Preferred Habitats and Timing in the World's Safe Asset

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Main goal

- We are interested in understanding investor behavior in the Treasury market. We do this in two main steps.
- There is a long tradition of inferring behavior from performance. In **Step 1** we carefully analyze the performance of U.S. and foreign investors in the Treasury market.
- **Step 2**: we take what we learn from that analysis, plus a bit more (e.g how investors alter portfolios), and opine on who will buy Treasuries going forward.

Motivation

- A long tradition of inferring behavior from performance measures:
  - Barber and Odean (2000) on small investors' overtrading in equities
  - Grinblatt, Titman, Wermers (1995) on herding behavior in MFs
  - many others
- More recently performance measures for Treasury portfolios have been a focus of the convenience yield literature (Krishnamurthy, Lustig (2019); Jiang et al. (2021))
  - Behavior inferred from poor performance include inelastic demand, having non-pecuniary benefits
  - But performance analysis has been hampered by data issues (and measures)
- Performance often measured as Actual Returns minus a Benchmark (usually market)
  - We show it is important to get the **composition effect** right:
    - ★ If in the calculation the market is the benchmark but investors have preferred habitats, using the wrong benchmark.
  - We show that the **timing effect** is also important

Paper focus and implications

- Analysis of **all** investors' behavior
- Analysis of the nature and evolution of Treasury portfolios; comparison among all investors
- Results shed light on research and policy questions:
  - Who steps in and buys
    - As the Fed continues to reduce the size of its bond portfolio;
    - As U.S. Treasury bill issuance increases to replenish the TGA.
  - More generally: who is most likely to absorb a marginal expansion in Treasury supply.
  - Sources of convenience yield and exchange rate implications.
  - How important a potential diversification of foreign reserves might be going forward.

Motivation

- Investors' behavior in world's safe asset, U.S. Treasuries, matters:
    - helps determine Treasury yields, impacting loan prices everywhere
    - how U.S. monetary policy is transmitted domestically and to ROW
- Investors' actions also matter for U.S. budget constraints:
    - If investors have inelastic demand, the government could run larger budget deficits for longer;
    - If *foreign* investors have inelastic demand for Treasuries, the country's international budget constraint is also relaxed
- But due to data issues we don't actually know much about investors' behavior in Treasuries.

What We Do

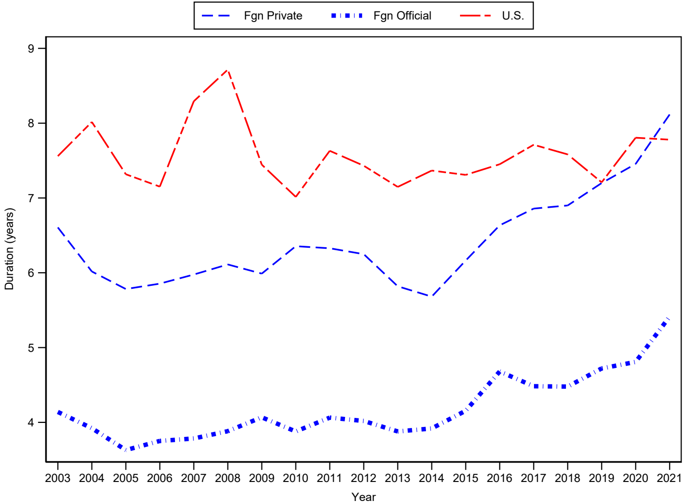
- Analyze security-level data (TIC) to understand the Treasury portfolios of all investors: U.S. & foreign private, foreign official, Fed
- Document the nature and evolution of Treasury portfolios: relative importance of the different investors and changing trends.
- Show that the composition effect, driven by investor groups' preferred habitats, and the timing effect can be quite different.
- Based on returns earned, as well as focusing on timing of purchases: can we describe different investors' demand as price sensitive?

What Makes This Study Possible: Security-Level Data

- Foreign holdings of U.S. Treasuries, each June 2003-2021
  - Confidential data from mandatory surveys
  - Primary input for U.S. official statistics, so sum to published data
  - Data include security characteristics
- Adding security-level Fed's Treasury portfolio and entire Treasury market, we construct as a residual U.S. investors' Treasury portfolios
- First-ever direct comparison of foreign and U.S. investors' portfolios
- Dataset enables accurate comparison of investors
- Survey-consistent measures of flows, coupon payments, returns
- The other data are monthly holdings and flows going back to 1979

To the security-level analysis...

The Effect of Portfolio Composition: Duration



- Investors have reasonably well defined **preferred habitats**.
- Just based on preferred habitats we expect U.S. investors to have substantially higher average annual returns (RoR) than FOIs.

	RoR (%)	*Sharpe*
Market	3.57	*0.84*
Fed	3.72	*0.85*
Float (Market-Fed)	3.53	*0.83*
Foreign	3.21	*0.88*
Official	3.02	*0.93*
Private	3.76	*0.79*
U.S. Private	4.25	*0.75*

- Composition Effect: U.S. investors' long-duration high volatility portfolio has the highest RoR.
- Differences in RoR: in line with returns from various constant maturity Treasury series.
- U.S. investors' high volatility portfolio has the lowest Sharpe ratio.

Actual Returns

- RoRs capture composition but not the timing of purchases. Internal rates of return (IRRs) capture the effects of both timing and magnitude of flows, and portfolio composition.
- Following Dichev (2007), compute IRRs using the following cash flows
  - initial investment: the market value of holdings at end-June 2003 (assumed to all be purchased at that time),
  - intermediate net purchases (mid-2003 through mid-2021),
  - receive coupon payments (mid-2004 through mid-2021), computed at the security-level from the bond's coupon yield and face value, and
  - final payout: the market value of their holdings as of end-2021.
- Critical is that the dataset is internally consistent (i.e., flows + returns = change in position), rare in international finance. Coupon streams calculated at the security-level matters too.

Table: Actual Returns on Treasury Bonds and Notes (2003-2021), in percent

	IRR
Market	2.80
Fed	4.16
Float (Market-Fed)	2.46
Foreign	2.59***
Official	2.66***
Private	2.42
U.S. Private	2.27

- Foreign official earn higher returns (2.66%) than private U.S. investors
- Difference with U.S. private: statistically significant at 1% level

The Effect of Timing

	IRR	RoR	IRR - RoR
Market	2.80	3.57	-0.77†
Fed	4.16	3.72	0.44†
Float (Market-Fed)	2.46	3.53	-1.07†
Foreign	2.59***	3.21	-0.63†
Official	2.66***	3.02	-0.36†
Private	2.42	3.76	-1.35†
U.S. Private	2.27	4.25	-1.99†

- Actual (IRR) versus av. ann. returns (RoR): a measure of timing.
- Investors timing is such that FOIs returns are degraded only slightly by timing, while U.S. investors lose almost 200 bps to poor timing.

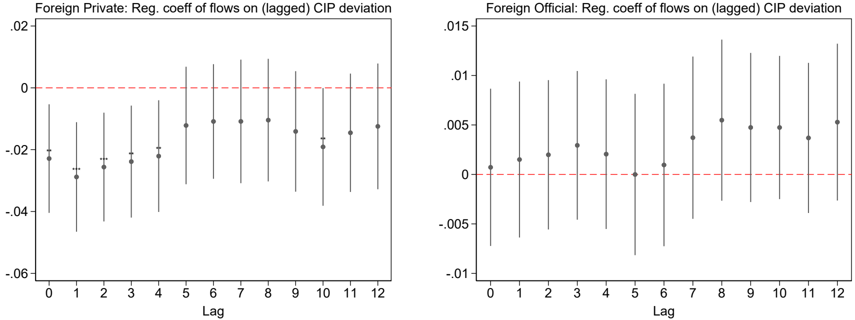
Summary of Security-Level Returns Analysis

- Portfolio composition drives average annual returns.
  - U.S. investors, with long duration portfolios, had high average returns with high volatility.
  - At the other end are FOIs, whose short duration portfolios had low volatility.
- Timing: Wouldn't conclude that U.S. investors do better than foreign investors. (And even the market doesn't earn market returns.)
- Would be hesitant to do such analysis without security-level data (miss information of coupon yields) or pre-2003.

How Investors Alter Their Treasury Portfolios

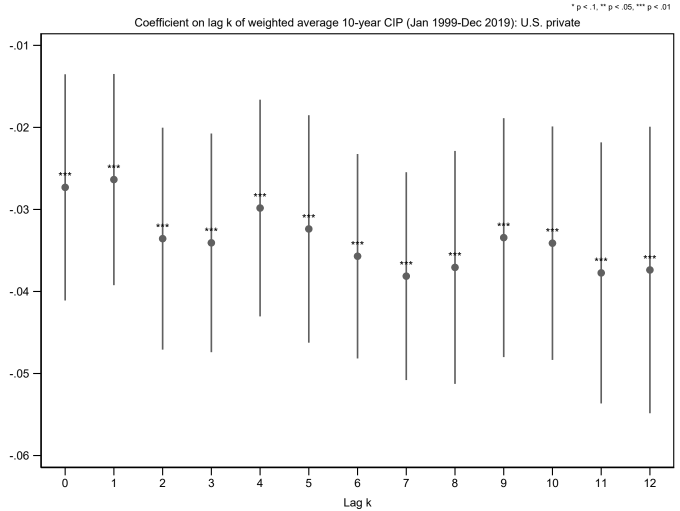
- Data limitations have impeded the ability to gauge how foreigners alter their Treasury portfolios.
- The literature has cited foreigners' low returns and poor timing as evidence of inelastic demand.
- Our returns results are inconsistent with that.
- We cannot definitively address this, but some progress using monthly flow data and CIP deviations:
  - Question: do flows react to changes in spreads?
    - Results: Yes for private investors (U.S. and foreign), No for foreign official.

Reaction of Flows to Spreads Lagged 0 to 12 months



- Private foreigners (left graph) increase purchases of Treasuries after CIP deviations become more negative. Foreign officials (right) do not.
- Consistent with Krishnamurthy, Vissing-Jorgensen (2007); inconsistent with Krishnamurthy, Lustig (2019), Jiang et al. (2021).

U.S. investors: Reaction of Flows to Spreads

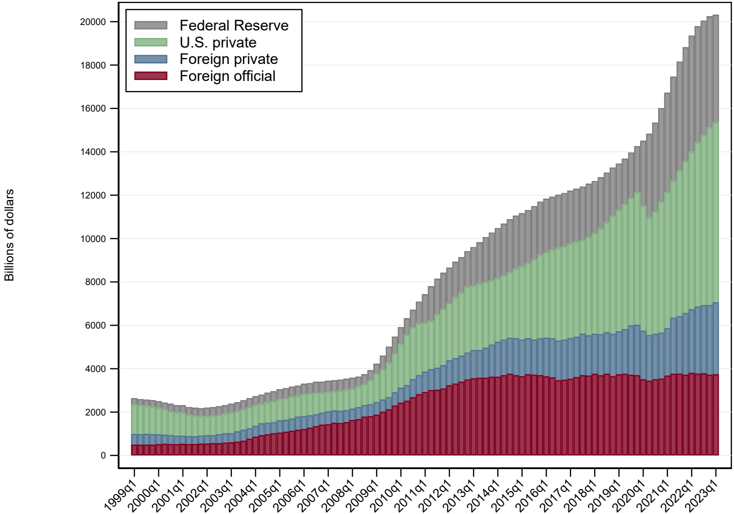


- U.S. private investors' behavior similar to foreign private: purchases of Treasuries increase after CIP deviations become more negative

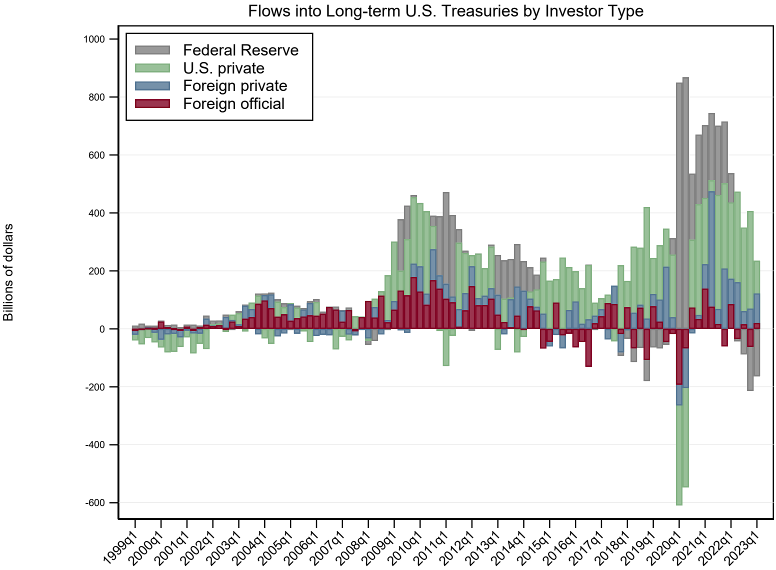
Who Buys from Whom?

- Timely questions on who will step in and buy:
  - As the Fed unwinds QE policies, hence reduce the size of its bond portfolio;
  - As U.S. Treasury prepares to issue substantial amounts of Treasury Bills to replenish TGA.
- We cannot answer these questions definitively, but our comprehensive data and analysis of investor behavior help shed light:
  - Preferred habitats results
  - How investors alter portfolios results
  - Historical correlations
  - Examination of actual flows data

Holdings of Long-term U.S. Treasuries by Investor Type



- FOIs' positions have been flat for a decade, and have short duration portfolios, while Fed's is long duration. Unlikely FOIs will be buyers.
- Private positions have grown substantially (both U.S. and foreign), and are longer duration. Likely buyers.



- FOIs: majority of purchases until GFC; still sizeable until 2012;
- More recently: private investors' purchases have become more important (90% of net purchases 2014 – 2021).

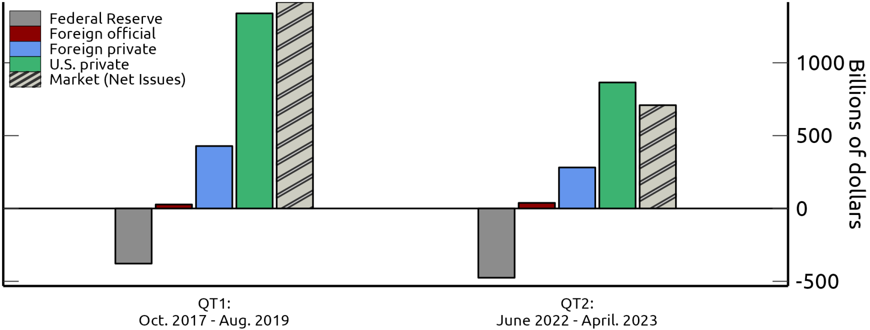
Correlations of flows into long-term Treasuries

	Fed	U.S. Private	Foreign Private	Foreign Official
Fed	1.000			
U.S. Private	-0.220***	1.000		
Foreign Private	0.026	-0.241***	1.000	
Foreign Official	0.201***	-0.155	-0.002	1.000

Correlations suggest U.S. private investors buy more when Fed buys less

- Our findings on preferred habitats in Treasury market and differences in demand elasticities: further support private investors stepping in:
  - Fed's portfolio: long duration, a portion of the yield curve favored by private investors, who seem to have elastic demand
  - FOIs have not purchased Treasuries in meaningful amounts for a decade and focus on the shorter end.

QT1 and QT2: Who buys Treasuries



- Private investors (U.S., foreign) have been absorbing long-term Treasuries, incl. the net issuance (hashed bars). And not FOIs.
- Note: Fed "sales" have been "not rolling over some maturing bonds".

Implications: Treasury Convenience Yield

- Common notion in literature: foreigners have poor timing, poor performance, inelastic demand in their Treasury portfolios.
- Implication: convenience yield much larger for foreigners
  - Comparisons are of market index returns and foreigners' IRRs.
  - Krishnamurthy and Lustig (2019), Jiang et al. (2021, 2022).
- We provide clarity:
  - two distinct groups of foreign investors: private and government;
  - assess U.S. investors using identical techniques;
  - FOIs: inelastic demand, but timing and performance relatively good;
  - Private foreign investors are very much like U.S. investors:
    - ★ operate in a similar part of the yield curve,
    - ★ have elastic demand, poor timing and poor performance.
- Our results are consistent with all non-governmental investors placing similar convenience yields on Treasuries
  - the literature should focus on notions (and calculations) of convenience yields that do not rely on foreigners being different.

Implications: FX reserves diversification

- Concern: will foreign CBs diversify away from Treasuries in light of geopolitical tensions (and following the U.S. sanctions).
  - We document that foreign CBs had already plateaued their holding of Treasuries a decade ago,
  - therefore, likely that their diversification will matter less for Treasury demand going forward than is commonly thought.

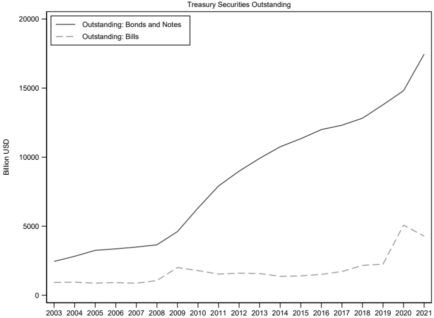
Conclusion

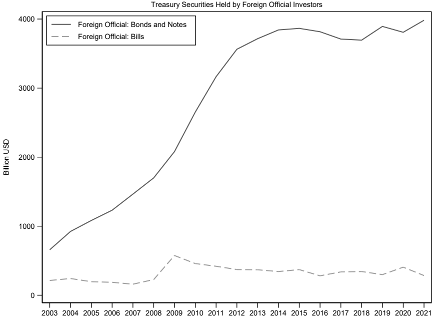
- Using the best quality data and focusing on direct comparisons of measures calculated for all investors in the Treasury market, we find:
  - Investors have preferred habitats. U.S. private: longest, FOI shortest duration;
  - taking into account timing and composition, foreigners do just fine in the Treasury market, especially compared to U.S. investors;
  - any difference in average annual returns (a function of composition, not timing) is due to duration;
  - private investors, whether U.S. or foreign, appear to be price sensitive.
- Implications:
  - Only governments have inelastic demand, and they have been retreating from the Treasury market;
  - Private investors have elastic demand;
  - U.S. budget constraints, whether the government's or internationally, won't be relaxed by private investors;
  - Theories shouldn't differentiate between foreigners and domestic investors, but rather between private investors and governments.

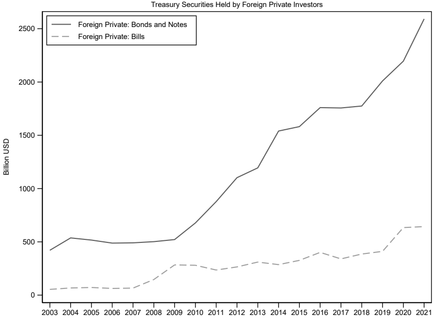
Appendix

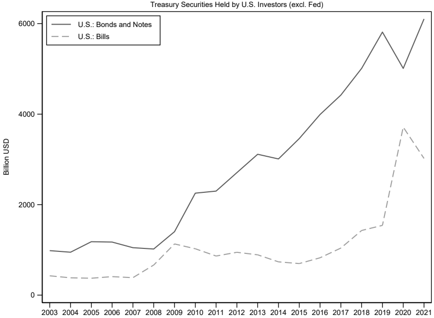
Treasury Bills

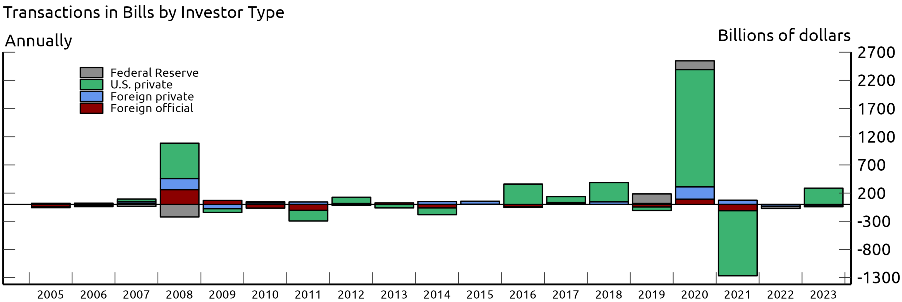
- Bills are small both in terms of outstanding Treasuries and in foreign portfolios.
- Sizeable share only for U.S. private investors, especially in periods of strong issuance (GFC, COVID).


Treasury Securities Outstanding
Outstanding: Bonds and Notes
Outstanding: Bills
Billion USD
0
5000
10000
15000
20000
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


Treasury Securities Held by Foreign Official Investors
Foreign Official: Bonds and Notes
Foreign Official: Bills
Billion USD
0
1000
2000
3000
4000
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


Treasury Securities Held by Foreign Private Investors
Foreign Private: Bonds and Notes
Foreign Private: Bills
Billion USD
0
500
1000
1500
2000
2500
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021


Treasury Securities Held by U.S. Investors (excl. Fed)
U.S.: Bonds and Notes
U.S.: Bills
Billion USD
0
2000
4000
6000
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021



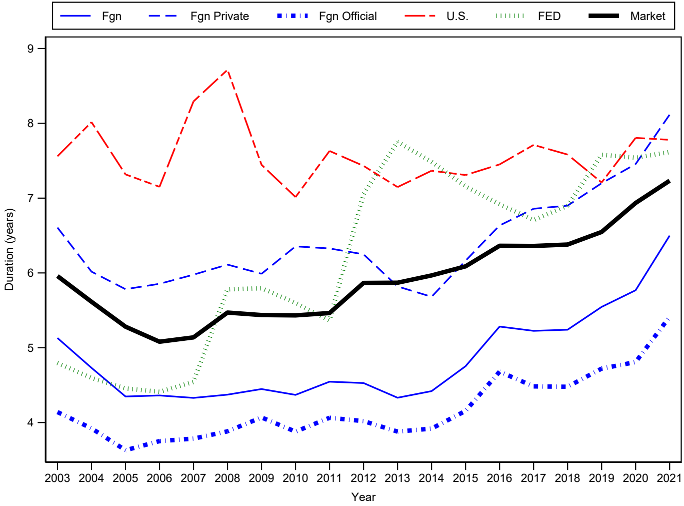
Source: Based on the analysis of Tabova and Warnock (2023) NBER Working Paper 30722.
Note: Data for 2023 ends in April.

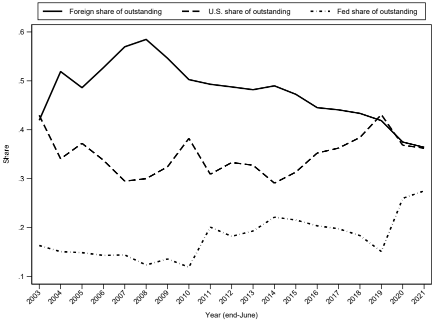
- While during GFC foreign investors also moved into bills,
- In 2020, it was mostly a U.S. private story,
- 2023 YTD: U.S. private absorb majority of net issuance.

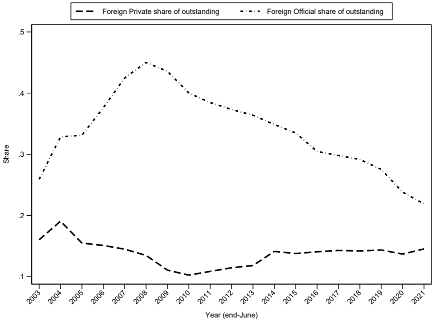
Implications: Bills Issuance

- Who is absorbing the increased bill issuance aimed to rebuild TGA
- Comprehensive June TIC data not available yet
  - More timely auctions data are a noisy signal for true foreign demand as not all purchases go through the primary market
- Expect bills to be mostly absorbed by U.S private investors, based on:
  - relative size of bills in investors' portfolios; and
  - absorption patterns over time and during large issuance periods.

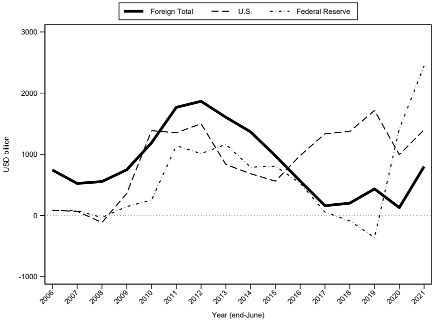
The Effect of Portfolio Composition: Duration

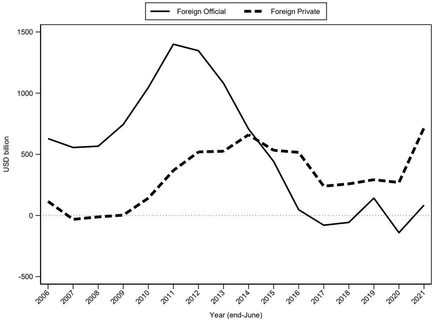






- Foreigners own much of the TBond market, down from a high of 58% in 2008 but still near 40%.
- The decline is entirely due to reduced purchases by foreign officials.





- Foreigners were biggest buyers through 2015, now surpassed by U.S. investors.
- Amongst foreigners, governments' purchases have fallen the most.

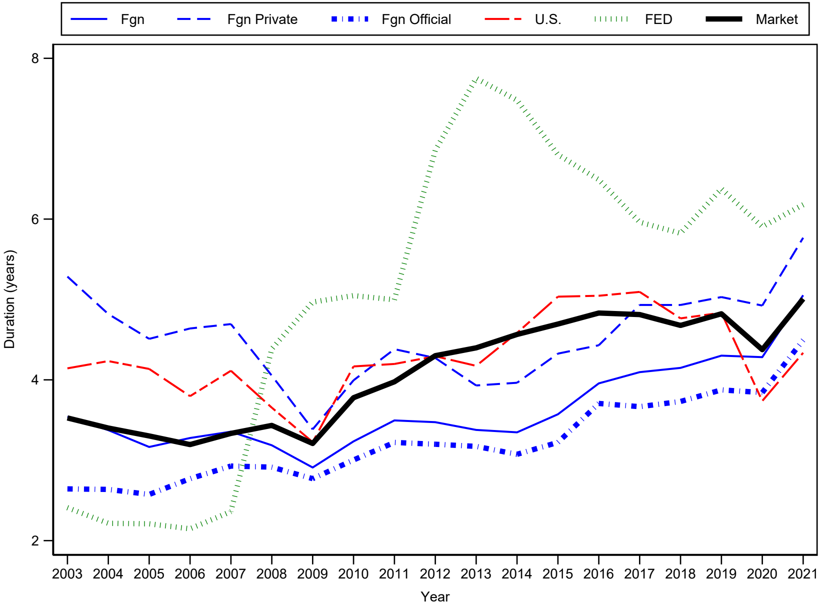
Robustness

- Annual estimates precise (sec-level data) but cannot capture trading that occurs within the year.
    - Annual data: streams by applying index coupon yields to mkt values
    - Quarterly data: IRRs using index, aggregate flows, mkt value positions
    - Results:
        - material difference when moving from sec-level data and best methodologies to applying index coupon yields to market values;
        - moving to quarterly data has near-zero effect on the estimates
- Data from the 1990s: pre-dates annual holdings surveys, caution
- Including Treasury Bills

Table: Internal Rate of Return (IRR) on U.S. Treasury Purchases (%)

Period	2003q2-2021q2			1994q4-2000q1	
Data source	TIC Survey		BTBJ	FOF	BTBJ
	mkt & face	mkt	mkt	mkt	mkt
	sec-level	aggreg.	aggreg.	aggreg.	aggreg.
	(1)	(2)	(3)	(4)	(5)
Market	2.74	3.14	3.10	6.88	6.88
Fed	4.21	3.97	3.90	7.24	7.24
Foreign Investors	2.54	3.24	3.30	4.76	7.88
Official	2.60	3.31	3.35		
Private	2.39	3.08	3.10		
U.S. Private	2.21	2.41	2.27	7.92	6.31

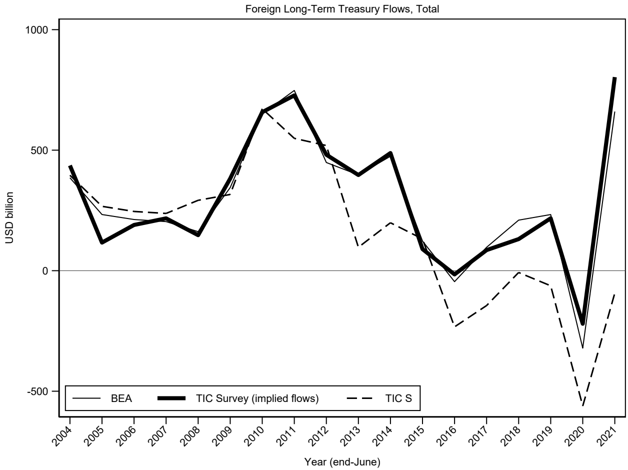
Duration of Treasury Holdings, Including Bills, by Investor Type



	IRR	RoR	*Sharpe*	IRR - RoR
Market	2.52	3.09	*0.91*	-0.56†
Fed	3.26	3.73	*0.92*	-0.47*
Float (Market-Fed)	2.65	2.97	*0.90*	-0.32†
Foreign	2.36***	2.89	*0.93*	-0.53†
Official	2.46***	2.80	*0.97*	-0.33‡
Private	2.11	3.09	*0.82*	-0.97†
U.S. Private	1.91	3.27	*0.83*	-1.36†

- U.S., foreign private timing erodes returns substantially: 136, 97 bps;
- RoR lower bur ordering same; IRR similar as with LT Treasuries;
- **Incl. bills alters duration pictures a bit - private investors have similar durations - but does not affect returns, timing analysis**

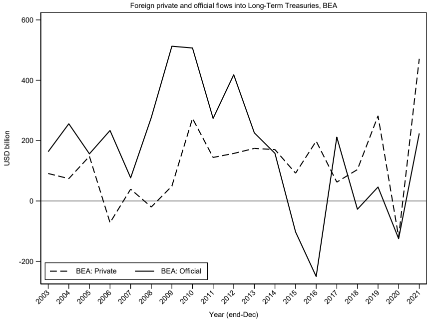
Survey-Implied Flows Indicate Problem with TIC S Flows



The oft-used TIC S has significantly underreported foreign flows since 2010 and incorrectly indicated much more foreign private than official inflows. Survey (and BEA) data tell a different story.

Timing and magnitude of investors' Treasury flows?

- Researchers have not had an accurate picture of timing and magnitude of investors' purchases. E.g., stark differences in split between foreign private and foreign official.
  - TIC S (left) has consistently more foreign private than official flows. BEA (right) shows the opposite. What are researchers to do?
  - And nothing is pristine pre-2000 or so.



Relation to Existing Literature

- Our study revealed a number of stylized facts (just from inspection of data) and results that will inform future work.
  - Some are surprising given existing results.
- Difference between IRR and RoR:
  - We extend, complement Dichev (2007): investor trading in equity substantially reduces previous estimates of equity premium.
  - We take the timing aspect seriously for Treasuries and explore not only for the market but by investor type.
    - Actual market returns on Treasuries: 77 bps lower than index returns
    - By-investor type: timing of private investors (U.S. or foreign) is worse (130-200bps)

Relation to Existing Literature: Convenience Yield

- Our findings on elasticities are consistent with Krishnamurthy & Vissing-Jorgensen (2007) (private foreign vs FOIs); and with the model of Greenwood et al. (2022).
- Our findings are inconsistent with Krishnamurthy and Lustig (2019) and Jiang et al. (2021, 2022).
- Going forward, convenience yield literature should focus on distinction between private (both U.S. and foreign) and official investors, not U.S. versus foreign.