DEAR CONFERENCE PARTICIPANTS

THIS DRAFT IS VERY PRELIMINARY AND IS FAR FROM FINISHED. I WISHED, HOWEVER, TO TRY AND PRESENT THE IDEA IN ORDER TO GAIN THE EXPERT COMMENTS FROM THIS CONFERENCE OF LAW AND FINANCE SCHOLARS AND POLICYMAKERS. I VERY MUCH APOLOGIZE FOR THIS UNFINISHED AND UNPOLISHED "DRAFT" BUT I REMAIN IMMENSELY GRATEFUL FOR YOUR THOUGHTS AND COMMENTS IN ADVANCE.

YESHA

THE MYTH OF RISK FREE MARKETS

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INTRODUCTION

"But who would lend to a government that prefaced its overtures for borrowing by an act which demonstrated that no reliance could be placed on the steadiness of its measures for paying? The loans it might be able to procure…would be made...with a sparing hand and at enormous premiums." Alexander Hamilton, 1787.[1]

On October 15 2014, the (then) $12 trillion market for buying and selling U.S. government debt – experienced a convulsive morning.[2] It began with the release of less-than-stellar retail sales numbers – unexpected but far from unusual – that caused the price of U.S. government debt securities (or "Treasuries") to surge well in excess of what would have been normal under the circumstances.[3] In the hour or so after the news release, the market for U.S. Treasuries – a lynchpin for U.S. and global economic stability – was roiled by some of the highest trading volumes in its history and prices that fluctuated seemingly at random.[4]

[1] THE FEDERALIST NO. 30 (Alexander Hamilton) ("But who would lend to a government that prefaced its overtures for borrowing by an act which demonstrated that no reliance could be placed on the steadiness of its measures for paying? The loans it might be able to procure would be as limited in their extent as burdensome in their conditions. They would be made upon the same principles that usurers commonly lend to bankrupt and fraudulent debtors, with a sparing hand and at enormous premiums.")

[2] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT: THE U.S. TREASURY MARKET ON OCTOBER 15, 2014, 15-19 (JUL. 13, 2015) (The study was conducted jointly by the Department of the Treasury, the Federal Reserve, the Federal Reserve Bank of New York, The Securities Exchange Commission and the Commodity Futures Trading Commission) (hereinafter, "Joint Staff Report"); On the size of the marketable U.S. Treasury debt at end-October 2014, UNITED STATES TREASURY, MONTHLY STATEMENT OF THE PUBLIC DEBT OF THE UNITED STATES (OCT. 31 2014) (noting that the marketable U.S. public debt stood at approximately $12 trillion).

[3] Matt Levine, *Algorithms Had Themselves a Treasury Flash Crash*, BLOOMBERG, (JUL. 13, 2015). In general, it would be usual for the price of U.S. Treasuries to rise (i.e. for the interest paid under the U.S. Treasury bond to fall) when there is certain bad news in respect of the economy. In such situations, investors generally seek a "flight to safety" and lend money to the U.S. government that is generally regarded as a virtually risk-free asset. As a result, the interest rates that the government must pay falls, and the price of the bond rises. This is a simplification of complicated trends that encompass such indicia as inflation, interest rates and competing international investment opportunities. Daniel Kruger, *U.S. Government Bonds Fall, as 10-Year Yield Approaches 3%*, WALL ST. J., APR. 13 2018; SECURITIES EXCHANGE COMMISSION, *Interest rate risk — When Interest Rates Go Up, Prices of Fixed-rate Bonds Fall*, SEC Investor Bulletin, https://www.sec.gov/files/ib_interestraterisk.pdf.

[4] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 15-19; Levine, *supra* note [ ]. On the significance of U.S. Treasury markets for global financial stability see generally, Antoine Bouveret et al., *Fragilities in the U.S. Treasury Market: Lessons from the "Flash Rally" of October 15, 2014*, IMF Working Paper, 5-6 (Oct. 2015) ("The U.S. Treasury market is one of the largest and most liquid financial markets in the world, as well as one of the most important. Treasury securities are the bedrock of the financial system."). On the macroeconomic explanations for changes to the "risk-free"

Despite the absence of any significant news, this abnormally rapid rise – and subsequent correction – caused the market to suffer some of its largest price moves since 1998.[5] The three occasions that had seen greater price shifts had each responded to news of major crises and policy changes.[6] This so-called *Flash Rally* in U.S. Treasuries, however, had come out of nowhere. And attempts to explain it since have largely floundered and delivered little by way of firm conclusions.[7]

That policymakers were caught off guard by an event such as this is unsurprising. For much of its recent past, commentators have viewed the market in U.S. government debt as a staid and steadying hand to an otherwise boisterous securities marketplace.[8] While other types of securities – like shares or derivatives – have undergone major changes to their regulation in response to evolving trading environments, the framework for overseeing U.S. Treasuries has remained remarkably static.[9]

Yet the importance of Treasuries to the U.S. economy has only grown over time, particularly since the 2008 Financial Crisis. In its immediate response to the fallout, U.S. authorities issued Treasuries raising trillions of dollars to cover the costs of emergency support facilities

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nature of U.S. Treasury markets see generally, John Y. Campbell et al., *Macroeconomic Drivers of Bond and Equity Risks*, Harvard Business School Working Paper 14-031 (2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2332106.

[5] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 15-17.

[6] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 15-17.

[7] Bouveret et al., *supra* note [ ], 5-7; UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 1-7; Levine, *supra* note [ ].

[8] *See for example*, Eamon Javers, *Report Contains Red Flag for Treasury Market Fraud*, CNBC, (JUL. 30, 2015), https://www.cnbc.com/2015/07/30/report-contains-red-flag-for-treasury-market-fraud-source.html (noting the usually "sleepy" nature of the U.S. Treasury market); Robert Burgess, *It's Nothing But Lucky 7s for Bond Traders*, BLOOMBERG, (MAY. 24, 2018); Bouveret et al., *supra* note [ ], 5-6 (highlighting the fundamental quality of U.S. Treasury markets for the financial markets as a whole).

[9] Title VII Dodd–Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, § 901, 124 Stat. 1376, 1822 (2010) (codified as amended at 15 U.S.C. § 78a (2010)) [hereinafter Dodd–Frank Act]. On changes to the derivatives markets see generally, Arthur W.S. Duff & David Zaring, *New Paradigms and Familiar Tools in the New Derivatives Regulation*, 81 GEO. WASH. L. REV. 677 (2013) (detailing the core regulatory shifts in the oversight of derivatives markets in the wake of the Dodd-Frank Act; On equity markets, regulatory changes have sought to bring greater competition and price efficiency, Regulations National Market System and Alternative Trading Systems, notably, have enabled the flourishing of automated, high speed traders. For discussion, see generally, Yesha Yadav, *Insider Trading and Market Structure*, 63 UCLA L. REV. 968 (2016). On regulation fostering the growth of automated trading, see for example, Securities Acts Amendments of 1975, Pub. L. No. 94-29, § 7, 89 Stat. 97, 111-17; Regulation NMS - National Market System, Exchange Act Release No. 34-51808, 70 Fed. Reg. 37,496, 37,532 n. 300 (2005); Regulation ATS—Alternative Trading Systems, 17 C.F.R. § 242.300(a) (2015); Laura Tuttle, *Alternative Trading Systems: Description of ATS Trading in National Market System Stocks*, SEC Division of Economic and Risk Analysis, 9-10 (Oct. 2013). On systems resiliency, see, SEC Regulation Systems, Compliance and Integrity (Reg. SCI), Release No. 34 7363917 CFR Parts 240 (Feb. 2015) (hereinafter, Reg SCI). In Treasury markets, some developments to introduce greater information sharing and transparency have been introduced since the Flash Rally. However, regulations like Reg SCI applicable to. the equity markets, for example, have generally not been extended to also cover the Treasury Markets. See, Mary Jo White, Prioritizing Regulatory Enhancements for the U.S. Treasury Market, Speech at the Evolving Structure of the U.S. Treasury Market Second Annual Conference, Oct 24, 2016, https://www.sec.gov/news/speech/white-keynote-us-treasury-market-conference-102416.html.

for the financial system. [10] As at August 2008, then, the government debt market comprised around $4.9 trillion in outstanding marketable Treasuries; by February 2010 this figure had risen to $7.4 trillion.[11] Showcasing efforts to stabilize financial markets, effect monetary policy, as well as to fund the U.S. government over the last decade, outstanding marketable Treasury debt has grown to around $15 trillion (as at mid-2018).[12] Even as the U.S. economy steadies course and booms, commentators project that U.S. authorities will continue to borrow heavily in the years ahead. Anticipating budgetary hits from the Trump-era tax cuts, tariffs, as well as the rising costs of programs like Social Security, the importance of the Treasury market for enabling core governmental functions stands out as a matter of indisputable fact.[13] Put more starkly terms, the efficient operation of this market represents an imperative of near existential economic (and social) significance for the U.S. economy.[14]

This Article argues that the design of the U.S. Treasury market – and its regulatory framework – presents a source of serious structural risk for the U.S. economy. It makes three contributions.

First, I argue that conventional accounts of U.S. Treasuries as a reliable and risk-free corner of the marketplace do not match the reality of their operation. Far from being predictable and staid, Treasuries trading has come to be governed by technologies that have introduced new risks and yet failed to attract sustained regulatory attention about the implications of this innovation for the market.[15]

Historically, the purchase of Treasuries issued by the U.S. government – and their subsequent trading – has been dominated by a select cohort of top-tier financial institutions.[16] These so-called "primary dealers," currently comprising 23 international banks and investment

[10] Bryan J. Noeth & Rajdeep Sengupta, *Flight to Safety and U.S. Treasury Securities*, FEDERAL RESERVE BANK OF ST. LOUIS, (JUL. 2010) https://www.stlouisfed.org/publications/regional-economist/july-2010/flight-to-safety-and-us-treasury-securities; Marketable debt refers to U.S. treasury debt that is liable to be traded in the marketplace after purchase. Dominique Dupont & Brian Sack, *The Treasury Securities Market: Overview and Recent Developments*, Federal Reserve Bulletin, 786-787 (1999) (defining marketable securities and the types of bonds that generally comprise the UST market).

[11] Noeth & Sengupta, *supra* note [ ].

[12] UNITED STATES TREASURY, MONTHLY STATEMENT OF THE PUBLIC DEBT OF THE UNITED STATES (AUG. 31, 2018) (noting a total of around $15 trillion in marketable debt out of a total of around $21 trillion in overall public debt (marketable as well as non-marketable).

[13] Burgess, *supra* note [ ] (discussing that US Treasury borrowing stands at the highest levels since the Financial Crisis in summer 2018 to deal with projected deficits, forecasting an annual $1 trillion borrowing going forward); Saleha Mohsin, *Treasury Sees Second-Half U.S. Borrowing at Most Since 2008*, BLOOMBERG, (JUL. 30, 2018), https://www.bloomberg.com/news/articles/2018-07-30/treasury-raises-borrowing-outlook-with-2h-hitting-769-billion.

[14] Bouveret et al., *supra* note [ ], 5-6.

[15] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 15-17; For discussion on the historical evolution, purpose and regulation of the U.S. Treasury Market, see generally, Jerry Markham, *Regulating the U.S. Treasury Market*, 100 MARQ. L. REV. 185 (2016)

[16] Dupont & Sack, *supra* note [ ], 787-789.

houses, enjoy special authority to bid for and purchase freshly issued Treasuries.[17] In other words, these 23 banks and investment banks represent the core purchasers of new Treasury debt, providing regular, direct infusions of debt capital into government coffers.[18] They have also been assumed to be dominant in the secondary trading in these securities, ensuring that the busy market to buy and sell Treasuries following their issue operates smoothly.[19] In something of a quirk of practice, Treasury trading between dealers and their customers as well as between the dealers themselves has been thought of as operating largely along analog lines, conducted mostly over-the-phone, rather than electronically on the major national exchanges like the New York Stock Exchange or NASDAQ.[20] Understood through this set of priors, trading Treasuries might rightly be viewed as unproblematic and risk-free: a market dominated by a small group of deep-pocketed, regulated actors, transacting a security backed by the credit of the U.S. government, using analog mechanics that have long stood the test of time.

These assumptions are, however, fast eroding – raising concerns about the structural underpinnings of the U.S. Treasury market and the conventions governing its regulation. As made clear by the *Flash Rally*, a growing segment of U.S. Treasury trading is underpinned by algorithms – sequences of pre-set computerized instructions – that can automate the processes for buying and selling securities.[21] Instead of human traders

[17] Dupont & Sack, *supra* note [ ], 787-789.

[18] Dupont & Sack, *supra* note [ ], 787-789. For a current list of authorized primary dealers, see, FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: LIST OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers.

[19] As described in Part I, dealers are expected to buy and sell securities using their own capital in order to ensure the smooth functioning of the market. In this way, dealers intermediate supply and demand by standing ready to purchase or sell a security for an end user, even if there is no available market for this security. Doing so, dealers maintain ongoing market function and prevent periodic price shocks arising out of ebbs and flows in demand for a security. On the role of dealers generally, see, Yakov Amihud & Haim Mendelson, *Dealership Market: Market-Making With Inventory*, 8 J. FIN. ECON. 31 (1980) (analyzing the role of dealers and their risk management); Hendrik Bessembinder et al., *Why Designate Market Makers? Affirmative Obligations and Market Quality* (Working Paper, 2011) (analyzing the significance of formally asserting market making obligations on dealers for capital efficiency). On Treasury market structure, see, Dupont & Sack, *supra* note [ ], 787-789; Markham, *supra* note [ ], 198-199. As noted by Dupont and Sack, there is a far larger group of dealers authorized to trade in government debt and registered with the SEC. However, primary dealers constitute the major participants in the primary market for Treasuries trading. For sample statistics on the percentage volume of primary dealer purchases in government debt securities, FEDERAL RESERVE BANK OF NEW YORK, QUARTERLY MARKET SHARE DATA OF PRIMARY DEALER TRANSACTIONS (JUL. 12, 2018).

[20] Dupont & Sack, *supra* note [ ], 787-789; Markham, *supra* note [ ], 198-199. With computer technology, dealer-to-customer markets have utilized "request for quotes" through portals and specialist electronic platforms. For discussion, Kevin McPartland, *U.S. Treasury Trading: the Intersection of Liquidity Makers and Takers*, Greenwich Associates Research, 3 (2015).

[21] John Bates, *Algorithmic Trading and High Frequency Trading Experiences and Thoughts on Regulatory Requirements* 27-28 (July 2010) ("An algorithm is a sequence of steps to achieve a goal" and the general case of algorithmic trading is "using a computer to automate a trading strategy"), *available at* http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/tac_071410_binder.pdf.

placing orders to buy and sell Treasuries, confirming trades, and responding to changing market conditions with new orders, these tasks can be performed by algorithms. Using powerful algorithms, that harness artificial intelligence and sophisticated data processing, trades can take place at high frequency, turning over in milliseconds or less and responding to vast quantities of new information.[22]

High-frequency trading (HFT) is, of course, old news in equity markets, responsible for around 50-70% of trading volume.[23] A rich body of academic literature explores its implications for market quality, and a slew of regulatory initiatives have sought to address its risks.[24]

Yet its rise within U.S. Treasury markets appears to have caught regulators and commentators off-guard.[25] The official inquest into the *Flash Rally* revealed that high frequency traders now constitute an influential presence, responsible for around 50% of Treasuries trading volume in the inter-dealer market.[26] No longer the cloistered preserve of a handful major financial firms, Treasury markets have come to include lesser-known, specialist HFT houses deploying their own money (rather than client capital) to trade at high volume and high speed. The traditional cohort of bank dealers has ceded ground to a looser, more mixed network of firms willing to trade quickly and often, offering a steady set of counterparties for those looking to buy and sell Treasuries. According to one 2015 study of the top-10 traders (by volume) on the leading Treasury-trading platform, 8 out of the 10 of these firms were not the usual primary dealer banks. Rather they were specialist HFT firms: the top three from

[22] INT'L ORG. SEC. COMM'NS, REGULATORY ISSUES RAISED BY THE IMPACT OF TECHNOLOGICAL CHANGES ON MARKET INTEGRITY AND EFFICIENCY: CONSULTATION REPORT 10 (2011) ("An algorithm is 'a sequence of steps to achieve a goal' – and the general case of algorithmic trading is 'using a computer to automate a trading strategy.'"); SEC. & EXCH. COMM'N, EQUITY MARKET STRUCTURE LITERATURE REVIEW, PART II: HIGH FREQUENCY TRADING, 4–7 (2014).

[23] JEFFREY G. MACINTOSH, HIGH FREQUENCY TRADERS: ANGELS OR DEVILS? 2 (2013); Automated trading and HFT is also very widespread in the exchange-traded derivatives market, such as the market for various types of futures and options. For discussion on the prevalence of automated trading strategies in the derivatives markets, see generally, Richard Haynes & John Roberts, *Automated Trading in Futures Markets*, Working Paper (2015); For the implications of HFT in futures markets and possible abusive practices, see, Gregory Scopino, *Do Automated Trading Systems Dream of Manipulating the Price of Futures Contracts? Policing Markets for Improper Trading Practices by Algorithmic Robots*, 67 FLA. L. REV. 221, 250-260 (2015) On regulatory initiatives for HFT in equity markets, see, for example, SEC Regulation Systems, Compliance and Integrity (Reg. SCI), Release No. 34 7363917 CFR Parts 240 (Feb. 2015); Mary Jo White, *Equity Market Structure in 2016 and for the Future*, Speech to the Security Traders Association 83rd Annual Market Structure Conference, Sept. 14, 2016, https://www.sec.gov/news/speech/white-equity-market-structure-2016-09-14.html.

[24] SEC. & EXCH. COMM'N, EQUITY MARKET STRUCTURE LITERATURE REVIEW, PART II: HIGH FREQUENCY TRADING, Part II (2014) (offering a literature review of some key studies of HFT); GOV'T OFFICE FOR SCI. FORESIGHT: THE FUTURE OF COMPUTER TRADING IN FINANCIAL MARKETS: FINAL PROJECT REPORT 20–48 (2012) (describing key features of HFT and evidence from supporting literature).

[25] Levine, *supra* note [ ] (noting the unexpectedly high level of HFT activity in the U.S. Treasury trading market.

[26] UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ].

this list – Jump Trading, Citadel, and Teza Technologies – transacted around $4.2 trillion in Treasuries by volume between May-June 2015.[27]

HFT in Treasuries trading offers important benefits – but also creates risks that are unique to this market. As I have observed in earlier writings, HFT – by design – carries the intrinsic risk of random error and imprecision.[28] Algorithms that must transact in milliseconds and microseconds – too fast for human traders to direct in real-time – demand that programmers specify prior to trading exactly how these algorithms will transact in the real world. This anticipatory dynamic, while relying on sophisticated data, statistical analyses and artificial intelligence to back it up, still requires that programmers take a view on future trading conditions. Because forecasting is, by its nature, an inexact and imperfect exercise, it follows that HFT programming can be vulnerable to the risks of incorrectly or imperfectly reading future markets. Of course, human beings, too, make mistakes. But correcting the course of HFT algorithms is an especially difficult task, where catching mistakes in real-time is made impracticable by the forces of speed, automation and data complexity.[29]

This intrinsic risk of error, imprecision or poorly adaptive programming constitutes a new and serious source of fragility for the Treasury market. And troubles here can extract the highest price in terms of system-wide stability. U.S. Treasury markets constitute, arguably, the most prized store of (virtually) guaranteed returns for sovereigns, financial institutions, corporates and everyday investors anywhere in the world.[30] Their prices offer a benchmark against which to measure the worth of other kinds of assets like loans. Price dislocations in the Treasury market can lead to broader spillovers into other kinds of linked asset-types.[31] Critically, their workings mediate the ease by which the U.S. government can borrow to fund its operations and the economy.[32] Investors that cannot

[27] Robert McKenzie Smith, *Client List Reveals HFT Dominance on BrokerTec*, RISK MAGAZINE, Sept. 23, 2015; Portia Crowe, *High Frequency Traders Are Dominating Another Huge Market*, BUSINESS INSIDER, Sept. 23, 2015, https://www.businessinsider.com/high-frequency-traders-dominate-the-treasuries-market-2015-9 (BrokerTec, one of the major platforms for dealers trading Treasuries with one another, is reported to intermediate around 65-70% of interdealer trading volume).

[28] Yesha Yadav, *How Algorithmic Trading Undermines Efficiency in Capital Markets*, 68 VAND. L. REV. 1607 (2015).

[29] Yadav, *supra* note [ ]. On the challenges of complexity for designing legal systems see generally, J.B. Ruhl et al., *Harnessing Legal Complexity*, 355 SCIENCE 1377 (2017).

[30] Bouveret et al., *supra* note [ ].

[31] Dupont & Sack, *supra* note [ ], 792-793. For example, the Treasury market constitutes the reference for the Treasury futures market – designed to help investors hedge and speculate on the future value of U.S. Treasury by agreeing to buy and sell Treasuries in the future at a certain price. Importantly, Treasury interest rates are used as benchmark against which to price corporate debt. For discussion on Treasuries as a benchmark, Michael Fleming, *The Benchmark U.S. Treasury Market: Recent Performance and Possible Alternatives,* FRBNY Economic Policy Review 128 (2000); On the Treasury futures market, Chicago Mercantile Exchange, *The Basics of U.S. Treasury Futures* (Feb. 2014), https://www.cmegroup.com/trading/interest-rates/files/basics-of-us-treasury-futures.pdf.

[32] Dupont & Sack, *supra* note [ ], 792-793.

buy Treasuries or easily and efficiently sell the risk that they have assumed may charge more to lend, or perhaps not offer their capital at all.

Pre-set HFT algorithms can generate risks to these operations for a number of reasons. For example, HFTs reacting in microseconds to announcements, like jobs numbers or economic performance, may be overly forceful in their response, focusing on certain pre-set data points over a more nuanced picture. Such trading can quickly convey information to the market. But it can also cause volatility as markets adjust to match what should be the "right" reaction to the news.[33] Where multiple HFTs deploy similar kinds of programming, scouring releases for the same types of data, there is a risk that Treasury prices reflect a more intense reaction than what the information would otherwise deserve or what a diverse group of traders would produce.[34] Traders acting in a correlated way to similar information can amplify the effects of certain news announcements, prompting potential price swings and creating a more complex environment for algorithms to navigate.[35] More broadly, algorithms can also be programmed precisely for the purpose of disrupting, manipulating, or carelessly engaging with the market. Such misbehavior is not new. But HFT and algorithmic trading introduces novel strategies by which to carry out these kinds of bad acts, such as by the rapid submission and cancellation of electronic orders, introduction of non *bona fide* orders or the use of systems that fail to police this kind of conduct.[36]

Indeed Treasuries may be more vulnerable to system-wide disruptions than other kinds of securities like shares. The equity market, for example, encompasses claims against an wide range of companies, with varying profiles, representing different industries, future prospects and riskiness. In trading these shares, algorithms confront a diverse environment, comprising a variety of companies, responsive to different kinds of information and news releases. An overreaction to news pertaining to the shares of a particular company like Google, may not necessarily affect those of others like Comcast or Ford.

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[33] *See discussion and sources cited infra* Part [ ]. On German Treasury (Bund) futures markets, Kathi Schlepper, *High-Frequency Trading In The Bund Futures Market*, Bundesbank Discussion Paper No. 15/2016 (2016) (highlighting that HFT in Bund futures markets react forcefully to news, increasing efficiency but also volatility).

[34] *See sources and studies cited infra* Part [ ].

[35] *See e.g.*, Alain Chaboud, Benjamin Chiquoine, Erik Hjalmarsson & Clara Vega, *Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market* (July 5, 2013) (highlighting the trend towards correlated trading behavior following macroeconomic announcements in the currency derivatives market). On the difficulties for algorithms to transact in crisis, raising the chance of algorithms retreating, see, Pradeep Yadav, Vikas Raman and Michel Robe, *Man vs. Machine: Liquidity Supply and Market Fragility*, Working Paper (July 2014).

[36] David Easley, Marcos M. López de Prado & Maureen O'Hara, *The Volume Clock: Insights into the High-Frequency Paradigm*, J. P'FOLIO MGMT., May 2012; UNITED STATES TREASURY ET AL., JOINT STAFF REPORT, *supra* note [ ], 31-32 (noting the high volume of self-trading and wash trades during the event window of the Flash Rally). See also, Markham, *supra* note [ ], 199-208.

This state of affairs stands in contrast to the Treasury market where traders confront a much plainer ecosystem focused on the particulars of a just single issuer – the United States government – with a presumed near-zero default risk. On the one hand, this simpler profile might ease the task of programmers calibrating their algorithms for trading. However, it can also heighten the chance that programmers build models that internalize and respond to information in similar ways. The reactions of automated programs, their interpretative focus, or some other misfiring (e.g. picking up and trading on "fake" news) can have a much bigger and system-wide impact than within a market comprising heterogenous types of claim.[37]

In its second contribution, this Article shows that the regulatory framework governing the Treasury market is institutionally unsuited to oversee these new risks and its changing structural dynamics.

For a start, public oversight is fragmented and straining in the face of new algorithmic technologies as well as the functional demands being placed on the market. Dating from 1986, the governing legislation for Treasury markets has undergone only episodic updating, most notably to remedy certain high-visibility deficiencies seen during the 2014 *Flash Rally*.[38] In contrast to securities like shares or derivatives, Treasuries have largely fallen outside the radar of policymakers as a target for meaningful reflection and rulemaking.[39]

This neglect is unsurprising. Rather than allocating oversight to one or even a small group of primary regulators, rulemaking and supervision for the U.S. Treasury market is divided across the spectrum of major financial policymakers. The Federal Reserve, the Federal Reserve Bank of New York, the SEC, Financial Industry Regulatory Authority (FINRA), Commodity Futures Trading Commission (CFTC) and the U.S. Treasury all possess some authority to make rules and supervise aspects of the market. Banks, performing a Treasury dealer function are registered with and overseen by the Federal Reserve, while the SEC supervises non-bank dealers.[40] The Treasury writes the core governing rules for the market; and the CFTC regulates and supervises the market for Treasury-linked derivative securities.[41] Ironically despite this multiplicity of overseers, traders without the formal designation of dealer, even if they might informally behave as one, can lack a primary registration with a

[37] *See sources and discussion infra* Part [ ].

[38] Gov't Sec. Act (GSA) of 1986, Pub. L. No. 99-571, 100 Stat. 3208. On the imperviousness of the US Treasury markets to significant rulemaking, Mary Jo White, *supra* note [ ].

[39] Markham, *supra* note [ ], 201-203.

[40] Markham, *supra* note [ ], 201-203. Even though Treasuries, as government securities, are not required to register with the SEC, they are still subject to the SEC's antifraud regulation under Rule 10b-5.

[41] Markham, *supra* note [ ], 201-203. On the market making function of HFT, see, for example, Albert J. Menkveld, *High Frequency Trading and the New Market-Makers*, 16 J. FIN. MKTS. 712 (2013).

regulator altogether. Many HFT traders, whose rapid fire and high-volume trading leads them to behave as *de facto* "market makers" or "dealers," even while lacking a formal registration, can fall within this category.[42]

While the U.S. is no stranger to a fragmented financial regulatory landscape, the shortcomings of this design choice are particularly problematic for the U.S. Treasury market.[43] Any one regulator faces high, perhaps even insurmountable, costs to obtain a system-wide understanding of its overall riskiness. To come up with policy priorities for rulemaking, regulators must first confront co-ordination costs to agree on evolving notions of riskiness, harm, and the vectors by which this damage can arise. As underscored by the *Flash Rally*, authorities were caught unawares by the changing composition of market participants, trading techniques as well as how this re-balancing has nurtured novel and poorly understood risks. Perhaps most troubling, no one regulator is entrusted with ultimate responsibility for securing the function and integrity of this singularly important market – like the SEC for equity markets, or the CFTC for derivatives.[44] While this absence of a deliberative center may once have sufficed in simpler times, its persistence at a time of algorithmic speed and automation leaves a dangerous gap in understanding this market, monitoring and enforcement.

The gaps left by public oversight are unlikely to be remedied by private self-regulation. A rich body of scholarly literature examines the role of industry self-governance in securities markets as a supportive pillar to bolster the public regulatory framework.[45] In Treasury markets, the effectiveness of private oversight seems compelling at first. This market

[42] UNITED STATES TREASURY ET AL., A FINANCIAL SYSTEM THAT CREATES OPPORTUNITIES (2017), 78-79.

[43] On the costs of regulatory fragmentation in financial regulation and the utility of the Financial Stability Oversight Council, *see generally* Daniel Schwarcz & David T. Zaring, *Regulation by Threat: Dodd–Frank and the Nonbank Problem*, 84 U. CHI. L. REV. 1813 (2017); See also, Christina P. Skinner, *Regulating Non-Banks*, 105 GEO. L. J. (2017) (analyzing flaws in the FSOC designation process for non-banks).

[44] While the SEC and the CFTC are specialist, primary overseers of discrete parts of the larger securities market, they can have straddling authority over certain kinds of securities, as well as work alongside other regulators such as the Financial Stability Oversight Council regarding questions of systemic-regulation. See e.g. Securities and Exchange Commission, SEC Proposes Joint Rules with CFTC to Define Swap Related Terms, Press Release, Dec. 3, 2010., https://www.sec.gov/news/press/2010/2010-237.htm; SEC. & EXCHANGE COMM'N, WHAT WE DO, https://www.sec.gov/Article/whatwedo.html

[45] This literature is extensive. On self-regulation in the securities industry, see, for example, Adam C. Pritchard, *Markets as Monitors: A Proposal to Replace Class Actions with Exchanges as Securities Fraud Enforcers,* 85 VA. L. REV. 925 (1999) (detailing the benefits of industry self-regulation in securities markets); Marcel Kahan, *Some Problems with Stock Exchange Based Securities Regulation,* 83 VA. L. REV. 1509 (1997); On self-regulation and exchanges, see, for example, David A. Lipton, *The SEC or the Exchanges: Who Should Do What and When? A Proposal to Allocate Regulatory Responsibilities for Securities Markets*, 16 U.C. Davis L. Rev. 527, 527-28 (1983); Onnig Dombalagian, *Demythologizing the Stock Exchange; Reconciling Self-Regulation and the National Market System*, 39 U. RICH. L. REV. 1069, 1072-79 (2005); Roberta Karmel, *The Future of Corporate Governance Listing Requirements*, 54 SMU L. REV. 325 (2001). For further discussion see, *infra* Part [ ].

has historically been dominated by a tight cohort of 23 (or fewer) primary dealers, top-tier financial firms with deep pockets and reputational capital to lose if they fail. And primary dealers do, in fact, have a great deal to lose if Treasury markets are unsafe and vulnerable to disruption. These dealers are tasked by the U.S. Government to bid for and buy the country's debt. This status burnishes their reputation and affords them access to a prestigious roster of clients that wish to transact in U.S. government debt.[46] Moreover, the NY Fed already requires primary dealers to contribute to the safe and reliable upkeep of the market by offering information to the NY Fed as well as by promoting sound risk management practices in their trading.[47] It follows, then, that this tight group of repeat, critical players in the market could also be charged with more actively policing its workings.

But hopes for private self-regulation in Treasury markets face long odds for success with its newer mix of traditional banks as well as the HFT traders that dominate its inter-dealer secondary market. No longer a group of similarly-regulated, mutually reliant firms – incentivized to behave in order to maintain their access to the primary market for government debt – Treasuries traders now comprise a more diverse number. These differences are significant and liable to hinder co-operation. For one, firms face varying compliance costs. Official primary dealers are subject to a host of obligations on account of this special status, unlike HFT firms, some of which may not even be subject to registration with a securities regulator.[48] Differential regulatory burdens can impact how traders behave. Those without formal obligations on the market may be more willing to exit in times of trouble, and less motivated to invest heavily in monitoring. In addition, where exit is cheap and firms face a lower compliance burden, they have every rational incentive to take greater risks.

Moreover, all actors, irrespective of type, may be less inclined to invest in tough self-policing where it increases their costs of participating in the market. Facing heightened competition and a multitude of players jostling for a slice of the pie, investment in the apparatus of governance erodes already thinning profits.[49] Competition, of course, promises important and desirable benefits, reducing the chances that primary dealers extract rents on account of their status.[50] But it can also increase the cost pressure on firms. Traders may collectively under-enforce to reduce this expense, or even strategically limit monitoring and discipline of one

[46] Joe Rennison & Ben McLannahan, *Wells Fargo Approved as 'Primary Dealer' for US Treasury Debt*, FIN. TIMES, Apr. 16, 2016.

[47] Treasury Market Practices Group, Best Practices for Treasury, Agency Debt and Agency Mortgage-Backed Securities Markets (Jan. 2018).

[48] *See discussion infra* Part [ ].

[49] *See discussion infra* Part [ ].

[50] *See discussion infra* Part [ ].

another because it gives each participant greater latitude to privately seek out risky profits in a competitive market.[51]

In its third contribution, this Article examines the implications of regulatory failure in Treasury market structure and offers proposals for re-thinking its design. To ground this discussion, this Part imagines frictions that may arise out of weak oversight of Treasuries that neglects to effectively address the risks posed by a high-speed, highly automated market structure. Invariably, this question intersects with a much more fundamental inquiry about how Treasury markets broadly anchor macroeconomic and financial stability in the U.S. and abroad. With concerns growing about the fiscal health of U.S. markets, for example, stressed by the possible ill-effects of over-leveraging, tariffs, and deficits, weaknesses in U.S. Treasury operations may diminish the attractiveness of U.S. government debt as a critical bulwark against risk. Can Treasury market structure withstand a sudden sell-off of Treasuries by a large foreign holder? How will a diverse set of electronic traders react to unusual, stressed trading environments where it is cheap and desirable for them to exit the market quickly? How can regulation equip market participants to counter these threats of instability? If it fails to do so, how will investors respond to a market that may be less risk-free in its trading structure than has otherwise been presumed? Ultimately, policymakers face difficult trade-offs in developing a new regulatory approach. Given its importance, there is a case for unflinchingly imposing toughest-possible regulatory standards on those that anchor this market. Only the most resilient firms are likely to qualify, offering comfort that the Treasury market is backstopped by those with the resources to absorb the costs of a fallout. At the same time, regulators also prize liquidity – that is, the ability for traders to enter and exit the market quickly – particularly at times of market stress. Where electronic traders stand ready to provide this access, and to do so cheaper and quicker than the old-guard, losing their participation risks a return to a possibly much less user-friendly market. While this tension may ultimately be intractable, this Article concludes by exploring possible avenues for reform, focusing on structural solutions to build a more unified system of public and private oversight [more].

This Article proceeds as follows.

I. THE ESSENTIAL ECONOMY OF U.S. PUBLIC DEBT

[51] *See discussion infra* Part [ ].

The U.S. Treasury market is essential to economic and social life. It constitutes a major mechanism by which the U.S. government funds itself. When tax receipts fail to raise sufficient money, or rapid infusions of capital are needed into public coffers, the Treasury market represents the go-to venue for raising these funds.[52] Beyond their borders, U.S. Treasuries also underpin global financial markets. Representing a credit risk on the trusted workings of the U.S. government, Treasuries are believed to be virtually risk-free.[53] Backed by the "full faith and credit" of the U.S. government, its political institutions, markets and taxing power, Treasuries are widely seen as a risk-free, default-proof asset.[54] Because of this special status, investors and institutions worldwide rely on them to serve as a fail-safe store of value, protecting against risk, volatility and investment losses.[55]

The well-functioning market for U.S. Treasuries can secure important and wide-ranging welfare objectives. It assures funding for critical government operations, easing the burden on taxpayers when public financing needs exceed their capacity to pay. Additionally, the availability of Treasuries – seemingly risk-free and easily traded – give market participants of all stripes access to an asset that can reliably safeguard the value of their investment portfolios.

This Part highlights the significance of Treasury market for the economy and global financial markets. In showcasing its uniquely powerful function, this Part describes the complex structure that undergirds the mechanics of trading Treasuries. It concludes by analyzing the regulatory framework governing Treasuries, one that has remained largely static over three decades despite securities markets undergoing thoroughgoing reform in this period, notably after the 2008 Crisis.[56] In setting out its descriptive analysis, this Part draws out the singular importance of U.S. Treasuries for markets and regulators. In other words, the costs of regulatory failure in this space are likely to carry far graver and more systemic consequences than those in other kinds of markets.

[52] Dupont & Sack, *supra* note [ ], 785-786.

[53] *See generally*, Aswath Damodaran, *What if Nothing Is Risk-Free?*, Working Paper (2010) (noting and questioning the general assumption of Treasuries are construed as risk-free assets); Thomas Heath, *What the 10-year Treasury Yield Means to You? Real Money*, WASH. POST, APR, 24, 2018 (observing how investors choose between investing in Treasuries v. equities). See also, Dupont & Sack, *supra* note [ ], 785-786 (noting reliance on the market for funding the War of Independence, Civil War and subsequent large-scale conflicts like World War I).

[54] Promontory, *Emerging Issues in the Functioning of the U.S. Treasury Market*, 10-11(2016).

[55] Bouveret et al., *supra* note [ ], 5-6.

[56] Dodd–Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, § 901, 124 Stat. 1376, 1822 (2010).

A. The Economics of Treasury Markets

U.S. government bonds – or Treasuries – have long nurtured the country's growth and financed its most significant national endeavors. In borrowing money to help pay for the Revolutionary War of 1776, the U.S. (then, the Continental Congress) began the practice of relying on debt capital to furnish the funds needed to support major public policy initiatives.[57] Beyond just financing wars, however, U.S. Treasuries have provided a means to raise the capital needed to buttress the social safety net, provided through programs like Social Security, Medicare and Medicaid.[58] The ability of the U.S. government to borrow money easily and reliably has enabled it to harness, as and when it has wished to, this access to capital to fund the apparatus and evolving needs of the State.[59]

This seemingly straight-forward role – enabling the U.S. government to borrow money – has given rise to a market that serves a multitude of ancillary functions that root it ever deeper into economic life. As detailed below, the fact that Treasuries represent a credit risk on the U.S. government have led them to become an attractive investment and an apparently fail-safe store of value that can help firms back-stop their risk.

1. The Basics of U.S. Public Debt

Treasuries represent the debt of the U.S. government. Rather than borrow using large loans from sovereign nations or deep-pocketed financial firms, the U.S. takes on debt using Treasury bonds that are designed to encourage investment from a broad swath of the citizenry and investor base.[60] Treasury bonds are specifically tailored to appeal to creditors of all types. First, they allow Main Street to lend to the

[57] For example, the size U.S. government debt expanded markedly to fund the Civil War and World Wars I & II. For discussion, Dupont & Sack, *supra* note [ ]. On occasions, the U.S. has issued various types of "War Bonds" by harnessing patriotic sentiment to encourage citizens to lend money to the government. David Cho, *U.S. Sitting on $17 Billion in Unclaimed War Bonds*, WASH. POST, NOV. 28, 2009.

[58] *See e.g.*, Justin Lahart, *The Treasury Market is Having a Senior Moment*, WASH. POST, JUN, 6, 2018.

[59] Dupont & Sack, *supra* note [ ], 785-786; Rafael A. Bayley, The National Loans of the United States of America from July 4, 1776 to June 30, 1880, as Prepared for the Tenth Census of the United States (Washington, DC: U.S. Government Printing Office, 1883), available online, https://catalog.hathitrust.org/Record/009011064.

[60] FINANCIAL INDUSTRY REGULATORY AUTHORITY, U.S. TREASURIES SECURITIES, http://www.finra.org/investors/us-treasury-securities.

Treasury.[61] Each bond represents debt of $100, giving average people a chance to invest. A person with a $100 to spare can lend it to the U.S. government by buying a Treasury security, making for an affordable and accessible investment. Further, different types of Treasury bond allow the debt to be repaid over varying periods of time, from maturities that come due within a year (Treasury Bills), to longer-term instruments that are paid back over periods of two years, five years, seven years, ten years (all Treasury Notes) and 30-years (Treasury Bonds).[62] Perhaps most crucial is the assumption that Treasury debt will always be repaid giving those that lend the U.S. money confidence in its future income streams.[63]

For many investing in the debt of the United States represents an essential part of their wealth-building strategy. Instead of putting money in stocks whose fluctuating values can leave investors anxious about long-term returns, or corporate bonds whose issuers may default, Treasury bonds provide a constant and steady source of reliable returns.[64] Investors in Treasuries thus purchase a kind of "insurance" against downturns, where the worth or volatility of their other ventures comes into question, but where the T-bond always promises to pay.[65] For the risk-averse, lending to the U.S. government is probably as close as it gets to betting on a "sure thing." But even for those with a larger appetite for risk, putting money into U.S. public debt provides a necessary hedge to cheaply safeguard against the possibility of losses elsewhere in the portfolio.[66] The resilience of the Treasury market as a haven for investors was amply in evidence in the worst days of the Financial Crisis. Despite serious concerns

[61] It is also relatively simple to purchase Treasuries using the website TreasuryDirect (https://www.treasurydirect.gov/). The TreasuryDirect website showcases a number of initiatives designed to foster Main Street citizen investment in the public debt of the United States, for example, by setting up the ability for direct investments to be made through payroll savings. TREASURYDIRECT, THE PAYROLL SAVINGS OPTION IN TREASURY DIRECT, HTTPS://WWW.TREASURYDIRECT.GOV/INDIV/PRODUCTS/PROD_TDPAYROLLINFO.HTM.

[62] FINANCIAL INDUSTRY REGULATORY AUTHORITY, U.S. TREASURIES SECURITIES, http://www.finra.org/investors/us-treasury-securities. In addition, investors can also purchase different types of Treasury bonds beyond just these common varieties. Investors might seek out inflation-protected Treasury bonds or TIPS, Floating Rate Notes, as well as different types of Savings Bonds. For details, TREASURYDIRECT, TREASURY INFLATION PROTECTED SECURITIES, HTTPS://WWW.TREASURYDIRECT.GOV/INDIV/PRODUCTS/PROD_TIPS_GLANCE.HTM; TREASURYDIRECT, FLOATING-RATE NOTES, HTTPS://WWW.TREASURYDIRECT.GOV/INDIV/PRODUCTS/PROD_FRNS_GLANCE.HTM; TREASURYDIRECT, SERIES EE SAVINGS BONDS, HTTPS://WWW.TREASURYDIRECT.GOV/INDIV/PRODUCTS/PROD_EEBONDS_GLANCE.HTM.

[63] FINANCIAL INDUSTRY REGULATORY AUTHORITY, U.S. TREASURIES SECURITIES, http://www.finra.org/investors/us-treasury-securities.

[64] WHY IT MAKES SENSE TO INVEST IN TREASURY BONDS, THE ECONOMIST, May 26, 2018, https://www.economist.com/finance-and-economics/2018/05/26/why-it-makes-sense-to-invest-in-treasury-bonds.

[65] Id. Noeth & Sengupta, *supra* note [ ].

[66] WHY IT MAKES SENSE TO INVEST IN TREASURY BONDS, THE ECONOMIST, May 26, 2018, https://www.economist.com/finance-and-economics/2018/05/26/why-it-makes-sense-to-invest-in-treasury-bonds. Jeff Sommer, *This Flight to Safety Wasn't Supposed to Happen*, N. Y. TIMES, Jun 5., 2010.

about the integrity of U.S. financial markets, the Treasury attracted a lasting surge of cash as investors liquidated their holdings in other securities and sought the comfort of Treasury bonds.[67] As the Recession worsened, the U.S. government was able to borrow at rates that edged ever-closer towards 0%, highlighting the enormous demand for Treasury securities at a moment of crisis and uncertainty in stock markets.[68]

With this mass appeal, the market is home to a diverse investor base that relies on it to build and protect wealth.[69] It comprises financial institutions like banks and hedge funds, foreign sovereign nations that look to U.S. government securities to safely park their cash reserves, other U.S. government agencies as well as retail investors. In each case, these segments of the investor base have all increased their holdings of U.S. Treasuries since the Financial Crisis, with the greatest rise seen in the value of securities held by foreign investors.[70] The U.S. has enjoyed access to a ready and steady supply of debt despite (or perhaps precisely because of) the deep turmoil in economies across the globe over the last decade.[71]

[67] Noeth & Sengupta, *supra* note [ ].

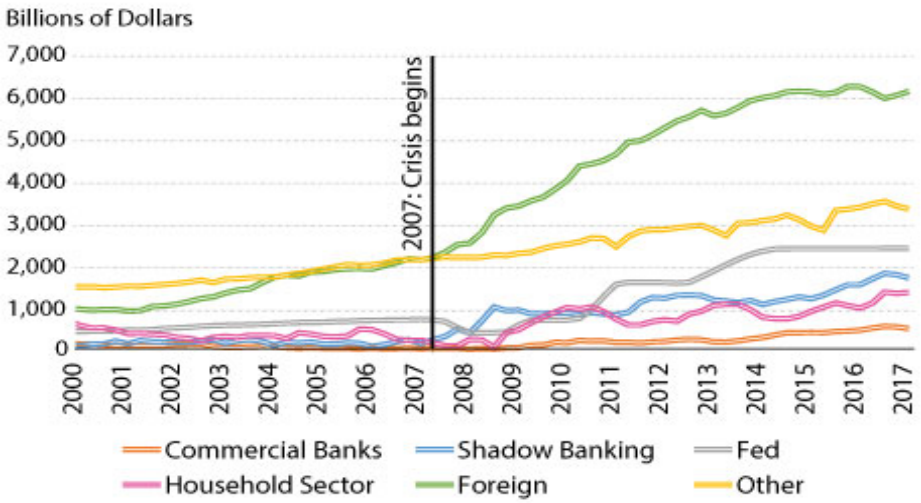
[68] Noeth & Sengupta, *supra* note [ ]; Sommer, *supra* note [ ]. Indeed, for some time in 2008, the rate on the 3-month T-Bill was negative, in other words, investors were paying to lend money to the U.S. government. Similarly, during the Great Depression, investor demand for Treasuries led to an interest rate of zero, or even negative, reflecting its status as a safe-haven asset. Vikas Bajaj & Michael M. Grynbaum, *Investors Buy U.S. Debt at Zero Yield*, N. Y. TIMES, Dec. 9., 2008. For trading dynamics during the 2008 Financial Crisis, see generally, Robert Engle et al., *Liquidity, Volatility, and Flights to Safety in the U.S. Treasury Market: Evidence from a New Class of Dynamic Order Book Models*, Federal Reserve Bank of New York Staff Reports, no. 590 (Dec. 2012) (noting a marked decrease in market depth and increased price volatility during the flight to safety after the September 2008 crash).

[69] Jochen R. Andritzky, *Government Bonds and Their Investors: What Are the Facts and Do They Matter?* IMF Working Paper, 8-10 (2012) (noting the depth of U.S. Treasury markets as a reason for attracting a diverse mix of investors).

[70] David Andolfatto and Andrew Spewak, *On the Supply of, and Demand for, U.S. Treasury Debt*, Federal Reserve Bank of St. Louis Economic Synopses (2018), https://research.stlouisfed.org/publications/economic-synopses/2018/03/09/on-the-supply-of-and-demand-for-u-s-treasury-debt/; Andritzky, *supra* note [ ].

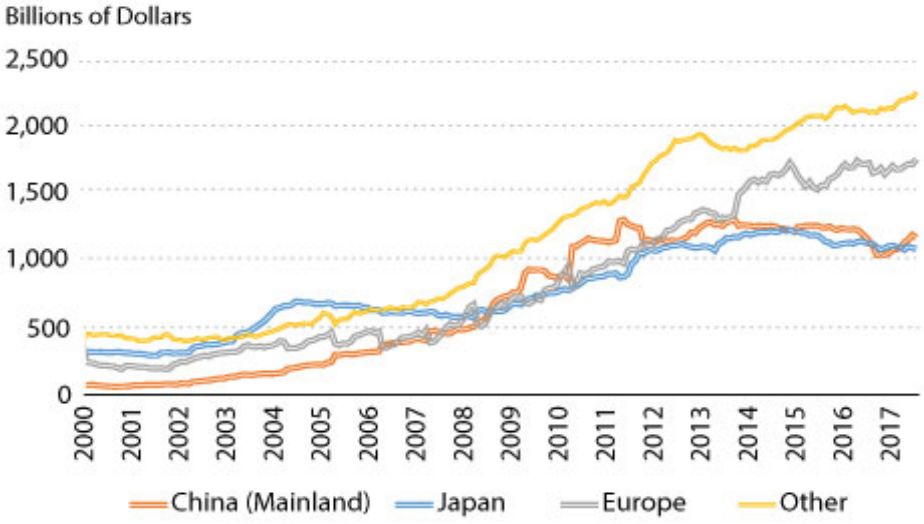
[71] Andolfatto & Andrew Spewak, *supra* note [ ]. However, as noted by the authors, foreign holders may be looking to reduce their commitment to U.S. public debt.

Figure 1
Ownership of U.S. Treasury Securities, 2000-17



SOURCE: Board of Governors of the Federal Reserve System.

Figure 2
Foreign Holders of U.S. Treasury Securities, 2000-17



SOURCE: U.S. Department of the Treasury.

The status of Treasury instruments as carrying near negligible risk also brings important advantages for the United States. It has permitted the

United States to borrow expansively to accommodate its need for capital. Financial crises that normally cause the cost of capital to spike for other actors, instead drive it down for the U.S. government as investors flock to the safety of its debt. This power to attract capital, even in the depths of economic distress, is exemplified by the increase in tradeable debt taken on by the Treasury in the decade since the 2008 Financial Crisis. The approximately $5 trillion of marketable U.S. public debt outstanding in 2008 has tripled to over $15 trillion by 2018. This reflects, in part, an expansion of the Treasury's balance sheet to contain the Financial Crisis and recession – as well as continuing appetite by investors to place their capital in a safe haven.[72] Commentators predict that the U.S. will continue to need the Treasury market to pay for increasing budget deficits, tax cuts, and the growing costs of programs like Social Security.[73]

The bigger picture here speaks to the enormous flexibility enjoyed by the U.S. government to craft and execute its policy choices because of its ready access to vast amounts of debt capital. Conventional theories generally highlight the powerful role played by creditors in monitoring and controlling the capital they place at risk.[74] As Professors Bratton and Gulati observe, even sovereign borrowers often confront some formal constraints on their ability to take on debt, albeit to a much weaker degree than what is common for other kinds of borrower (like people or companies).[75] Sovereign debt agreements, for example, especially those used within the developing world, often limit a sovereign's capacity to borrow freely and its ability to restructure that debt at will.[76] Developed economies, on the other hand, tend to enjoy greater latitude. As noted by Professors Buchheit and Gulati, restrictions on wealthier economies like

[72] Noeth & Sengupta, *supra* note [ ].

[73] Jim Tankersley, *How the Trump Tax Cut Is Helping to Push the Federal Deficit to $1 Trillion*, N. Y. TIMES, Jul 25., 2018; Thomas Kaplan, *Federal Budget Deficit Projected to Soar to Over $1 Trillion in 2020*, N. Y. TIMES, Apr. 9., 2018.

[74] *See generally* Douglas G. Baird & Robert K. Rasmussen, *Private Debt and the Missing Lever of Corporate Governance*, 154 U. PA. L. REV. 1209 (2006) (arguing for greater recognition of the power of creditors in corporate governance); George G. Triantis & Ronald J. Daniels, *The Role of Debt in Interactive Corporate Governance*, 83 CALIF. L. REV. 1073 (1995) (detailing the mechanisms by which creditors undertake corporate governance); Frederick Tung, *Leverage in the Board Room: The Unsung Influence of Private Lenders in Corporate Governance*, 57 UCLA L. REV. 115 (2009) (analyzing the real-world impact of debt governance in corporate life).

[75] William Bratton & G. Mitu Gulati, *Sovereign Debt Reform and the Best Interest of Creditors*, 57 VAND. L. REV. 1 (2004) (analyzing the operation of unanimous action clauses and collective action clauses that are common to sovereign debt and that reduce the borrower's ability to restructure its debt); Lee C. Buchheit & G. Mitu Gulati, *Responsible Sovereign Lending and Borrowing* (Jan. 2010) (advocating for greater intergenerational responsibility and a creditor code of vigilance to prevent excessive borrowing by profligate governments); Rodrigo Olivares-Caminal, *The Pari Passu Clause in Sovereign Debt Instruments: Developments in Recent Litigation*, Bank of International Settlements Paper Number 72, https://www.bis.org/publ/bppdf/bispap72u.pdf (describing and analyzing clauses that require sovereigns to only issue debt that ranks equal or subordinate to existing debt).

[76] *See generally*, Olivares-Caminal, *supra* note [ ]; Buchheit & Gulati, *supra* note [ ] (noting the limited constraints on developed countries).

the U.S. are usually more political in nature and governed by the market's capacity to absorb the sovereign's repeated demands for debt. Absent some formal legal limitations or supranational authority (like the International Monetary Fund or IMF), powerful, rich sovereigns wield great flexibility to deploy their access to capital markets for realizing policy goals.[77]

The U.S., unsurprisingly, faces few contractual fetters in its debt agreements, but legal, political and (sometimes) market discipline can bite to curb Treasury borrowing. Under the Constitution, only Congress can approve borrowing against the "credit of the United States."[78] In the early days of the Republic, this mandate meant that Treasury had to seek specific prior authorization for the loans that it assumed.[79] But the start of World War I and government's turn to seek out capital by borrowing from the public by issuing "Liberty Bonds" opened the Congressional hand.[80] Since 1917, Congress legislates a broad limit on how much Treasury can borrow, establishing a "ceiling" that represents a hard constraint on the overall face amount of dollar borrowing that Treasury can undertake.[81]

Professors Buchanan and Dorff advocate for looking beyond the debt ceiling when determining the intensity of legal controls on public borrowing. They note that Congress imposes detailed checks on Treasury borrowing through its annual budget and appropriations authorization process.[82] By minutely plotting the yearly bill for providing government services against the funds that the government is likely to acquire from tax revenues, fines and fees, Congress gets to determine how much Treasury needs to borrow in order to finance state needs.[83] If it will cost government more money to fund itself annually than what it will receive by way of revenue – creating a deficit – the remainder will need to be funded by public borrowing. Information gleaned through this "unofficial debt

[77] Buchheit & Gulati, *supra* note [ ].

[78] U.S. CONST. art. I §8, cl. 1 & 2. For discussions on the potential application of Section 4 of the Fourteenth Amendment (requiring recognition of the "validity of the public debt of the United States") see, Garrett Epps, *Our National Debt Shall Not Be Questioned*, ATLANTIC, May 4, 2011; Lawrence H. Tribe, *A Ceiling We Can't Wish Away*, N.Y. TIMES, Jul. 8., 2011; Neil H. Buchanan and Michael C. Dorf, *How to Choose the Least Unconstitutional Option: Lessons for the President (and Others) from the Debt Ceiling Standoff*, 112 COLUM. L. Rev. 1175, 1177-1181 (2011) (detailing the Constitutional implications of a default on the U.S. public debt on account of a failure to raise the debt ceiling).

[79] D. Andrew Austin & Kenneth R. Thomas, *Clearing the Air on the Debt Limit*, Congressional Research Service Report 7-5700 (Nov. 2, 2017) (setting out the history of the debt ceiling).

[80] Second Liberty Bond Act of 1917 (Pub.L. 65-43, 40 Stat. 288).

[81] Amendment to Second Liberty Bond Act, Pub. L. No. 76-201, 53 Stat. 1071(1939).

[82] Buchanan & Dorff, *supra* note [ ], 1183-1185; 31 U.S.C. § 1105(a)(10) (requiring that the budget submitted to Congress by the President must include "essential information on the debt of the United States").

[83] On deficits, see, for example, Neil H. Buchanan, *What Do We Owe Future Generations?*, 77 GEO. WASH. L. REV. 1237 (2009) (arguing for a de-emphasizing of deficit-driven conversations in understanding the policy trade-offs underlying federal debt levels).

ceiling" set by congressional budget authorization and appropriations ensures its added control over levels of Treasury's debt.[84]

In addition to legislative constraint, the Treasury itself establishes internal rules and norms to govern how it carries out debt issues. Its primary goal lies in ensuring that its debt management results in financing that comes at "lowest cost over time."[85] As Professor Garbade writes, this core Treasury tenet constitutes a key pillar that anchors how Treasury envisions market design, function and the relationship between the U.S. government and investors in its public debt.[86] While a full discussion of internal Treasury rules and regulations falls outside the scope of this Article, it is worth noting how this imperative to finance debt at lowest cost exerts a deep influence on market norms and practices. As Garbade highlights, to bring investors to the market, the Treasury seeks to assure investors that its debt management is "regular and predictable." What this means, in practice, is that Treasury issues bonds at "regular and predictable" intervals, using "regular and predictable" sales processes and bearing "regular and predictable" denominations and maturities.[87]

The significance of this policy is made clear by noting the consequences of its absence. Before this policy became institutionalized throughout the 1970s, Treasury used an *ad hoc* and "tactical" approach. This meant that Treasury only went to the debt markets as and when it needed the money and issued securities in denominations and maturities that suited it best at a particular moment. This lack of consistency in issuing Treasuries came with costs. Market participants lacked information about when they would be called on to supply debt capital. This fostered uncertainty that meant that the Treasury could not borrow at the lowest possible rate. Rather, investors priced in this absence of clear information and being asked to lend only at moments that best suited the Treasury but that may have come at times when investors also had access to competing investment opportunities (like in stocks or corporate bond offerings).[88] As Garbade argues, irregular Treasury issues resulted in the U.S. government facing an increased cost of capital that has since been reduced by a strict adherence to "regular and predictable" in U.S. Treasury policy.

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[84] Buchanan & Dorff, *supra* note [ ], 1183-1185; 31 U.S.C. § 3104(a) (allowing "The Secretary of the Treasury may borrow on the credit of the United States Government amounts necessary for expenditures authorized by law . . . .").

[85] U.S. DEP'T OF TREASURY, DEBT MANAGEMENT OVERVIEW AND QUARTERLY REFUNDING PROCESS, https://www.treasury.gov/resource-center/data-chart-center/quarterly-refunding/Pages/overview.aspx.

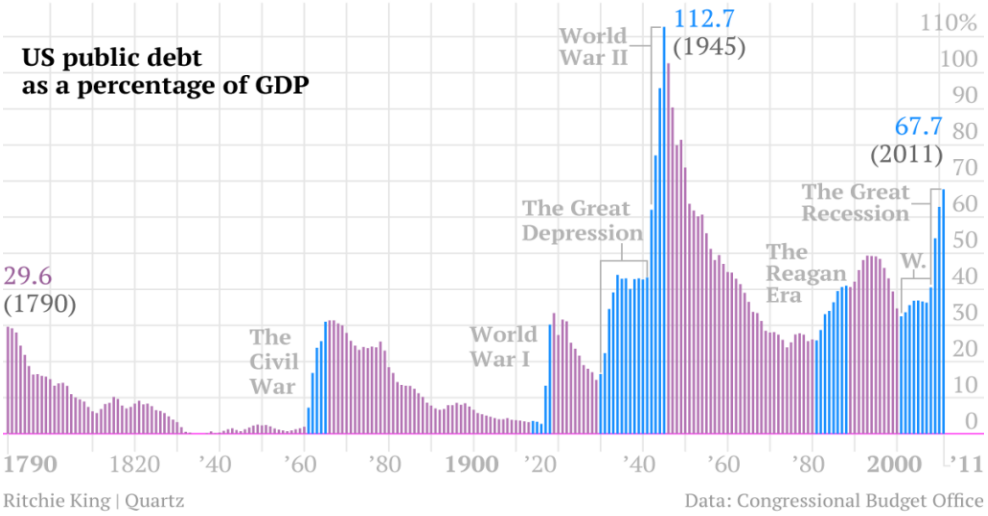
[86] Kenneth D. Garbade, *The Emergence of "Regular and Predictable" as a Treasury Debt Management Strategy*, FRBNY Policy Review, 55-56 (2007) ("Financing at least cost over time is the most frequently and consistently cited goal of Treasury debt management").

[87] Garbade, *supra* note [ ].

[88] Garbade, *supra* note [ ].

Within these legal boundaries set by Congress as well as by the Treasury in relation to how it runs bond issues, the capacity of the U.S. to borrow using capital markets has given the country policy freedom. The Treasury market has proven itself to be instrumental throughout the last two centuries in ensuring that the U.S. can access the capital it needs and when it needs it in order to achieve significant policy goals. Accordingly, levels of national public debt have routinely surged around critical periods like the Civil War, World War I, World War II, the Great Depression, World War II, the 1980s recession years, post-9/11 – and most recently, in the decade following the Financial Crisis.[89] This financial capacity has arguably placed the U.S. on a strong footing to take on large-scale geopolitical and domestic projects with greater facility than other countries that face tighter fiscal, financial and institutional constraints.[90]

Figure 3:[91]



[89] Matt Phillips, *The Long Story of U.S. Debt, From 1790 to 2011, in 1 Little Chart*, ATLANTIC, Nov. 13., 2012; Peter M. Garber, Alexander Hamilton's Market Based Debt Reduction Plan, NBER Working Paper 3587 (1992) (detailing the foundations of the public debt markets by describing Alexander Hamilton's strategy of paying off the Continental Congress's Revolutionary War debt in full).

[90] Rosa Capella, *The Political Economy of War Financing*, (2012), https://repository.upenn.edu/cgi/viewcontent.cgi?article=2985&context=edissertations (discussing the balancing that states must undertake between financing wars through taxation, domestic debt, external extraction and printing). This topic is necessarily extremely complex and a full discussion is outside of the scope of this Article.

[91] Phillips, *supra* note [ ].

2. Treasuries as Backstop to Financial Markets

Treasuries play an essential role in protecting financial markets against risk. Regular and predictable supplies of Treasury debt, promising reliable delivery of risk-free cash flows have made Treasuries the the quintessential "safe asset," backstopped by the full faith and credit of the United States.[92] This perception of infallibility means that Treasuries can act as an effective substitute for dollar currency, ideal for keeping as a safeguard for rainy days.[93] As a result, Treasuries are mandated by regulation as well as by private market norms to facilitate an enormous array of financial functions and transactions. While a full analysis is outside the scope of this Article, some examples serve to underscore the significance of Treasuries for markets particularly after the 2008 Crisis.[94]

Enabling Credit Flows: Treasuries help reduce the cost to financial firms (and others) to access capital most efficiently in financial markets. First, Treasuries constitute the highest quality collateral for firms looking to access credit or enter into risky transactions.[95] Because they are perceived as being only minimally risky, they offer an ideal type of security for those looking to use this collateral in exchange for cash or to convince a counterparty to do business. Unlike stock or corporate bonds, whose values can often fluctuate, the returns from Treasuries can be clearly and precisely calculated, making them easy to value at any given time.[96] As a consequence of virtually guaranteed cash flows paid by the U.S. government, Treasuries can more easily maintain their value relative to other types of non-cash asset. And because they pay out in U.S. dollars – a generally safe and stable currency – their returns tend to be absent unexpected currency risks.[97] Possessing these unique qualities, Treasuries constitute a form of collateral that can be secured to generate credit for the

[92] *See for example,* Promontory, *supra* note [ ], 10-14.

[93] *See for example,* Promontory, *supra* note [ ], 10-14. But see, Gordon & Ye, *infra* note [ ], 3-4 (showing why Treasuries and cash are not directly substitutable).

[94] *See generally*, Anna Gelpern & Erik F. Gerding, *Inside Safe Assets*, 33 YALE J. ON REG. (2016) (describing and detailing the regime of assets presumed to be risk-free and their importance in the wake of the 2008 Financial Crisis. The authors examine the categorization of such assets and question the assumptions undergirding it).

[95] On claims on the private sector as a source of safe-assets, see, for example, Marcin T. Kacperczyk et al., *The Private Production of Safe Assets,* HEC Paris Research Paper No. FIN-2017-1212 (2017) (noting the important role of very short term claims on the private sector as a source of safe assets).

[96] Gary Gorton & Ping Ye, *Optimal Monetary Policy in a Collateralized Economy*, Working Paper (2016) (highlighting the "convenience yield" of Treasuries).

[97] Katherine Greifeld, *Investors Are Dumping Treasuries and Dollar to Take On More Risk*, BLOOMBERG, Sept. 20, 2018; Ben S. Bernanke, *The Dollar's International Role: An "Exorbitant Privilege"?* Brookings, Jan. 7, 2016, https://www.brookings.edu/blog/ben-bernanke/2016/01/07/the-dollars-international-role-an-exorbitant-privilege-2/ (noting the dollar's preeminence in global economic governance and its sources in the currency's historical stability and also the stability of institutions).

holder with little discounting to reflect the risk of the debt. In other words, all things being equal, a borrower should be able to borrow more money by securing the debt by using Treasury securities than by using an equivalent dollar value of stocks or corporate bonds.[98]

The ability of Treasuries to be reliably exchanged for cash has nourished a thriving market in which institutions with cash to spare can lend it out on a short-term basis to those needing it.[99] In return, lenders take collateral over a variety of assets that can include Treasuries, stocks, and corporate bonds. Unsurprisingly, Treasuries have proved to be the most popular form of risk-proofing, representing collateral used for 48.5% of the $2.2 trillion in lending that took place in this market in 2016.[100]

This status of Treasuries as a virtually "fail-safe" asset, akin to cash, ensures their indispensability to an enormous swath of financial deal-making. Financial contracts often require that counterparties provide collateral to one another in order to lock-in the bargain.[101] Crucially, this principle supports the operation of critical market infrastructure like securities exchanges and the risk management systems that support them.[102] Hosting billions of dollars' worth of trades daily, exchanges must ensure that parties that agree to buy and sell securities with one another follow through on their bargain and do not leave exchanges (and their risk managers) exposed.[103] To prevent instances of failing firms causing expansive liabilities, exchanges require that traders regularly post

[98] Lenders and counterparties are likely to apply a larger "haircut" or "discount" when receiving collateral in the form of stocks or corporate bonds, relative to U.S. Treasuries. See, for example, Chicago Mercantile Exchange, Financial and Collateral Management: Standard Acceptable Collateral Management, https://www.cmegroup.com/clearing/financial-and-collateral-management.html.

[99] This market is known as the "repurchase" or "repo" market. Rather than being structured as a loan agreement, the agreement to exchange cash for securities is structured as a "sale" and repurchase" agreement. Securities are "sold" to the lender in return for cash, with a promise by the lender to then repurchase these securities in due course. Functionally, however, this transaction works much like a lending agreement to exchange cash taking security over Treasuries until such time as the debt is repaid. For discussion, see, for example, Viktoria Balkanova et al., *Reference Guide to U.S. Repo and Securities Lending Markets*, Federal Reserve Bank of New York Staff Reports 740 (2015), 1-4. On the utility of repo markets for credit expansion and an analysis of how collateral is handled by those using it, Manmohan Singh, *Collateral Flows and Balance Sheet Space*, 5 J. FIN. MARKETS INFRASTRUCTURE 65 (2016).

[100] SIFMA, US Repo Market Fact Sheet, 2016, https://www.sifma.org/resources/research/us-repo-market-fact-sheet-2016/.

[101] *See for example*, MAYER BROWN, ISDA VARIATION MARGIN PROTOCOL—WHAT IS IT ABOUT? Aug. 25, 2016, https://m.mayerbrown.com/Files/News/8ac11943-ea45-4b36-b5ed-970d64386a51/Presentation/NewsAttachment/a4f20b44-4514-4c89-8a3d-99a0ae336823/art_parker_aug2516_ISDA-variation-margin-protocol.PDF.

[102] Clearinghouses provide essential risk management services for exchanges by reducing the risks that individual counterparties create. To do this, they become the counterparty to each side of the trade, the buyer to every seller and the seller to every buyer. For discussion on the role and function of clearinghouses, see generally, Yesha Yadav, *The Problematic Case of Clearinghouses in Complex Markets* 101 GEO. L. J. 387 (2013).

[103] *See for example,* the Chicago Mercantile Exchange (CME) Group, CME Reports Average Daily Volume of More Than 3.2 Million Contracts in November, Up 40 Percent from Prior-Year Period, http://investor.cmegroup.com/investor-relations/releasedetail.cfm?ReleaseID=159301.

collateral to reflect the risks they create for an exchange.[104] Once again, cash and Treasuries constitute the preferred type of security to support the performance of all types of securities transactions.[105] To encourage users to maintain high-quality collateral, exchanges generally apply the lowest discount to collateral offered in the form of Treasuries and cash and, also, do not limit how much of these assets traders are allowed to provide.[106]

These measures showcase the deeply protective role played by Treasuries in assuring core securities trading functions in financial markets. In the absence of Treasuries, firms would be forced to hold large amounts of cash on hand, or a portfolio of high-performing corporate bonds or stocks. In the case of the latter, a dollar's worth of stock would cover a smaller exposure for a trader than would a Treasury bond of equivalent face value. Accordingly, a trader would have to purchase a much greater value of stocks and bonds to support their activities in the markets. Viewed more broadly, Treasuries thus introduce efficiencies into financial transactions by offering counterparties assurance of performance and a stronger ability to protect themselves against the risks of failure.

Regulatory Levers: The protective power of U.S. Treasuries makes them ideally suited for use as regulatory levers to constrain risk-taking by financial firms. A slew of post-Crisis rulemaking requires that firms maintain a prescribed amount of high quality assets on their books to protect themselves and the market in a crisis.[107] Each instance of risk-taking by a firm, like a bank extending a line of credit for example, must be "paid for" by the entity taking the risk. Here, the bank must set aside a contribution to its reserves to reflect the chance that this loan defaults and puts the bank's balance sheet in jeopardy. Importantly, financial firms need to keep assets that can be sold quickly to generate cash, allowing them to

[104] *See for example,* Chicago Mercantile Exchange, Financial and Collateral Management, https://www.cmegroup.com/clearing/financial-and-collateral-management.html.

[105] *See for example,* Chicago Mercantile Exchange, Collateral Types Accepted for Futures, Options, Forwards, OTC FX & Commodity Swaps Acceptable Collateral for Treasuries, TIPS & Strips, https://www.cmegroup.com/clearing/financial-and-collateral-management/acceptable-collateral-for-treasuries-tips-and-strips.html.

[106] *See for example,* Chicago Mercantile Exchange, Collateral Types Accepted for Futures, Options, Forwards, OTC FX & Commodity Swaps Acceptable Collateral for Treasuries, TIPS & Strips, https://www.cmegroup.com/clearing/financial-and-collateral-management/acceptable-collateral-for-treasuries-tips-and-strips.html.

[107] *See for example*, Office of the Comptroller of the Currency, Final Rule on Liquidity Coverage Ratio, OCC BULLETIN 2014-51 (Oct. 17, 2014); Dep't of the Treasury et al., Liquidity Coverage Ratio: Liquidity Risk Measurement Standards; Final Rule, 12 CFR Part 329 (Oct. 10, 2014); See also, Gelpern & Gerding, *supra* note [ ], 369, 371-373, 378. Professors Gelpern and Gerding note the recurring appearance of contracts labelled as "safe assets" for decades by regulators and policymakers, to include government debt but also other types of contracts such as AAA-rated corporate bonds. See also, INTERNATIONAL MONETARY FUND, GLOBAL FINANCIAL STABILITY REPORT: SAFE ASSETS: FINANCIAL SYSTEM CORNERSTONE?, 82-85 (2012) (noting the potential impact on the supply of safe assets owing, among other things, to prudential regulation). For a summary of bank capital regulation, Yesha Yadav, *Too-Big-to-Fail Shareholders,* 103 MINN. L. REV. 101, 114-133 (2018).

make payments rapidly to meet urgent short-term obligations.[108] Where firms do not have access to deep reserves of assets and if those assets cannot be easily liquidated, troubles from one institution can pass quickly to another as short-term debts go unpaid and firms try to sell whatever they can in distress to generate cash.[109]

U.S. Treasuries have assumed unique significance as critical bulwarks to forestall panic-prone financial crises. Unsurprisingly, U.S. government debt ranks as among the most dependably liquid asset in addition to an institution's cash reserves.[110] The stipulation on firms to maintain protective holdings of Treasuries extends beyond banks to include other kinds of institution that have system-wide resonance.[111] With this broad regulatory mandate applying to a host of large and complex financial institutions, scholars have raised concerns that it may prompt a possible glut in the supply of Treasuries. In other words, there may be too few Treasury securities available to meet the scale of mandated demand.[112] However, as the U.S. government ramped up borrowing following the Crisis, financial institutions like commercial banks have emerged as among the most active buyers of Treasury debt.[113]

In post-Crisis financial markets regulation, the ability of Treasuries to unfailingly produce cash flows, maintain value and be easily liquidated into cash increasingly constitutes a bedrock for market stability.

[108] *See generally,* MORGAN RICKS, THE MONEY PROBLEM (2016) (highlighting the role of financial panics as a key catalyst for the 2008 Crisis); HAL S. SCOTT, CONNECTEDNESS AND CONTAGION: PROTECTING THE FINANCIAL SYSTEM FROM PANICS (2016).

[109] RICKS, *supra* note [ ], 104-140.

[110] Jane Ihrig et al., How Have Banks Been Managing the Composition of High-quality Liquid Assets? Working Paper (2017), https://www.federalreserve.gov/econres/feds/files/2017092pap.pdf. Other types of assets like corporate debt are subject to limits and also discounting or haircutting to reflect risk.

[111] These can include, for example, clearinghouses. On derivatives clearinghouses see, for example, 17 CFR Part 39.11 on Derivatives Clearing Organizations (noting the need to keep Treasuries and other high quality assets as part of financial resources to be maintained by a clearinghouse); It may be worth noting that regulation of money market mutual funds, post-crisis, have led to a demand for funds that invest only in government debt. See, Investment Company Institute, Summary of Key Money Market Fund Regulatory Requirements, https://www.ici.org/mmfs/current/16_mmf_reg_summ; Andolfatto & Spewak, *supra* note [ ].

[112] IMF, *supra* note [ ]; Andolfatto & Spewak, *supra* note [ ].

[113] Andolfatto & Spewak, *supra* note [ ].

Figure 3
Commercial Bank Treasury Security Holdings to Private-sector Loans, 2000-17

SOURCE: Board of Governors of the Federal Reserve System.

B. The Importance of Tradability

For Treasuries to achieve this suite of goals – funding the U.S. government, anchoring transactions and protecting financial stability – they must be capable of being traded quickly and cheaply. To attract creditors as well as to ensure that Treasuries function as a constant source of value, investors need to be assured that their securities can be rapidly bought and sold. Fostering a "liquid" market for Treasuries – where those wanting Treasuries can readily buy them; and those needing cash can sell – represents a critical pillar of U.S. Treasury policy.[114]

On this front, U.S. Treasuries are really no different from any other kind of security like a share or corporate bond. It is almost a tautology in finance theory that "liquid" securities markets bring a multitude of economic gains.[115] If investors of all types can transact easily with one

[114] Jerome H. Powell, Structure and Liquidity in Treasury Markets, Speech at the Brookings Institution (Aug. 3, 2015), https://www.federalreserve.gov/newsevents/speech/powell20150803a.htm; Marcus Brunnermeier & Lasse Pedersen, *Market Liquidity and Funding Liquidity*, 22 REV. FIN. STUD. 2201 (2009) (discussing the significance of Treasury market liquidity for the repo or repurchase market).

[115] In their seminal work documenting the positive impact of liquidity on bid-ask spreads, Yakov Amihud & Haim Mendelsohn, *Asset Pricing and the Bid-Ask Spread*, 17 J. FIN. ECON. 223 (1986). The scholarly literature in finance and economic scholarship is extensive. It is also worth noting that

another to assume or offload risk, they gain privately but their interactions also create positive aggregate effects for the market as a whole.[116]

For a start, investors will be more generous with their money and information when they can cheaply enter and exit markets. Investors face a number of uncertainties when looking to trade: they must find another party to take the other side of the bargain; ensure that this bargain is honored by the counterparty – rather than broken whenever a better opportunity presents itself; assure themselves that they can make the most of private research to gain an edge against others and not have the fruits of this work pilfered by others; and possess confidence that they will be effectively protected from fraud, manipulation, mistakes and other misfeasance.[117] As Professor Damodaran writes, the more prevalent these risks are, the higher the cost any investor will have to incur to protect herself.[118] Rationally, those that regularly assume such risks will charge a higher premium to cover this exposure. They may enter the market less frequently, choosing only those opportunities where the pay-offs compensate them sufficiently well for the risks. Some may abstain from investing at all because the uncertainties are too daunting and they may be ill-equipped to take the steps needed to protect themselves.[119]

A secure trading environment, offering investors plentiful, low-cost opportunities for trading, should reduce transaction costs and limit rational discounting of capital. Importantly markets should become informationally richer. Where investors all come together to transact, each possessing varying pools of information and perspectives, securities prices should offer a more precise picture of what these claims are worth.[120]

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liquidity is a notoriously complex and slippery term that may be subject to multiple types of measure (such as bid-ask spread, depth of the market or overall trading volume). For discussion of the literature and the difficulty of defining liquidity, David Goldreich et al., *The Price of Future Liquidity: Time-Varying Liquidity in the U.S. Treasury Marke*t, 9 REV. FIN. 1 (2005); Darrell Duffie, *Special Repo Rates*, REV. FIN. 51 (1996); Rajna Gibson and Nicolas Mougeot, *The Pricing of Systematic Liquidity Risk: Empirical Evidence from the US Stock Market*, 28 J. BANKING & FIN. 157 (2004) (showing that the ability to trade easily – liquidity – is a significant aspect of the risk premium applied by equity investors).

[116] Aswath Damodaran, *Equity Risk Premiums, Determinants, Estimations and Implications*, 16-18 (2016) (noting the importance of liquidity in determining risk premia in equity markets, with greater liquidity resulting in lower premia).

[117] For a discussion of transaction costs in trading*,* Yesha Yadav, *Oversight Failure in Securities Markets,* CORNELL L. REV., PART I(A) (*forthcoming*)

[118] Damodaran*, supra* note [ ], 2-8.

[119] *See generally,* Damodaran, *supra* note [ ].

[120] This represents the classic theory underlying the efficient capital markets hypothesis that states that securities prices reflect the available public information in the market. While this theory has come in for considerable critique, it offers, at least, a partial account of the significance of information and liquidity as a way to generate informative prices. Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383 (1970) ("a market in which prices always 'fully reflect' available information is called 'efficient'). For critiques, see, for example, ANDREI SCHLEIFER, INEFFICIENT MARKETS: AN INTRODUCTION TO BEHAVIORAL FINANCE (2000); Lawrence H. Summers, *Does the Stock Market Rationally Reflect Fundamental Values?*, 41 J. FIN. 591 (1986). On the market structure explanation

These benefits, invariably, extend to Treasury markets. Investors in government debt – even if it comes with guaranteed pay-outs – gain from being able to quickly sell their claim for cash. Investors may face a cash crunch. They may not wish to be locked-in to a multi-year commitment; some may want to change their investment preference from a low-risk Treasury to a higher-risk corporate bond. Others will want to buy Treasury debt in a timely fashion. They may need to rapidly bolster their capital reserves, re-balance their portfolios into low-risk securities, or put their wealth into long-term investments with regular, assured cash flows (e.g. retirement planning). A sudden crisis will likely drive escalating demand for liquidity in Treasury markets.[121] Unlike other types of securities, Treasuries represent the quintessential safe asset – necessary for those looking to shore up dwindling reserves, as well as by those needing to sell their government debt to meet urgent cash needs.[122] It follows that when Treasury markets fail to allow investors to trade rapidly, investors will discount they capital they put into the market in response or refrain from entering it altogether.[123] Ultimately a systematic deficiency in Treasury market liquidity and the need for investors to incur high transaction costs to protect themselves will redound to the detriment of the taxpayer. The U.S. government will have to pay more to borrow and may face greater uncertainties about whether it will be able to gain access to capital when it needs. Put differently, the U.S. will have to raise more money from its citizens in order to cover a higher interest bill or re-evaluate policy choices to reflect this diminished and more expensive access to capital markets.

Scholars have shown that investors place heavy emphasis on liquidity in Treasury markets.[124] Historically Treasuries have tended to trade in a deeply liquid market, where investors can enter and exit with ease.[125] Indeed commentators and policymakers routinely flaunt the U.S. Treasury market as one the most liquid markets anywhere in the world.[126] But scholars also note that certain kinds of Treasuries enjoy greater interest from investors – and better liquidity – than others.[127] These more attractive

for how prices become efficient, see the classic account in, Ronald Gilson & Reinier R. Kraakman, *The Mechanisms of Market Efficiency*, 70 VA. L. REV. 549 (1984).

[121] Noeth & Sengupta, *supra* note [ ].

[122] Noeth & Sengupta, *supra* note [ ].

[123] Goldreich et al., *supra* note [ ].

[124] *See generally*, Goldreich et al., *supra* note [ ].

[125] James Clark & Gabriel Mann, *A Deeper Look at Liquidity Conditions in the Treasury Market,* U.S. Department of Treasury: Treasury Notes, May 6., 2016 ("The U.S. Treasury market is the deepest and most liquid government securities market in the world." The blog post goes on to note that current measures of liquidity are aligned with historical standards).

[126] *See for example*, Clark & Mann, *supra* note [ ]; Kevin McPartland, *Sizing and Segmenting in the U.S. Treasury Market*, Greenwich Associates (Dec. 12, 2017).

[127] Treasuries are classified as being "on-the-run" as well as "off-the-run." On-the-run Treasuries represent a brand-new issue of a Treasury bond (for example a 2-year bond). Off-the-run Treasuries are bonds that remain outstanding but with a newer issue of Treasury bonds that carries the same

securities have commanded a price premium, that is they have traded at higher prices (and, thus, at lower interest rates),[128] relative to those that investors regard as lacking this level of smooth liquidity.[129]

Still the issue of tradability poses distinct challenges for Treasuries than it does for other kinds of assets. In short, Treasuries are special. They represent a credit risk on the U.S. government, not a private company. Assumption of their default-free status means that firms use them (or are required to use them) as protection against risk. And in times of crisis, the market functions as a safe haven for investors from across the world, including other countries. These distinctive features of Treasuries – not shared by other kinds of claims like shares or bonds – raises dangers for the capacity of the market to maintain reliable liquidity.

Public Disclosure and Trading: Liquidity conditions for Treasuries must be robust enough to withstand heavy and potentially one-directional trading in response to periodic public disclosures by the U.S. government. Unlike private companies, whose securities prices vary by firm depending on public as well as private information, the value of Treasuries tend to link to regular public news releases by the U.S. government.[130] Moreover, nearly all types of Treasuries tend to respond to these macroeconomic news releases (albeit at varying intensities).[131] While the share prices of Google or Comcast depend on general economic events as well as firm-specific news, U.S. Treasuries react as a whole to episodic releases of government data (e.g. unemployment numbers, retail sales, interest-rate changes and so on).[132] According to one study, Treasury prices responded most significantly within one-minute (in 1997) of a scheduled news release. Modern Treasury markets react with much greater alacrity. Automated computerized trading means that Treasuries prices change

maturity. To take an example, if the U.S. Treasury issues 2-year bonds on a monthly basis, then there will be 24 outstanding issues of 2-year bonds. The newest issue is called "on-the-run" and generally attracts the greatest investor interest and liquidity, whereas past issues of 2-year bonds are known as "off-the-run." As Goldreich et al., note, off-the-run issues get gradually less liquid the closer they get to being fully paid out by the Treasury. So, an off-the-run bond with 14-months left until redemption will be more liquid than one with 8-months left until it is redeemed. The newest issue of a 2-year bond, with the full 24 months (approx.) left until repayment will be the most liquid. Goldreich et al., *supra* note [ ]. In addition, Treasury Inflation Protected Securities or TIPS (a kind of Treasury bond that is indexed to inflation) can also trade at a discount relative to a conventional Treasury bond. Stefania D'Amico et al., *Tips from TIPS: the Informational Content of Treasury Inflation-Protected Security Prices*, Federal Reserve Board Discussion Series (2014).

[128] In trading bonds, bond interest rates have an inverse relationship with prices. So bonds with a higher interest rate (meaning, the debtor poses a high risk) trade a lower current price; by contrast, the lower the interest rate (the debtor is low risk) trade at a higher present price.

[129] Goldreich et al., *supra* note [ ]. See also, Jean-Sébastien Fontaine and René Garcia, *Bond Liquidity Premia*, Bank of Canada Working Paper 2009-28 (2009).

[130] Pierluigi Balduzzi et al., *Economic News and the Yield Curve: Evidence from the Treasury Market*, NYU Stern Working Paper Fin-98-005 (1997).

[131] Balduzzi et al., *supra* note [ ].

[132] Balduzzi et al., *supra* note [ ].

rapidly and forcefully – in milliseconds or less – following a release, creating an immediate surge of trading activity to good or bad news.[133]

This kind of trading behavior is understandable. Despite varying maturities, Treasuries represent credit risk on the U.S. government and the value of the U.S. dollar. Investors in the equity market can choose from an array of public companies, each promising varying future cash flows, corporate governance outcomes or competitive gains. Investors can perform private research on these companies and model likely price changes based on this effort as well as publicly available information. By contrast, Treasuries offer a more monolithic risk profile. Price changes follow regularly scheduled, freely distributed, macroeconomic government news releases. Private research on U.S. economic news – though useful – is quickly superseded by the government's own disclosures.

Treasury markets thus confront enormous pressure to supply liquidity at such revelatory moments. Depending on whether the news is good or bad, the rush to trade can mean that investors transact in a similar way. Empirical studies confirm the intuition that liquidity in Treasuries markets should come under extreme stress following major macroeconomic data releases. Trading volumes surge, prices rise, volatility increases as investors clamor to enter the market.[134]

The Impact of Regulation: As noted above, Treasuries play an essential role in post-Crisis regulation as a safe asset for financial firms to maintain in prescribed quantities. In addition, government debt helps to facilitate any number of transactions where it offers a trusted security against losses and counterparty default.

This regulatory reliance on Treasuries can complicate the dynamics that drive liquidity. First, scholars note that the requirement that firms maintain prescribed levels of Treasuries creates a pool of market participants that are likely to hold onto their securities, rather than actively trade them.[135] The fact that firms must maintain a steady supply of Treasuries can reduce the number of trading counterparties and potentially raises the transaction costs of buying and selling Treasuries if finding

[133] George J. Jiang et al., *High-Frequency Trading around Macroeconomic News Announcements: Evidence from the U.S. Treasury Market*, Bank of Canada Working Paper 2014-56 (2014) (noting that high frequency traders cause a surge of activity in Treasuries trading in the wake of macroeconomic news announcements).

[134] *See for example*, Michael J. Fleming & Eli Remolona, *Price Formation and Liquidity in the U.S. Treasury Market: The Response to Public Information*, 54 J. FIN. 1901 (1999) (describing a two-stage trading process following the release of announcements, culminating in a "surge" of trading volume and price volatility); Jiang et al., *supra* note [ ] (noting large and immediate trading volumes driven by automated high frequency traders transacting around news announcements); Albert Menkveld et al., *The Informativeness of Customer Order Flow following Macroeconomic Announcements: Evidence from Treasury Futures Markets*, Working Paper (Nov. 2006) (observing correlated trading in Treasury futures).

[135] Mark House et al., *Understanding the New Liquidity Coverage Ratio Requirements*, Federal Reserve Bank of Richmond Economic Brief EB16-01, 4-5 (2016); Ihrig et al., *supra* note [ ].

trading partners becomes too difficult. Conversely, when firms face a systemic crisis and must all sell Treasury holdings at once, their actions may spur convulsive pressure on markets where important market participants try to liquidate their holdings. During periods of panic, there may be an insufficient availability of buyers, particularly where firms lack access to cash or other funding with which to buy Treasuries.

Finally, the stipulation that firms maintain a supply of Treasuries, combined with the risk that these securities may need to be sold-off during a panic, places heavy demand on the market. Major financial firms may want all at once to buy and sell large orders of U.S. Treasuries, meaning that the market must be able to find counterparties to take on sizable position without triggering price swings. Quite apart from periodic crises, the significance of the Treasuries as a regulatory and risk management mechanism implies that the market must be prepared to absorb orders of all sizes and to do so in way that still leaves trading opportunities for other investors. As a source of immense economic utility, maintaining tradability for Treasuries constitutes the ultimate policy prerogative for regulators.

II. PUBLIC REGULATION AND PRIVATE BACKSTOPS

The centrality of Treasuries to global finance sits uneasily within a regulatory framework that is unusually fragmented and stubbornly resistant to change.[136] Unlike equities or bonds that are overseen by a lead primary regulator like the Securities and Exchange Commission (SEC), Treasury markets are supervised jointly by a plurality of multiple top regulators.[137] Crucially, they rely on a core group of 23 large financial firms – so-called primary dealers – that are expected to support the market's function and provide insight and information on its workings to regulators.[138]

Belief in the risk-free nature of Treasuries and the reputation of this market as an unspectacular part of an otherwise bustling securities ecosystem might explain this tradition of looser oversight.[139] A supporting network of 23 repeat participants also makes sense where these firms

[136] The financial regulatory system of the U.S. is famously fragmented where it is common for firms to be subject to regulation by a multiplicity of functional regulators. The literature on this topic is extensive. For discussion see for example, Stavros Gadinis & Howell E. Jackson, *Markets as Regulators*, 80 S. CAL. L. REV. 1239, 1244 (2007).

[137] Markham, *supra* note [ ].

[138] FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: LIST OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers.

[139] Katy Burne, *Federal Reserve's Charles Evans Says Treasury Market Needs a Clear Regulator*, WALL ST. J. May 6. 2016.

might be motivated to promote good behavior on account of having skin-in-the-game in the market's continued integrity.

This Part describes the key pillars of public oversight in Treasury markets as well as the role played by the primary dealers in offering a private backstop to monitor and manage everyday trades. Despite its persistence, this Part shows that this framework confronts a major challenge with the arrival of automated, algorithmic trading.[140] Whereas high-speed, hi-tech automated trading is ubiquitous in equity markets, its incorporation into Treasury markets poses difficult questions for a regulatory system that has long avoided fundamental reform. As automated traders join the usual cast of primary dealers, this Part shows that the underlying structural mechanics of this market are transforming, while regulation struggles to keep pace.

A. Dispersed Public Oversight

The importance of the Treasury market to the economy and the financial system gives several regulators a stake in its workings. This shared interest is reflected in a plural division of oversight between regulators, where no single one enjoys primary, lead regulator status.[141]

Briefly the framework may be described as follows. The U.S. Treasury is charged with writing the rules for governing how Treasuries are issued as well as for how these securities are bought and sold in the secondary market. This gives the Treasury the power to set the conditions by which auctions are conducted that place Treasuries in the hands of initial purchasers.[142] Pursuant to the Government Securities Act 1986, the Treasury is authorized to set out the terms on which traders in the secondary market interact.[143] The Federal Reserve Bank of New York (FRBNY) acts as an agent for and helps Treasury ensure the smooth operation of its auctions.[144] Importantly, a network of sector-expert regulators monitors the firms they would normally oversee. The Federal Reserve (the Fed) and the Office of the Comptroller of the Currency (OCC) (and state banking regulators, where appropriate) supervise the banks that act as dealers in Treasuries. The SEC and FINRA regulate and

[140] *See discussion infra* Part [ ].

[141] Burne, *supra* note [ ]; Markham, *supra* note [ ], 199-204.

[142] See also, 31 U.S.C. § 3121; Dep't of Treasury, Securities and Exchange Commission & Board of Governors of the Federal Reserve System, Joint Report on the Government Securities Market, 3-5, A-14 (1992) (hereinafter, the "Securities Market Joint Report").

[143] Securities Market Join Report, *supra* note [ ], A-14-A-15.

[144] Federal Reserve Bank of New York, Treasury Debt Auctions and Buybacks as Fiscal Agent, https://www.newyorkfed.org/markets/treasury-debt-auctions-and-buybacks-as-fiscal-agent.

monitor non-banks securities dealers. The CFTC, the primary U.S. regulator for derivatives, is, unsurprisingly, the key authority for derivatives that are linked to Treasuries (notably, Treasury futures).[145]

These overlapping jurisdictional boundaries are also at play when deciding who enforces the rules. The U.S. Treasury guards enforcement authority to promote standards relating to debt auctions.[146] But the SEC, Finance Industry Regulatory Authority (FINRA), the Fed, CFTC (and others, like state banking regulators) possess power to take action against fraud, manipulation, problematic sales practices, transaction reporting, dealer fees and commissions etc. against those they regularly supervise.[147] Where maintaining Treasuries is mandated to meet particular compliance objectives, regulators that prescribe them (e.g. banking authorities) will take action to assure compliance.[148] These complex, shared spheres of oversight reflect a simple design objective: to harness the existing network of agencies to oversee the Treasury market rather than to create a specific and new regime for this purpose.[149]

Moreover the usual panoply of securities rules often apply with lesser intensity to trading in government debt. As a general matter, Treasuries enjoy "exempt" status in securities regulation, meaning that issues of government debt do not need to be registered and be subject to the SEC's rulebook on detailed mandatory disclosure.[150] They do, however, fall within the purview of anti-fraud and anti-manipulation provisions governing securities, ensuring that regulators can punish creative schemes to rig Treasury auctions, bid-up prices, or trade on insider information.[151] While broadly protective, other kinds of regulation – common to trading in equities or bonds – apply with caveats or do not apply at all to trading in Treasuries.

Take reporting obligations, for example. For much of its history, trading in U.S. Treasuries has lacked a systematic reporting regime for secondary market trades.[152] Rather than requiring firms to submit to a standardized reporting regime – as is common in equities, for instance –

[145] Markham, *supra* note [ ], 199-204; Securities Market Join Report, *supra* note [ ], A-14; Chairman Jay Clayton, Remarks at the Third Annual Conference on the Evolving Structure of the U.S. Treasury Market, Nov. 28, 2017, https://www.sec.gov/news/speech/clayton-2017-11-28.

[146] Securities Market Join Report, *supra* note [ ], xi., A-14-A-16.

[147] It should be noted that, although Treasuries are "exempt" securities under the Securities Act 1933, meaning that they do not require to be registered, they are still subject to anti-fraud and anti-manipulation protections under Rule 10b-5 of the Securities Exchange Act. Markham, *supra* note [ ], 200; Securities Market Join Report, *supra* note [ ], xi., A-14-A-16; Joint Report, *supra* note [ ], 9-10.

[148] *See discussion supra* Part I; Clayton, *supra* note [ ].

[149] Securities Market Joint Report, *supra* note [ ], A-16.

[150] Markham, *supra* note [ ], 200-204.

[151] Markham, *supra* note [ ], 200-204.

[152] *For discussion,* Joint Report*, supra* note [ ], 9-10; Commissioner Luis Aguilar, *Ere Misery Made Me Wise: The Need to Re-visit the Regulatory Framework of the U.S. Treasury Market*, Jul. 14, 2015.

regulation had left the matter for market participants to largely organize between themselves.[153] While firms and trading platforms have long kept private records or provided private feeds of information, regulation has avoided imposing affirmative reporting requirements.[154] The consequences of this permissive approach came sharply into focus during the October 2014 *Flash Rally* when authorities struggled to retrieve the data needed to piece together an account of what happened.[155] As a result, in 2017 regulators scrambled to devise a reporting framework for Treasuries, requiring dealers to provide data to FINRA in order to close the gap.[156] As noted below, despite this determined effort on the part of policymakers, sizable gaps in data collection remain.[157]

Beyond reporting requirements, a host of other securities rules apply with qualifications or exemptions to dealers in Treasuries.[158] As one industry commentator notes, out of the thousands of FINRA rules for securities trading, just 46 apply to Treasuries.[159] Well-worn FINRA regulations like those prohibiting dealers from using information on clients to trade ahead of them ("front running") do not apply to Treasuries.[160] And rules that do apply have, unsurprisingly, been difficult to enforce. In the absence of mandatory reporting and regulatory resources devoted to

[153] Aguilar, *supra* note [ ]. On equities reporting, see for example, SEC Rule 13h-1, 17 CFR PARTS 240 and 249 (on mandatory reporting of trades by large traders).

[154] For example, trading platforms that only transact in U.S. Treasuries do not need to comply with the SEC's rules governing Alternative Trading Systems and public reporting rules have not applied to Treasuries, unlike for equities or derivatives. Joint Report, *supra* note [ ], 10. It is worth noting that platforms where Treasuries trade have often offered market data by way of a subscription service or for those utilizing their platform. See for example, NEX Markets, *BrokerTec Market Data*, https://www.nexmarkets.com/products-and-services/data-and-analytics/brokertec-market-data.

[155] Aguilar, *supra* note [ ]; Joint Report, *supra* note [ ], 9-10.

[156] FINRA, TRACE TRADE REPORTING OF TREASURY SECURITIES, http://www.finra.org/industry/trace/trace-trade-reporting-treasury-securities; Board of Governors of the Federal Reserve, Federal Reserve Board Announces Plans to Enter Negotiations with FINRA to Potentially act as Collection Agent of U.S. Treasury Securities Secondary Market Transactions Data, https://www.federalreserve.gov/newsevents/pressreleases/other20161021a.htm. For discussion, Doug Brain et al., *Unlocking the Treasury Market Through TRACE*, Federal Reserve Bank of New York Liberty Street Economics, Sept. 28, 2018, https://libertystreeteconomics.newyorkfed.org/2018/09/unlocking-the-treasury-market-through-trace.html (noting the impact of data reporting on more fully calibrating the composition of the Treasury market and trading volumes).

[157] Alexandra Scaggs, *The Dealer-Trader Distinction and Treasury Market Regulation (updated)*, FIN. TIMES (ALPHAVILLE), Oct. 28 2016.

[158] Note FINRA Rule 0150 setting out the key rules applicable to trading in exempt securities such as US Treasuries. FINRA, Rule 0150, http://finra.complinet.com/en/display/display_main.html?rbid=2403&element_id=5454.

[159] Kevin McPartland, *TRACE "Unlocks" the Treasury Market for the Official Sector. Everyone Else Gets a Peek Through the Keyhole*, Greenwich Associates, Oct. 3, 2018 (noting also that this figure used to be 39 prior to the 2017 Treasury reporting reform).

[160] Kevin McPartland, *supra* note [ ]. FINRA, Rule 5320. Prohibition Against Trading Ahead of Customer Orders, http://finra.complinet.com/en/display/display_main.html?rbid=2403&element_id=9989 (applying to equity securities).

information gathering, ferreting out instances of misconduct and misbehavior has proven to be costly at best and near impossible at worst.[161]

B. Bridging Gaps with Private Oversight

A group of private securities dealers – primary dealers – has long played a critical role in maintaining the functioning of the government debt market.[162] Their importance for assisting Treasury in issuing new debt as well as in ensuring the efficient workings of secondary trading has afforded them an elevated position from which to monitor the market.

Primary dealers are critical to virtually all stages of issuing and trading a Treasury. To understand this significance, it is worth briefly outlining the peculiar structure of the Treasury market which stands apart from all others in the uniqueness of its design.

Issuing Treasuries: The U.S. Treasury needs to have a reliable group of buyers for the debt that it issues. These counterparties must have deep pockets and possess the capacity to supply capital regularly and safely to the U.S. government.

Every issuer of debt or equity confronts the problem that there may be no buyers for its securities. It cannot, therefore, count on a guaranteed infusion of cash for contemplated projects. To solve this difficulty, typical public offerings look to underwriters – brand-name financial institutions that promise to buy all the securities offered and that take on the risk of having to on-sell these claims to investors.[163] In return, underwriters charge a (sizable) fee and, given the risk they will be taking on their books, carry out thorough due diligence on prospective issuers.[164]

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[161] Kevin McPartland, *supra* note [ ] (noting that certain kinds of offenses require regulators to obtain trading data in order to be noticed and punished). The Government Securities Act was enacted in response to instances of misconduct by securities dealers and there have been crackdowns against manipulation and price-rigging at auctions. For discussion, see, Markham, *supra* note [ ], 200-204. On allegations of bid-rigging in Treasury auctions, see, for example, Keri Geiger & Alexandra Scaggs, *U.S. Probes Treasuries Niche That Investors Claim Is Rigged by Big Banks*, BLOOMBERG, Nov. 9, 2015.

[162] Dupont & Sack, *supra* note [ ].

[163] *See for example*, Shane Corwyn & Paul Schultz, *The Role of IPO Underwriting Syndicates: Pricing, Information Production, and Underwriter Competition*, 60 J. FIN. 443 (2005) (detailing the role of underwriting syndicates in enhancing issuer signaling and producing information). On the firm commitment underwriting model, where underwriters take on the risk of the offering, Sung C. Bae and Haim Levy, *The Valuation of Firm Commitment Underwriting Contracts for Seasoned New Equity Issues: Theory and Evidence*, 19 FIN. MANAGEMENT 48 (1990).

[164] Hsuan-Chi Chen & Jay Ritter, *The Seven Percent Solution*, 55 J. FIN. 1005 (2000)(a seminal article that notes clustering in underwriter IPO fees at around 7% gross spread, much higher than in other developed markets). See also, Corwyn & Schultz, *supra* note [ ] (on the information production function of underwriters).

The U.S. Treasury, as issuer, faces a more interesting trade-off. It presents a far fewer credit risks than the typical corporate issuer, diminishing the need for due diligence. But its need for capital is expansive and continuous, particularly where money is needed to fund major public policy initiatives like national defense, financial crises or to support the social safety net (e.g. Social Security, Medicaid and Medicare). If the Treasury is unable to successfully raise this capital whenever it needs, it faces the risk that investors eventually lose faith in its quality of its debt as prospective investment.[165] When investors must think twice before funding the Treasury, they may charge more and force taxpayers to bear higher costs in debt repayment over and above what might correctly reflect the government's real credit risk.[166] Perhaps more importantly for everyday life, these fiscal dynamics will likely cause the U.S. government to be constrained in its capacity to carry out policymaking.

In short, the U.S. Treasury must ensure that the capital markets will purchase its debt at a reasonable price. Those who do lend need to be reliable and well-capitalized. Further, they cannot easily renege on commitments to invest in case their actions cause Treasury issues to fail or to convey an overly negative signal to the market.

Reliance on so-called "primary dealers" in the Treasury market is anchored in these high-stakes trade-offs. Even though Treasury issues are open to the broad swath of securities dealers, the main purchases of Treasury debt come from the group of 23 designated, pre-selected primary dealers.[167] According to one 2007 study, primary dealers purchased around 71% of all new issues using their own money and for their own account.[168]

Primary dealers comprise major international bank and investment banks that possess sufficiently robust balance sheets to offer a safe and reliable counterpart to the U.S. government.[169] They agree to "participate meaningfully" in Treasury auctions by bidding for a pro-rata share of new issues at "reasonably competitive" prices.[170] As part of this commitment, they must purchase Treasuries even if market environments look

[165] Garbade, *supra* note [ ]. For a history of the primary dealer system and its origins, Kenneth D. Garbade, *The Early Years of the Primary Dealer System*, Federal Reserve Bank of New York Staff Reports No. 777 (2016).

[166] Garbade, *supra* note [ ].

[167] Dupont & Sack, *supra* note [ ], 786-787.

[168] Michael J. Fleming, *Who Buys Treasuries at Auction*? Current Issues in Economics and Finance 13 (2007).

[169] FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: EXPECTATIONS OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers; FEDERAL RESERVE BANK OF NEW YORK, FEDERAL RESERVE BANK OF NEW YORK POLICY ON COUNTERPARTIES FOR MARKET OPERATIONS, https://www.newyorkfed.org/markets/counterparties/policy-on-counterparties-for-market-operations.

[170] FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: EXPECTATIONS OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers.

unfavorable.[171] Owing to the demands faced by primary dealers, only large and well-capitalized international banks and investment banks possess the resources, experience and expertise needed to take on the risks entailed.[172]

Becoming a primary dealer can have important pay-offs. Despite the risk and regular demands on capital, commentators have noted the positive impact of this designation on a firm's reputation. As an institution specifically chosen by the U.S. government for its reliability and financial strength, firms that join the club can expect a gain in terms of how they are perceived by the market. Indeed, one study observed that dealers enjoyed a noticeable boost to their stock price in the weeks following their designation as a primary dealer in government securities.[173]

Secondary Trading: Primary dealers are also key participants in the secondary market for transacting in Treasuries. As detailed in Part I, Treasuries constitute a crucial part of investor portfolios. Savers sometimes wish to keep Treasuries as a close-substitute for cash; firms rely on access to Treasuries in order to maintain a cushion of protection against a rainy day; and many need a supply of Treasuries in order to enter into common financial transactions.

Because primary dealers hold large inventories of Treasuries, investors need to be able to transact with them. Further, securities dealers of all types (not just primary dealers) might want to transact with one another in order to manage their inventories of government debt. For example, if one dealer has a surplus amount, she might wish to sell these to another whose stores are depleted. To manage these temporal fluctuations in supply and demand, dealers might need to connect with one another in order to have ready access to a market in Treasuries.

The secondary market for transacting in Treasuries has evolved so as to divide itself into two fairly distinct spaces: (i) one where customer-investors (e.g. a mutual fund) can connect with dealers (primary as well as other securities dealers) in order to procure or divest themselves of Treasuries; and (ii) an inter-dealer market where securities dealers transact

[171] FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: LIST OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers.

[172] FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: LIST OF PRIMARY DEALERS, https://www.newyorkfed.org/markets/primarydealers. In 2016, the Treasury and the NY Fed made changes to eligibility criteria for primary dealers. The NY Fed cut capital requirements for non-bank broker dealers but raised qualifying capital requirements for bank dealers (though this capital needs to be held at the broader bank holding company level), in order to diversify the kinds of firms that can become dealers. In addition, in a change from past practice, applicants must also show that they had active participation in Treasury trading in the year before applying, so they have to have 0.25% of market share. For discussion, Alexandra Scaggs, *What is a Primary Dealer (Updated)*, FT ALPHAVILLE, Nov. 22, 2016; FEDERAL RESERVE BANK OF NEW YORK, PRIMARY DEALERS: FAQS ABOUT THE NEW YORK FED'S COUNTERPARTY FRAMEWORK FOR MARKET OPERATIONS, https://www.newyorkfed.org/markets/counterparties/faq-counterparty-framework-for-market-operations.

[173] M. Carpinetti, *The Impact of Becoming a Primary Dealer: A Cross-Country Analysis*, Working Paper (2017).

with one another to modulate their supplies of securities.[174] Both markets have traditionally operated outside of traditional exchanges like the New York Stock Exchange or NASDAQ.[175] Instead, at least historically, interactions between a dealer-customer or between dealers themselves have utilized telephones or electronic screens where dealers can quote prices to customers or to each other at which they are prepared to trade.[176]

The dominance of primary dealers in the auction process has allowed them to hold a key position within the secondary market as transmission channels for securities between government and investors.[177] As prized counterparties to the U.S. Treasury, acquiring regular and ample reserves of government securities, they are best placed to create networks of customers that might regularly purchase from them and, through these repeat interactions, to predict future investor appetite. Moreover, on account of these holdings, primary dealers are equipped participate actively in the interdealer space, mediating ebbs and flows of demand to reflect the changing inventories of dealer counterparts.[178]

This central place of primary dealers in Treasuries makes them well-placed to exercise private oversight – that is, to monitor the market and to discipline each other as well as other participants.[179] While the U.S. Treasury has expressly disavowed any express mandate for primary dealers to function as private overseers, their tight network can and does offer a supportive pillar to public regulators to bridge gaps in supervision.[180] Most notably, the FRBNY tasks primary dealers with performing some market surveillance.[181] In return for their designation, they must provide information to the NY Fed and offer a continuing source of insight and intelligence into the market, its activities and trends.[182]

While the scope of this mandate remains relatively modest, it signals an institutional reliance placed on primary dealers by U.S. authorities. And it makes sense that regulators would have such confidence. Primary dealers, as this Part notes, are deeply enmeshed into

[174] Dupont & Sack, *supra* note [ ], 798-790.

[175] As a technical matter, Treasuries can be registered with the New York Stock Exchange (NYSE), though secondary trading on the NYSE is limited. Dupont & Sack, *supra* note [ ].

[176] In other words, transactions take place on an over-the-counter (OTC) basis. Michael J. Fleming et al., *The Microstructure of a Treasury ECN: the BrokerTec Platform,* Federal Reserve Bank of New York Staff Report No. 381, (2017) (hereinafter, "BrokerTec").

[177] Fleming et al., *BrokertTec, supra* note [ ], 6; Bruce Mizrach & Christopher Neely, *The Microstructure of the U.S. Treasury Market*, FRB St. Louis Working Paper No. 2007-052B, 5-6 (2007).

[178] Fleming et al., *BrokertTec, supra* note [ ], 6; Mizrach & Neely, *supra* note [ ], 5-6.

[179] The exercise of self-regulation by the industry is embedded in securities markets, for example, in the requirement that exchanges act as self-regulatory organizations with the power to write rules, monitor and discipline those that utilize their facilities. For discussion, Yesha Yadav, *Oversight Failure in Securities Markets*, CORNELL L. REV. (*forthcoming*).

[180] Securities Market Joint Report, *supra* note [ ], 19-20.

[181] Securities Market Joint Report, *supra* note [ ], 23-24.

[182] Securities Market Joint Report, *supra* note [ ], 20.

the primary as well as secondary market for Treasuries. Through this presence, they offer a relatively low-cost, system-wide monitoring mechanism that can discern trouble-spots and emerging risks. They may notice problematic, predatory sales practices targeting vulnerable customers; spot firms looking to sell large batches of their Treasuries, presaging a financial panic; or point out misbehaving dealers that may regularly be reneging on their bargains with peers in the inter-dealer market. Importantly, as a small group of firms with considerable skin in the game, primary dealers have much to lose from the inefficient functioning of the Treasury market. They can privately extract considerable reputational as well as real-world gains from their role. Beyond enjoying the U.S. government's imprimatur of approval on a cohort of firms, primary dealers can leverage their position to develop client networks, offer these customers a bevy of related financial services, and count on repeat business as they replenish their reserves of Treasury holdings.[183] In the inter-dealer space, they can work to keep the market running smoothly by buying and selling Treasuries, mediating supply and demand, to avoid a sudden collapse in prices or sharp jumps where an excessive need for Treasuries is not met with sufficient supply. This helpful "market-making" function confers public benefit by maintaining the integrity of Treasury markets and keeping them unaffected by episodic lulls and jolts to supply and demand. But primary dealers also reap gains for their own books. Each purchase and sale of a Treasury generates a fee (or "spread") for the dealer, when she sells the security for a price that is slightly higher than what she pays for the purchase.[184] Being active in this inter-dealer market, then, also holds out lucrative promise.

Of course, a tight-knit, cohesive and similarly situated group (large banks and broker-dealers) invites the risk of collusion, price-rigging or a tolerance for risk-taking from those within the "in-group." And primary dealers have, on a number of occasions, faced sanction for trying to manipulate the market in their favor.[185] This downside risk notwithstanding, as a small and highly visible part of Treasury markets

[183] Kevin McPartland, *U.S. Treasury Trading: the Intersection of Liquidity Makers and Takes,* Greenwich Associates (2015).

[184] On market-making, see generally, Yakov Amihud & Haim Mendelson, *Dealership Market: Market-Making With Inventory*, 8 J. FIN. ECON. 31 (1980) (a seminal article on the key mechanisms of market-making and the tools used by dealers to manage inventory risk); Lawrence R. Glosten, *Insider Trading, Liquidity, and the Role of the Monopolist Specialist,* 62 J. BUS. 211, 211-12 (1989); Lawrence R. Glosten & Paul R. Milgrom, *Bid, Ask and Transaction Prices in a Specialist Market With Heterogeneously Informed Traders*, 14 FIN. ECON. 71 (1985). On market-making in Treasuries, Fleming, *supra* note [ ].

[185] Markham, *supra* note [ ]; Geiger & Scaggs, *supra* note [ ]. In addition, market makers in the equity markets have undertaken price manipulation and rent-extraction from their position. William G. Christie & Paul H. Schultz, *Why Do NASDAQ Market Makers Avoid Odd-Eighth Quotes?* 49 J. FIN. 1813 (1994); Prajit K. Dutta & Ananth Madhavan, *Competition and Collusion in Dealer Markets*, 52 J. FIN. 245 (1997).

possessing a valuable franchise, they also have a lot to lose if Treasury operations go awry. These factors might suggest that primary dealers have incentives to keep an eye on the market (beyond what is required by regulators), maintain self-discipline as well as monitor their peers for disruptive behaviors that raise the cost of doing business.

In sum, however, Treasury markets stand apart in their reliance on a fairly loose and dispersed model of public oversight. Perhaps on account of this fragmentation, regulators have allied themselves with a cohort of financial firms to help manage primary issues and to count on this franchise as a motivating dynamic that nudges good behavior in secondary markets. The governing assumption underlying regulation appears to be that the relative simplicity of Treasuries and their near default-free status makes stricter regulation unnecessary.[186] Combined with time-tested analog means of trading – the use of telephones or display screens in over-the-counter secondary markets – the risks of failure appear amenable to easy monitoring and control.

C. Transformations in Market Design

The current regulatory design for the Treasury market is premised on an underlying transactional structure that has remained fairly static since the 1980s.[187] Yet over the last decade, securities markets – including those for U.S. Treasuries – have undergone a transformation as automation and algorithmic traders have flourished, endowing markets with speed, data-intensity and interconnectivity.[188] While policymakers have introduced rule-making to better tackle these phenomena in other markets (e.g. those for equities), the U.S. Treasury market has remained largely impervious to adaptive oversight.[189] Indeed, as the inquest into the 2014 *Flash Rally* revealed, regulators appear to have been caught completely off-guard by these developments.[190] A full discussion of high speed, algorithmic trading is outside the scope of this Article. A growing body of

[186] *See for example*, Securities Market Joint Report, *supra* note [ ], 19-20.

[187] Dupont & Sack, *supra* note [ ]; Garbade, *supra* note [ ] (discussing the emergence of regular and predictable issuances and their impact on the secondary market for inter-dealer trading as well as customer-dealer trades);

[188] *See for example,* Austin Gerig, *High-Frequency Trading Synchronizes Prices in Financial Markets* (Nov. 2015) (discussing the interconnection built by HFT markets in modern markets).

[189] Following the *Flash Rally* inquest, regulators introduced fuller reporting of secondary market Treasury trades since 2017. For discussion see sources cited *supra* note [ ].

[190] Aguilar, *supra* note [ ]. On new regulations to tackle HFT in equity markets see, for example, SEC Regulation Systems, Compliance and Integrity (Reg. SCI), Release No. 34 7363917 CFR Parts 240 (Feb. 2015). For discussion, see generally, Yesha Yadav, *the Failure of Liability in Modern Markets*, 102 VA. L. REV. 1031 (2016).

literature examines its implications for the quality of securities markets.[191] Yet some brief observations may be helpful to underscoring the scale of transformation underway in Treasuries and the challenges it poses for the assumptions traditionally governing regulation.

1. Automation

Algorithms in Securities Markets: Algorithms represent pre-set computerized sequences that can be programmed to facilitate various aspects of securities trading.[192] While they have been used in markets for decades, advances in communications technology, programming, artificial intelligence and data processing, have enabled trading algorithms to showcase powerful utility.[193] Rather than have human traders enter orders, transmit them to trading platforms, match buy and sell orders and, once paired, to move the trade towards execution, algorithms can be programmed to achieve these feats.

Algorithms can be programmed to respond automatically to data on securities prices, news, economic trends, prevailing market sentiment (e.g. by scraping Twitter feeds) or behavioral cues (by observing how others are trading) and to respond by submitting a series of orders for securities at a particular price.[194] Programming can include instructions on how to value particular data, using financial models and statistical analysis that allow an algorithm to attribute values to incoming news and to determine how to trade and at what price.[195] The growth of ever more sophisticated programming, availability of data sources, and artificial intelligence have produced trading algorithms that are capable of

[191] Jonathan Brogaard, Terence Hendershott & Ryan Riordan, *High Frequency Trading and Price Discovery* (European Central Bank Working Paper Series No. 1602, 2013); Merritt B. Fox, Lawrence R. Glosten & Gabriel V. Rauterberg, *The New Stock Market: Sense and Nonsense*, 65 DUKE L.J. 191 (2015); SEC. & EXCH. COMM'N, EQUITY MARKET STRUCTURE LITERATURE REVIEW, PART II: HIGH FREQUENCY TRADING, 4–7 (2014) For discussion, Yesha Yadav, *How Algorithmic Trading Undermines Efficiency in Capital Markets*, 68 VAND. L. REV. 1607 (2015).

[192] INT'L ORG. SEC. COMM'NS, REGULATORY ISSUES RAISED BY THE IMPACT OF TECHNOLOGICAL CHANGES ON MARKET INTEGRITY AND EFFICIENCY: CONSULTATION REPORT 10 (2011) ("In its simplest guise, algorithmic trading may just involve the use of a basic algorithm . . . to feed portions of an order into the market at pre-set intervals to minimize market impact cost. At its most complex, it may entail many algorithms that are able to assimilate information from multiple markets . . . in fractions of a second.")

[193] GOV'T OFFICE FOR SCI. FORESIGHT: THE FUTURE OF COMPUTER TRADING IN FINANCIAL MARKETS: FINAL PROJECT REPORT 20–50 (2012) (hereafter, "Foresight Report.").

[194] Foresight Report, *supra* note [ ].

[195] For an insightful discussion of computational modeling and analytical techniques underpinning algorithmic trading programming, Elaine Wah, *Computational Models of Algorithmic Trading in Financial Markets*, Working Paper, 15-25, 50-60 (2016).

transacting virtually independently and intelligently in real-time.[196] In other words, instead of waiting for human traders to review the analytical basis for each trade, algorithms can send out orders, receive confirmation about their success or failure, and respond automatically by tweaking their underlying programming to reflect learning from their real-world performance.[197] As Professors Rajan and Wellman note, artificially intelligent algorithms have become ubiquitous in securities markets, displacing human traders in granular, trade-by-trade decision-making processes.[198] With computerized systems tasked with buying and selling securities, trades can turnover at high-speed, measured in milliseconds and microseconds (high frequency trading or HFT), harness large quantities of data and utilize complex financial modeling.[199] By some estimates, HFT is responsible around 50-70% of U.S. equity trading by volume and as much as 80% in certain kinds of futures markets.[200]

There are good reasons to explain HFT's success. For one, it can help markets to enjoy easy and cheap tradability – or liquidity. With automated traders capable of transacting in milliseconds, holding slivers of risk at any given point in time, investors can count on an ever-present counterparty that can trade at low-cost. Moreover, the capacity of algorithms to transact rapidly and continuously throughout the day can cause automated traders to behave as market makers in function, if not always in name. By trading readily and often, their activity can keep markets working smoothly, reducing price spikes and plunges. Finance scholars have long spoken to the positive impact of high-speed algorithms in enhancing liquidity for securities markets as well as reducing the costs ("spread") faced by investors, in some cases by as much as 50%.[201]

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[196] Wah, *supra* note [ ], 50-60; Michael Kearns & Yuriy Nevmyvaka, *Machine Learning for Market Microstructure and High Frequency Trading*, in HIGH FREQUENCY TRADING: NEW REALITIES FOR TRADERS, MARKETS AND REGULATORS (David Easley, Marcos Lopez de Prado & Maureen O'Hara eds., 2013). On algorithms and their programming capacity for autonomous reasoning, Michael Wellman & Uday Rajan, *Ethical Issues for Autonomous Trading Agents,* Strategic Reasoning Working Paper (2017) (noting the significance and need for high-speed, non-human decision-making in stock markets, but emphasizing that algorithms are programmed by humans).

[197] Kearns & Nevmyvaka, *supra* note [ ].

[198] Wellman & Rajan, *supra* note [ ], 1-2.

[199] Note that there is no settled definition of HFT, simply proxies that highlight the capacity for securities to turnover in milliseconds (or less) undertaken by traders that locate their servers next to those of exchanges, utilize automated decision-making and big data. SEC. & EXCH. COMM'N, *supra* note [ ], 4-7.

[200] Rina Miller & Gary Shorter, *High Frequency Trading: Overview of Recent Developments*, Congressional Research Service Report 7-5700 (Apr. 2016) (observing that HFT-related trading drives around 55% volume in equities; 80% of volume in foreign-exchange-related futures and around 66% in interest rate and 10 year Treasury futures). Michael Mackenzie, *High Frequency Trading Under Scrutiny*, FIN. TIMES (Jan. 9. 2013) (noting that HFT equity volume was over 70%).

[201] Albert J. Menkveld, *High Frequency Trading and the New Market Makers*, 16 J. FIN. MKTS. 712, 714—718 (2013); Jonathan Brogaard, Terence Hendershott & Ryan Riordan, *High Frequency Trading and Price Discovery* (European Central Bank Working Paper Series No. 1602, 2013) (highlighting greater efficiencies and liquidity in equity markets); But see also, X. Frank Zhang, High-Frequency Trading, Stock Volatility, and Price Discovery 2–3 (Dec. 2010) (unpublished manuscript) (noting that HFT can increase

Additionally, markets are much more informationally efficient, at least in the short term. It is a mantra of finance theory that markets work better when securities prices quickly incorporate the impact of available public information. As new intelligence emerges, traders respond with buy or sell orders at a price that reflect the worth of this new learning. The more fluid this process and the richer the reserve of data capable of being processed by traders, the more informative the price formation process should be – thereby enhancing the "efficiency" of the market.[202]

It follows that HFT – capable of responding in milliseconds to expansive pools of data – should generate powerful informational efficiencies as prices constantly adjust to emerging insights.[203] Moreover, as high speed traders transact across multiple markets – like those for shares, derivatives, or Treasuries – prices across all these different asset classes can synchronize quickly.[204] Finance studies have empirically observed these intuitions play out the reality of securities trading: (i) prices are (near) instantly absorbing vast quantities of data in response to HFT; (ii) these efficiencies are traversing different kinds of markets to minimize differences between them; and (iii) securities prices across the board showcase short-term efficiencies in response to these dynamics.[205]

But HFT and automated trading also carries risks. Algorithms misfire. "Fat finger" trades may cause programs to send out orders in error; in reacting to new data, algorithms may trade on "fake news" or inaccurate information; they may all respond in tandem to similar kinds of data, amplifying the effect on prices; programming may be ill-designed to handle overly complex market environments; and algorithms may be

volatility). On HFT market-making, see discussion of the activity by one major HFT firm, Virtu Financial, a firm that operates as a market maker across multiple asset classes. On account of becoming a publicly traded company, Virtu's activities have been subject to greater disclosure, Greg Laughlin, *Insights Into High Frequency Trading From the Virtu Initial Public Offering*, 2–4 (Ctr. for Analytical Fin., Univ. of Cal. Santa Cruz, Working Paper, 2014). As Prof. Laughlin notes, Virtu depends on high volumes of trading in order to generate profits. The firm has a history of near constant profitability.

[202] Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383, 383 (1970) ("A market in which prices always 'fully reflect' available information is called 'efficient.'"); Ronald J. Gilson & Reinier H. Kraakman, *The Mechanisms of Market Efficiency*, 70 VA. L. REV. 549, 549–60 (1984) (describing the process by which the interaction of informed and other types of traders help build efficient markets); For a critical discussion of efficiency in algorithmic markets, Yadav, *supra* note [ ].

[203] See for example, RAVENPACK, FINANCE, *supra* https://www.ravenpack.com/data/?filter=finance (showing the available data packages for financial firms).

[204] Gerig, *supra* note [ ].

[205] See for example, Brogaard et al., (noting that HFT traders tend to make markets very efficient in the short-term as HFT trades transact in the direction of near-term price changes); Gerig, *supra* note [ ] (highlighting interconnection between markets and the ability of HFT traders to foster this synchronicity). Alain Chaboud, Benjamin Chiquoine, Erik Hjalmarsson & Clara Vega, *Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market,* 69 J. OF FIN. 2045 (2014) (noting high efficiencies in foreign exchange markets). The literature here is considerable. For discussion, SEC. & EXCH. COMM'N, *supra* note [ ], 4-7.

manipulative and predatory.[206] Importantly, the costs of these errors can compound incrementally as prices across the system rapidly incorporate these problems far too fast for human traders to contain the damage.[207]

Algorithms in Treasuries: High speed algorithms have, in a short period of time, become a significant force in Treasuries. As the inquest into the *Flash Rally* revealed, the inter-dealer market for Treasuries relies heavily on HFT. On the day of the *Flash Rally* itself, HFTs accounted for over 50% of all trading volume; in subsequent analysis, regulators have estimated that around 62% of the inter-dealer market is driven by HFT; with 70% conducted using electronic trading (i.e. 8% is guided by slower automated algorithms).[208] In other words, a market that was, until quite recently well-known as slow, staid and steady – reliant on telephonic trades and quotes on electronic screens – is nearing ever fuller levels of automation.[209] Inter-dealer Treasury trading occurs largely on two, specialist electronic platforms – BrokerTec and E-Speed – with BrokerTec enjoying as much as 60% of trading volume in certain Treasuries.[210] All told, the inter-dealer market mediates $270 billion of trading daily.[211]

Just like in equity markets, there are advantages to this development. According to one study, HFT has resulted in Treasury markets becoming much quicker in responding to new information. Measuring reactions to macroeconomic reports, crucial for valuing Treasuries, the study notes that HFT traders are first off the block to transact on this incoming data. As a result, Treasury prices have come to showcase high efficiencies in rapidly reflecting new information.[212]

But as indicated by the *Flash Rally*, there are also dangers whose underlying dynamics are poorly understood. Despite a year's work, five regulators could not pinpoint a cause for what caused the sudden flux in

[206] *See for* example, Alexandra Stevenson, *Knight Capital Fined*, N.Y. TIMES, Oct. 17, 2013 (discussing the debacle of Knight Capital, when a misfiring router caused the firm to lose around $450 million in 45 minutes); Alina Selyukh, *Hackers Send Fake Market-Moving AP Tweet on White House Explosions*, REUTERS (Apr. 23, 2013) (when a "fake news" tweet caused a rapid fall in the Dow Jones index and other indices); Raman et al., *supra* note [ ] (showing that algorithms are worse responding to crisis than human traders); Bruno Biais et al., *Equilibrium Pricing and Trading Volume Under Preference Uncertainty*, 81 REV. ECON. STUD. 1401, 1402–03 (2014) (noting the difficulties of algorithms to choose between different possible trading pathways during complex trading conditions); Robert A. Jarrow & Phillip Protter, *A Dysfunctional Role of High Frequency Trading in Electronic Markets* 3–6 (Johnson Sch. Res. Paper Series No. 08-2011, 2011) (on predatory algorithms).

[207] *See generally*, Gerig, *supra* note [ ].

[208] Kevin McPartland, *supra* note [ ].

[209] Fleming et al, *BrokerTec*, *supra* note [ ], 5-6 (noting that up until 1999, nearly all trading in the inter-dealer platform took place using telephones).

[210] Fleming et al, *BrokerTec*, *supra* note [ ], 5-6.

[211] Kevin McPartland, *supra* note [ ], 2.

[212] George Jiang et al., *High-Frequency Trading in the U.S. Treasury Market Around Macroeconomic News Announcements*, HKIMR Working Paper No.19/2018 (Aug. 2018) (however, this study notes some negative effects on liquidity as high speed traders transact aggressively on new disclosures).

Treasury prices. Perhaps more importantly, commentators query whether the gains in efficiency are real. Measures of price efficiency tend to be (very) short term in nature.[213] Whether algorithms designed to transact in milliseconds can be expected to reflect deeply on the meaning of macroeconomic disclosures is an open question.[214] From the operational standpoint, algorithms remain imperfect in their capacity to process all kinds of information with equal ability. Scholars note their greater advantage in interpreting hard data (e.g. numbers, statistics) versus softer input such as opinions, judgments or qualified predictions about future market events.[215] This limitation may be especially relevant in Treasuries where market-moving disclosures take the form of complex macroeconomic reports on matters such as unemployment, inflation, retail reports or the health of the country's agriculture.[216] In many instances, such disclosures often include heavy use of footnotes, statistical assumptions, qualifiers and explanatory text.[217]

2. A New Market Structure

Perhaps the most visible transformation underway in the Treasury market lies in its changing cast of actors. As noted earlier, primary dealers have long dominated the market as buyers of government debt (by franchise) as well as in its secondary trading with customers and each other. This state of affairs has – seemingly to the surprise of regulators – changed rapidly with the growth of HFT in Treasuries and the arrival of expert specialists in automated trading that have taken large chunks of market share from primary dealers in the inter-dealer market.

According to one report, the usual primary dealers have slipped far down in the rankings of the most active participants in the inter-dealer market. Examining trading data on BrokerTec – a platform that hosts around 60-70% of Treasury trading by volume – HFT firms (convincingly) took the top spots. 8 out of the 10 most active firms were HFT specialists.

[213] Brogaard et al., *supra* note [ ] (noting short term efficiency gains over increments of a few seconds).

[214] Yadav, *supra* note [ ].

[215] Sarah Zhang, *Need for Speed: An Empirical Analysis of Hard and Soft Information in a High Frequency World*, Working Paper, July 2012; Bastian von Beschwitz, Donald B. Kaim & Massimo Massa, First to "Read" the News: News Analytics and Algorithmic Trading, International Finance Discussion Papers 1233 (2018) (describing the reliance placed on sentiment coding by news analytics companies that supply packages of coded news to HFT firms).

[216] Jiang et al., *supra* note [ ].

[217] *See for example*, Bureau of Labor Statistics, *News Release: The Employment Situation – October 2018* (Nov. 2, 2018).

The (then) top 3 firms – Jump Trading, Citadel and Teza –intermediated around $4.2 trillion dollars in Treasuries over two months.[218]

These new entrants present a different regulatory profile to the traditional roster of banks and investment banks. Unlike primary dealers, who do business with retail and institutional investors, HFT specialists tend to trade using their own money. In equity markets, they are known to rely on relatively small amounts of capital and to use this to buy and sell through the day.[219] This manner of doing business has permitted HFT Treasury traders to be subject to lower regulatory burden than primary and other known securities dealers. The fact of trading with their own money and not being beholden to investor-clients leaves regulatory room for HFT traders to avoid registration with the SEC or FINRA. In other words, if HFT firms can show that they act as individual traders that use their own money, rather than act as securities dealers, they can avoid a host of commonly applicable to compliance burdens. Importantly, by avoiding the need to register with FINRA, firms do not have to comply with reporting requirements introduced in the wake of the 2014 *Flash Rally*.[220] Within the already permissive regulatory environment of Treasuries, this concession to HFT firms offers further incentive to utilize this business model.[221]

It is worth recognizing that HFTs are active across multiple markets. They trade in different types of assets such as shares, derivatives, foreign exchange as well debt – often as *de facto* market makers. Firms like Virtu Financial, Citadel, or Jump Trading might not be household names but they occupy a critical position in maintaining market function on account of the variety and volume of securities they transact daily.[222] This broad presence throughout capital markets is significant in strengthening interconnections between different types of securities and trading platforms. Because HFT traders do business across the system, they can transact on the same data rapidly in different venues. By operationally linking markets together at ultra-high speeds, HFTs are able to fluidly connect the Treasury market to others, and vice versa.[223]

[218] Crowe, *supra* note [ ]; Smith, *supra* note [ ].

[219] SEC. & EXCH. COMM'N, *supra* note [ ], 4-7.

[220] Alexandra Scaggs, *The Dealer-Trader Distinction and Treasury Market Regulation* (Updated), FIN. TIMES (ALPHAVILLE), Oct. 28, 2016; Joint Staff Report, *supra* note [ ], 9-10.

[221] Scaggs, *supra* note [ ].

[222] Indeed, Jump Trading is looking to explore entry into the customer-dealer space in addition to the inter-deal market, Joe Rennison, *Jump Trading Joins Challenge to Banks in Treasury Market Making*, FIN. TIMES, Aug. 20, 2018. There are also collaborations. Virtu has provided JP Morgan with technologies to assist the bank to trade in the interdealer market. Nicole Bullock, *High-frequency Traders Adjust to Overcapacity and Leaner Times*, FIN. TIMES, Oct. 09, 2017. On the reach of HFT market makers, see for example, Matthew Leising, *Virtu Never Loses (Well, Almost Never)*, BLOOMBERG, Aug. 10, 2016.

[223] Gerig, *supra* note [ ]

III. RISKINESS IN RISK FREE MARKETS

U.S. Treasuries have long constituted the quintessential safe asset, offering sanctuary to investors in volatile capital markets. Parts I and II highlight their significance in anchoring a variety of essential financial functions and the assumption of "risk-freeness" that is critical to this reliance. This Article posits that this default-free status impacts the regulatory design governing Treasuries. Overseen by a loose network of major public regulators and forgoing the thicket of rules and norms observed in other markets (e.g. equities), Treasury operations have come to rely on a cohort of repeat-players - primary dealers - for continuity.

This Part develops these observations to provide an account of emerging structural risks for Treasuries. First, I show that today's market suffers from new information asymmetries arising out of the shift to automation and the arrival of specialist high-speed algorithmic traders. Facing gaps in understanding the fuller implications of how Treasuries trade, regulators cannot easily and reliably predict how automation's risks might materialize and impact Treasury market function. Secondly, the current regulatory structure renders efforts to model such risks and consequences uniquely difficult. Shared supervision between top market regulators raises well-known dangers of administrative paralysis, turf conflict, coordination costs and divergences in agency culture and approach.[224] Further, reliance on primary dealers as a soft private supervisory backstop can no longer be taken for granted. With the arrival of (increasingly dominant) HFT specialists, the capacity for primary dealers to monitor markets and co-operate is deeply diminished. Indeed, individual dealers have a lot to gain privately from non-cooperation and risk-taking. With this, despite the lure of Treasuries as a default-free security, the trading structure critical to this status faces serious challenges that regulators both private and public appear ill-equipped to manage.

A. Information Deficits

Modern Treasury markets exhibit new and complex information asymmetries. Such gaps in understanding are unusual in the otherwise transparent, "regular and predictable" market. All Treasuries measure the ability of the U.S. government to repay what it borrows over varying

[224] *See discussion and sources infra* Part [ ].

periods of time (or maturities). Rather than transact in diverse types of claim, like in equity, or corporate debt, Treasuries represent the risk of just a single borrower. By and large, calibrating this default risk, to the extent it really exists, entails relatively few costs.[225] The U.S. is expected, with near certainty, to be able to pay back its debts. And information that is most germane to determining the country's cost of capital is provided regularly to the public in the form of reports on matters such as national employment, the state of its agriculture, retail health and interest rates.[226] Difficult or complex economic conditions add uncertainty to analysis and determinations, of course. But as far as borrowers go, the U.S. government constitutes a resoundingly safe and reliable debtor.

Moreover, the structure governing secondary trading of Treasuries is familiar and long-used. Primary dealers have dominated in both the primary and secondary markets. Given their role, regulators have imposed entry restrictions and compliance burdens on their operations, effectively limiting the circle to established firms with a Wall Street pedigree.[227] Buying and trading Treasuries has thus followed fairly consistent routine, looking to telephones, screens and bilateral dealings for execution.

Modern Treasury markets create new information costs on account of the emergence of sophisticated, automated trading and the entry of firms that, while quickly dominant, still remain relatively new to Wall Street.

Automated Trading: As noted in Part II, trading in the secondary market for Treasuries is carried out, to ever increasing degrees, using high-speed, automated algorithms, capable of transacting in milliseconds or less.[228] Reliance on automated, artificially intelligent trading systems, offers a multitude of benefits. But it also raises serious information gaps. First, rapid-fire automated traders require that their algorithms be sufficiently powerful so as to navigate the trading day without need for granular human decision-making.[229] Programming must anticipate most likely future environments and leave algorithms to deploy this programming to make determinations on how much to trade, when and at what price. In other words, an algorithm's instructions must govern how it responds to new data, interprets this data by placing a value on its meaning and respond with an order to buy or sell at a particular price. As this process is dynamic, with prices constantly evolving in response to trading

[225] There are, however, complexities in measuring the future rate of inflation that is built into the measure of Treasury interest rates. Liz McCormick & Sydney Maki, *Inflation Is the Missing Piece From Treasury Yields*, *Fed Liftoff*, BLOOMBERG, Oct. 04, 2018.

[226] *See sources cited supra* note [ ].

[227] Scaggs, *supra* note [ ].

[228] McPartland, *supra* note [ ].

[229] Yadav, *Algorithmic Trading*, *supra* note [ ].

behavior and news, algorithms need to display artificial intelligence to keep up with changing market behavior, sentiment and how other traders behave.[230] Algorithms showcasing powerful artificial intelligence can use input from changing markets to decide whether their strategies have succeeded and how and, to then utilize this learning, to re-sequence their instructions in real-time – with varying levels of human supervision.[231]

[230] Yadav, *Algorithmic Trading*, *supra* note [ ]; Wellman & Rajan, *supra* note [ ].

[231] Wellman & Rajan, *supra* note [ ], Chris Brummer and Yesha Yadav, *Fintech and the Innovation Trilemma*, GEO. L. J. , PART III(B) (*forthcoming*).