Where are the market devices?
Exploring the links between regulation, markets, and technology at the Securities and Exchange Commission, 1935-2010

Juan Pablo Pardo-Guerra
Department of Sociology
University of California, San Diego
9500 Gilman Dr. La Jolla, CA 92093
jpardoguerra@ucsd.edu
Abstract

This article examines regulation’s understanding of technology in American financial markets as an opportunity for thinking about the contours and institutional limits of governance in the age of financialization. For this, the article identifies the ways in which the Securities and Exchange Commission perceived markets and their conceptual relation to technology throughout much of the long twentieth century by distilling the ‘ontologies’ expressed by the regulator’s leadership. Despite the fact that SEC’s Commissioners recognized technologies as playing a central role in the market’s current and future operations, these were never effectively brought under regulatory scrutiny even when such action fell under their jurisdictional remit. Rather than regulating technologies as constitutive of markets, the governance of the material devices of finance was discursively distanced by presenting them as intractable objects that were essentially external to the financial realm. Triangulating across several techniques of computational text analysis, this article shows how this interpretation of technology mirrored the distinct shifts in how regulators understood markets, from being physical trading sites populated by agents that required vetting and certification to a distributed, multi-sited system surveilled through transparency and disclosure. Throughout these ontological transitions, technology’s inscrutability remained, limiting the capacity of the state and its regulatory agencies to shape the evolution of finance.

Keywords: computational triangulation, finance, markets, ontologies, regulation, technology.
There is an intriguing ‘stylized fact’ in the governance of contemporary stock markets: despite their longstanding, intimate dependence on vast networks of devices—pigeons and telegraphs, formulas and sophisticated computer systems—stock markets are seldom regulated through their taken-for-granted, physical technologies. Unlike other industries where technological devices play a critical role in practices and organizational operations (Wilson 1980, Stehr 2015, Slotten 2000, Weiner 2004), finance and its regulators are peculiar in how they decide to surveil the workings and design of the market’s prisms, scopes, and engines (Knorr Cetina and Preda 2007, MacKenzie 2008, Williams 2013). Technology is profoundly constitutive of financial markets, posing immediate and long ranging challenges to the work of regulators. Devices can altogether alter how information is defined, collected, organized, communicated, and valued within the marketplace (Pardo-Guerra 2010); they can shape the temporalities of interactions and topology of trading (MacKenzie 2018); they can transform the nature, materiality and portability of property (Coeckelbergh 2018); they can define the mechanics of access to and interaction in the marketplace (Knorr Cetina and Preda 2007); and can they define what constitute transactions and their multiple traces (Grundfest 1988). But despite this fundamental role co-constituting market behaviors, cultures, and organizational routines (Zaloom 2006; Muniesa 2003; Pardo-Guerra 2019), regulators have until avoided direct regulation of technological innovations in markets. Intriguingly, they recognize the importance of technology in fueling capitalism, disrupting its institutions, restricting its operations, or offering opportunities for change, but historically chose not to meddle with this powerful factor when governing markets. Finance misses even some of the more mundane and informal regulations that populate other domains: there are no equivalents of engineered redundancies (Vaughan 1997, Downer 2011a), discussions of tight couplings (Perrow 2011), or cultures of audit and failure reporting (Downer 2011b).

Why did financial regulators neglect to oversee rapid technological change in markets, despite the increasingly transformative power of technology? In this paper, I turn to this puzzling omission as an opportunity to consider the conjoined histories of technology, governance, and regulatory imaginaries in
finance. For this, I leverage the concept of market ontologies (Lie 1997) as a way of addressing the semantic and cultural constellations that shape attitudes about, and the governance of, the economic world. To understand the relative neglect of technology as an object of regulation, I study the content, constraints, and possibilities implied by the market ontologies of the arguably most prominent American financial regulator between c. 1930 and 2010—the Securities and Exchange Commission. In identifying the loose and nebulous constellations of understanding that reflected the Commission’s work, I link my exploration of ontologies to their uses in computer science, taking advantage of their operationalization as representations of discourse that outline domain-specific meaning as formed by how concepts fit into larger, interrelated sets (Poli et al 2010). This computational characterization inspires my methods and allows tracing the ontological evolution of the Securities and Exchange Commission’s understanding of technology in relation to markets over much of the twentieth century. To regulate markets, agents must first conceptualize these entities to render them concrete objects for governance. Studying regulators’ market ontologies is thus an opportunity to understand what type of objects they think need governing and which might be bracketed over.

Tracing the evolution of market ontologies among regulators also allows for assessing the strategies they used to mobilize images of technology in reconfiguring markets. Part of the puzzle of the missing devices of finance stems from the fact that, despite not regulating them as elements endogenous to the market, regulators used promissory images of technology as instruments to shape legislation and its support for critical national financial infrastructures. In the United States of America, this strategy—supporting technology while avoiding its direct regulation—resulted in vastly complex equities markets. At the time of writing, United States stock markets were fragmented across 11 exchanges, 44 alternative trading systems, and more than 200 broker-dealer internalizers linked through an amalgam of public and private communication networks. This distributed structure is part of what motivates the uncanny investments in speed and computer technologies observed in recent times (MacKenzie 2018; Aldridge 2009; McGowan 2010; Angel et al. 2011). As SEC
Commissioneer Luis Aguilar noted in 2015, such complexity poses a ‘paradox’: the technologies that populate stock trading facilitated a form of fragmentation and competition that resulted in markets lauded as the most “liquid, transparent, efficient, and competitive … in the world” (Aguilar 2015). Their technical and structural opacity, however, underpins widespread criticisms of the financial system—from popular claims that stock markets are ‘rigged’ in favor of the most sophisticated market participants (Lewis 2015) to discussions about the risks of cybernetic manipulation (Arnoldi 2012), and catastrophic disasters (Kirilenko et al. 2017). By selectively deciding when and how to regulate technologies, regulators also constituted boundaries that remain relevant to how these convoluted systems of trade are made legitimate today: carefully leaving technologies just slightly outside their regulatory purview, regulators configured financial markets as objects sitting in a peculiar position between public and private spheres of activity and oversight. More specifically, while the Securities and Exchange Commission made the ‘technical’ visible in many of its initiatives, as Aguilar suggests, its arms-length engagement with explicitly technical questions forestalled the possibility of broader reforms of the financial system by ‘black boxing’ technologies through discourses of innovation that deferred designs and implementation to private market actors. If market devices are missing from regulatory action, it is partly because they were lost on purpose.

Placing attention on how financial regulators make sense of their technological objects of governance is also an opportunity for bridging two important yet somewhat disconnected literatures. The first relates to the greater attention that social scientists have placed on materialities and their roles in markets. Arguably starting with Michel Callon’s Laws of the Markets (1998), the sociological literature on economies in general and financial markets in particular has turned towards material configurations as critical to framing and shaping economic action (Muniesa, Millo and Callon 2007; MacKenzie 2009). This turn away from social ties and individual interests as the principal elements of our analytical foundations is mirrored, in an admittedly more moderate ways, by discussions taking place in economics that focus on the rules and implications of different trading microstructures of exchange (Easeley and O’Hara 1987;
O’Hara 1995; Lee 1998) as well as the purposeful construction of allocation mechanisms (Roth 2002; Roth 2008; see Breslau 2013). While important in contributing to our understanding of how markets work, these traditions have yet to establish a stronger dialogue with a second literature, namely, the work of socio-legal scholars concerned with the politics and dynamics of the legal technicalities of finance (Pistor 2013; Deakin et. al. 2017; Black 2013; Riles 2011; Maurer 2012; Pernell et al. 2017) or historical and comparative sociologists who, with great dexterity, have analyzed the role of finance, credit, and banking in the capitalism and its variation among welfare states (Krippner 2011; Quinn 2019).

There are several important points of convergence between the literature on market devices and those on the sociolegal foundations of financial capitalism. Consider Sarah Quinn’s (2019) exceptional contribution, which stresses the ideological lightness of credit as motivating its widespread adoption as an apparently neutral (though deeply political) instrument of statecraft. Like credit, market devices are similarly light in their presentation, often framed in the language of restless markets and disruptive, benevolent innovation. And like credit, market devices are also shaped by legal and regulatory interventions—even those that involve ignoring or delegating control over how certain infrastructures, technologies, and techniques are implemented, maintained, and redesigned. Because they lock-in the capacities of market actors (Muniesa and Callon 2005), decisions on what happens to technologies also dictate how markets evolve far into the future. For economic sociologists and allied scholars, attention towards the awkward position of devices in financial law and regulation sheds light on important ‘paradoxes’ about the character and legitimacy of financialization. This is particularly clear in the case of equity markets. The uncanny systemic complexity and rickety public legitimacy of equity markets that Commissioner Aguilar raised is a prime example for, as he notes, today’s market structure was “keenly influenced by a number of regulatory initiatives” of the Securities and Exchange Commission. Without state support and influence, the technological infrastructure of contemporary financial markets would arguably not exist, at least not in its present form (c.f. Pistor 2013). Part of this support, however, involved neglect, delegation, and
surrendering control. Understanding this relation, and how it fits in the constellation of meanings of the SEC and its leadership, is the task at hand in the remainder of this paper.

**Context: Regulating Markets within, and without, Technology**

The Securities and Exchange Commission is historically intertwined with technology and its role in shaping and reinventing markets. This may not be apparent from its foundational remit, which reflected the agency’s creation as a response to national financial calamity. After the 1929 stock market crash, the United States Senate Committee on Banking and Currency held hearings to gain a better understanding of the problems facing American securities markets at a time of great uncertainty and weakened public confidence. Three legislations resulted from this process that jointly sought to rebuild trust in the financial marketplace —the Glass-Steagall Act of 1933, the Securities Act of 1933 and the Securities Exchange Act of 1934. In addition to these legislative instruments, Congress created the Securities and Exchange Commission as the enforcer of their new legislative framework, appointing Joseph Kennedy and Ferdinand Pecora, the Senate commission’s chief counsel, as the SEC’s first commissioner.

The challenges facing American finance were tremendous and so was the scope of action of the SEC. The new regulator was not only concerned with overseeing the buying and selling of securities by registering the country’s numerous stock exchanges and investigating potential cases of collusion and deceitful operations; importantly, the SEC also had to guarantee the worth of the securities traded in the United States’ public markets. This entailed intervening in corporate disclosure, particularly for firms wanting to raise capital through the market: Were their accounts in order? Were their bonds worthy? Or were they merely empty promises? The organization of the early SEC reflected such objectives: an Examination Division (later renamed Registration Division) enforced the 1933 Securities Act while the early Stock Market Trading Division oversaw activity in securities exchanges. These would later splinter into other divisions—including Corporation Finance, Market Regulation, Investment
Management, and Enforcement (Wilder 2003)—regulating securities from origination to settlement.

As a New Deal institution, the SEC was created with a very clear orientation. Legal scholar and historian Joel Seligman (1982: 39-40) writes of the SEC’s ethos during its early period as focused on compelling “disclosure of data by firms involved in securities markets, indirectly inducing these firms to avoid illegal activity or embarrassing activities”. In her decisive study of the regulator’s changing relation to expertise, Khademian (1992) agrees, noting that the overarching work of the organization was directed towards actions of disclosure and enforcement: those involved in the securities markets must reveal information about their state of affairs, be this corporate accounts or trading reports, to guarantee the stability of the marketplace; failure to do so results in prosecution and the resultant enforcement of United States securities law.

In these initial years, technology seemed peripheral to the Commission’s concerns. This changed as the SEC’s operations broadened into guiding what is often referred to as the ‘structure’ of United States securities markets. The SEC was, undoubtedly, a pro-market regulator and had to be so to guarantee support from the established exchanges where most stock issuance and trading took place. For example, in a speech broadcast in in 1937, Joseph Kennedy, the SEC’s first commissioner, said of the organization: “We of the SEC do not regard ourselves as coroners sitting on the corpse of financial enterprise […] We regard ourselves […] as partners in a cooperative enterprise. […] We want to see the wheels turn over and gather speed. We want to see the security business, by far the greatest in volume and most important in its effects of any in the country go forward on a broad scale” (Seligman 1982: 112). The SEC was meant to actively lubricate and shift the gears of financial capitalism. This surely occurred by fostering confidence in the marketplace. But it was also a product of actively shaping the architecture of the market itself as demonstrated in various occasions. Perhaps the most notable was the period between 1967 and 1975 when, after a series of technical failures in settlement and trading (Wells 2000) in the context of a rising influence of institutional investors and increased public
concerns about access and fairness in stock markets (Burk 1988), Congress directed the Commission to create a central market system that would incorporate the then fragmented and disparate trades occurring across numerous exchanges in America into a single national infrastructure.

Much of this work of reshaping the market was associated to legislative efforts to reform securities laws and regulations in the 1970s. These reforms were a notable attempt of re-shaping financial markets along a distinct design: a unified, national market that aggregated and protected, in some fashion, the orders from investors across the continental United States (Pardo-Guerra 2019; Kennedy 2017). As Commissioner Bradford Cook noted 1973, in

Today, [...] for many securities there are now many markets--both on the exchanges and off the exchanges in the offices of broker-dealers. At any given time, the public investor sees only part of this picture. He is looking at a goldfish bowl while really living in the middle of an aquarium There are many reasons for the separation of these markets, but few would make much sense to the public investor. For example, some of the exchanges display all of their trades as they take place. Other exchanges display some trades but leave out others. Markets off the exchanges generally don't display trades as they occur. Some of the securities markets operate under an extensive system of regulation. Others operate under lesser standards. Some exchanges try to block their members from taking business off the exchange. Others don't have these barriers. Finally, and perhaps most importantly, there is no communications link really tying these markets together.

The crucial phrase in this passage is ‘communication linkages’. As early as 1963, the Commission recognized that linking different trading sites was an important step towards guaranteeing fair and efficient markets (SEC 1963): with fragmentation and poor communication across the continental United States, prices could not reflect true national supply and demand, therefore privileging local actors who had superior access to information and trading institutions. Promoting linkages between exchanges, brokerages, and over-the-counter dealers became a priority for the Commission, one that required coping with the
emerging ensemble of information technologies that were fast populating financial services (Cortada 2003).

The ability to link markets with technology was clear to the SEC and market participants alike. After all, the commission had been central in moving over-the-counter dealers onto the National Association of Securities Dealers’ Automated Quotation system in 1971. The reforms of the 1970s, however, were rather more ambitious and contentious. To resolve the ultimate shape of the system, the SEC relied heavily on industry, and particularly on the New York Stock Exchange’s technical services division, the Securities Industry Automation Corporation. The results of this collaboration were two regulated mechanisms that formed the cornerstone of what came to be known as the National Market System. The first, the Consolidated Tape, aggregated price and volume information of all trades reported in the New York Stock Exchange, the American Stock Exchange, and a number of regional exchanges for its distribution across other trading venues. The second, the Inter-market Trading System, routed trades between the NYSE, AMEX and other marketplaces to for execution. While developed by industry, these systems were forged through the regulatory actions of the Commission.

The mechanisms developed for the National Market System in the 1970s became the unexpected platforms on which new generations of technologies flourished. When the SEC confronted the growth of Electronic Communication Networks and Alternative Trading Systems—instiutions facilitated by the internet and cost improvements in computers in the 1990s—they were incorporated into the existing structures of the National Market System (MacKenzie 2017). And when discussions about the future of stock markets inspired a new round of regulatory activity in the early 2000s, both the consolidated tape and the inter-market trading system remained as central features of the SEC’s design. The commission was certainly no stranger to technological innovations in markets. Yet despite their importance, and surprisingly so, they were never made explicit objects of regulatory oversight. Technology mattered, but not as something to be regulated. Why did the SEC
neglect regulation of rapid change in markets given its clear centrality to markets?

**Empirical approach**

To gain an understanding of how the Securities and Exchange Commission made sense of technologies and technological change in relation to markets, I analyze the ‘ontologies’ contained in the speeches of the regulator's leadership. Historically, the SEC has five acting commissioners with one serving as the agency’s chairperson. Commissioners are nominated by the President and confirmed by Congress, serving for five-year staggered terms. The Commission is politically balanced: there are no more than three commissioners with the same party affiliation serving concurrently. As part of their activities, Commissioners are asked to give public speeches that capture the activities, concerns, and agendas of their organization. The speeches range from short introductory notes containing a few hundred words to longer statements that reflect the position of the SEC in relation to key challenges. The SEC makes available the Commissioner speeches in a number of digital formats through their website; these documents are the primary empirical data for this paper.

The SEC’s archive contains a total of 3,068 speeches published between 1933 and 2011 (figure 1), equivalent to roughly 34,000 pages of plain text. These do not exhaust the public speeches given by Commissioners, but they provide a satisfactory representation of the discourses and worldviews associated to the Commission’s work. Despite some discontinuities, the patterns of publication of the speeches reflect different moments of activity by the SEC. The successive ‘waves’ of speeches correspond to different moments of institutional buildup, public outreach, and intervention in markets. We can observe, for example, an initial period of growth in the number of speeches followed by a lull during the second world war and immediate post war period. This was continued with a slow yet steady growth of public outreach, leading to heightened activity in the mid 1970s surrounding the creation of a National Market System. Drastic contractions in the number of speeches (for instance, in 1994) are mostly related
to how commissioner speeches were archived in the SEC’s systems rather than indicators of changes in the agency’s behavior.

Within these documents, I am interested in ontologies related to markets and technology. By ontologies, I follow the computational definition of “formal specifications of the terms in the domain and relations among them” (Gruber 1993). From this perspective, ontologies are representations of knowledge domains in terms of concepts, their relative prominence, and their interrelations. In sociological practice, similar webs of meaning and conceptual associations are often inferred through close textual reading. Ethnographic observation, for example, requires discerning the polyvalent senses of concepts by locating their relative positions within larger, dynamic constellations of meanings. Historical analysis can also be thought of as implying an ontological search, seeking to understand the textures of concepts as they were used by various speakers in their different agential and contextual positions.

While a close textual reading is certainly possible (and was also part of the empirical strategy for this study), in this paper I also approached ontologies through computational methods that extract terms and classify texts according to their distinctive discursive features. The texts I use are Commissioner speeches in their entirety. Speeches are calculated interventions that serve several aims: while tailored for their immediate audience (say, the American Bankers Association), they also convey a message to broader publics (including the press, or industry analysis that follow the course of regulation). Similarly, speeches are not a passive acts of information broadcast but, more fundamentally, strategic interventions meant to elicit support, bolster legitimacy, rally constituencies, convey core values and practices, or produce shared imaginaries about the organization and its future. Like legal documents, speeches are strategic, structured texts that, owing to regularities over time, constitute a set of comparable elements within a broader, cohesive corpus. Speeches thus provide an important reflection of organizational worldviews, particularly when aggregated over time (Pettigrew 1979; Campbell 1998; Seider 1974). ‘False’ and ‘low fidelity’ speeches may populate the corpus, for example,
but because the leadership’s speech acts are a constant focus of attention within and without the organization, the persistency of such speeches is likely low.

Because these speeches are highly structured, I use a combination of three computational methods that, treated through a meticulous computational abductive approach (Karell and Freedman 2019), discern the changing ontologies of SEC Commissioners and, by proxy, of their organization. I see this technique as a form of ‘computational triangulation’ (cf. Denzin 1978) that, coupled with a close textual reading of the texts, allows identifying changes in the ontological worldview of the regulatory agency and their connection to broader historical transformations. Note that my use of computational methods is primarily descriptive and tied to domain-specific knowledge of texts and the broader history of American securities markets. These descriptive methods range from the blunt—those that do not take semantic structure into account—to the slightly more sophisticated—those that take great care in preserving the structure of texts and their underlying conceptual universe. I present these methods briefly below.

**Topic models**

Topic models are fast becoming part of the standard toolkit of computational social science (Bail 2014; DiMaggio, Nag and Blei 2013), largely because they offer an efficient, descriptive overview of themes describing a collection of texts. Examples of the use of topic models in the sociological literature include studies of newspaper articles (DiMaggio, Nag and Blei 2013), government documents (Mohr, Wagner-Pacifici, Breiger and Bogdanov 2013), transcripts from the meetings of the Federal Open Market Committee (Fligstein, Brundage and Schultz 2017), and pages from radical Afghan groups (Karell and Freedman 2019). In these cases, topic models were used as means for identifying the evolution of meaningful frames concerning public attitudes towards arts funding, changing views on national security, the use of macroeconomic theory in crafting policy decisions, and discourses of contention. In this study, I adopt a similar approach, using topic models as means for evaluating the themes discussed in Commissioners speeches.
Topic models emerged in computer science as part of a family of algorithms that automate the classification of large collections of texts. Their classification, which consists in identifying ‘topics’, is based on a probabilistic account of the distribution of the words within the corpus. Because topic models rely on a probabilistic representation of texts, they are blind to syntactic structure: the relative position of words is lost under this method. Rather, topic models involve thinking of texts as ‘bags-of-words’ related through probabilistic clustering. For example, in a certain collection of texts, the word “report” may co-occur with the words “account” and “corporation” with a relatively large probability. This co-occurrence could signal the existence of a set of words often used together in the context of discussions of corporate disclosure. The presence of this set of terms in a text therefore allows for its classification as a document containing the topic of ‘corporate disclosure’. An important feature of topic models is that they are not greedy: terms can be shared across topics, reflecting the existence of homonymous and homographs (e.g. the word “report” can act as both a noun and a verb with different implications) as well as more complex forms of heteroglossia (Bakhtin 1994). Note that the process of determining topics does not imply an automated identification of what conceptual themes they might refer to. The conceptual associations between topics and theoretically relevant themes are necessarily the product of an expert interpreter who can extract meaning from the clusters identified by the algorithm. Like language itself, the outputs of automated text analysis only acquire meaning when given sense through interpretation. Contra aspirations of scientism or mechanical objectivity (Porter 1996), then, topic modeling is an interpretative exercise (Kitchin 2014; Wiedemann 2013). What automated text analysis permits is an increase in the volume of processed text without forgoing the role of expert input. Algorithms do not find units of meaning, merely clumps of potentially meaningful associations (Lee and Martin 2015).

N-grams
An important tasks of text analysis consists in identifying linguistic units formed by two or more words. The term “Securities and Exchange Commission” is an
example, referring to one rather than four independent concepts. This concatenation of terms is an example of an N-gram, that is, a sequence of words of length ‘n’ that occur with sufficient frequency and consistency throughout the text. Specialist algorithms, such as those provided with Python’s Natural Language Toolkit, allow parsing textual data to identify such multi-term objects. While less computationally demanding than automated text classification techniques such as topic models, n-grams take into account some of the linguistic features of a corpus: by being sensitive to the relative position of words, they provide a heuristic for identifying the presence of simple conceptual themes within documents.

For this study, I identified the most frequent bi-grams and tri-grams in the Commissioners’ speeches. Following standard approaches, these were ranked by frequency of occurrence (KcKie and Ryan 2015). The n-grams were found both over the entire corpus as well as in smaller subsets of speeches covering 15 years, starting in 1935. The fifteen-year periodization is both convenient (it divides the corpus into five periods of equal lengths) and meaningful: each period covers important transformations within the SEC and its regulated markets. The first period (1935-1949), for instance, relates to the establishment and initial growth of the agency. The second period (1950-1964) corresponds to the postwar growth of equity markets and the rise of institutional investors, leading to a critical stage (1965-1979) when the regulator reconsidered its position vis-à-vis markets and the nature of these in relation to technology. While a more fine-grained analysis such as studying texts on a yearly basis is certainly possible, it would have missed some of the temporal structures that are relevant for the history of the Securities and Exchange Commission (Seligman 1982, Kennedy 2017). Slicing the corpus of speeches this way uncovers broader, structural changes in discourse that are captured, for instance, in changes in n-gram frequencies and semantic network structures.

Semantic networks
As noted earlier, topic models and n-grams are relatively blind to syntax. To preserve some of the semantic structures of speeches, I recurred to a network
analysis of the Commissioner’s texts to better appraise how terms were conceptually interconnected. Like topic models, semantic networks are used in sociological research to discern structures of meaning. Studying autobiographical accounts, for example, Bearman and Stovel (2000) examined narrative arches as networks to identify common mechanisms that led individuals to become supporters of the Nazi regime. Similarly, Chow-White used semantic networks to disentangle different online narratives about sexual tourism (2006).

I use two modeling approaches here. The first involves a naïve semantic network formed by counting the co-occurrence of all pairs of words in sentences of more than three words throughout the speeches. The weights given to the edges are determined by the relative distance of terms in sentences through the following procedure: the algorithm looks at every sentence in the text and registers every pair formed by the 1000 most common words in the text. The edge for each pair is then assigned a weight. If the words are contiguous, the weight of the edge is set at 1; if there are \( n \) words between the pair, the weight attributed to their respective edge is \( 1/(n+1) \). The weights for all the edges attributed to a specific pair of words are then added to produce the final network. This technique takes into account the relative position of words within sentences, assuming that more distant terms are less strongly related.

In addition to this naïve network, I use an implementation of semantic networks introduced by Rule, Cointtet and Bearman (2015) in their analysis of the temporal evolution of political discourse in State of the Union addresses over more than two centuries. Rule et. al.’s work is based on a critique of topic models’ bag-of-words approach and its obliviousness to the structure of texts. To capture the “semantic standpoint of contemporary observers” (2015: 10838), Rule et. al. transform speeches into a network where nodes represent terms and edges the co-occurrence of two words in some syntactic unit. In their work, Rule et. al. use paragraphs as their units of analysis—in the case of this paper, however, I build the network using co-occurrence at the level of sentences to capture more discrete meanings. Rule et. al. introduce a further innovation,
transforming the edges of their co-occurrence network by considering a proximity score based on the positive point-wise mutual information (PPMI) between pairs of words. Their measure weighs the frequency of a co-occurrence by the characteristics of its semantic context. For example, the edge formed by ‘securities’ and ‘exchange’ has a large weight of naïve co-occurrence, as does the edge formed by ‘securities’ and ‘commission’. The proximity score developed by Rule et. al. compares these weights against those of other edges in a semantic context to calibrate them accordingly, reducing the prominence of this combinations of words that are uninformative given the structure of the network (e.g. ‘United’ and ‘States’).

**Results**

What do these computational techniques tell us about changing ontologies at the SEC? The descriptive computational approaches outlined above provide evidence that the SEC’s understanding of markets changed notably between 1934 and 2010. Consider the evidence from the semantic networks, presented in figure 2 as two sets of sub-graphs for the term ‘market’. Each graph captures a non-overlapping period of 15 years of Commissioner speeches. Graphs on the left side of the figure show sub-graphs for the ten words most frequently mentioned in connection to the term ‘market’ under a naïve co-occurrence network. Graphs on the right correspond to the same corpus, transformed under the point-wise mutual information proximity measure—indexing the structural similarity of words in the network. Both sets of graphs suggest a movement away from a view of markets as objects that required protection, facilitation, and expansion, to a more proactive discourse of systems, information, and reorganization. There are two important indicators of this change: firstly, the disappearance of the word ‘exchange’ in the naïve semantic networks after 1965; second, the cotemporaneous appearance of ‘system’ and ‘electronic’ as terms relevant to markets within the regulators’ speeches. As I explain below, these transformations in discourse signal both continuities in the apprehension of markets—that is, as mechanisms based on information—and important
discontinuities—a move from physical trading places to distributed, electronic systems.

The linguistic evidence offered by the changing frequencies of bigrams and trigrams in the commissioner speeches confirms this discursive and ontological shift. By identifying composite terms formed by two and three words, it is possible to distinguish more detailed, technical concepts in the regulator’s discursive universe that also offer a glimpse into what they understood mattered about the substance and governance of markets. To give a general example of how such composite terms provide information about discursive practices, the reader can consider how a simple bigram like “free markets” condenses a specific understanding of the politics of markets and their location in society. By looking at the frequency of particular sets of bigrams, we can get a proximate sense of how complex, charged concepts have gained or lost prominence over time. For our corpus, the result of this decomposition is shown in tables 2 and 3, which display the most frequent bigrams and trigrams for the commissioner speeches over time. There are several notable features of how these composite terms changed, reflecting the same type of ontological shift suggested by the semantic networks. The early years of the Commission were populated by references to markets bound by the trading floors of specific institutions (in particular, the New York Stock Exchange), focused heavily on stocks, and tinted through the language of openness and freedom. This was still a period of recovery during which the commissioners sought to foster confidence in the trading through direct interventions: the bigram of ‘declining market’, for example, is linked the introduction of regulations on short selling that tackled the conditions leading to the rapid downward movements in stocks that were part of the 1929 market crash.

Later speeches reveal a distinct change in the conceptual repertoire of commissioners that neatly reflects known institutional histories of American finance. By the 1970s, discussions about municipal securities gained prominence (Weeden 2002). This was a period during which, following New York City’s 1975 fiscal crisis, Congress and the Securities and Exchange Commission redesigned
the regulation of municipal bonds by creating the Municipal Securities Rulemaking Board that sought to “and perfect the mechanism of a free and open market in municipal securities, and, in general, to protect investors and the public interest”. In addition to the expansion of regulatory oversight, this period was characterized by two important changes. The first was a shift away from the more spatially localized scope of Wall Street, reflected in the bi- and trigrams through the explicit references to the central and national market systems. Albeit the NYSE still figured largely in the regulators’ language, this was a critical period during which the notion of an internal, national market for securities gained a firm grounding in the conversations of practitioners and regulators alike (Pardo-Guerra 2019). The second key shift implied the introduction of a new paradigm of what constituted a virtuous, ideal market. The late 1960s and early 1970s are prominent, partly because of the fact that they heralded the notion of ‘efficient markets’ as a central element in the vocabulary and worldview of regulators. As time passed, and as these n-grams show, this expansion continued: markets became increasingly global (‘global market’) and diverse in their constitution (‘futures market’, ‘money market’, ‘bond market’, ‘hedge fund market’, ‘mutual market’, options market).

Despite the evidence of shifts in the SEC’s speeches, key network measures suggest that the semantic significance of markets changed little over time—that is, the concept of ‘markets’ held a relatively stable and surprisingly peripheral location in the constellation of terms that formed part of the agency’s ontological framework. Consider measures of betweenness centrality in the semantic networks. Higher levels of betweenness centrality indicate that terms operate as junctions across elements of the network (Freeman, 1977; Brandes, 2001): the measure hence serves as a proxy for the importance of a word within the structure of its surrounding discourse. Table 4 shows changes of betweenness centrality for the word ‘market’. As a point of contrast, the table also shows the node with the highest betweenness centrality in the network during the corresponding period. All measures are normalized for comparison. The table is notable for presenting ‘market’ as a relatively marginal term within the SEC’s discursive corpus, particularly when compared with the most important nodes,
namely, ‘settlement’ before the 1950s and ‘self regulatory organization’ before the 1980s.

The same measures of betweenness centrality show that technology was more significant in the discursive field of the SEC commissioners than markets. Table 5 presents the relevant details for the terms ‘technology’ and ‘electronic/electric’ (the speeches contain terms related to technology, including ‘tele(phone)’, ‘tele(type)’ and ‘tele(graph)’, but these are so sparsely used that they were not counted in the corpus). On average, these two words have higher betweenness centrality than ‘markets’, suggesting that they served as bridging or coordinating nodes across meaning components. This does not necessarily imply that connections between ‘markets’ and ‘technology’ became stronger or more semantically salient, even as stock trading was increasingly made dependent on technological networks and computers. On the contrary, and consistent with the argument about the neglect of the ‘devices’ of financial regulation, technology was progressively less central, rather than more, to the SEC’s understanding of markets. This is apparent from the structure of the semantic networks. Each network can be parsed into clusters of proximal nodes by applying a community detection algorithm (Girvan and Newman 2002). The result of this procedure is a series of non-overlapping groups of terms that encompass related concepts as structured in the speeches. Rule, Cointet and Bearman (2015) apply a similar technique to identify the key themes covered by State of the Union speeches. In the case of SEC speeches, we can say that there is a convergence between ‘market’ and ‘technology’ if these two terms are mapped onto the same community. The data suggests these mappings do not occur. Table 6 shows the results of applying the community detection algorithm on the semantic networks of the five different periods. The terms ‘market’ and technology’/‘electronic’ never occur within the same class.

Discussion

What explains the SEC’s relation to technology over much of the agency’s history? Through several evidentiary supports, the computational results
presented in the previous section complement and expand existing histories of
the Securities and Exchange Commission by shedding light on how technology
was positioned within the regulator’s cultural and discursive worldview. For
example, and much in line with existing accounts, the way language changed
among commissioners suggests an expansion of the SEC’s focus from issues of
investor protection—as made particularly visible in the topic models—to
discussions about market structure, accounting practices, and matters of
corporate disclosure (Seligman 1982; Bealing 1994; Khademian 1992). More
importantly, though, they suggest significant shifts in the understanding of
technology and its relation to markets that had effects on how these were to be
shaped over time.

Changes in the speeches’ discursive structure and composition certainly
provide fodder for existing claims about the SEC’s retreat from direct corporate
regulation, the nurturing of a broad, share based corporate marketplace through
initial public offers (de Fontenay 2017), and an increased emphasis on matters of
disclosure, transparency, compliance and accounting standards as means for
governing intermediaries and their financialized markets (Mehrpouya and
Salles-Djellic 2019). The topic models presented in figure 3, in particular, are
supportive of these broad transformations in the regulation of American finance.
Figure 3 shows rather fine-grained transformations in texts, including some the
growths of discussions about rulemaking in the early 2000s (connected to terms
like ‘market’, ‘regulate’, ‘investor’, ‘risk’, ‘rule’) and the waning, after the mid
1970s, of speeches concerned with public offers (identified through words that
included ‘register’, ‘companies’, ‘offer’, ‘require’). This fine-grained structure,
however, occludes some of the larger transformations in regulatory ontologies.
Regrouping the 15 topics into 5 themes, we can gain a smoother, more sweeping
perspective of how changing priorities were reflected in discourse1. The

1The 15 topic models were grouped into 5 themes through the following
coding strategy. The theme of ‘corporations’ was composed of the topics of
‘corporate governance’, ‘corporate disclosure’, ‘corporate finance’ and ‘public
companies’. The theme of ‘intermediaries’ is formed by the topics ‘investment
composite graph in figure 3 presents a particularly stark account of regulatory reinvention, showing a relative increase in themes that index disclosure and intermediaries at the expense of those connected to matters of public corporations and corporate governance.

These focal shifts allude to some of the environmental challenges that the SEC faced during the late twentieth century. Increased discussions of market organization, for example, reflected the internationalization of accounting standards (Porter 2005) as well as structural changes to the global economy that altered how corporations organized their activities and raised capital through financial markets. These same patterns, however, also suggest a more profound transformation of the agency’s market ontologies. This is not directly and solely apparent in the topic models. Like the n-grams presented above, topic models serve mostly to trace broader shifts in the aggregate content of the agency’s discourse without much care for semantic details (that is, they answer questions of frequency and commonality of sets of words, rather than about interconnections). The ontological transformation of markets is observed, rather, by triangulating these bag-of-words findings with those from semantic networks where the salience, proximity, and relationality of terms the issue at hand. Together, these computational results point to a significant change in how the agency spoke, and ostensibly ‘thought’, of markets.

The computational triangulation of the corpus of speeches suggest that, during its early existence, the Securities and Exchange Commission conceptualized markets mostly in reference to the local systems of exchange and brokerage houses of New York’s Wall Street: while the most prominent trigram in 1935-1949 period was ‘New York market’, reference to a ‘national securities intermediaries’, ‘investment managers’ and ‘public offers’. The theme of ‘enforcement’ is formed by the topics of ‘enforcement’, ‘public mandate’ and ‘rulemaking’. ‘Market organization’ included the topics ‘market structure’, ‘global markets’ and ‘accounting standards’. Finally, the theme of ‘disclosure’ combined the topics of ‘accounting’ and ‘investment information’.
market’ would become relevant only after 1950. Arguably, this connection to a particular set of institutional actors and devices for trading shaped how regulators imagined markets and defined them in relation to other terms. This is clear in the almost palpable physicality with which Commissioners spoke of markets in these early days: they referred to them as collections of trades occurring in a specific place, rather than as exchanges occurring in some abstractly defined regulatory construct (consider the legal/economic definition of a ‘relevant market’ based on Cournot 1838; see Onto 2017). As revealed by the semantic networks, the main concerns of the SEC for these ‘markets’ was maintaining the value of securities by enhancing and strengthening the public trades facilitated by self-regulated stock exchanges. Speaking in 1933 before the Detroit Stock Exchange, for example, James Landis stressed the importance of the then emerging legislative framework to “eliminate fraudulent and dishonest market practices” to retain the ‘true functions’ of the exchange markets. These ‘true functions’ were clear to Commissioners: raising capital while maintaining truthful and informed valuations of securities. Doing so required engaging in a certain type of policing work, as Landis stressed in 1936 speaking to an audience of investors in Chicago: “An exchange market is obviously a privilege”, he noted, “and admission to this market could therefore be conditioned upon the disclosure of adequate information”. Early on, then, regulation was best achieved controlling access to the trading floor by guaranteeing the moral standing of those who traded on its wooden boards. This partly explains the frequency with which Commissioners talked about over-the-counter markets: they represented the type of laxly regulated trades that had fueled risky forms of speculation in the past and jeopardized future investors’ confidence and interests.

The SEC’s market ontology shifted, however, as the idea of markets became attached to other concepts. Notably, both ‘information’ and ‘electronic’ entered the vocabulary of the agency between the late 1950s and early 1960s, signaling a different valence of markets and their role in the economy. Part of this shift may have been motivated by the sheer adoption of electronic devices in securities trading. The semantic networks show, for instance, the emergence of a
connection between the terms ‘technology’, ‘electric’ and ‘electronic’ with ‘market’ as early as the 1950-1964 period. This is largely consistent with the histories of the changing structure of United States securities markets, as seen in Kennedy’s recent work on regulators and the introduction of computers to stock exchanges. As Kennedy writes, the SEC saw information and communication technologies as instruments for breaking the “concentration of information and power in the physical space of the Exchange floor” (2017: 908), specifically of the NYSE’s centralizing role in trade, and so actively promoted and engaged with these electronic frontiers.

The semantic networks also suggest another important lexical shift: linking ‘markets’ to ‘information’. Coinciding with the initial wave of studies in financial economics where metaphors of information abound (Mirowski and Nik-Khah 2017) and the growth of economists within the SEC’s organizational hierarchies (Khademian 1992) and across policy circles more generally (Fourcade 2010), the agency’s language increasingly framed markets in informational terms. This had concrete effects. At one level, the Commission’s earlier emphasis on matters of disclosure was redefined around issues of informational access. What mattered now was not simply some form of mechanical reporting to the bureaucracies of the state but, more centrally, providing a form of transparency that would make events visible and legible to a broader public.

At another level, a focus on information as the token and character of the market implied a move away from references to a physical place of exchange to more abstract ideas of ‘systems’. This is an important feature of the data that remains largely unexplored in the existing literature: a shift in ontologies from those anchored on ‘place’ to those based on ‘systems’. From about 1965 onwards, the language of ‘systems’ pervaded the Commissioners’ speeches: from references to the central market and national market systems conceived by Congress, to loosely defined mentions of the capital and over-the-counter market systems. The coupling of markets and technology, along with the growth of
formal economic theories that represent transactions in informational terms, transformed the meaning of the former by disassociating trade from space.

This is precisely what explains the apparent inattention to ‘market devices’ as objects of regulatory attention within the SEC history. In addition to the computational evidence, a close reading of the texts of commissioner speeches in conversation with existing literature on the SEC in particular and American financialization more generally suggests why these ontologies of ‘places’ and ‘systems’ made technologies elusive objects of oversight—akin to credit and its ideological lightness (Quinn 2019). Technology was rendered both inevitable and inscrutable by presenting its relations to markets through very specific conceptual frames. Commissioners may have embraced technology's role in facilitating trading and providing growth for the economy—this explains, perhaps, why ‘technology’, rather than ‘market’ occupied a more salient position in the agency's discourse—but they did so in a way that made it impervious to direct regulatory action. Specifically, the frames that they mobilized presented technology as either a motor of capitalism, a disruptive force, a bottleneck, or an opportunity for change. These frames made technology and technological change objects that were foreign to the industry and that regulators and markets had to adapt to, obscuring both the capacity of the state to shape how technological systems were designed into the future as well as the contents, features, and capacities of systems already in place.

Technology, then, did exist in the worldview of securities regulators but mostly as a moniker for interventions from an outside—a conceptual black box that indexed structural transformations of the financial system falling under the remit of the SEC but shaped by forces out of its control. From 1935 to 1949, for example, the uses of technology in the speeches often elicited images of rapid progress. Commissioners spoke of the “onward sweep of technology”, “new developments in technology” or the “patient accumulation of facts [underlying] science and technology”. Crucially, these uses correspond to images of an external factor impinging on markets, investors, and the general economy—a generic reference to technology as a motor of progress. This was also the sense
of technology in later speeches, when Commissioners referred to the “problems created by modern technology of communication”, utilizing “the best of the technology” for the back office, or the improvements in research and technology that created new opportunities for companies and investors. As computers arrived, they too were framed as external resources: these modern technologies were “a tool for coping” and transforming the “archaic methods for handling” trades. Computers were central to the “age of advanced technology and electronic wizardry”. But they were necessarily outside the market, not matters of regulation in and of themselves. If anything, the strategies through which the SEC engaged with technology reproduced its extant approach to dealing with technical matters, that is, relying on the abilities of self-regulatory organizations to guide change. The system of the market was, above all, configured through rules rather than devices—it was an object of law and regulation (Pistor 2018), not standards—leaving much of the control over market structures to the gears of self-regulatory organizations.

For the SEC, this framing of technology was politically advantageous yet had unexpected consequences on the evolution of American market structures. I can illustrate this with the history of the SEC and its role in creating the National Market System, the peculiar legal construct that encompasses trading across the United States. The creation of the National Market System (NMS) is often considered a crucial turning point in American finance, when SEC engaged directly with the affordances of technologies by promoting computerization and automation as solutions to the problems of trading (e.g. Castelle et al 2016). As I argue below, however, it is an episode that exemplifies how the SEC maintained the regulation of market technologies purposefully outside of its institutional purview.

When Congress passed the 1975 Securities Acts Amendment, it instructed the SEC to “remove impediments to and perfect the mechanisms of a national market system for securities” so as to provide “fair competition among brokers and dealers, among exchange markets and between exchange markets and markets other than exchange markets” (US Congress 1975). This broad mandate
gave the Commission ample leeway to redesign the structures of trading, information processing, and settlement in American securities markets along the lines of a system that would “centralize all buying and selling interest so as to permit each investor the opportunity for the best possible execution of his order, regardless of where in the system it originated” (Gillis and Dreher 1982: 13). For some, this aggregated market system could have been created through communication linkages between trading institutions: by transmitting price and quote information in real-time throughout the continental United States and routing orders to marketplaces along strict parameters, the existing, spatially fragmented mechanisms of trade could be brought together to foster greater liquidity, competition, and efficiency. Technologies were, in this sense, sources of opportunities.

A more radical option was to overhaul existing institutional structures by creating a truly centralized trading mechanism. One of the most prominent proposals for the National Market System involved establishing a single trading platform that, through centralization, would guarantee investors equal access to the marketplace and the highest possible levels of competition and liquidity—the so-called Consolidate Limit Order Book, also known as the “National Limit Order File” (US Congress 1975). As noted by the National Market Advisory Board, by guaranteeing a national standard of order routing and execution, CLOB would “contribute the most to reestablishing the confidence of individual investors,” constituting the “fairest and most efficient” implementation of the NMS. Although supported by over-the-counter dealers and brokerage houses, the Consolidated Limit Order Book was fiercely opposed by some members of Congress, who saw no benefits in distorting innovation in financial markets, as well as by incumbent exchanges that would have seen their business disappear. For these actors, as Kennedy notes, marketplaces should be “locally managed and privately owned, and largely left to self-regulate and free to compete through the creation of innovative rules and market systems” (2017). Technologies were motors of capitalism that, unrestrained and left to the hands of practitioners, would result in optimal solutions.
In tackling the National Market System, the Commission left much of the system's development in the hands of self-regulatory organizations. As noted above, the two systems that ultimately dictated the fate of NMS—the Consolidated Tape and the Inter-Market Trading System—were developed not under the auspices of the Commission but, rather, under the control of the industry's self-regulatory bodies. The Securities Industry Automation Corporation, a subsidiary of the New York and American Stock Exchanges, played a critical part in this process. As Dan Schiller notes in his historical analysis of communications regulation in the United States, delegating innovation onto SIAC mirrored broader government policies on telecommunications: first, that there be freedom to innovate, which the securities industry seized upon by setting its own standards and designs; and second, that the system maintain a "broad diversity of suppliers—to avoid an undue concentration of power in one entity [which] could adversely affect an industry as communication intensive as [finance]" (Statement of Vincent P. Moore Jr., in Schiller 1982). The SEC decided on the shape of markets by not intervening in their design, favoring a model that preserved multiple trading sites linked through a growing set of rules around quote transmission and execution, rather than a more involved centralized mechanism with heavy intervention by the Commission. This was despite heavily moralized battles over how CLOB might have accomplished the regulator's goal of providing fair, equitable access to the market: as a centralized trading system, a CLOB established strict parameters of participation (more technically, it implemented a universal form of time-price priority that guaranteed equal execution to all market participants). Perhaps, as the textual data shows, this choice was already given: for the commission, markets had moved away from places and onto systems. A centralized CLOB might have worked years earlier, when markets were still thought of as physical spaces of exchange, but it no longer made sense under an ontology of markets-as-systems where information, rather than access and control over participants through credentialization, was what mattered principally.
The tension between centralization and interconnected fragmentation was clearly ontological, boiling down to competing definitions of markets (Schwartz et al. 2006). But this same tension was also deeply political: in choosing an approach to the implementation of the market’s structure, the Commission was arguably also defining the boundaries between the work of markets as public zones of trade and fact-making and as private organizations. The relatively light-footed metaphor of a market ‘system’ avoided difficult decisions about designs and policy implementations while serving the interests of incumbents. A concerted engagement with the technicalities of the National Market System and, in particular, the Consolidated Limit Order Book, would have required rebuilding the nation’s financial infrastructure as something akin to a public utility thereby challenging the organizations such as the New York Stock Exchange and putting aside smaller regional investors and brokers who clamored for access to the big board. This radical possibility was well within the remit of the SEC under the 1975 Securities Acts Amendments. In fact, setting up a public utility is precisely what the SEC did to deal with revenue sharing around market data feeds by establishing the Securities Information Processors which Congress suggested “should be regulated accordingly [and] not be under the control or domination of any particular market center” (US Congress 1975). With technology placed along with other external and inscrutable forces that acted upon markets with seemingly little possibility of control, the shift towards a market ontology of systems as opposed to places afforded the SEC with the possibility of forestalling public interventions (regulation) into the workings of private institutions (stock exchanges) while maintaining claims that it was actively pursuing the objectives of the Securities Acts. Addressing the regulation of technologies as used in markets would have required taking a likely uncomfortable decision: opting for a more restrained, more publicly controlled market at a time when financialization was the emerging policy consensus (Krippner 2011). ‘Black-boxing’ technology as an external entity to financial markets was thus an institutional strategy to reinforce the public-private partnerships between the state and the securities industry.
This was surprisingly consequential. The ‘paradox’ of efficiency, transparency, and diminished public confidence in equities markets that Commissioner Aguilar alluded to at the outset of this paper was fundamentally shaped by the decision not to regulate technology as a means for governing finance and its markets. An often forgotten, if not purposefully ignored dimension of finance is that it runs as much on information, capital, and human interests as on cables, routers, and algorithms. For the latter, regulation is often asymmetric despite the fact that its effects are increasingly public. Finance is politics, conducted in part with the apparently incontrovertible, and seemingly neutral aid of technological means. While controversial market activities often involve technology and its intersection with regulatory institutions (consider the exemplar of high frequency trading, often deemed an illegitimate form of trading owing to its conceptual dissociation from ‘meaningful’ face-to-face trading), technologies are seldom put on the stand. Yet insofar as finance requires technologies that make the trading of promises and claims possible, its trajectories of legitimacy will involve specific decisions about the devices used to visualize, operate in, and engage with the marketplace. The decision not to regulate these as meaningful market actors or elements of the market process, treating them instead as unavoidable innovations developed outwith finance, allows for their design, making, and implementation to remain outside of the view of the state’s apparatus and comfortably within the control of private firms and their proxies. This omission is not simply a statement of the taken-for-grantedness and apparent remorselessness of technological change but, as importantly, of how it is interpreted with respect to the state’s capacities to govern. And it is fully consequential.

Keeping ‘hard’ technological innovations outside of the agency’s regulatory scope may well create a lag between the state’s capacities to understand and oversee markets and what occurs in the semi-private domains of finance. The ideological lightness of credit (Quinn 2019) is mirrored, thus, by the ideological inscrutability of technology, providing private actors with a head start in expanding the scope of financialization by creating and capturing advantageous positions in the field through the development of novel
infrastructures and systems that are simply out of reach of regulatory action. A recent report on Goldman Sachs’ trading division makes this clear. As *Bloomberg* details, the investment bank is “planning its biggest hiring spree in years”, not of traders but of “more than 200 engineers for tech-related roles on the trading floor [...] a sign of where Wall Street is headed” (Natarajan 2019). In this same piece, Adam Korn, co-head of engineering in the trading division at Goldman Sachs noted: “You are going to see us very actively in the marketplace going after this kind of talent [...] Historically, engineers were not seen as a part of the business. That’s obviously changed.”

Although a frontrunner in technological and infrastructural investments in the past (former employee, personal communication), Goldman Sachs’ proactive approach to technology is not unique. As early as 2011, the *Wall Street Journal* noted the increased competition for technology-related talent between Wall Street and Silicon Valley: at the time, the Journal reported starting salaries for trading programmers with no advanced degree of between $75,000 and $95,000 in finance, about ten percent above the equivalent starting-level position in Silicon Valley (Peterson 2011). In the more rarified space of high-frequency trading, the average payout far surpassed these numbers: firms like Virtu Financial compensated their employees with about $563,000 per year, comparable to the $492,000 average for the electronic market-makers KCG (Clarke 2015). The SEC also hires technologists—for example, a recent job posting included an IT specialist with a starting salary of $129,000 (USAJOBS.gov 2019)—but mostly to work on general information security, maintaining and redeveloping EDGAR, the regulator’s central electronic dataset for corporate filings, or in the Division of Enforcement’s forensic laboratory (that is, in either disclosure or enforcement functions; SEC 2015). Technologists and allied experts are not primarily hired to vet and monitor market technologies, but to maintain existing systems within the agency focused on record keeping rather than the surveillance of markets and transactions.

**Concluding remarks: making devices visible**
I bring this paper to a close with an empirical caveat. The corpus I study here stops in 2010, shortly before a qualitative shift in the SEC’s approach to matters of technology. Since then, public debates about algorithmic trading and the new challenges of securities market microstructure have acquired prominence in the regulatory limelight in the United States and overseas. Part of this may well stem from the events of May 10, 2010, when United States market indices fell suddenly and dramatically owing to unforeseen interactions between algorithms, human traders, and delays in data feed. Part may also stem from the rise of the so-called FinTech industry which seeks to disrupt in varying degrees (and with varying success) existing means for banking and investment. For the last decade, then, the Securities and Exchange Commission has sought to engage with technological changes in the marketplace in a more direct and concerted fashion, be it through the development of a Consolidated Audit Trail that takes the agency’s concern with informational disclosure to the mechanics of real-time in the new millennium, or the more striking Regulation Systems Compliance and Integrity regulation that guarantees the operation and continuity of some of the securities markets’ most critical infrastructures. Alas, a reading of the SEC’s RSCI suggests continuity rather than change. The policy will require “entities to establish written policies and procedures reasonably designed to ensure that their systems have levels of capacity, integrity, resiliency, availability, and security adequate to maintain their operational capability and promote the maintenance of fair and orderly markets, and that they operate in a manner that complies with the Exchange Act” (SEC 2015); it is an exercise in disclosure rather than an intervention in design.

Ontologies are sticky, and despite its increasing perception of technology’s relevance, the Securities and Exchange Commission still thinks of markets through the abstract languages of systems. Technology matters more than in the past, but it is still rendered external to the market, a largely neutral and inscrutable object that needs guardrails rather than intervention and redesign. Keeping the devices of the markets outside of the purview of regulation continues to exclude them from deliberative discussions about the shape that markets could take in the future and the social commitments they might make
possible. Here, Pistor's (2018) provocative metaphor of the code of capital becomes a productive invitation to think about reinventing financial regulation. Finance is certainly produced at the intersection of profit, capital, and the logic of modern capitalist states. Yet the distinct features of capital's code are not drawn only by lawyers, legislators, and regulatory who, as masters of the code, can wrangle contracts, operations, and legitimate sites of action within the financial realm. Ultimately, the capacities of markets to operate, the rails of capitalism and financialization, are predicated on the multiple devices that make actions possible, on infrastructures that provide possibilities for markets to monetize, quantify, expand, reproduce, and mutate. Without reckoning with these as internal to markets, without recognizing the role played by the circuitry that channels flows of capital, information, and interaction in the financial sphere, regulation will tackle but the surface of the code without transforming the underlying hardware on which it runs. This ontological move—rendering markets as built objects and infrastructures of sociality—is a key challenge for our reckoning with financialization and our collective political imaginations.

Acknowledgments
I thank Bruce Carruthers and Stephen Craig Nelson for their always constructive advice, as well as the generous suggestions from audiences at the London School of Economics and Political Science, the University of Leicester, the University of California at Berkeley, and the 2015 Meeting of the Society for the Advancement of Socio-Economics.

References


Juan Pablo Pardo-Guerra is an Assistant Professor at the University of California, San Diego. He is an economic sociologist and scholar of science and technology whose work explores the material, organizational, and social consequences of markets in contemporary societies. His empirical field span art markets, finance, quantification in higher education, and the politics of urban design. He is author of *Automating Finance: Infrastructures, Engineers and the Marking of Electronic Markets* (Cambridge University Press).

**Figure 1.** Distribution of SEC Commissioner speeches
Table 1. Topic models of the SEC Commissioner Speeches corpus, indicating the top 20 words for each topic. Each column represents a distinct ‘topic’ in the speeches. The words in the cells are arranged in decreasing frequency within each topic and are represented by their stems. For example, ‘businesses’ and ‘business’ are both represented by ‘busi’.
**Figure 2.** Sub-graphs of the semantic network for 1935-2010 for the term 'market'. Each subgraph contains the $k$ most relevant nodes that share an edge with ‘market’. The size of the nodes is scaled to their betweenness centrality, and their color is ranked according to their degree.

<table>
<thead>
<tr>
<th>Collocation frequency</th>
<th>PPMI proximity measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Collocation frequency" /></td>
<td><img src="image2.png" alt="PPMI proximity measure" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>1935-1949</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Collocation frequency" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>1950-1964</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Collocation frequency" /></td>
</tr>
</tbody>
</table>

| **1965-1979** |
### Table 2. Top fifteen bigrams in the commissioner speeches. Bigrams are filtered to have a frequency of at least 5 occurrences and are ordered by descending likelihood ratio.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-the-counter market</td>
<td>Capital market</td>
<td>Market system</td>
<td>Securities market</td>
<td>Capital market</td>
<td></td>
</tr>
<tr>
<td>Capital market</td>
<td>Over-the-counter market</td>
<td>Securities market</td>
<td>Capital market</td>
<td>Market participant</td>
<td></td>
</tr>
<tr>
<td>Market price</td>
<td>Securities market</td>
<td>Capital market</td>
<td>Money market</td>
<td>Securities market</td>
<td></td>
</tr>
<tr>
<td>Securities market</td>
<td>Market price</td>
<td>National market</td>
<td>Market participant</td>
<td>Money market</td>
<td></td>
</tr>
<tr>
<td>Market value</td>
<td>Market place</td>
<td>Central market</td>
<td>Equities market</td>
<td>Market structure</td>
<td></td>
</tr>
<tr>
<td>Current market</td>
<td>Market (of the) country</td>
<td>Over-the-counter market</td>
<td>Stock market</td>
<td>Equities market</td>
<td></td>
</tr>
<tr>
<td>Market place</td>
<td>Market manipulation</td>
<td>Market place</td>
<td>Market value</td>
<td>Financial market</td>
<td></td>
</tr>
<tr>
<td>Rise (of/in the) market</td>
<td>Open market</td>
<td>Third market</td>
<td>Futures market</td>
<td>Bond market</td>
<td></td>
</tr>
<tr>
<td>Open market</td>
<td>Market activity</td>
<td>Equities market</td>
<td>Market fund</td>
<td>Trade market</td>
<td></td>
</tr>
<tr>
<td>Primary market</td>
<td>Fair market</td>
<td>Trade market</td>
<td>Free market</td>
<td>Market data</td>
<td></td>
</tr>
<tr>
<td>(New) York market</td>
<td>Primary market</td>
<td>Market price</td>
<td>Over-the-counter market</td>
<td>Market fund</td>
<td></td>
</tr>
<tr>
<td>Declining market</td>
<td>Market securities</td>
<td>Stock market</td>
<td>US market</td>
<td>Options market</td>
<td></td>
</tr>
<tr>
<td>Stock market</td>
<td>Market condition</td>
<td>Fair market</td>
<td>Financial market</td>
<td>National market</td>
<td></td>
</tr>
<tr>
<td>Free market</td>
<td>Third market</td>
<td>Efficient market</td>
<td>Efficient market</td>
<td>Stock market</td>
<td></td>
</tr>
<tr>
<td>Trade market</td>
<td>Market today</td>
<td>Market value</td>
<td>Market disclosure</td>
<td>Global market</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Top fifteen trigrams in the commissioner speeches. Trigrams are filtered to have a frequency of at least 5 occurrences and are ordered their likelihood ratio.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New York market</td>
<td>Market securities exchange</td>
<td>Market New York</td>
<td>United States market</td>
<td>Hedge fund market</td>
</tr>
<tr>
<td>Common stock market</td>
<td>Market securities act</td>
<td>Market securities exchange</td>
<td>Market United States</td>
<td>Market hedge fund</td>
</tr>
<tr>
<td>Exchange over-the-counter market</td>
<td>Securities market commission</td>
<td>National market system</td>
<td>Insider trade market</td>
<td>Mutual fund market</td>
</tr>
<tr>
<td>Transaction over-the-counter market</td>
<td>National securities market</td>
<td>Securities market system</td>
<td>Market insider trade</td>
<td>Market mutual fund</td>
</tr>
<tr>
<td>Dealer over-the-counter market</td>
<td>Integral capital market</td>
<td>Stock exchange market</td>
<td>New York market</td>
<td>Capital market participant</td>
</tr>
<tr>
<td>Regulation over-the-counter market</td>
<td>Confidence capital market</td>
<td>Market mutual fund</td>
<td>Mutual fund market</td>
<td>US capital market</td>
</tr>
<tr>
<td>Region capital market</td>
<td>Capital market county</td>
<td>Central market system</td>
<td>Municipal securities market</td>
<td>Market credit rating</td>
</tr>
<tr>
<td>Rise market price</td>
<td>Function capital market</td>
<td>Securities market commission</td>
<td>Market securities exchange</td>
<td>Market United States</td>
</tr>
<tr>
<td>Raise market price</td>
<td>Access capital market</td>
<td>Capital market system</td>
<td>Securities market commission</td>
<td>United States market</td>
</tr>
<tr>
<td>Market price securities</td>
<td>Capital market securities</td>
<td>Municipal securities market</td>
<td>US securities market</td>
<td>Raise capital market</td>
</tr>
<tr>
<td>Current market value</td>
<td>Capital market today</td>
<td>Market exchange commission</td>
<td>Market invest company</td>
<td>Global capital market</td>
</tr>
<tr>
<td>Confidence securities market</td>
<td>Operation capital market</td>
<td>Market United States</td>
<td>Market exchange commission</td>
<td>Capital market regulation</td>
</tr>
<tr>
<td>Market value securities</td>
<td>Public capital market</td>
<td>Over-the-counter market system</td>
<td>Securities market participant</td>
<td>Competition capital market</td>
</tr>
<tr>
<td>Relation current market</td>
<td>Today capital market</td>
<td>Market securities industry</td>
<td>Market Wall Street</td>
<td>Capital market system</td>
</tr>
<tr>
<td>Free open market</td>
<td>Regulation capital market</td>
<td>Securities industry market</td>
<td>Equities securities market</td>
<td>Efficient capital market</td>
</tr>
</tbody>
</table>
Figure 3. Evolution of topics for the SEC speeches, 1937-2011.
<table>
<thead>
<tr>
<th>Year</th>
<th>BC for 'market'</th>
<th>Degree</th>
<th>Node with the highest BC</th>
<th>BC of the most central node</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935-1949</td>
<td>0.001496</td>
<td>5</td>
<td>Settlement</td>
<td>0.135386</td>
</tr>
<tr>
<td>1950-1964</td>
<td>0.009928</td>
<td>6</td>
<td>Technology</td>
<td>0.179561</td>
</tr>
<tr>
<td>1965-1979</td>
<td>0.001423</td>
<td>5</td>
<td>SRO</td>
<td>0.385074</td>
</tr>
<tr>
<td>1980-1994</td>
<td>0.000415</td>
<td>2</td>
<td>Regime</td>
<td>0.256935</td>
</tr>
<tr>
<td>1995-2010</td>
<td>0.004587</td>
<td>5</td>
<td>Reorganize</td>
<td>0.190976</td>
</tr>
<tr>
<td>Year</td>
<td>BC for 'technology' or 'electronic'</td>
<td>Degree</td>
<td>Node with the highest BC</td>
<td>BC of the most central node</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------</td>
<td>--------</td>
<td>--------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>1935-1949</td>
<td>0.043373</td>
<td>51</td>
<td>Settlement</td>
<td>0.135386</td>
</tr>
<tr>
<td>1950-1964</td>
<td>0.179561</td>
<td>90</td>
<td>Technology</td>
<td>0.179561</td>
</tr>
<tr>
<td>1965-1979</td>
<td>0.032643*</td>
<td>15</td>
<td>SRO</td>
<td>0.385074</td>
</tr>
<tr>
<td>1980-1994</td>
<td>0.0*</td>
<td>1</td>
<td>Regime</td>
<td>0.256935</td>
</tr>
<tr>
<td>1995-2010</td>
<td>0.082544*</td>
<td>73</td>
<td>Reorganize</td>
<td>0.190976</td>
</tr>
<tr>
<td>Year</td>
<td>Class 1</td>
<td>Class 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950-1964</td>
<td>Market [understand, purchase, exchange, domestic, inform]</td>
<td>Technology [innovation, industry, enterprise, secure, system, regulatory]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965-1979</td>
<td>Market [competition, consumption, industry, nation, regime]</td>
<td>Electronic [manage, participant, process]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electronic [manage, participant, process, problem, risk]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 7. Frames for ‘technology’ in SEC speeches

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology as motor of capitalism:</strong></td>
<td><strong>Technology as disruptive force:</strong></td>
<td><strong>Technology as a problem/bottleneck:</strong></td>
</tr>
<tr>
<td>&quot;The Securities and Exchange Commission is one of the outposts of capitalism. [Its is not] a patrol designed to protect investors against risk of loss or depreciation in investment. Risks of investment still persist under this phase as under the earlier phases of capitalism. The onward sweep of technology is not arrested&quot; Commissioner Douglas, 1938</td>
<td>&quot;The Congress, the Commission, the self regulatory organizations and other elements of the securities industry have been engaged in a long and frequently contentious endeavor to establish in our country a coordinated competitive system of markets for the more widely held and traded securities, a system that will take full advantage of modern technology to provide markets for all investors which will offer liquidity continuity and fairness to the maximum extent attainable&quot;. Commissioner Garrett, 1974</td>
<td>&quot;The further back we push the domain of ignorance the nearer we approach the power to control within a democratic framework the technological and social forces which we must master in order to keep them from overpowering us&quot;. Commissioner McDonald, 1950</td>
</tr>
<tr>
<td>&quot;Because of the increasing complexity in making investment decisions in our technological economy some call it post industrial, many individuals prefer to leave their investment decisions in the hands of professional investment managers&quot;. Commissioner Smith, 1969</td>
<td>&quot;Some participants in the policy debate have a perfectly rational incentive to continue to confuse the message with the messenger in order to forestall technological progress that threatens traditional trading mechanisms that generate substantial rents for certain market participants&quot;. Commissioner Grundfest, 1988</td>
<td>&quot;Communications and data analyzing technology has progressed to a point of magnitude superior to that available just brief years ago. Although these developments have augmented the complexity and efficiency of the private financial sector, the SEC has not enjoyed all the benefits of this improved technology&quot;. Commissioner Karmel 1979</td>
</tr>
<tr>
<td>&quot;Beyond the statistics, small businesses are important because they often produce new technology and innovations like computers, robotics, and pharmaceuticals that enable us to make strides in our standard of living, as well as compete in a global economy that rewards new ideas with new jobs&quot;. Commissioner Shapiro, 1992</td>
<td>&quot;Changing economic conditions, major mergers and acquisitions, and technological advances have engendered new financial products and services that make it increasingly difficult to distinguish between the many types of financial services activities&quot;. Commissioner Goelzer, 1986</td>
<td>&quot;Communications and data analyzing technology has progressed to a point of magnitude superior to that available just brief years ago. Although these developments have augmented the complexity and efficiency of the private financial sector, the SEC has not enjoyed all the benefits of this improved technology&quot;. Commissioner Karmel 1979</td>
</tr>
<tr>
<td>Technology as an opportunity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| “For this reason, we must do all we can to minimize the risk of error. I would hope that the data produced by a carefully designed system of broker dealer financial reports, coupled with computer technology, would enable us to evaluate the impact of suggested changes to a degree never before available. The securities industry is already using electronic data processing equipment to perform a wide variety of functions”. | Commissioner Cohen, 1966.

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>“the commission s attempts to stay at the forefront of technology. One important area has to do with electronic communications, especially what e-mail to keep and what to discard”.</td>
</tr>
</tbody>
</table>