

The TIPS-Treasury Bond Puzzle

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Introduction

Introduction (1)

- Treasury bond and the Treasury Inflation-Protected Securities (TIPS) markets: two of the largest and most actively traded fixed-income markets in the world.
- Find that there is persistent mispricing on a massive scale across them.
- Treasury bonds are consistently overpriced relative to TIPS.
- Price of a Treasury bond can exceed that of an inflation-swapped TIPS issue exactly matching the cash flows of the Treasury bond by more than \$20 per \$100 notional amount.
- One of the largest examples of arbitrage ever documented.

Introduction (2)

- Use TIPS plus inflation swaps to create synthetic Treasury bond.
- Price differences between the synthetic Treasury bond and the nominal Treasury bond: arbitrage opportunities.
- Average size of the mispricing: 54.5 basis points, but can exceed 200 basis points for some pairs.
 - ▶ The average size of this mispricing is orders of magnitude larger than transaction costs.

Introduction (3)

What drives the mispricing?

- Slow-moving capital may help explain why mispricing persists.
- Is TIPS-Treasury mispricing related to changes in capital available to hedge funds? Answer: Yes.
- Mispricing gets smaller as more capital gets to the hedge fund sector.

Introduction (4)

Also find that:

- Correlation in arbitrage strategies: size of TIPS-Treasury arbitrage is correlated with arbitrage mispricing in other markets.
- Predictability of TIPS-Treasury mispricing: size of TIPS-Treasury arbitrage can be predicted using measures of changes wealth.

TIPS Treasury Arbitrage

The TIPS Market

- TIPS vs. Bonds
 - ▶ Principal amount of a TIPS issue is adjusted over time to reflect changes in the CPI.
 - ▶ Semiannual coupon varies over time as the principal amount changes.
 - ▶ Final principal paid: the maximum of the original principal amount or the inflation-adjusted amount.
- The total principal amount of all TIPS outstanding at the end of the sample period (Nov. 2009): \$550+ billion.
- First TIPS auction: in January 1997.

The Inflation Swap Market

- TIPS market has grown \Rightarrow the inflation swap market has become liquid and actively traded.
- Estimates (Pond and Mirani, 2011): The notional size of the inflation swap market is on the order of hundreds of billions.
- Conversations with inflation swap traders: instruments are fairly liquid, typical bid-ask spreads close to 5 bps.

Inflation Swaps

Inflation Swaps: zero-coupon swaps

- Example: 5 year swap.
- At maturity: exchange cash flow of $(1 + 0.0200)^5 - I_t$.
- If realized inflation was 1.50% per year: $I_t = 1.0155^5 = 1.077284$.
- Cash flow: $(1 + 0.0200)^5 - 1.077284 = \0.026797 per dollar notional of the swap.

Synthetic Treasury Bond Replicating Strategy (1)

Table 1: Cash Flows from the Treasury Bond and the Synthetic Treasury Bond Replicating Strategy.

Strategy	0	1	2	3	...	T
Buy Treasury	$-P$	c	c	c	...	$c + 100$
Buy TIPS	$-V$	sI_1	sI_2	sI_3	...	$(s + 100)I_T$
Inflation Swap ₁	0	$s(F_1 - I_1)$	0	0	...	0
Inflation Swap ₂	0	0	$s(F_2 - I_2)$	0	...	0
Inflation Swap ₃	0	0	0	$s(F_3 - I_3)$...	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
Inflation Swap _{T}	0	0	0	0	...	$(s + 100)(F_T - I_T)$
STRIPS ₁	$-(c - sF_1)D(1)$	$c - sF_1$	0	0	...	0
STRIPS ₂	$-(c - sF_2)D(2)$	0	$c - sF_2$	0	...	0
STRIPS ₃	$-(c - sF_3)D(3)$	0	0	$c - sF_3$...	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
STRIPS _{T}	$-(c + 100)D(T) - (s + 100)F_T D(T)$	0	0	0	...	$(c + 100) - (s + 100)F_T$
Total Cash Flow	$\sum_{i=1}^T (c - sF_i) D(i) + 100(1 - F_T) D(T) - V$	c	c	c	...	$c + 100$

Synthetic Treasury Bond Replicating Strategy (2)

Table 2: A Specific Example of the Synthetic Treasury Bond Replicating Strategy.

Date	Treasury	TIPS	Inflation Swaps	STRIPS	Total
0	-169.4793	-101.2249	0	-45.6367	-146.3786
1	3.8125	1.1875 I_1	1.1856 - 1.1875 I_1	2.6269	3.8125
2	3.8125	1.1875 I_2	1.1638 - 1.1875 I_2	2.6487	3.8125
3	3.8125	1.1875 I_3	1.1480 - 1.1875 I_3	2.6645	3.8125
4	3.8125	1.1875 I_4	1.1467 - 1.1875 I_4	2.6658	3.8125
5	3.8125	1.1875 I_5	1.1307 - 1.1875 I_5	2.6818	3.8125
6	3.8125	1.1875 I_6	1.1376 - 1.1875 I_6	2.6749	3.8125
7	3.8125	1.1875 I_7	1.1566 - 1.1875 I_7	2.6559	3.8125
8	3.8125	1.1875 I_8	1.1616 - 1.1875 I_8	2.6509	3.8125
9	3.8125	1.1875 I_9	1.1630 - 1.1875 I_9	2.6495	3.8125
10	3.8125	1.1875 I_{10}	1.1773 - 1.1875 I_{10}	2.6352	3.8125
11	3.8125	1.1875 I_{11}	1.1967 - 1.1875 I_{11}	2.6158	3.8125
12	3.8125	1.1875 I_{12}	1.2095 - 1.1875 I_{12}	2.6030	3.8125
13	3.8125	1.1875 I_{13}	1.2248 - 1.1875 I_{13}	2.5877	3.8125
14	3.8125	1.1875 I_{14}	1.2466 - 1.1875 I_{14}	2.5659	3.8125
15	3.8125	1.1875 I_{15}	1.2683 - 1.1875 I_{15}	2.5442	3.8125
16	3.8125	1.1875 I_{16}	1.2866 - 1.1875 I_{16}	2.5259	3.8125
17	3.8125	1.1875 I_{17}	1.3058 - 1.1875 I_{17}	2.5067	3.8125
18	3.8125	1.1875 I_{18}	1.3304 - 1.1875 I_{18}	2.4821	3.8125
19	3.8125	1.1875 I_{19}	1.3556 - 1.1875 I_{19}	2.4569	3.8125
20	3.8125	1.1875 I_{20}	1.3792 - 1.1875 I_{20}	2.4333	3.8125
21	3.8125	1.1875 I_{21}	1.4009 - 1.1875 I_{21}	2.4116	3.8125
22	3.8125	1.1875 I_{22}	1.4225 - 1.1875 I_{22}	2.3900	3.8125
23	3.8125	1.1875 I_{23}	1.4427 - 1.1875 I_{23}	2.3698	3.8125
24	3.8125	1.1875 I_{24}	1.4635 - 1.1875 I_{24}	2.3490	3.8125
25	3.8125	1.1875 I_{25}	1.4806 - 1.1875 I_{25}	2.3319	3.8125
26	3.8125	1.1875 I_{26}	1.4979 - 1.1875 I_{26}	2.3146	3.8125
27	3.8125	1.1875 I_{27}	1.5126 - 1.1875 I_{27}	2.2999	3.8125
28	3.8125	1.1875 I_{28}	1.5277 - 1.1875 I_{28}	2.2848	3.8125
29	3.8125	1.1875 I_{29}	1.5407 - 1.1875 I_{29}	2.2718	3.8125
30	3.8125	1.1875 I_{30}	1.5548 - 1.1875 I_{30}	2.2577	3.8125
31	3.8125	1.1875 I_{31}	1.5676 - 1.1875 I_{31}	2.2449	3.8125
32	3.8125	1.1875 I_{32}	1.5823 - 1.1875 I_{32}	2.2302	3.8125
33	103.8125	101.1875 I_{33}	135.9861 - 101.1875 I_{33}	-32.1736	103.8125

Transaction Costs (1)

- Average cost of trading 10-year bond is on the order of 0.78 ticks (32nds), rarely more than 1.5 ticks (Fleming, 2003).
- Cost is lower for shorter maturity notes and bonds.
- Average bid-ask spread for Treasury STRIPS at about three ticks (Daves and Ehrhardt, 1993).
- Bid-ask spreads for 5-year, 10-year, and 20-year TIPS issues are 2.6, 2.7, and 7.3 ticks, respectively (Fleming and Krishnan, 2009).

Transaction Costs (2)

- Assume bid-ask spreads for Treasury bonds, TIPS, and STRIPS are 2, 6, and 4 ticks, respectively.
- Assume bid-ask spread for inflation swaps is 6 basis points.
- Apply these to strategy in Table 2.
- Compute the transaction costs for 2-year, 5-year, and 10-year versions of the strategy.
 - ▶ Cash flows held fixed, but maturity date is changed.
- Estimated costs for the 2-year, 5-year, 10-year, and actual strategies: 20.2, 29.5, 46.3, and 69.1 cents per \$100 notional amount.

Data (1)

- Source: Bloomberg.
- Daily closing prices for U.S. Treasury bonds, TIPS, STRIPS, and inflation swaps.
- Period: July 23, 2004 to November 19, 2009.
- The TIPS and Treasury pairs have maturities ranging from 2007 to 2032.
- Closing prices for TIPS and Treasury bonds are adjusted for accrued interest following standard market conventions.

Data (2)

- Inflation Swaps

- ▶ Traded maturities are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, and 30 years.
- ▶ Swap rates for intermediate maturities: cubic spline interpolation.
- ▶ Seasonal patterns in inflation are taken into account (for maturities in-between traded ones). Regress CPI-U index values for the January 1980 to October 2009 period on monthly indicator variables. Estimated seasonal weights are normalized to ensure no seasonal effect for full-year swap.

Data (3)

- TIPS and Treasury bonds matched based on maturities.
- Mismatch ≤ 31 days.
- Total: 29 TIPS-Treasury bond pairs.
 - ▶ seven exact matches, nine mismatches of 15 days, and 13 mismatches of 31 days.
 - ▶ 31-day mismatches occur only for maturities of February 2015 or later (a very small percentage mismatch in the maturities).
- Adjustment for mismatch: compute YTM on synthetic fixed-rate bond and apply it to calculate price of a synthetic bond that exactly matches the maturity of the Treasury bond in the pair.

Results - Mispricing (1)

Table 3: Summary Statistics for TIPS-Treasury Mispricing.

TIPS			Treasury	Mismatch in Days	Dollar Mispricing					Basis-Point Mispricing					N
					Mean	SDev	Min	Max	ρ	Mean	SDev	Min	Max	ρ	
January 15, 2007	3.375	December 31, 2006	3.000	15	0.18	0.39	-0.76	1.10	0.97	34.57	92.03	-255.56	357.23	0.98	506
January 15, 2008	3.625	December 31, 2007	4.375	15	0.34	0.34	-0.25	1.26	0.96	53.82	66.57	-80.99	270.41	0.96	502
January 15, 2009	3.875	January 15, 2009	3.250	0	0.67	0.46	-0.34	2.56	0.95	72.54	135.34	-25.55	723.29	0.98	1,109
January 15, 2010	4.250	January 15, 2010	3.625	0	0.85	0.59	-1.05	4.69	0.91	55.14	71.91	-64.47	420.39	0.97	1,215
April 15, 2010	0.875	April 15, 2010	4.000	0	1.09	0.65	-1.18	4.51	0.93	58.25	57.84	-69.20	316.69	0.96	1,161
January 15, 2011	3.500	January 15, 2011	4.250	0	1.32	0.71	-0.03	4.94	0.92	50.24	33.67	-1.07	231.07	0.94	971
April 15, 2011	2.375	March 31, 2011	4.750	15	1.67	0.70	-0.37	5.03	0.91	56.13	33.04	-15.24	213.25	0.94	736
January 15, 2012	3.375	January 15, 2012	1.125	0	1.84	0.75	0.79	4.64	0.96	72.32	24.20	31.10	163.04	0.95	215
April 15, 2012	2.000	April 15, 2012	1.375	0	1.42	0.41	0.62	2.32	0.91	54.11	14.90	21.83	90.97	0.90	154
July 15, 2012	3.000	July 15, 2012	1.500	0	1.66	0.37	0.94	2.89	0.86	60.25	12.44	35.72	104.19	0.83	91
April 15, 2013	0.625	March 31, 2013	2.500	15	2.19	1.18	-1.07	6.37	0.95	55.44	28.02	-24.54	156.69	0.95	395
July 15, 2013	1.875	June 30, 2013	3.375	15	4.02	1.83	1.77	9.36	0.98	96.27	39.99	49.04	212.92	0.97	353
January 15, 2014	2.000	December 31, 2013	1.500	15	4.38	1.50	2.30	7.86	0.98	103.66	30.32	59.34	173.67	0.97	225
April 15, 2014	1.250	March 31, 2014	1.750	15	1.76	0.30	1.07	2.58	0.85	41.24	6.97	23.77	56.82	0.85	143
July 15, 2014	2.000	June 30, 2014	2.625	15	3.01	0.48	2.04	4.04	0.95	67.20	9.76	46.45	88.47	0.93	101

(Continued)

Results - Mispricing (2)

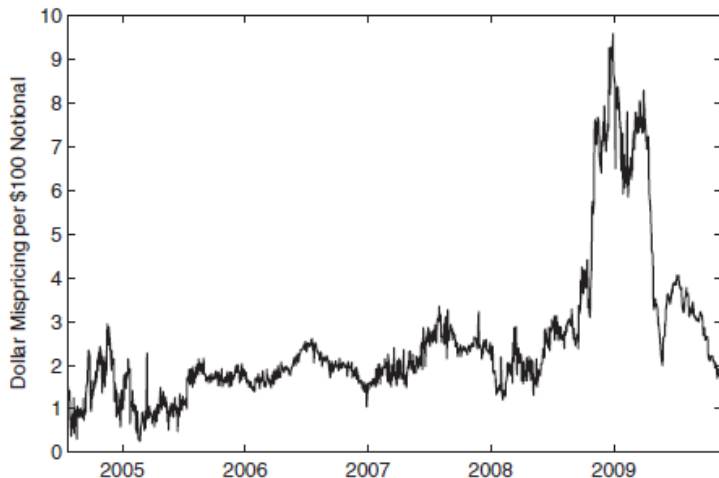
					Dollar Mispricing					Basis-Point Mispricing					
			Mismatch in Days												
TIPS	Treasury			Mean	SDev	Min	Max	ρ	Mean	SDev	Min	Max	ρ	N	
January 15, 2015	1.625	February 15, 2015	4.000	31	3.36	2.04	1.22	12.52	0.99	55.48	37.53	15.62	214.11	0.99	1,204
July 15, 2015	1.875	August 15, 2015	4.250	31	3.61	2.18	1.54	13.24	0.99	56.39	36.45	22.68	207.57	0.99	1,079
January 15, 2016	2.000	February 15, 2016	4.500	31	4.01	2.29	1.63	13.14	0.99	59.66	35.41	22.46	206.56	0.99	950
July 15, 2016	2.500	June 30, 2016	3.250	15	3.76	0.59	2.46	4.99	0.98	62.34	9.63	40.75	82.58	0.98	101
January 15, 2017	2.375	February 15, 2017	4.625	31	4.27	2.35	1.51	12.56	0.98	58.22	31.97	18.92	166.06	0.98	698
July 15, 2017	2.625	August 15, 2017	4.750	31	4.43	2.34	1.70	11.20	0.97	57.29	29.83	20.51	143.82	0.97	573
January 15, 2018	1.625	February 25, 2018	3.500	31	5.00	2.51	2.13	12.05	0.98	65.33	31.57	26.99	147.04	0.97	446
July 15, 2018	1.375	August 15, 2018	4.000	31	5.38	2.62	1.78	12.31	0.98	65.78	29.84	21.72	137.22	0.97	320
January 15, 2019	2.125	February 15, 2019	2.750	31	5.32	2.08	2.56	10.14	0.99	68.36	24.60	33.66	123.37	0.99	194
July 15, 2019	1.875	August 15, 2019	3.625	31	3.94	0.78	2.40	5.09	0.99	47.98	9.44	29.05	62.51	0.99	68
January 15, 2025	2.375	February 15, 2025	7.625	31	4.27	3.57	-0.89	23.06	0.98	29.40	23.45	-5.51	138.97	0.98	1,342
January 15, 2026	2.000	February 15, 2026	6.000	31	4.90	3.16	-0.06	18.49	0.97	36.85	21.96	-0.50	118.59	0.96	961
January 15, 2027	2.375	February 15, 2027	6.625	31	5.30	3.46	0.54	18.53	0.97	36.42	22.03	3.70	108.12	0.96	709
January 15, 2029	2.500	February 15, 2029	5.250	31	6.84	3.49	1.68	15.22	0.98	48.43	23.69	12.22	103.74	0.98	205

Findings

- Dramatic: TIPS and Treasury markets are two of the largest and most liquid markets.
- Treasury bonds appear uniformly “rich” relative to synthetics.
- Few cases of negative mispricing (2.56%).
- Concentrated in pairs involving TIPS with highest coupons.
- Could reflect investor preference for short-term high-coupon TIPS issues.

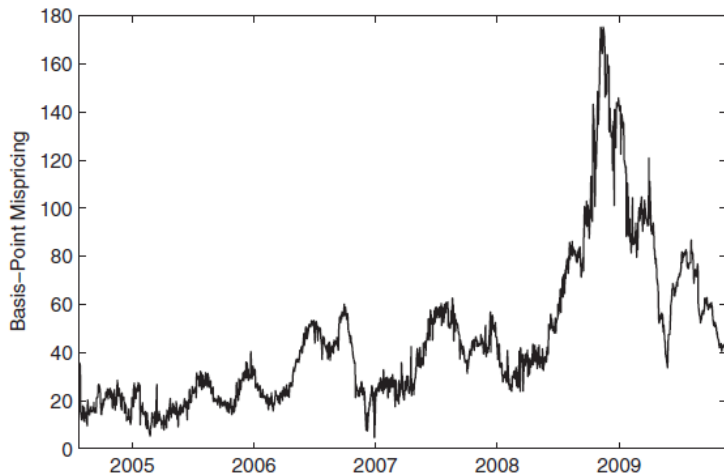
Mispricing Over Time (1)

Figure 1: TIPS-Treasury mispricing (in units of dollars per \$100 notional).



Mispricing Over Time (2)

Figure 2: TIPS-Treasury mispricing (in basis points).

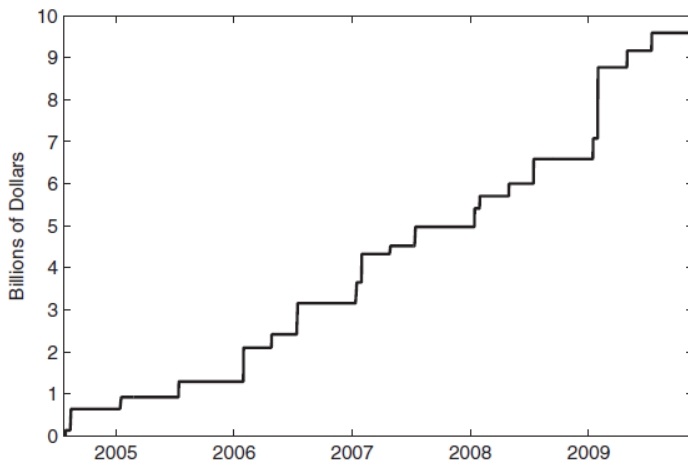


Treasury

- Treasury could generate significant savings by buying back all the outstanding TIPS issues, issuing Treasury bonds with the same maturity, and hedging out the inflation risk in the inflation swap market.
- One perspective on this: compute cost of issuing TIPS instead to Treasury bonds.
- 27 TIPS issuances during the sample period.

Savings

Figure 3: Cumulative total cost to the Treasury from issuing TIPS rather than Treasury bonds.



Inflation Swap Mispricing?

Corporate Inflation-Linked Debt Arbitrage (1)

- If inflation swap mispricing were the underlying reason for the TIPS-Treasury results \Rightarrow same type of mispricing between corporate fixed-rate and inflation-linked debt.
- Issuers: Bank of America, Citigroup, JP Morgan, Morgan Stanley, Prudential, and Sallie Mae.
 - ▶ Original maturities of inflation-linked debt: 10 years.
 - ▶ The mismatch ranges from zero days to a maximum of 31 days.
- Corporate fixed-rate and inflation-linked debt is much less liquid than Treasury debt.

Corporate Inflation-Linked Debt Arbitrage (2)

Table 4: Comparison of Corporate Fixed-Rate and Inflation-Linked Debt Mispricing with TIPS-Treasury Mispricing.

CDS Threshold	Corporate Mispricing			TIPS-Treasury Mispricing			Corr.	N
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.		
25	-6.11	-7.15	56.26	31.78	26.97	13.23	-0.281	465
50	-0.28	-4.34	58.96	31.76	26.88	13.41	-0.164	542
75	7.55	0.68	65.92	32.45	28.06	13.56	-0.052	581
100	9.17	1.09	68.11	32.95	28.35	14.26	0.019	598

Discussion and Additional Checks

- Median corporate mispricing and average corporate mispricing are close to zero.
- If swaps are mispriced: correlation between corporate-bonds and government-bonds mispricings.
- Additional check: credit spread for the fixed-rate corporate bond and for inflation-linked corporate bond.
 - ▶ Should be similar if all bonds are fairly priced.
 - ▶ Fixed-rate spread is higher than inflation-linked spread.
 - ▶ Consistent with view that Treasury bonds are rich relative to TIPS.

Other Potential Factors Affecting Inflation Swaps (1)

Corporate Inflation-Linked Issuance

- Regress weekly changes in inflation swap rates on weekly inflation-linked corporate debt issuance.
- No evidence that inflation-linked debt issuance affects inflation swap prices.

Counterparty Credit Risk

- CDS contracts (Navneet Arora and Longstaff, 2012): differences in the credit risk of dealers selling credit protection have very small effect on the pricing of CDS contracts.
- Much less volatility in inflation rates than in credit spreads.
 - ▶ Counterparty credit risk on inflation swaps would be even smaller.

Other Potential Factors Affecting Inflation Swaps (2)

Hedging Costs and Illiquidity

- Inflation swap dealers may face additional costs related to the hedging of their positions.
- Dealers in interest rate swaps and foreign exchange swaps are also exposed to these.
- Studies of swap pricing have discovered that these costs have at most a minor effect on rates.

TIPS and Treasury Bonds

Factors that may drive a wedge between prices of TIPS and Bonds (1)

A. Tax Differences

- The federal and state income taxation of Treasury bonds is identical to that of TIPS in all but one small respect.
- “Phantom Income”.
- Large portion held by tax-sheltered entities such as pension plans and retirement funds.
 - ▶ The phantom income provision is irrelevant for many of these investors.
- Treasury STRIPS: also subject to the phantom income provisions.
- Studies of the pricing of Treasury STRIPS have not found evidence of phantom income-related tax effects.

Factors that may drive a wedge between prices of TIPS and Bonds (2)

B. Credit Risk

- If the market views the default risk of Treasury bonds as lower than that of TIPS, TIPS might trade at prices lower than those implied by the no-arbitrage model.

C. Bid-Ask Spreads

- Costs of trading Treasury bonds and TIPS: both very small \Rightarrow difference in bid-ask spreads between Treasury bonds and TIPS: roughly 15 cents.
 - ▶ TIPS-Treasury mispricing greater than, say, five basis points cannot be explained by transaction costs.

Factors that may drive a wedge between prices of TIPS and Bonds (3)

D. The Deflation Floor

- Embedded put option incorporated into the TIPS issues.

E. Repo Financing

- Discussions with bond traders, however, indicate that both types of debt are treated similarly by repo dealers.

Factors that may drive a wedge between prices of TIPS and Bonds (4)

F. Special Repo Rates

- On-the-run Treasury Bonds and TIPS.
- PV of the special repo financing benefit for on-the-run Treasuries is much smaller than the average TIPS-Treasury mispricing.
 - ▶ Differences rates: 30 to 125 basis points.
 - ▶ A back-of-the-envelope upper bound calculation: six months (the maximum time between auctions) special financing \Rightarrow 62.5 cents per \$100 notional.
 - ▶ Upper bound is lower than the average size of the TIPS-Treasury mispricing.

Factors that may drive a wedge between prices of TIPS and Bonds (5)

G. Collateral Value

- Both are acceptable collateral for almost all obligations.

H. Eligibility for the Treasury STRIPS Program

- Both are eligible for stripping.

I. Futures Contracts

- Futures contracts on TIPS are not currently traded on any futures exchange.

Distinction likely has little impact on the relative pricing of most Treasury bonds and TIPS.

Factors that may drive a wedge between prices of TIPS and Bonds (6)

J. Foreign Ownership

- Only aggregate foreign ownership data for Treasury bonds and TIPS are available.
- Graph from U.S. Treasury: during the 2000 to 2008 period, 60% of TIPS were auctioned to dealers and brokers, 30% to investment firms, and 10% to foreign entities.

K. Institutional Ownership

- Form 13F
- On average, 31.58% of the notional amount of the TIPS bonds in the sample are reported on Form 13F.
- The corresponding value for a set of maturity matched Treasury bonds is 25.02%.
- Investment firms: 20.69% of the TIPS, but only 4.71% of the matching Treasury bonds.
- NY Fed: 8.41% of the TIPS, but 17.35% of the matching Treasury bonds.

Factors that may drive a wedge between prices of TIPS and Bonds (7)

L. Bond Dealers and Market Microstructure

- Rules: No difference between Treasury bonds and TIPS in terms of how primary dealers are expected to conduct their operations.
- Traders: little difference in how bond dealers make markets in the two types of securities.

M. Supply Considerations

- Notional amount of TIPS was less than 10% of the total amount of Treasury debt held by the public during recent years.

N. TIPS Liquidity

- Treasury notes and bonds: ADTV (2011) = \$212.6 billion.
- TIPS: ADTV (2011) = \$9.5 billion.
- Info from trader: Roughly 15 dealers who were competitive in providing quotes for Treasury bonds. About 5 who could provide same level of liquidity for TIPS; felt TIPS were liquid.

Factors that may drive a wedge between prices of TIPS and Bonds (8)

O. Costs of Shorting Treasury Bonds

- Difference between reverse repo rates and market rates.
- Fall of 2008 \Rightarrow arbitrageur wishing to short a bond might have needed to allow the owner of the bond to borrow at a cost of zero.
- Short-term repo rates were on the order of only 25 basis points during this period.

P. Quantitative Easing

- March 18, 2009 (QE1): FOMC announced an program to purchase up to \$300 billion of longer-dated Treasury bonds.

What Drives the Mispricing?

The Variables (1)

Regress monthly changes in average basis points mispricing on explanatory variables.

1. Supply

- Literature suggests it may be easier to execute arbitrage strategies when there is an increase in the supply of on-the-run or recently auctioned bonds.
- Supply variables: total notional amounts of TIPS and Treasury bonds auctioned each month during the sample period (in \$ billions).
- Data Source: Treasury website.

The Variables (2)

2. Liquidity

- Liquidity variable 1: notional amount of repo fails experienced by primary bond dealers (in \$ billions).
 - ▶ Repo fails: breakdown in liquidity.
 - ▶ Participants are not able to locate Treasury securities.
 - ▶ Should increase when liquidity and supply dries up.
- Liquidity variable 2: ratio of TIPS trading volume by primary dealers to Treasury note and bond trading volume by primary dealers.
- Data Source: Federal Reserve Bank of New York.

The Variables (3)

3. Credit Risk

- Monthly basis point change in the 10-year USD swap spread.
- Data Source: Bloomberg.

4. Slow-Moving Capital

- Slow-moving capital variable: changes in global hedge fund NAVs.
 - ▶ Measures amount of capital available that could be directed toward arbitraging mispricing.
- Data Source: estimated by Hedge Fund Research Inc. and reported via Bloomberg.

What Drives the Mispricing? Results

Table 5: Results from Regression of Monthly Changes in Average Basis-Point Mispricing on Supply, Liquidity, Credit, and Capital Flow Factors.

Explanatory Variable	Regression Coefficient	Newey-West <i>t</i> -Statistic
Intercept	3.6174	0.29
TIPS Issuance	-0.5304	-1.85*
Treasury Issuance	-0.0579	-1.71*
Repo Fails	0.0011	2.23**
Trading Ratio	1.9019	0.27
Swap Spread	0.3732	0.99
Hedge Fund Flows	-2.2727	-2.32**
Adj. R^2		0.175
<i>N</i>		66

What Drives the Mispricing? Discussion

- (i) Liquid on-the-run Treasury securities of either type allows arbitrageurs to drive prices closer.
- (ii) Evidence that the supply or liquidity of these securities is linked to the size of the arbitrage.
 - ▶ First time that such a result has been documented in the literature.
- (iii) Repeat analysis using other measures of credit risk: CDX index, sovereign CDS spread on the U.S. Treasury (both not significant).
- (iv) Test if changes in mispricing are related to the total amount of Treasury debt purchased as part of QE 1 (no relation).
- (v) Changes in Hedge Funds NAVs: significant.

Correlated Arbitrage

Correlated Arbitrage

- Implication of slow-moving-capital explanation of the persistence of mispricing: different arbitrages could be driven by a common factor.
- Example: if capital returns slowly to the fixed-income arbitrage hedge fund sector after periods of flat performance, then arbitrages arising in various types of fixed-income markets could display significant commonality.

Variables

- (1) CDS arbitrage (Duffie, 2010): based on credit spreads. Compare corporate CDS spread with spread from corporate bond.
- (2) CDX arbitrage: based in the CDX index. Compare CDX index and average spreads for the 125 firms included in the CDX index.
- (3) On-the-run vs. off-the-run yields (Krishnamurthy, 2002): compare yield between on-the-run and off-the-run Treasury bonds of similar maturities.
- (4) Refcorp vs. STRIPS (Longstaff, 2004): yield difference between 10-year Refcorp and Treasury STRIPS. Refcorp: guaranteed by Treasury.

Correlated Arbitrage - Results

Table 6: Results from the Regression of Monthly Changes in Average Basis-Point Mispricing on Monthly Changes in CDS Mispricing, CDX Mispricing, On/Off-the-Run Spreads, and Refcorp/Treasury Spreads.

Explanatory Variable	Regression Coefficient	Newey-West t -Statistic
Intercept	0.1698	0.12
CDS_t	0.0986	1.77*
CDS_{t-1}	0.0599	1.25
CDS_{t-2}	-0.1937	-3.59**
CDX_t	-0.1940	-1.85*
CDX_{t-1}	-0.4390	-3.60**
CDX_{t-2}	0.3335	3.97**
On/Off_t	0.5093	0.84
On/Off_{t-1}	-1.2045	-2.02**
On/Off_{t-2}	1.1413	2.39**
$Refcorp_t$	0.3445	2.11**
$Refcorp_{t-1}$	-0.4088	-3.85**
$Refcorp_{t-2}$	0.2014	1.23
Adj. R^2		0.616
N		66

Predictable Arbitrage

Predictable Arbitrage

Implication of slow-moving capital explanation: mispricing in the market should be predictable.

- Stock: excess return on the CRSP value-weighted index.
- Bond: return on the Bloomberg index of all Treasury debt with maturities in excess of one year.
- HedgeFund: return on the HFRI value-weighted index of all hedge funds.

Predictable Arbitrage - Results

Table 7: Results from the Forecasting Regression of Monthly Changes in Average Basis-Point Mispricing on Lagged Stock, Bond, and Hedge Fund Returns.

Explanatory Variable	Regression Coefficient	Newey-West <i>t</i> -Statistic
Intercept	5.6081	2.61**
Stock _{<i>t</i>-1}	-1.8203	-2.95**
Stock _{<i>t</i>-2}	2.1812	3.33**
Bond _{<i>t</i>-1}	-4.3274	-3.24**
Bond _{<i>t</i>-2}	-3.5386	-2.82**
HedgeFund _{<i>t</i>-1}	0.3471	0.23
HedgeFund _{<i>t</i>-2}	-3.8906	-2.62**
Adj. <i>R</i> ²		0.471
<i>N</i>		66

Conclusion

Conclusion

- Study the relative pricing of TIPS and Treasury bonds.
- No-arbitrage relation is frequently violated in the markets.
- The mispricing is among the largest ever documented in the literature.
- Mispricing narrows as additional capital flows into the hedge fund sector.
- TIPS-Treasury mispricing is correlated with arbitrage mispricing in other markets.
- TIPS-Treasury mispricing can be forecast using measures of changes in aggregate investor wealth.

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