Discussion of:

An Empirical Decomposition of Risk and Liquidity in Nominal and Inflation-Indexed Government Bonds

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Overview

1. Background – TIPS and Treasuries
2. Estimating Liquidity Premia
3. Testing for Segmentation

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- *Please note that much of this discussion is adapted from George Pennachi's excellent discussion of this paper at the NBER-AP-SI, 7/14/2011*

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  - This actually led to a large premium for some newly issued TIPS during the financial crisis.
- Both Treasuries and TIPS are eligible for the Treasury strip program.
  - However, stripping for TIPS is complicated since each issue has it's own reference CPI level.

Historical TIPS Returns

- The yields on TIPS were initially perceived to be high, given expected inflation levels.
  - Numerous studies, including Sack and Elssaser (2004), Shen (2006), and D'Amico, Kim, and Wei (2008) conclude that prior to 2004 TIPS yields were unreasonably large and difficult to account for in any rational valuation model.

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- This high return has occured over a period in which the amount of outstanding TIPS grew to 7.91% of all oustanding marketable US Treasury debt (11/2009).
- Note that Fleckenstein, Longstaff, and Lustig (2010) in particular argue that the Treasury could have gained up to $56 billion by purchasing TIPS, and issuing nominal Treasurys and inflation swaps.

Treasuries and TIPS in the Crisis

- During the financial crisis, the price of the benchmark nominal treasury rose dramatically
  - Interestingly, the price of TIPS did not rise comparably.
- This led to a dramatic drop in estimated breakeven inflation.
- Some commentators attributed this drop to deflation fears.
- The evidence presented here suggests that this is not the case.
  - It would be interesting to attempt to reconcile this with the pricing of the “deflation option” during the crisis

Basic Math - Nominal Bonds and TIPS

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- The annualized returns to these two zero-coupon bonds realized between t and $t+n$ will be:

	Nom. Treas.	TIPS
Nom. Return:	$y^{\$}_{n,t}$	$y^{\text{TIPS}}_{n,t} + \tilde{\pi}_{t,t+n}$
Real Return:	$y^{\$}_{n,t} - \tilde{\pi}_{t,t+n}$	$y^{\text{TIPS}}_{n,t}$

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An inflation bet

- If we form a long-short portfolio in which we go long TIPS and short the nominal treasury, we will realize an excess return of:

$$r_n^x = \tilde{\pi}_{t,t+n} - (y_{n,t}^{\$} - y_{n,t}^{\text{TIPS}})$$

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  as break-even inflation (BEI).
- $b_{n,t}$ is the (log) inflation rate at which the TIPS and nominal treasury provide equal return.

Break-Even Inflation decomposition

- PV decompose BEI into three components:

$$b_{n,t} \equiv y^{\$}_{n,t} - y^{\text{TIPS}}_{n,t} = E_t[\tilde{\pi}_{t,t+n}] + \psi_{n,t} - L_{n,t}$$

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- $\psi_{n,t}$ is the inflation risk-premium for a n-year nominal bond, as of t.
- $-\hat{L}_{n,t}$ is the liquidity premium for the n-year TIPS.
  - The identifying assumption here is that the nominal treasury had a liquidity premium of zero.

Paper Results

$$b_{n,t} \equiv y^{\$}_{n,t} - y^{\text{TIPS}}_{n,t} = E_t[\tilde{\pi}_{t,t+n}] + \psi_{n,t} - L_{n,t}$$

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This decomposition is the basis for the tests in the paper:

1. PV first estimate $-L_{n,t}$ by regressing $b_{n,t}$ onto a set of liquidity proxies:

$$b_{n,t} = a_1 + \underbrace{\mathbf{a}_2' \mathbf{X}_t}_{\hat{L}_{n,t} = -\hat{\mathbf{a}}_2' \mathbf{X}} + \epsilon_t$$

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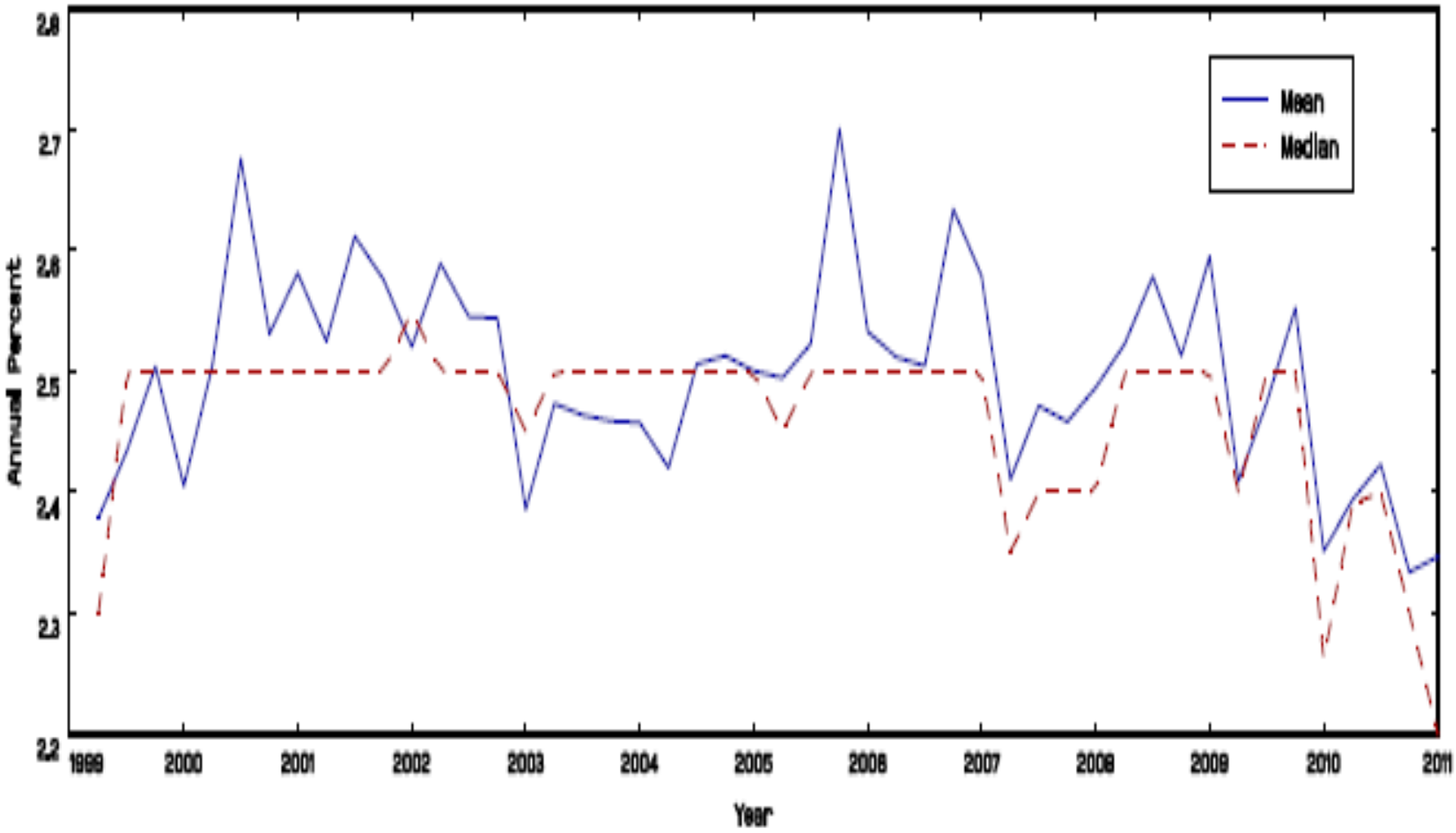
2. They then attempt to determine whether $b_{n,t}$ is a result of segmentation by examining whether the $\hat{L}$-adjusted $b_{n,t}$ is linked to the supply of TIPS.
3. Finally, they explain the returns to TIPS as a combination of liquidity risk effects and inflation risk premia.

Estimating Inflation Expectations

- The regression (sometimes) controls for time-varying expected inflation, $E_t[\tilde{\pi}_{t,t+n}]$, using the Survey of Professional Forecasters (SPF) 10-year CPI forecast, probably the best measure (Ang, Bekaert, and Wei, 2007).
- Whether the SPF forecast is included or assumed to be constant does not make much difference.
- From 1999-2011, the median SPF 10-year CPI forecast varied only from 2.2% to 2.55%.
  - The mean varies between 2.29% and 2.70%.

SPF 10-year CPI Inflation Expectations



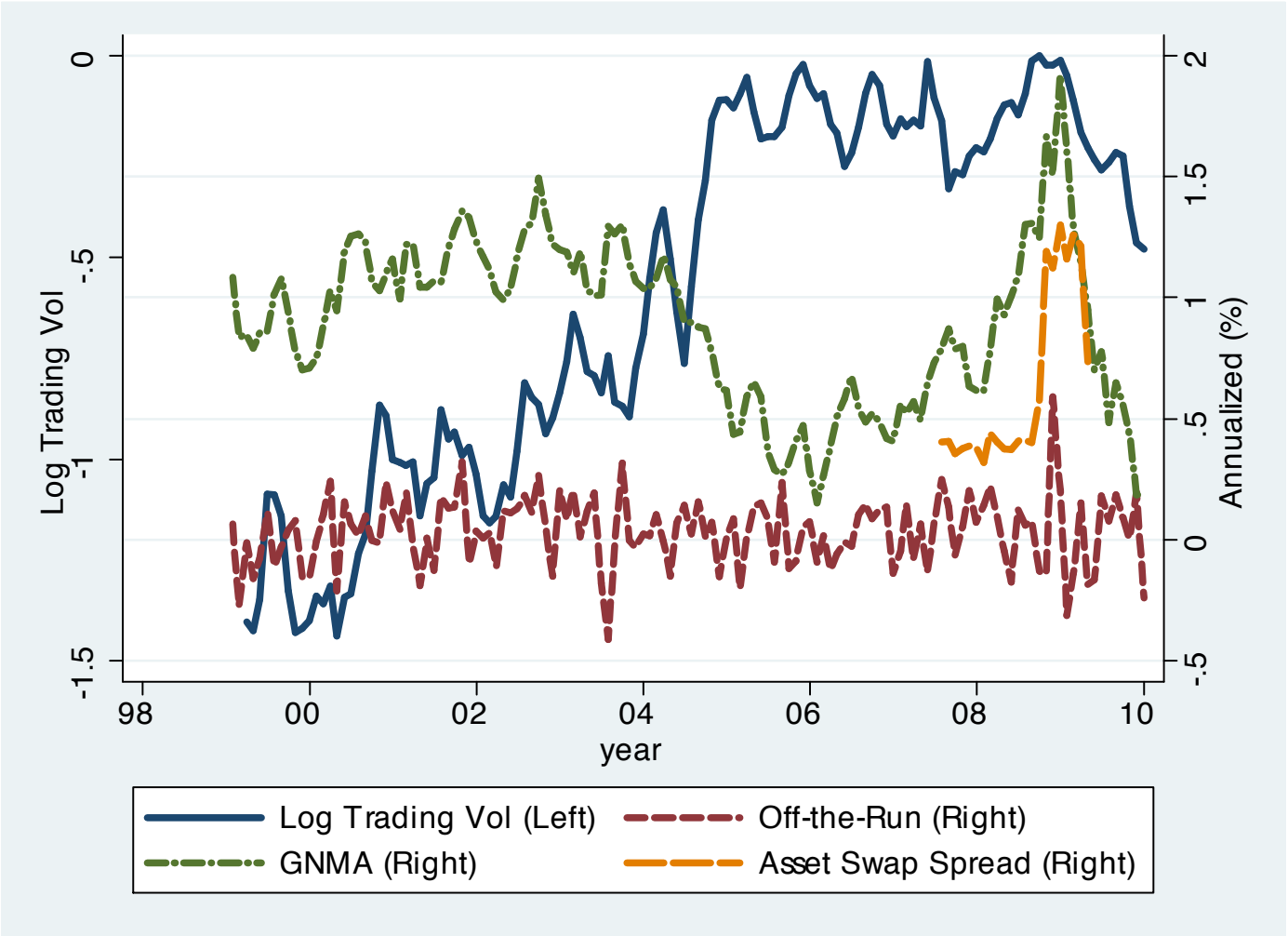
Liquidity Instruments

PV utilize four liquidity proxies:

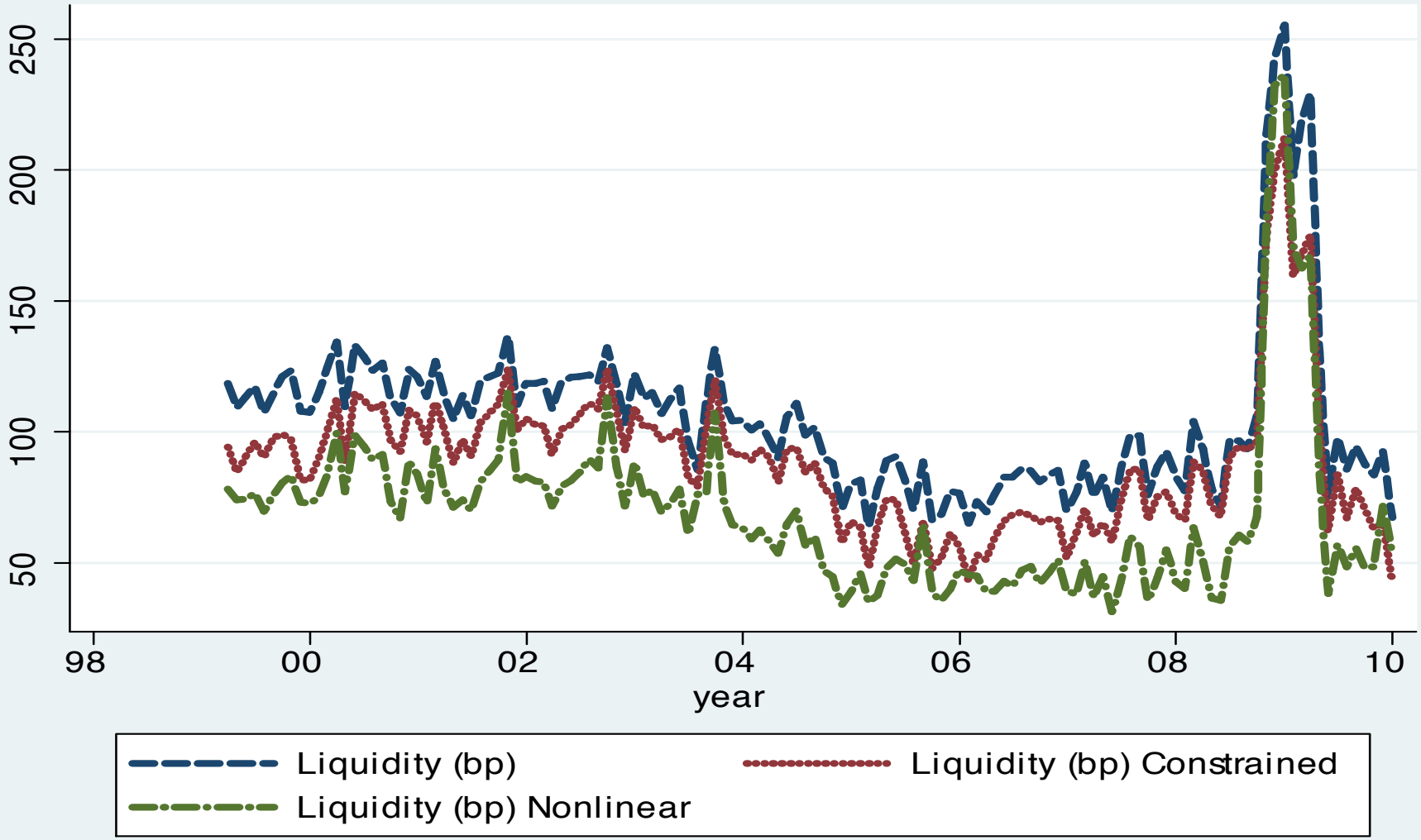
1. The on/off-the run spread $(-)$
2. The GNMA spread $(-)$
3. The TIPS transactions volume, divided by the nominal treasury transaction volume $(+)$
4. The difference between the asset swap spreads for TIPS and nominal bonds $(-)$.

All these variables are normalized in such as way that they go to zero in a world of perfect liquidity

Liquidity Instruments



Liquidity Estimates



Liquidity Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
				$y^{\$}_{n,t} - y^{TIPS}_{n,t}$		
Off-the-run Spr.	-0.63^{**}	-0.49^{**}	-0.53^{**}	-0.59^{**}	-0.48^{**}	-0.56^{**}
	(0.23)	(0.18)	(0.18)	(0.17)	(0.14)	(0.15)
GNMA Spr.		-0.46^{**}	-0.37^{**}	-0.19	0.56^{**}	-0.21
		(0.08)	(0.12)	(0.11)	(0.27)	(0.16)
Transaction Vol.			0.16	0.28^{**}	0.30^{**}	0.32^{**}
			(0.09)	(0.08)	(0.08)	(0.12)
Asset-Swap-Spr.	set -1	set -1	set -1	-1.59^{**}	-1.31^{**}	
				(0.20)	(0.15)	
$(\text{Off-the-run Spr.})^2$					-488.7^{*}	
					(189.9)	
$(\text{GNMA Spr.})^2$					-171.9^{**}	
					(63.3)	
const.	$2..71^{**}$	3.12^{**}	3.13^{**}	3.30^{**}	2.95^{**}	2.72^{**}
	(0.04)	(0.08)	(0.08)	(0.09)	(0.11)	(0.09)
p-value	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.44	0.56	0.64	0.67	0.70	0.47
Sample			$1999.3 - 2009.12$			$1999.3 - 2006.12$

Liquidity Estimates

- Most interesting here is the strong relation between $b_{n,t}$ and the off-the-run spread.
  - The regression R^2 is 44% with just the off-the-run-spread.
  - As PV note, this is suggestive of a special role for treasuries.
  - Note also the strong increase in log trading volume over the 2002-2004 period.

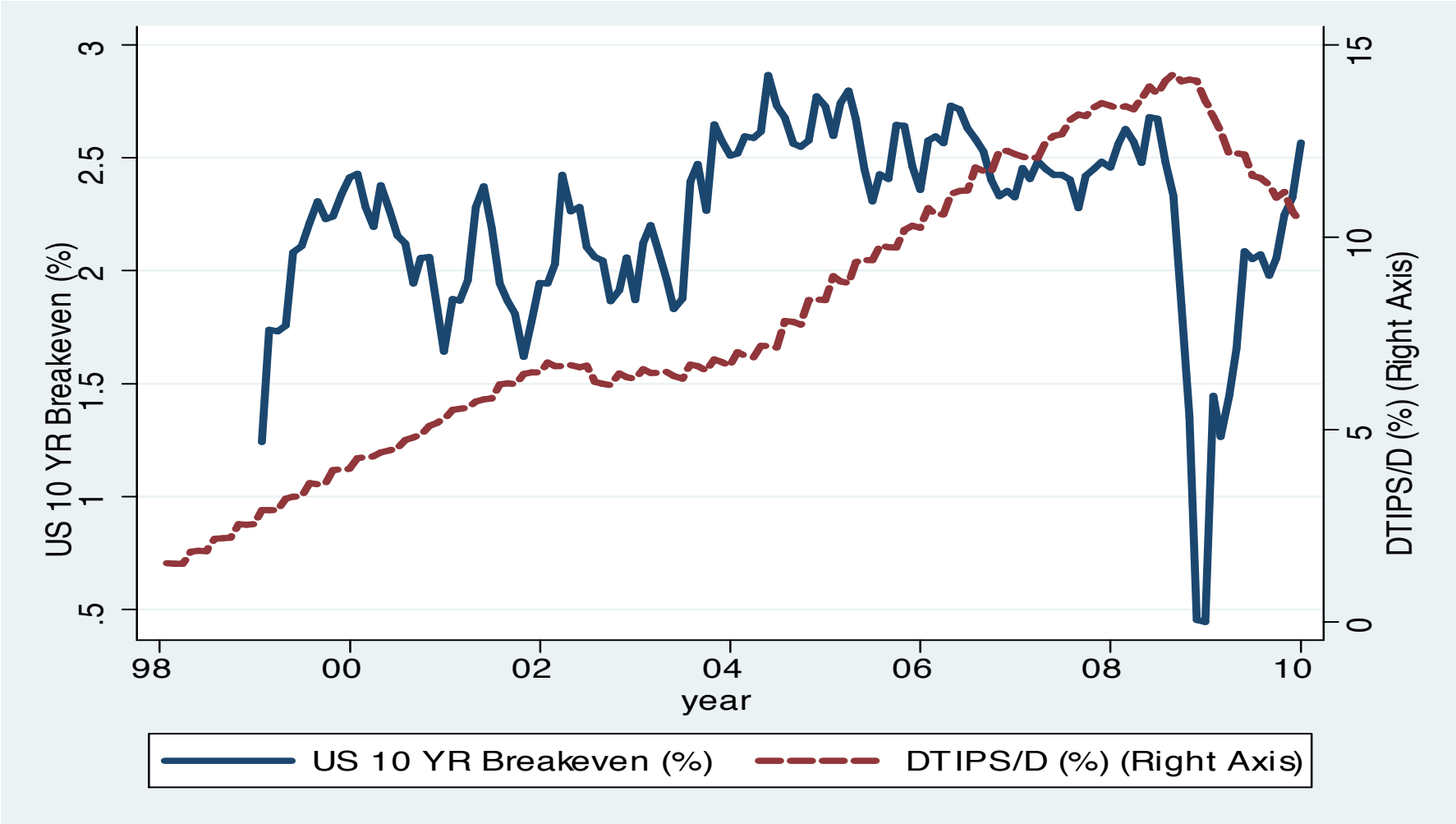
Tests for Market Segmentation

- PV explore the possibility that Market Segmentation is driving the relative pricing of TIPS and Treasuries:

$$\text{Supply}_t = \left(\frac{D_t^{TIPS}}{D_t^{\$}} \right)$$

- PV find that $b_{n,t}$ is unrelated to their Supply measure.

Relative Supply & BEI



Inflation Swaps

- Inflation Swaps began active trading in about 2003.
- They are now perceived to be very liquid.
- An *inflation swap* swaps a fixed nominal payment for an inflation adjusted payment based on the n-period inflation swap rate $r^{S\pi}_{n,t}$ (*e.g.*,

$$\$1 \cdot e^{n r^{S\pi}_{n,t}} \quad \longleftrightarrow \quad \$1 \cdot e^{n \tilde{\pi}_{t,t+n}}$$

Inflation Swaps

- A zero-coupon TIPS's cashflows can be replicated by an equivalent maturity nominal bond plus an inflation swap which converts the bond's nominal cashflow into an inflation adjusted cashflow.
- Based on this, we get an covered-interest-parity-like relation that, *in the absence of frictions*, BEI must equal the inflation swap rate:

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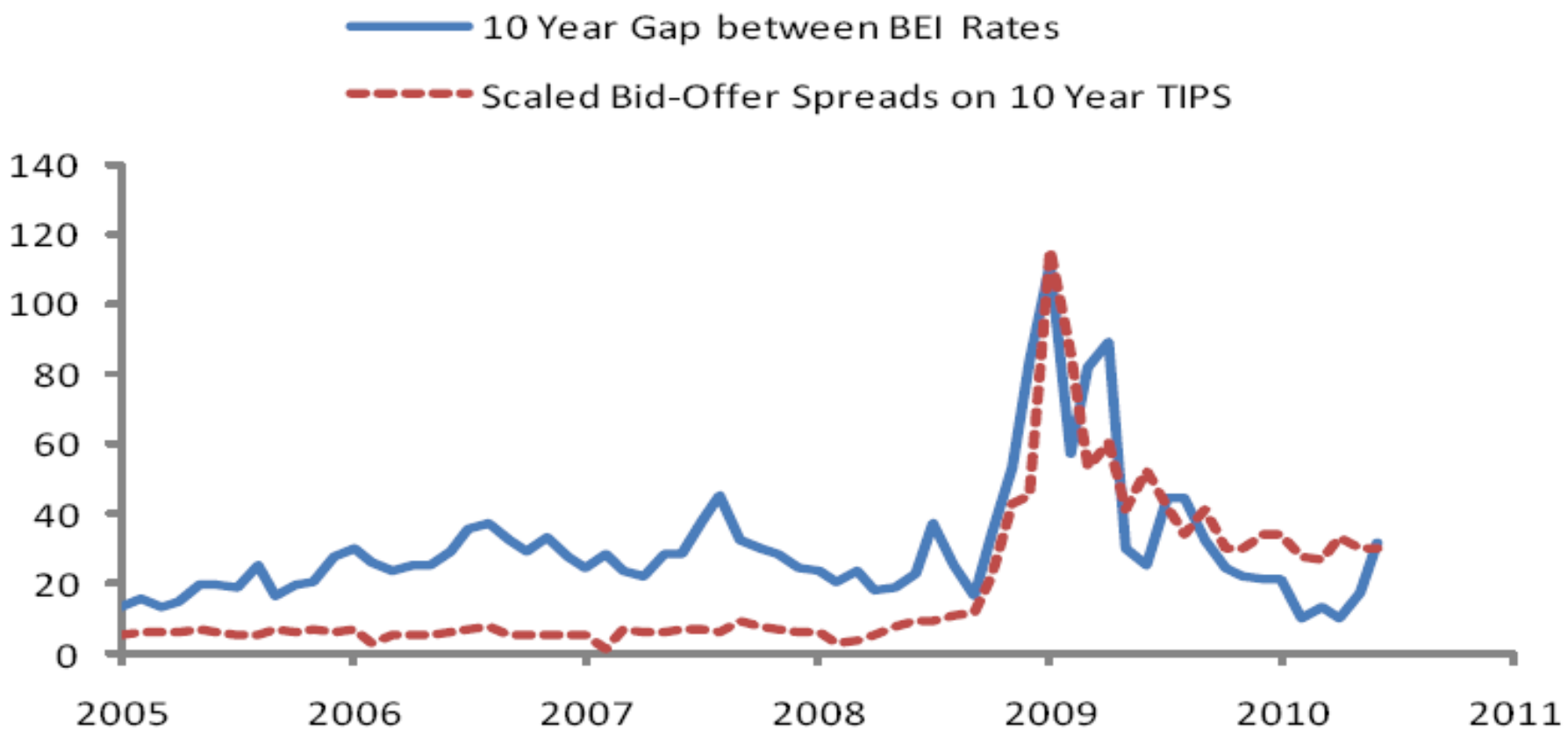
- It is reasonable that any difference be attributed to liquidity effects.
- $b_{n,t}$ is generally less than $r^{S\pi}_{n,t}$, consistent with the view that TIPS are relatively illiquid.

BEI minus Inflation Swap Rate

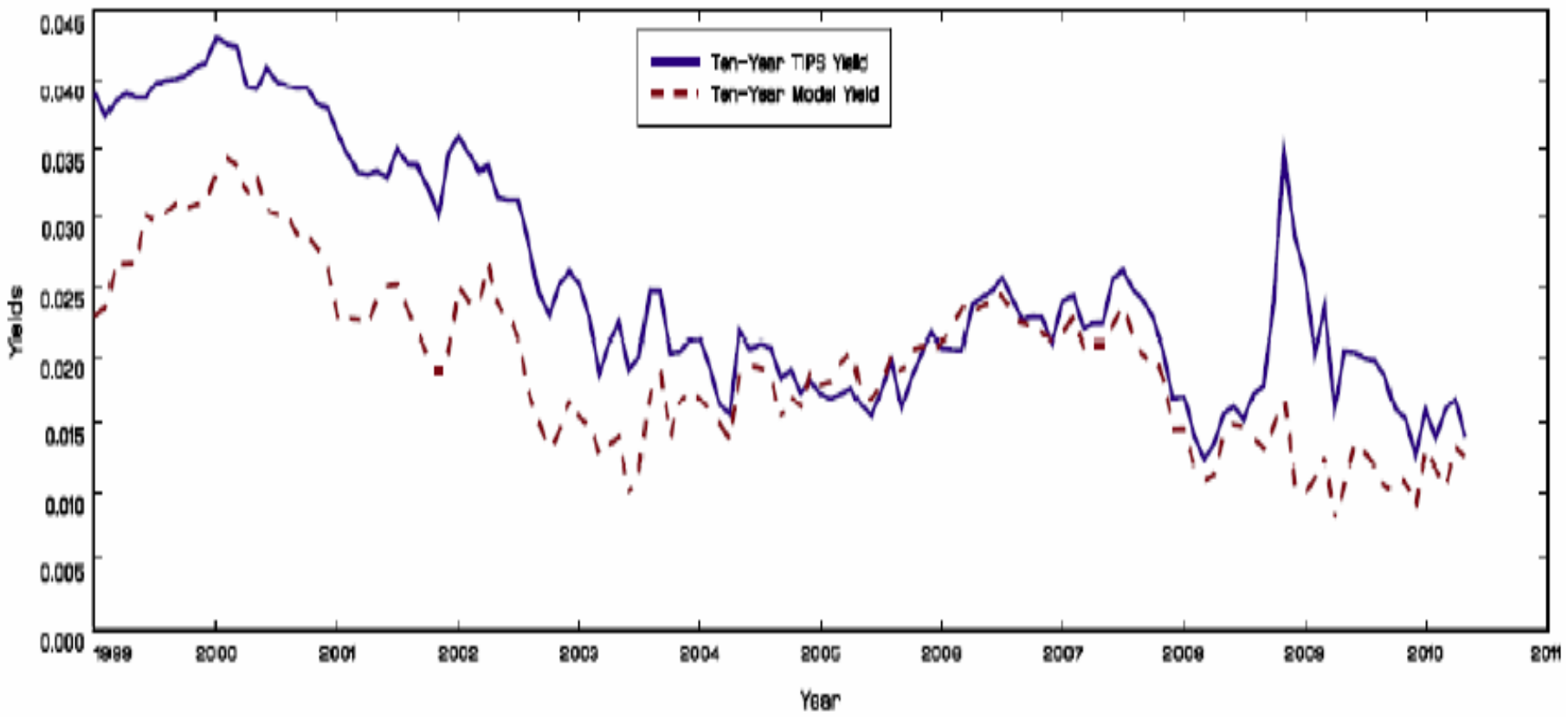


The Model Approach

- The downside of adjusting the illiquidity regression with inflation swaps is that swap data begins only in 2003.
- Alternatively, a nominal-real term structure model might be estimated over a longer period to account for expected inflation and an inflation risk premium.
- Haubrich, Pennacchi, and Ritchken (2010) estimate inflation risk premium from nominal yields, survey inflation forecasts, and inflation swap rates over the 1999 to 2010 period.
- Accounting for this estimated inflation risk premium still implies significant illiquidity in TIPS yields

HPR Model Estimates

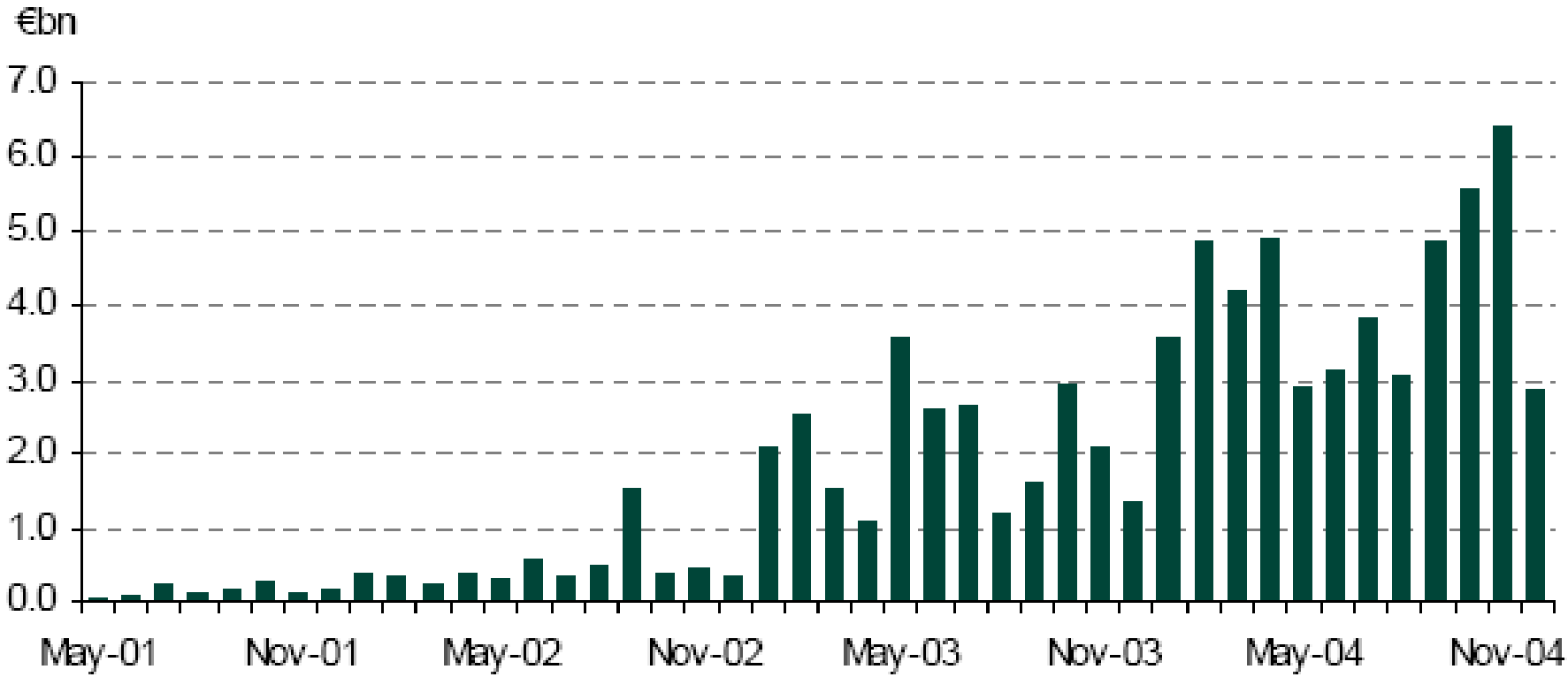
10-year TIPS, and HPR Model-Implied Real Yields:



TIPS/Inflation-Swap Discrepancies

- As noted earlier, many studies have concludes that prior to 2004 TIPS yields were unreasonably large and difficult to account for in any rational valuation model.
- Then, around 2003-04 TIPS yields – and TIPS illiquidity – both declined substantially.
- The paper argues that for a direct link between the liquidity and the premium.
- Another possibility is that the development of the inflation swap market allowed proprietary trading desks and hedge funds to arbitrage the excessive TIPS yields.

Inflation Swap - Trading Volume



Source: ICAP; Lehman Brothers. The graph also includes non-Euro swaps.

TIPS/Inflation-Swap Arbitrage Breakdown during the crisis

- Similarly, the break-down of TIPS - inflation swap arbitrage coincided with the Lehman Brothers bankruptcy.
- Campbell, Shiller, and Viceira (2009) and Hu and Worah (2009) note that Lehman had a large inventory of repoed TIPS that creditors sold at the same time that proprietary traders and hedge funds were forced to withdraw from arbitrage trades.
- Gradually, TIPS liquidity was restored as a wider array of investors, including pension funds, took advantage of the TIPS - inflation swap arbitrage (*Risk*, April 30, 2010).

Conclusions

- PV do a great job linking movements in various liquidity proxies to relative TIPS yields.
- As PV note, the "liquidity premium" that they estimate seems too large to be consistent with standard notions of liquidity
  - This is particularly true given that the natural investor in a TIPS should be buy-and-hold.