adjusted

real return of TIPS would be 2.8%.⁵ Even using a conservative real yield of 6% for REITs, this would generate a 3.2% yield advantage over the leveraged TIPS. Therefore, a REIT investor could experience a 26% loss of principal at the end of ten years and still have a return equal to the hypothetical 1.86 times leveraged TIPS portfolio. Put another way, one would have to leverage TIPS over five times to get the same expected real return as real estate. In the past, when TIPS yields were 4%, one would only have to leverage TIPS two times to get the same expected real return as real estate. Based on this simple comparison, equity REITs seem attractively priced relative to TIPS, for those investors willing to withstand the higher volatility, lower liquidity, and greater principal uncertainty of public real estate.

Cash. As of the end of October, the current TIPS yield is higher than the 1.44% yield on cash. However, TIPS and T-bills have different characteristics that must also be considered in determining which asset class offers better value. Historically, Treasury bills and TIPS have provided a similar degree of inflation protection. Estimates of real yields on T-bills have averaged approximately 1% since 1950, thus providing the same inflation pass-through properties as TIPS. However, TIPS have a greater exposure to real yields than do cash, and therefore are expected to be more volatile. On the other hand, cash lacks the deflation-protection characteristics provided by TIPS. The combination of a higher yield and deflation protection make TIPS a very compelling cash substitute, despite the greater expected volatility.

Implementation

Endowments and foundations generally seek both the inflation- and deflation-hedging features of TIPS. While these characteristics are not mutually exclusive, proper implementation is critical to ensure that the desired balance of these hedges is achieved.

Deflation Hedging

In theory, the best TIPS for hedging deflation would have no inflation accrual, trade at par, and have a long duration. The most effective way to obtain TIPS with these characteristics would be to buy them at the Treasury auction on issue. Annually, one should trade in the old bond for the most recently issued one (this is called "rolling the bond forward") in order to reset the inflation accrual back to zero.⁶ While rolling the bond forward historically has been an inexpensive, or even cost free, means of preserving the deflation-hedging properties of TIPS, the increased efficiency of the market has made this a much less mechanical process. In the past, the lack of demand at auction time and a positively sloped real yield

⁵ Assumes a ten-year TIPS was purchased at par with a 2.2% real yield and held to maturity.

⁶ See our research report titled, *TIPS: Fixed Income Substitute?*

curve enabled investors to roll into the most recent bond while picking up a yield premium. However, investors must now be more vigilant in evaluating the yield differential between the old and new bonds to determine if any loss in yield is worth the increased deflation-hedging properties of the new bonds.

Inflation Hedging

In theory, a portfolio of TIPS with a low real duration would provide the best inflation hedge because the short duration limits the exposure of these bonds to a rise in real rates, should that occur at the same time as a burst of unexpected inflation.⁷ Since one cannot predict with accuracy what will happen to real interest rates during inflation, sensitivity to real interest rates should be kept to a minimum. However, in an upward-sloping real yield-curve environment, yield must be sacrificed in order to obtain the shorter the duration. As of the end of October, the ten-year TIPS offers an 86-bp yield advantage over the five-year TIPS, requiring investors to evaluate whether the lower real rate sensitivity is worth the yield disadvantage.

Investor-Directed versus Active Implementation

Given that the two objectives above imply contradictory portfolio construction, how should one implement a TIPS allocation? If TIPS are used as a substitute for nominal bonds, a long duration portfolio may be desirable to maintain some deflation-hedging characteristics. If the allocation is a pure inflation hedge or cash substitute, shorter maturity TIPS are most appropriate. Below we explore the implementation alternatives.

Active Management. Active management or indexing of TIPS is an operationally simple way to implement a TIPS allocation. An indexed portfolio would have a duration of 9.8⁸ years and significant inflation accruals, making it possess neither of the attributes needed if one desires either low inflation accruals to maximize deflation protection or low duration to reduce sensitivity to real interest rates. Active managers, unless otherwise instructed in their guidelines, are likely to own a portfolio that is relatively close to the index in order to reduce index and peer tracking error, therefore making most active portfolios less than optimal for institutions with specific inflation- or deflation-hedging objectives.

⁷ Our discussion of inflation hedging relates specifically to hedging endowment spending against inflation, such that TIPS could be sold to support spending during periods of unexpected inflation when the value of equities and nominal bonds decreases.

⁸ Characteristics of the Barclays Inflation Linked Bond Index as of 10/7/2002.

Another potential issue with active management is the use of the yield enhancement technique of borrowing against the value of the TIPS portfolio to purchase short-term corporate paper. During extreme deflation, we would expect corporate spreads and default rates to increase, reducing the value of the portfolio, and defeating the purpose of the hedge. Finally, an active management fee of 20 bps seems a high hurdle to overcome in a maturing asset class with only ten outstanding issues.

For institutions that choose to employ an active manager, a clearly specified investment mandate is essential. If indexing is used, one should be cognizant of the index characteristics and how they relate to the desired role of the allocation.

Investor-Directed Investing. While not operationally as simple as active management, the investor-directed approach allows investors to control both inflation accruals and portfolio duration. With only ten U.S. TIPS issues and a Treasury issuing only one maturity (the ten-year TIPS), it would seem easy to implement a TIPS program. However, as noted above, recent market developments make the "do-it-yourself" approach potentially less straightforward than it has been, requiring analysis of the trade-off between the yield differential and deflation-hedging properties of held bonds and new issues at each auction.

The current ten-year TIPS (the 3% July of 2012) offers both sufficiently long duration and low inflation accruals to act as a deflation hedge, and may also serve as a reasonable inflation hedge. The bond has an eight-year real duration, low inflation accrual, 86 bp-yield advantage over the five-year TIPS, and virtually no yield loss relative to longer maturity bonds. However, institutions interested in a pure inflation hedge might want to consider the five-year 3.375% of July 2007, which has less sensitivity to a rise in real rates.

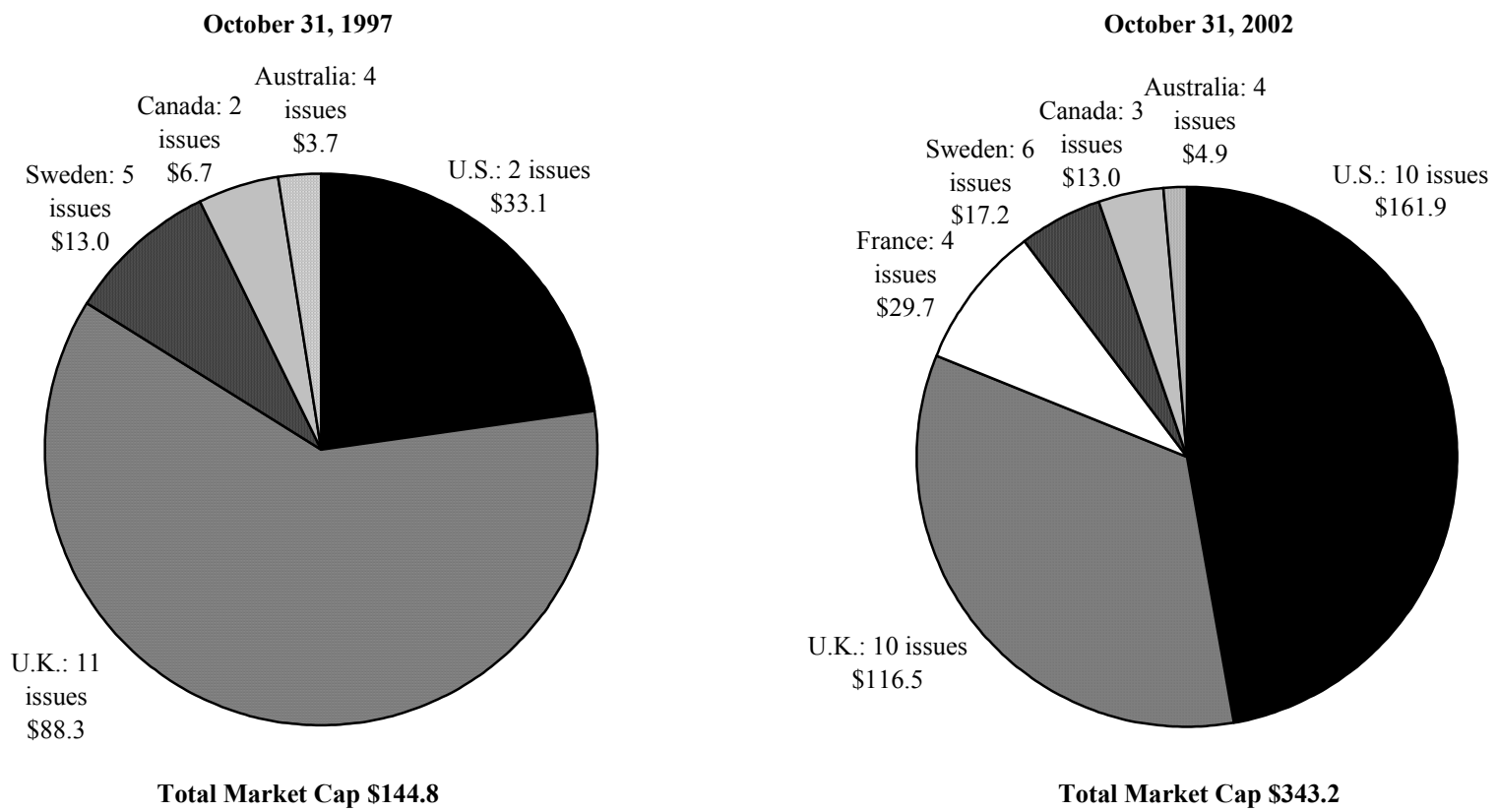
While the "do it yourself" days of TIPS have not passed, investors should consider that this is becoming a more efficient market and that the deflation protection may not always be available for "free" as it has been in the past.

EXHIBITS

Exhibit 1

GLOBAL INFLATION-INDEXED BOND MARKET DEVELOPMENT

**Market Capitalization
(US\$ billions)**

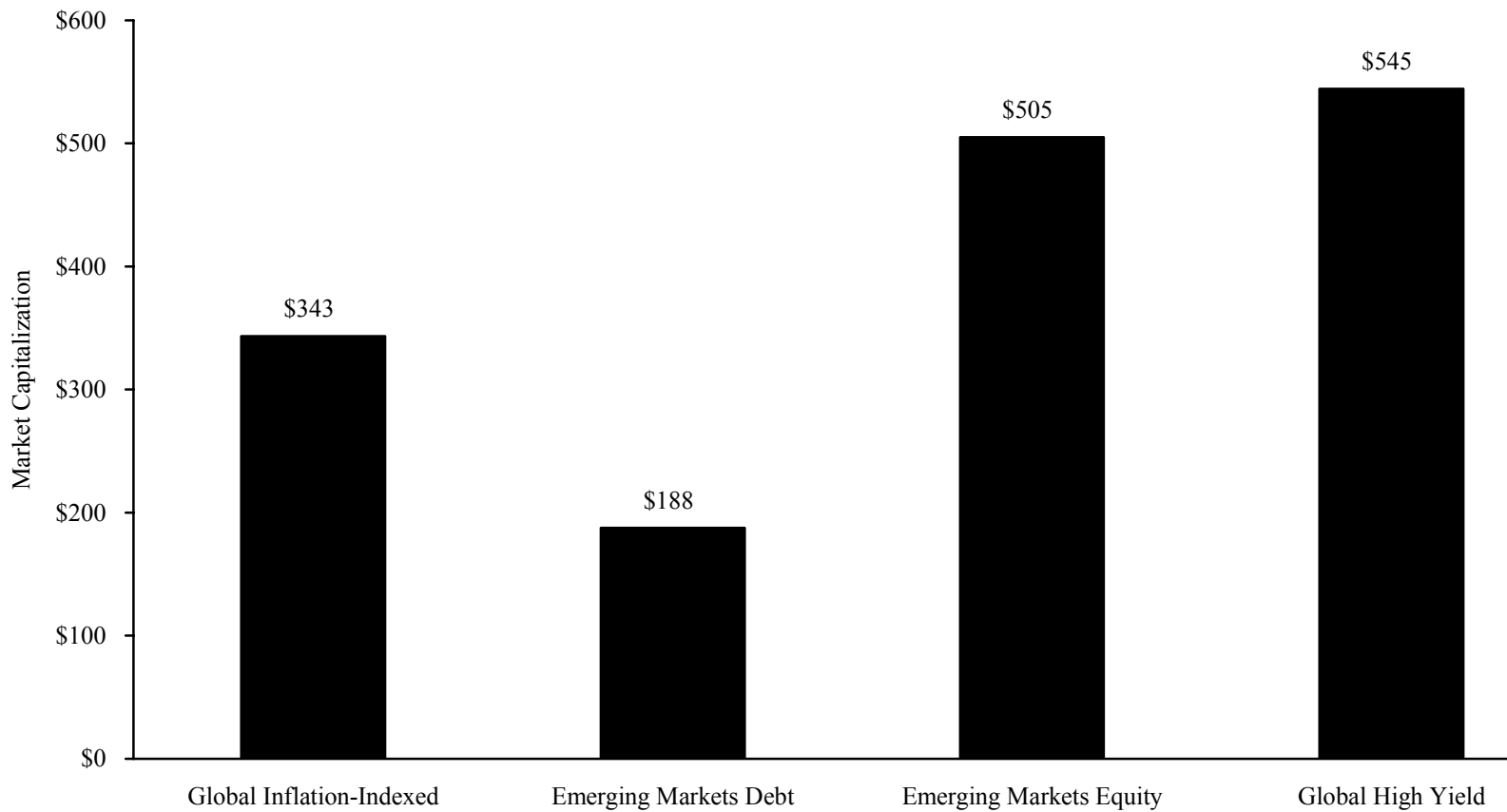


Source: Barclays Capital.

Exhibit 2

SIZE OF GLOBAL INFLATION-INDEXED SECURITIES MARKET VS. OTHER ASSET CLASSES

**As of October 31, 2002
(US\$ Billions)**

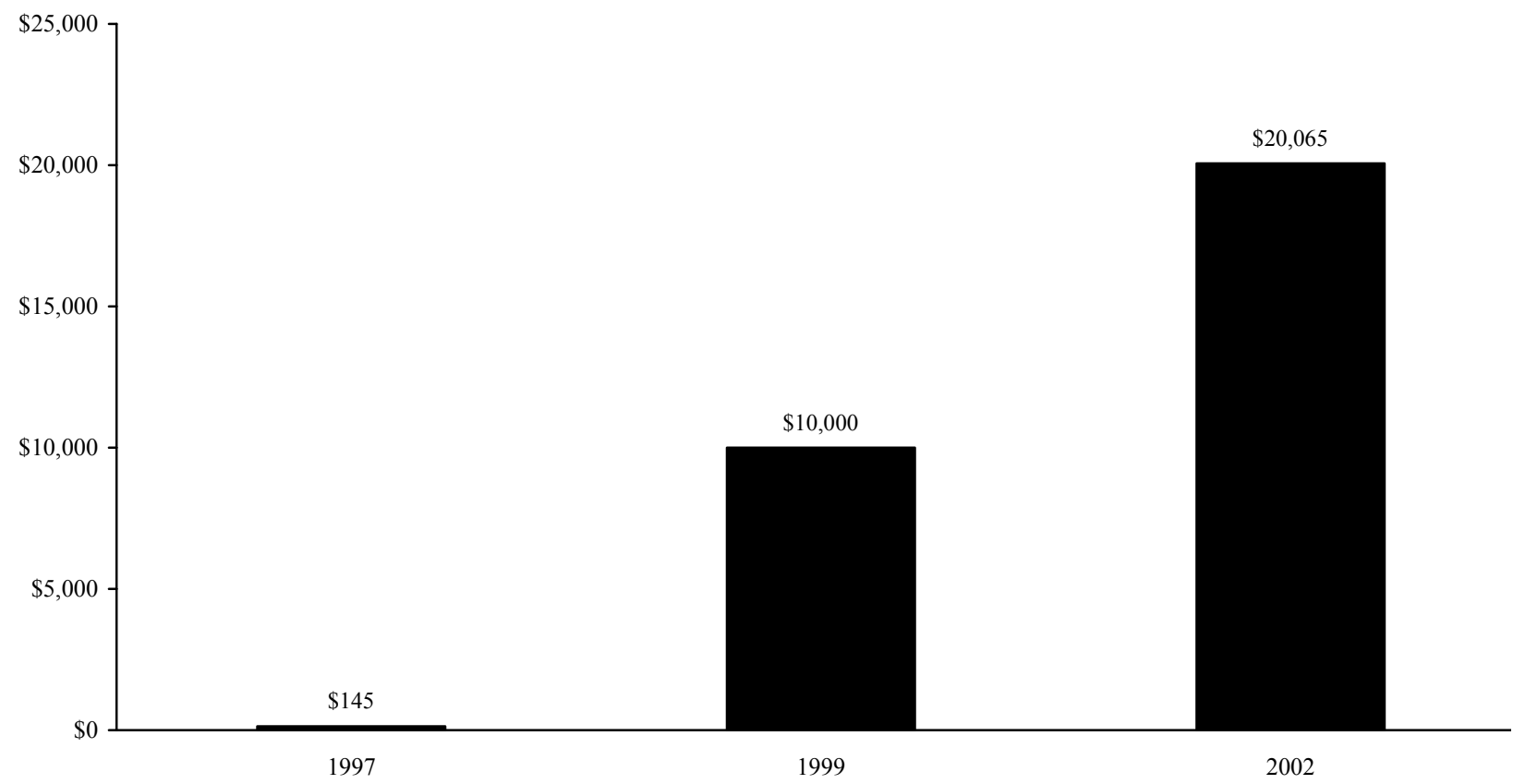


Sources: Barclays Capital, J.P. Morgan Securities, Inc., Lehman Brothers, Inc., and Thomson Datastream.

Exhibit 3

GROWTH OF MANAGED ASSETS FOR U.S. TREASURY INFLATION-INDEXED SECURITIES

(US\$ Millions)



Source: Cambridge Associates LLC Investment Manager Database.

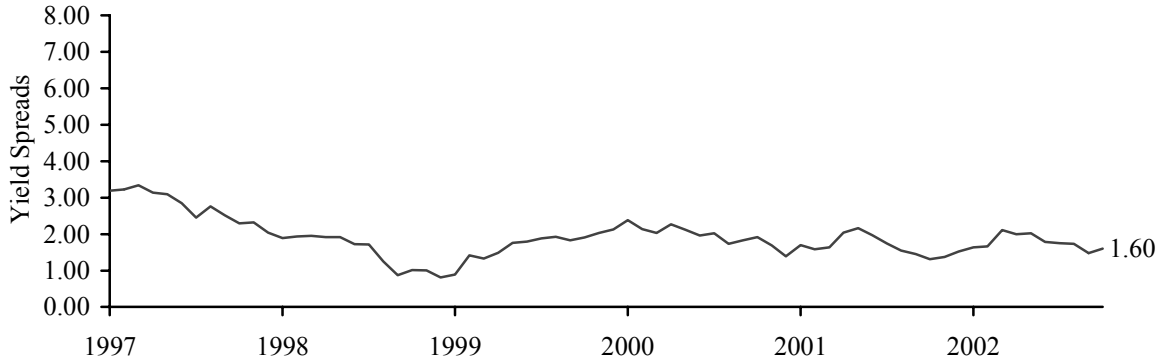
Notes: Based on a representative list of investment managers including: Barclays, Bridgewater Associates, Brown Brothers, Commonfund, CREF, GMO, Income Research & Management, PIMCO, State Street, and Vanguard. Data are as of 12/31/1997, 12/31/1999, and 6/30/2002.

Exhibit 4

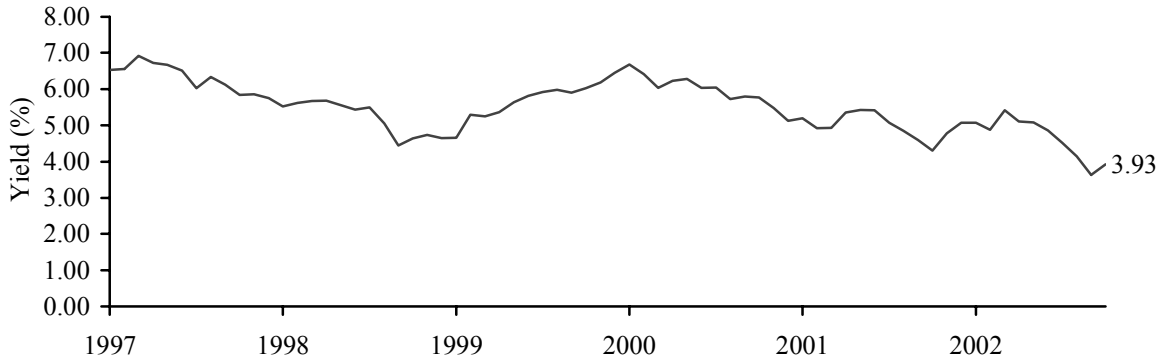
INFLATION EXPECTATIONS AND TEN-YEAR TREASURY YIELDS

January 31, 1997 - October 31, 2002

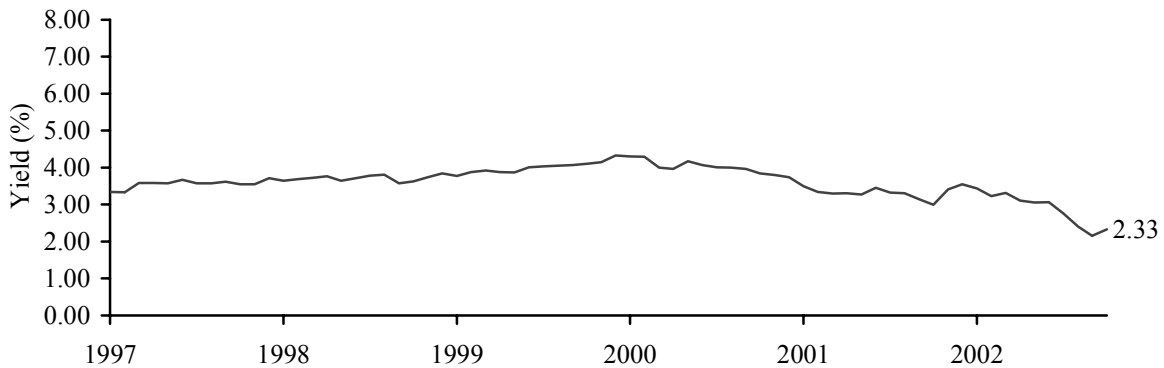
Inflation Expectations



Ten-year Treasuries



Ten-year Treasury Inflation-Protection Securities (TIPS)



Sources: The Bloomberg and Thomson Datastream.

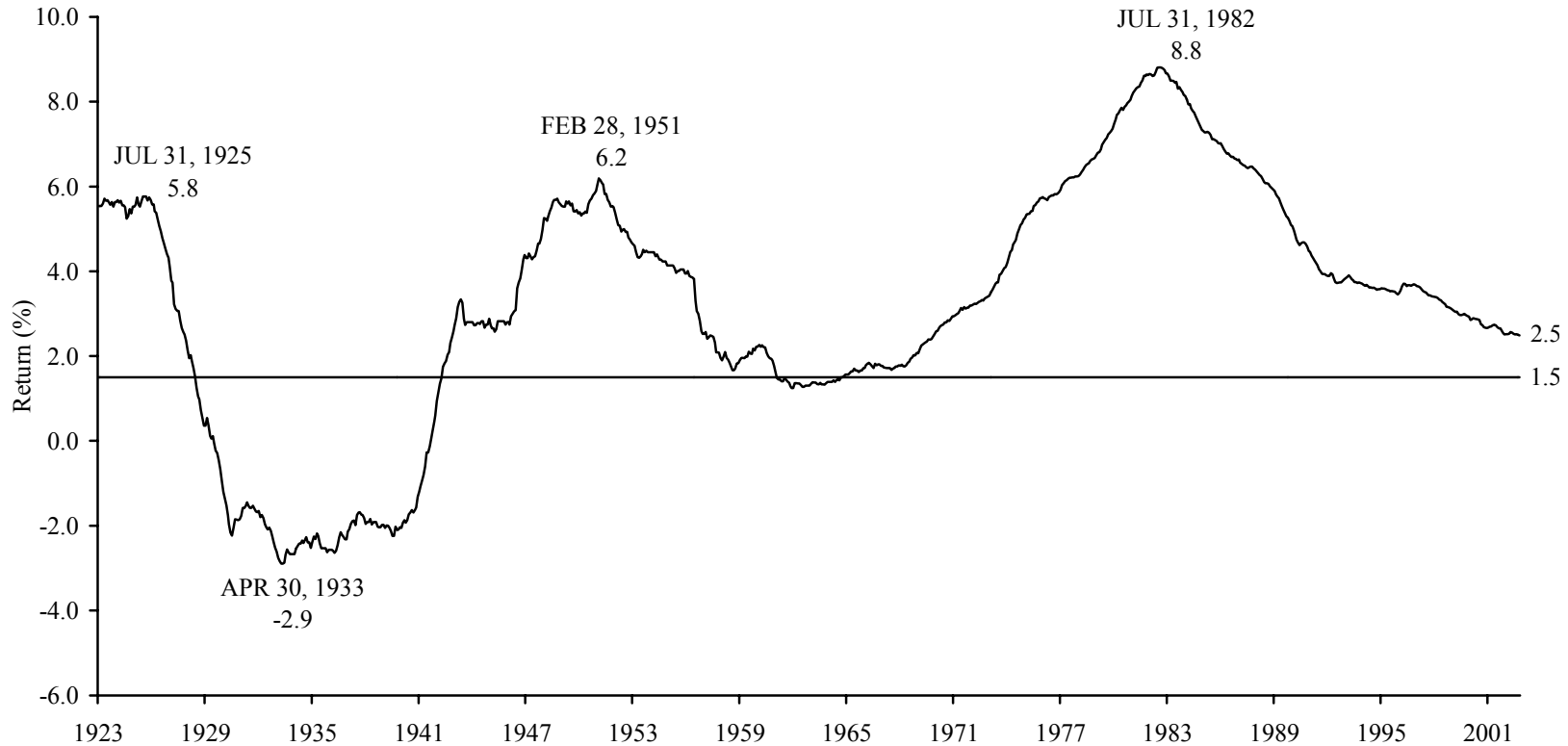
Note: Inflation expectations are based on the yield spreads between ten-year Treasuries and TIPS.

175m

Exhibit 5

ROLLING TEN-YEAR CPI-U AVERAGE ANNUALIZED COMPOUND RETURNS

January 1, 1913 - October 31, 2002



22.0% of the rolling 10-year AACRs for CPI-U were under 1.5% since January 1923.

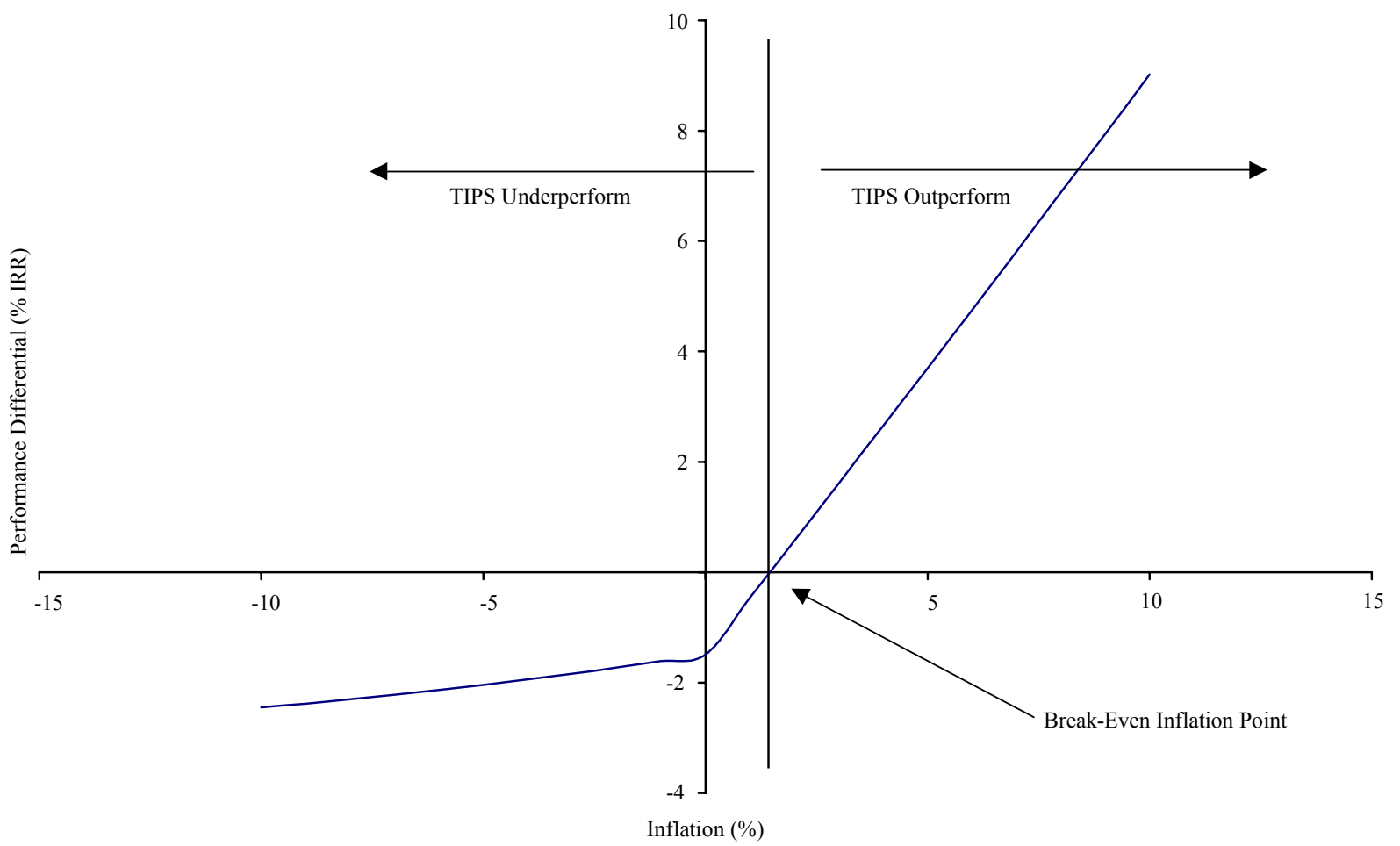
9.7% of the rolling 10-year AACRs for CPI-U were under 1.5% since January 1940.

7.1% of the rolling 10-year AACRs for CPI-U were under 1.5% since January 1950.

Source: Bureau of Labor Statistics.

Note: Chart based on monthly data.

Exhibit 6
PERFORMANCE DIFFERENTIAL (10-YEAR TIPS - 10-YEAR CONVENTIONAL TREASURY)
UNDER DIFFERENT INFLATION SCENARIOS

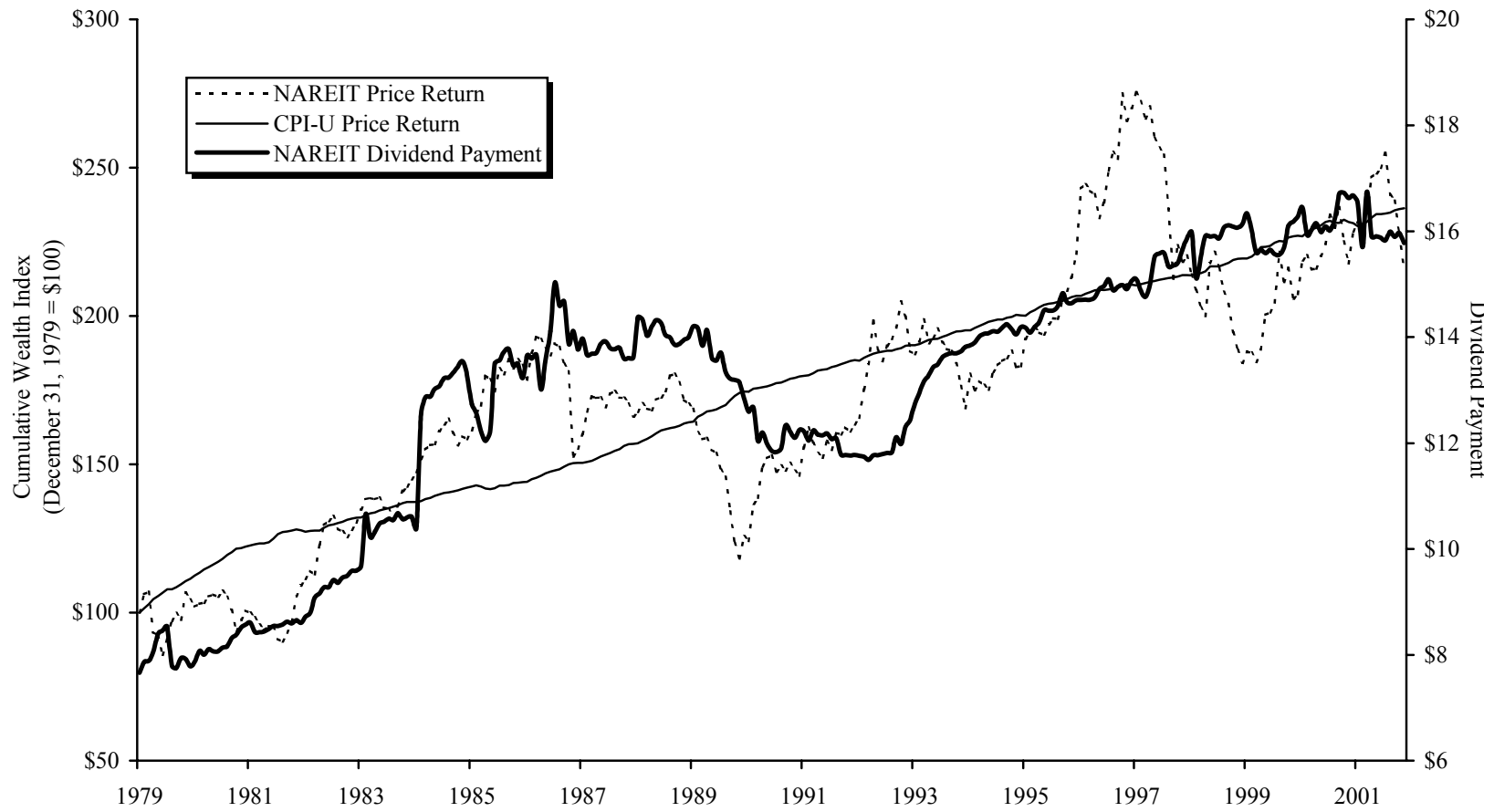


Source: Cambridge Associates LLC

Exhibit 7

COMPARISON OF REAL ESTATE (NAREIT) TO THE CONSUMER PRICE INDEX

January 1, 1980 - October 31, 2002



Sources: The Bloomberg, Bureau of Labor Statistics, and National Association of Real Estate Investment Trusts.

Exhibit 8

REIT SECTOR CURRENT VALUATION ANALYSIS

As of November 1, 2002

	<u>Apartments</u>	<u>Industrial</u>	<u>Office</u>	<u>Shopping Centers</u>	<u>Regional Malls</u>	<u>Health Care</u>	<u>Lodging/ Hotels</u>	<u>Self- Storage</u>	<u>Diversified/ Other</u>	All Equity REITs Cap-Weighted Mean
Market Capitalization (\$ Bil)*	27.4	10.2	28.9	18.5	17.7	7.9	7.8	5.2	10.3	133.9
Premium to NAV (%)	-10.9	-0.6	-14.8	2.2	-1.9	---	-28.8	-6.1	-6.8	-7.9
Dividend Yield (%)	9.1	7.4	7.0	7.5	7.6	9.0	5.1	7.1	4.8	7.5
Debt as percentage of capitalization (%)	46.7	36.9	51.7	40.0	56.3	35.3	58.4	10.7	51.0	46.3

Sources: National Association of Real Estate Investment Trusts and *Realty Stock Review*.

Notes: Debt as percentage of capitalization is calculated by dividing the total debt by the total market capitalization. Market capitalizations are provided by National Association of Real Estate Investment Trusts.

* Data are through October 1, 2002.