

Hedge funds and the Treasury cash-futures disconnect

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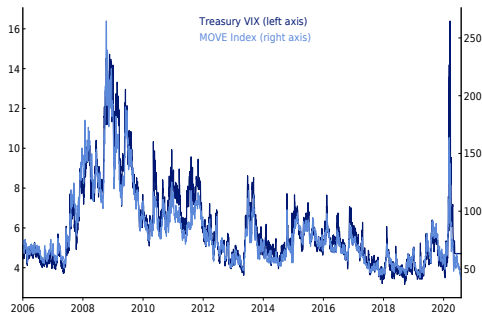
² Board of Governors of the Federal Reserve System

2021 Financial Stability Conference

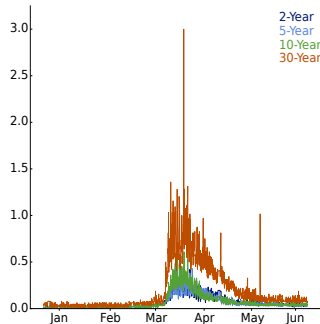


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March 2020 disruption in Treasury markets



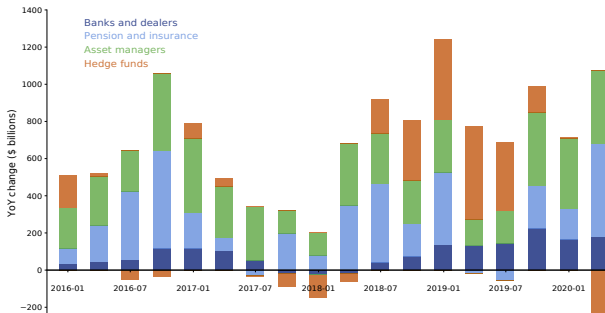
► **Most dramatic increase in Treasury volatility since at least 2009.**



During March, hedge fund Treasury exposure decreased by >\$200B

Document a major shift in Treasury markets:

- ▶ HF Treasury exposure increased by \$960B between 2017 and 2019.



In this paper we ask three questions:

1. Why were hedge funds holding so many Treasuries?
2. Why did they sell so many in March 2020?
3. What, if any, are the implications for financial stability?

Why were hedge funds holding so many Treasuries?

1. **>70% associated with disconnect of cash and futures prices.**

- ▶ Treasury futures overvalued to replicating cash portfolio.
- ▶ Disconnect made arbitrage through the repo market profitable.
- ▶ Rely on mixture of public aggregates and regulatory micro data to link to hedge funds.

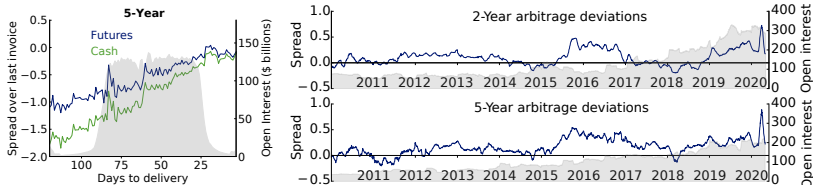
2. **Model shows trade facilitates risk-sharing and economizes on balance sheet costs between dealers and asset managers.**

- ▶ Basis traders act as **warehouses for Treasuries**.
 - ▶ Exposed to both **margin** and **rollover risk**.
- ▶ Present empirical evidence consistent with model.
- ▶ Present evidence of effect on underlying cash securities.

3. **Discuss how trade contributed to March illiquidity.**

- ▶ Roughly \$100B in sales associated with basis trade.
- ▶ However, prices of Treasuries associated with the trade *rose* during March.
- ▶ **Timely intervention by the Fed may have prevented further spillovers.**

Cash and futures prices of Treasuries related through arbitrage



In a frictionless market:

$$\underbrace{P_{t,T}}_{\text{Note price}} = \underbrace{\sum_{s=t}^T B_{t,s} C_s}_{\text{Intervening coupons}} + \underbrace{B_{t,T} F_{t,T,T}}_{\text{Discounted futures price}}.$$

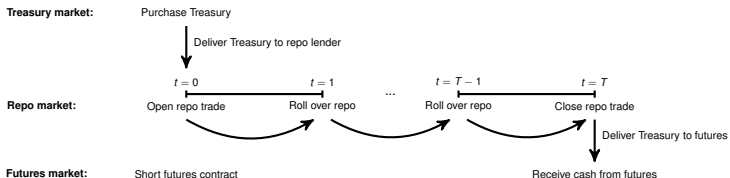
Convergence only occurs for cheapest-to-deliver (CTD) Treasuries.

Establish empirical counterpart: cash prices from CRSP, futures prices from Bloomberg.

► **Show that this relationship does not hold in recent years.**

Non-convergence Deliverability premium Past crises

The cash-futures basis trade



In reality, arbitrageurs rely on repo financing to arbitrage this spread.

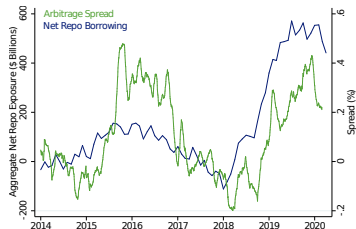
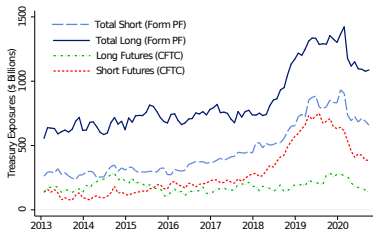
- ▶ Short futures, long cash, funded using the cash note as collateral.
- ▶ Borrowing appears to be largely overnight.

Trade is exposed to two sources of risk:

1. Rollover risk on repo borrowing.
2. Margins on short futures position.

Risks compounded by leverage on the trade, in principle only limited by Treasury haircut.

The basis trade and hedge fund Treasury exposure



Form-PF data consistent with large basis positions.

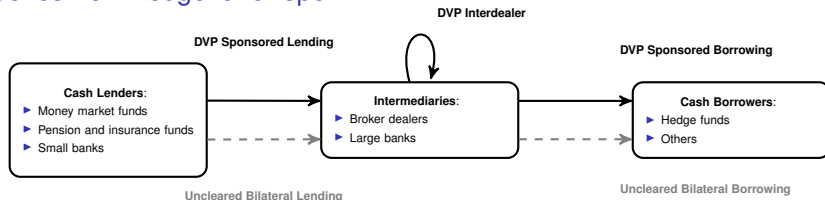
- ▶ In 2017, gross HF Treasury exposures were \$1.06T and net repo borrowing was -\$49B.
- ▶ In 2019, gross HF Treasury exposures were \$2.02T and net repo borrowing was \$535B.

Classify funds as “large basis traders” using their net repo borrowing and Treasury exposures.

- ▶ In 2019, >\$714B (60%) of HF gross Treasury exposure and \$505B (94%) of net repo borrowing was attributable to basis traders.
 - ▶ 30% of primary dealer repo lending against Treasuries.

Basis traders have median leverage of 17.6 and average leverage of 21.

Evidence from hedge fund repo



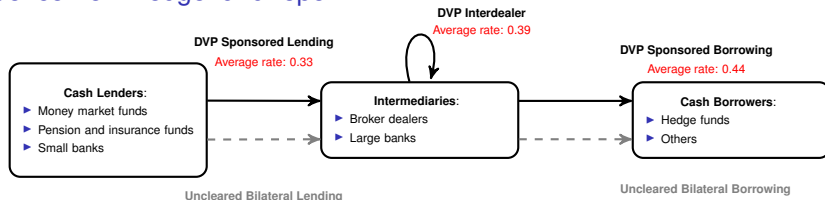
Hedge funds borrow in two repo markets:

- ▶ DVP sponsored borrowing (cleared bilateral).
- ▶ Uncleared bilateral repo.

Use OFR DVP repo data for additional evidence.

- ▶ All trades since October 2019.
- ▶ Provides detail on collateral, rates, counterparties.
- ▶ Hand-mapped to hedge funds.

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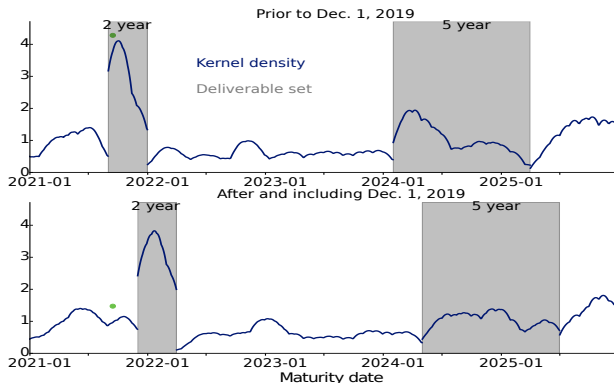
- ▶ All trades since October 2019.
- ▶ Provides detail on collateral, rates, counterparties.
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Data on DVP important since repo markets are segmented.

- ▶ *Compare to tri-party repo rate of 0.34.*

Sponsored repo

Data from DVP repo also consistent with large basis positions



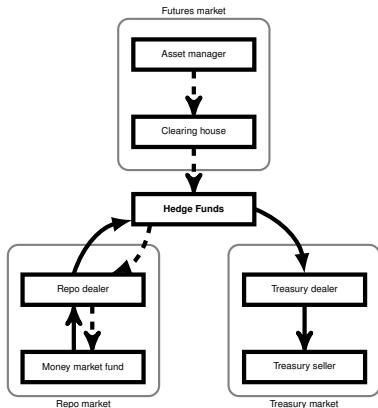
All outstanding hedge fund Treasury position by collateral maturity.

- ▶ Deliverable maturities shaded gray.
- ▶ Borrowings using the cheapest-to-deliver are particularly high:
 - ▶ \approx \$4.5B, or 10% of outstanding. Reduced directly prior to first delivery date.

Especially large given only fraction of trades likely to be funded in DVP.

Model of the cash-futures disconnect

Show disconnect results from limits to arbitrage & segmented markets.



Model detail

- ▶ Emphasizes HF role in risk sharing between asset managers and dealers.
 - ▶ **Hedge funds act as warehouses for Treasuries.**
 - ▶ Limits to arbitrage mean warehousing is imperfect
 - ▶ Dealers face more risk than optimal.
- ▶ But basis trades also expose Treasury market to potential risks.
 - ▶ **Margin constraints and repo market tightening → sudden decreases in prices.**
 - ▶ Can be triggered by sales by noise traders.

Empirical evidence on limits to arbitrage

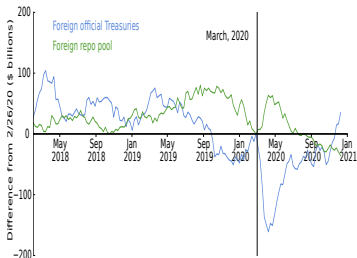
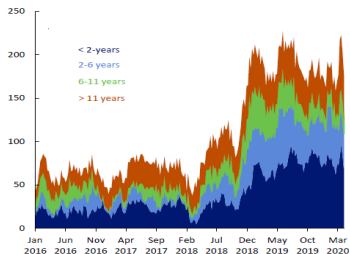
CF Disconnect	Univariate regressions			
	2-Year	5-Year	10-Year	Bond
GCF - IOER	0.30***	0.36***	0.52***	0.30**
Dealer exposure	1.13***	1.74***	2.23***	1.44***

CF Disconnect	Multivariate regressions			
	2-Year	5-Year	10-Year	Bond
Maintenance margins	0.051	0.450***	0.214**	0.070***
VIX	0.665***	0.271	0.640***	1.555***

Regressions use second-to-deliver.

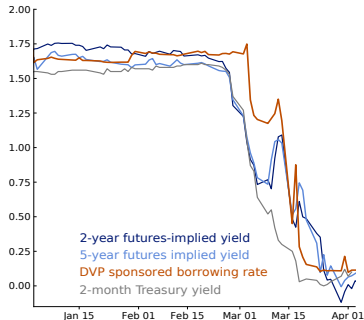
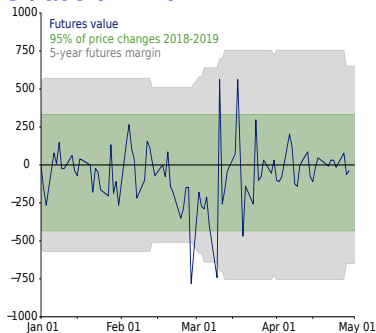
- ▶ GCF-IOER as proxy for repo spread.
- ▶ Net Treasury exposure from primary dealer statistics.
- ▶ Use VIX because Treasury volatility measures tied to futures.
- ▶ Maintenance margins from CME group.
- ▶ Fixed effects to control for distance to delivery.

Onset of March illiquidity



- ▶ Dealer balance sheets saturated with Treasuries. (top)
- ▶ Large sales from foreign official accounts and mutual funds in response to COVID-19. (bottom)
- ▶ Cost of making markets rose, leading to rising volatility.

Basis trade unwind



As volatility rose, margins were breached in early March. (left)

- ▶ Moves large relative to 95% of movements 2018-2019 (green area).
- ▶ CBOT responded by raising margins, increasing cost of basis trade.

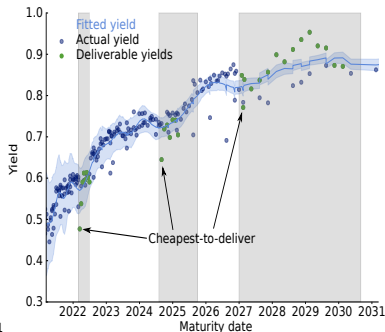
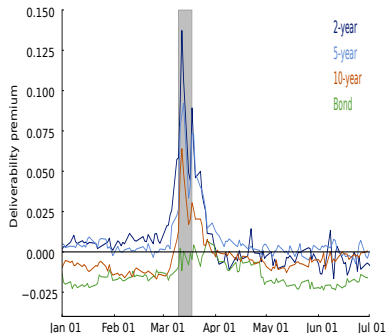
Hedge funds exited the basis trade:

- ▶ \$105B decrease in hedge fund short futures exposure.
- ▶ \$104B decrease in large basis trader long Treasury exposures.

As a result, cash-futures disconnect increased. (right)

Deliverability premium during March

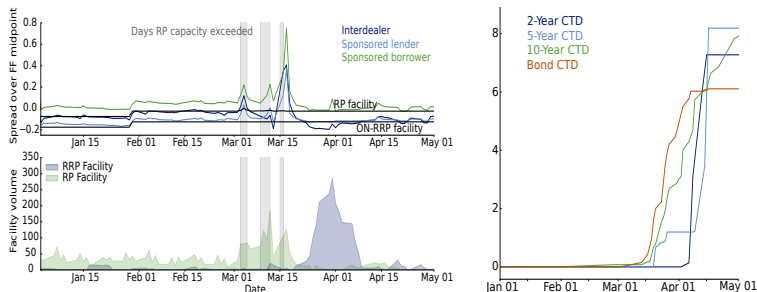
Premium on CTDs suggests trade continued to provide liquidity to underlying.



- ▶ Despite selling pressure, CTD price particularly high during March. (left)
- ▶ Especially high for the more popular securities (2-year, 5-year).
- ▶ Concentrated in the CTD in a snapshot on March 11. (right)

Suggests dealers more willing to hold CTDs during March.

Federal reserve may have intervened at exactly the right time



Support was provided to dealers on two fronts:

- ▶ Expansion of the repo facility lowered borrowing costs and made carrying Treasuries less expensive.
- ▶ Inclusion of CTD in purchases made it easier for dealers to wait out stress.

Conclusion

In the wake of March stress, focus on hedge fund holdings of Treasuries.

- ▶ A sizeable amount of these holdings are associated with the cash-futures basis trade.
- ▶ Show this trade became profitable because of a disconnect between Treasury cash and futures prices.

We emphasize this trade is popular because of broad changes in Treasury market structure.

- ▶ Hedge funds act as warehouses for Treasuries when dealers and asset managers find them costly to hold.
- ▶ Consistent with empirical evidence on the behavior of the cash-futures disconnect.

The model also emphasizes the risk that the trade amplifies dashes for cash.

- ▶ While basis trading appears to have decreased, this risk is still present.

Appendix

Size of hedge fund sales over March

Combine data figures from OFR annual report derived from PF and from the CFTC Traders in Financial Futures:

	Long		Short		Feb-Mar	
	Feb	Mar	Feb	Mar	Long	Short
Exposure (OFR AR)	1,406	1,164	905	735	242	170
Less derivatives (TFF)	311	275	721	618	36	102
Cash estimate	1,095	889	184	116	206	68
Price adjustment (VBILX)					30	5
Cash sales					236	73

Compare to:

- ▶ \$35 billion estimated decrease in flow of funds.
- ▶ \$250 billion decrease from Cayman islands in TIC data.

Of a similar size to sales by foreign official accounts and mutual funds.

Non-convergence of cash and futures prices for other deliverable Treasuries



Arbitrage requires that cash and futures prices converge

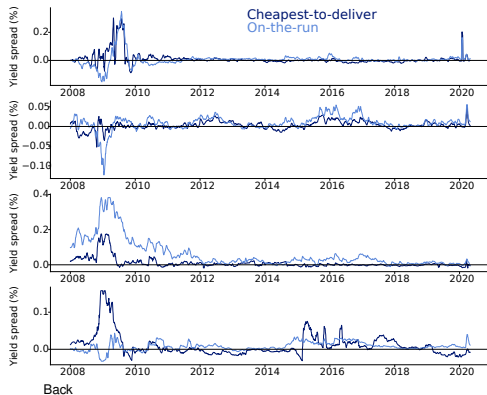
- Show deviations from final invoice price for 5-year deliverables:

$$\tilde{P}_{t,\tau,T} - F_{T,\tau,T} \quad F_{t,\tau,T} - F_{T,\tau,T}$$

Deliverability premium

Convergence solely for the CTD provides a close link between arbitrage trades and the CTD.

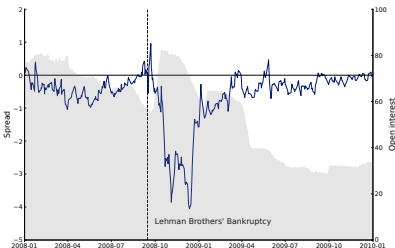
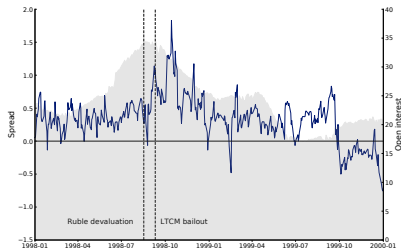
► **How does this affect cash prices of the CTD?**



- Calculate error from a fitted yield curve spline.
- Compare to the error for a similar maturity on-the-run.

	CTD premium	
	2-year	5-year
OTR prem.	1.167***	0.492***
R^2	0.832	0.532
	10-year	Bond
OTR prem.	0.115***	0.631***
R^2	0.044	0.109

Cash-futures disconnect: past crises



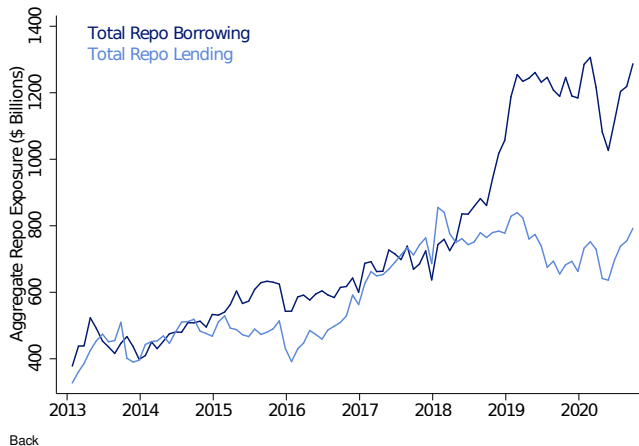
Cash-futures disconnect responds to stress in financial markets

- ▶ **LTCM:** Price of futures rose relative to cash (left).
 - ▶ Liquidity crisis, similar to March 2020.
 - ▶ LTCM had non-trivial bond basis positions.
- ▶ **Lehman Brothers:** Price of cash rose relative to futures (right).
 - ▶ Dash to safety rather than cash.

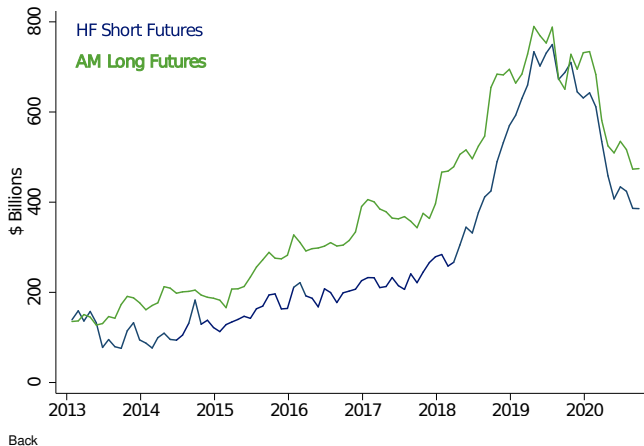
Both suggest the importance of limits to arbitrage in the disconnect.

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Hedge fund net repo



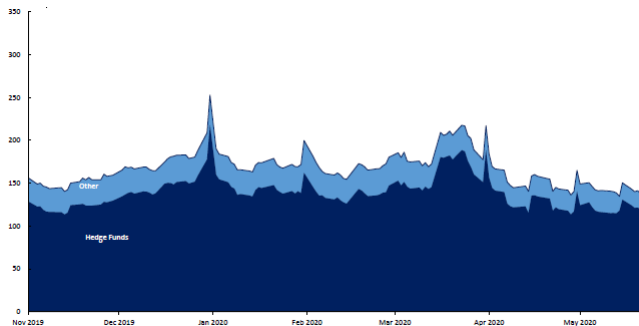
Large Treasury futures positions



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Hedge fund participation in sponsored repo

- ▶ Classification of hedge funds part of broader OFR effort on mapping cleared repo.
- ▶ Hedge funds represent the major source of sponsored borrowing:

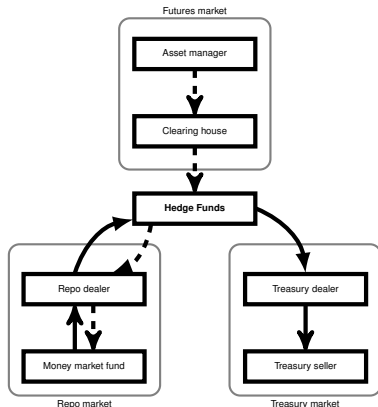


- ▶ Over 2020, sponsored lending made up around 20% of all DVP transactions, sponsored borrowing around 13%.

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Model of the cash-futures disconnect

Show disconnect results from limits to arbitrage & segmented markets.



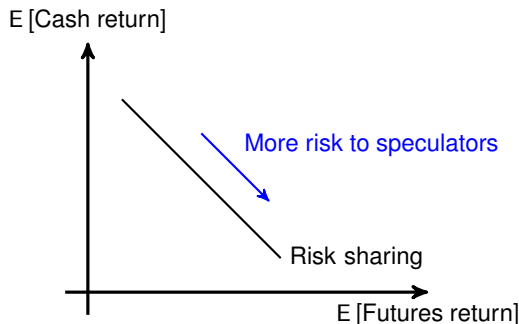
Four assets: bills ($P_{N,t}$), notes ($P_{N,t}$), repo ($B_{RR,t}$) and futures (F_t).

Four agents:

- ▶ **Dealers:** Mean-variance preference, choose portfolio of bills and notes.
- ▶ **Speculators:** Mean-variance preference, hold futures to delivery.
- ▶ **Money market funds:** Liquidity tradeoff between bills and repo.
- ▶ **Hedge funds:** Risk neutral, subject to margin constraints, fund basis positions in the repo market.

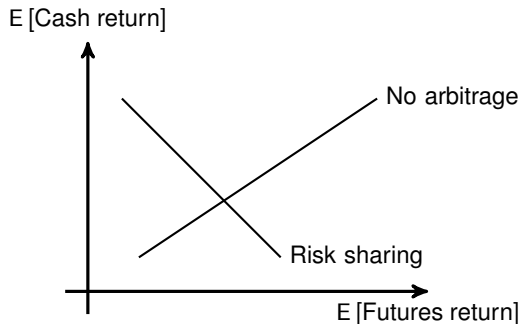
Futures deliver at time 2, at time 1 the note market has net supply, S .

Model equilibrium



- ▶ Given a supply of notes, there is a fixed amount of short-rate risk at $t = 2$ that must be split between dealers and speculators.
- ▶ As more risk is allocated towards speculators, futures prices fall while cash prices rise (mean-variance preferences).

Model equilibrium

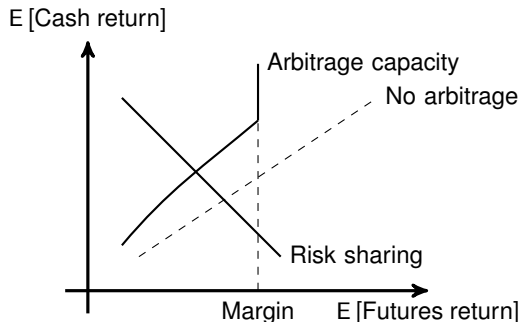


- ▶ In absence of limits to arbitrage, HFs act as perfect warehouses for Treasuries:

$$E[\text{Cash return}] = E[\text{Futures return}]$$

- ▶ Risk shared optimally between dealers and speculators, no disconnect between cash and futures prices.

Model equilibrium

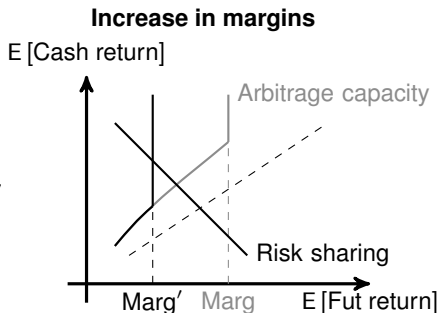
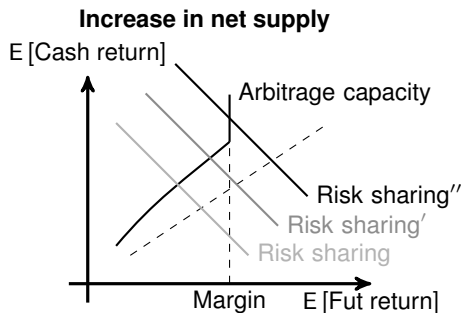


- ▶ In **presence** of limits to arbitrage, HFs act as **imperfect** warehouses for Treasuries:

$$E[\text{Cash return}] > E[\text{Futures return}] \text{ (cash undervalued)}$$

- ▶ Dealers end up with more risk than optimal, **disconnect results between cash and futures prices.**

Risks of the trade can impact the cash market



- ▶ Increase in net supply can lead to large increase in prices.
- ▶ Increases in margins shift in arbitrage capacity, force sales by HFs.
- ▶ Repo illiquidity increases disconnect and leads to sales by HFs.

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