
Big Data and the Regulation of Banking and Financial Services

By Thomas Groll, Sharyn O'Halloran, Sameer Maskey, Geraldine McAllister, and David Park

Introduction

In the wake of the 2008 mortgage crisis, the nation has struggled to redesign the regulatory architecture of its financial markets. Hampering efforts is disagreement over the contours of the previous regime and the nature of the regulatory failures that brought the entire system to the brink of collapse. This is an important discussion, for the different interpretations of history have different implications for the road ahead.

Some claim the problem lies in the past, regulators had too little authority, especially when it came to overseeing newer forms of financial organization, such as hedge funds, private equity firms, and other elements of the “shadow banking system.” Under this view, reforms need to concentrate on giving executive branch officials more power, bringing more institutions under regulatory scrutiny and making sure that regulators have the resources and authority to assure the safety and soundness of our banking system. Others, though, claim that executive officials did have the authority to regulate exotic new firms and financial instruments, but that they failed to fully use the policy tools at their disposal. If this is true, then reforms will mean little unless they are coupled with strong incentives for regulators to use the power delegated to them and resist capture by the industry they are supposed to be overseeing.

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In a recently concluded study, reviewing regulation of the financial industry since 1950, we find that, in part, both sides are correct. Congress has, indeed, continued to pass new laws regulating financial actors over the entire period studied, and executive branch officials did possess the authority necessary to bring new beasts in the financial menagerie under regulatory control. But it is also true that the nature of this delegated authority has changed: over time, it has become more constrained by administrative procedures, it has been split among more actors, and it has been vested in agencies under more political control, as opposed to independent regulatory commissions. Together, these changes have made financial regulation more difficult in practice, and reforms to the system should therefore emphasize creating a consistent, independent, and non-partisan financial regulatory structure.

To illustrate the logic of our findings, we first detail the theoretical arguments for why and how government regulates financial markets. The key insights are that regulatory design responds to the preferences of political actors as well as the uncertainty inherent in regulating firm-specific and systemic risk. We identify under what conditions legislators delegate discretionary decision-making to better-informed executive regulators and when lawmakers retain that authority for themselves. Moreover, we show the impact that such regulatory design decisions have for the safety and soundness of financial markets.

To test these predictions, we develop a novel comprehensive data set of financial regulation laws since 1950 and construct measures of agency discretion over time. Manually coding banking and financial service laws requires aggregating measures from thousands of pages of text-based data sources with tens of thousands of provisions, containing millions of words. Such a large-scale manual data tagging project is time consuming, expensive and subject to potential measurement error.

To mitigate these limitations, we employ Natural Language Processing (NLP) and Machine Learning (ML) techniques to complement the observational study. These methods allow us to efficiently process large amounts of text and represent them in feature vectors, taking into account words, phrases, syntax, and semantics. These vectors can be paired with predefined policy features specified in the manual coding, thereby enabling us to build better predictive measures of financial services regulation. The results show that combining observational methods with computational analysis greatly improves the accuracy of the estimates.

The analysis offers policymakers and the business community alike a tool to automatically score policy features of financial regulation laws to measure their impact on financial markets. This report thereby offers a new path, illustrating how triangulating different methods can enhance our understanding of an important substantive public policy concern of how best to regulate the banking and financial sectors to promote stable markets and economic prosperity.

The Why and How of Financial Regulation

What explains the structure of financial regulation? Where, how, and by whom policy is made significantly impacts market outcomes. When designing financial regulation laws, Congress specifies the rules and procedures that govern executive actions. The key is how much discretionary decision-making authority Congress delegates to regulatory agencies. In some cases, Congress delegates broad authority, such as mandating the Federal Reserve to ensure the “safety and soundness” of the financial system. Other times, Congress delegates limited authority, such as specifying interest rate caps on bank deposits.

A recurring theme in the political economy literature of regulatory design is that the structure of policy making is endogenous to the political environment in which it operates.¹ Epstein and O’Halloran show that Congress delegates policymaking authority to regulatory agencies when the policy preferences of Congress and the executive are closely aligned, policy uncertainty is low, and the cost (political and otherwise) of Congress setting policy itself is high.² Conflict arises because of a downstream moral hazard problem

between the agency and the regulated firm, which creates uncertainty over policy outcomes.³

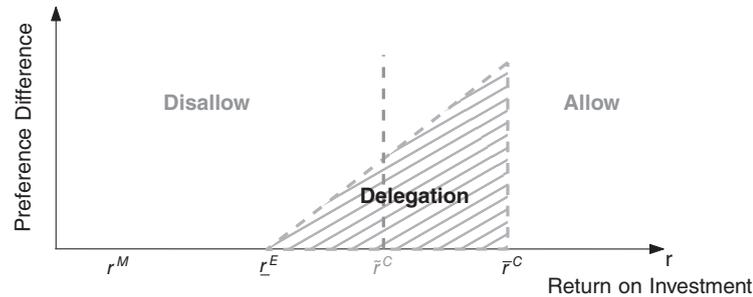
Application of these theoretical insights to financial regulation is well-motivated. Banking is a complex policy area in which bureaucratic expertise is valuable, and market innovation makes outcomes uncertain. Morgan, for instance, shows that rating agencies disagree significantly more over banks and insurance companies than over other types of firms.⁴ Furthermore, continual innovation in the financial sector means that older regulations become less effective, or “decay,” over time. If it did not delegate authority in this area, Congress would have to continually pass new legislation to deal with new forms of financial firms and products, which it has shown neither the ability nor inclination to do.⁵ Overall, then, the literature leads the following testable hypotheses: Congress delegates more discretion when: (1) The preferences of the president and Congress are more similar; and (2) Uncertainty over market outcomes (moral hazard) is higher.⁶

Groll, O’Halloran, and McAllister expand on this work, addressing whether policymakers regulate financial markets on their own or delegate regulatory authority to government agencies when faced with uncertainty about firm-specific investments and systemic risk at the financial services level.⁷ The executive is better informed and knows the exact correlation but puts greater weight on the social cost of a possible bailout.⁸

They conclude that Congress delegates regulatory authority when (1) the preferences of the executive and Congress are more similar, (2) the costs of a bailout are high, (3) there is more uncertainty about investment risk and systemic risk, and (4) Congress’s bailout concern is high. Further, financial services are more heavily regulated when firm-specific investments and systemic risks are uncertain. But when interbranch preferences differ or perceived systemic risk is low, Congress may allow risky investments to be made that, *ex post*, it wished it had regulated.

To illustrate the trade-off between policy differences and market uncertainty, we focus on Congress’s and the executive’s preferences and information differences. Congress prefers, in general, lower regulation thresholds than the executive because it puts less weight on

Figure 1: Delegation and Preference Differences



the cost of a possible bailout. This is referred to as the preference difference between Congress and the executive, which is part of Congress's trade-off between the information advantage of the executive and the difference in preferred policy.

Figure 1 illustrates the implications when Congress would regulate on its own and when it would delegate to the executive. The shaded area indicates situations in which Congress delegates, while outside this area Congress makes policy on its own. Firms do not internalize a potential systemic failure in the absence of regulation and would make any investment that yields them a nonnegative expected return—that is, any investments at or above r^M in Figure 1. When Congress regulates, then any investments that would yield Congress a negative expected social return including the cost of a possible bailout—that is, any returns below \bar{r}^C in Figure 1—would be banned and all others would be allowed. When Congress delegates, then, the executive sets a requirement in a similar spirit: banning investments with a negative expected social return that accounts for the cost of a possible bailout and the executive's salience. The executive knows the correlation and can set therefore a standard for uncorrelated investments, r^E , and for correlated investments that of Congress's preferred threshold of \bar{r}^C because of limited discretion from Congress. The delegation to the executive with discretion follows then from these two thresholds. All three regulatory standards are increasing in (1) the actual cost of a bailout, (2) the salience of a possible bailout, and (3) the perceived likelihood of correlated investments. But the stringency decreases when the likelihood of successful investments increases.

Focusing on the preference difference and expertise, the executive puts relatively more weight on the bailout

cost than Congress, and therefore Congress values the executive's expertise most when there is no preference difference and delegates most discretion to the executive. But as the executive puts an increasing weight on the bailout cost, or Congress a decreasing weight, the preference difference increases and Congress delegates less to the executive because of its higher standards, which would imply a movement along the vertical axis in Figure 1. In other words, the delegation area shrinks as the disagreement between Congress and the executive increases and Congress prefers to regulate on its own. However, when the costs of a potential bailout increase or Congress's uncertainty over correlated investments increases, the area of delegation expands as Congress gains relatively more from the executive's expertise increase.

The preference difference also has implications for investments that are highly risky but high-returning when Congress perceives a low likelihood of correlated investments. In such situations, Congress prefers to regulate the financial investments on its own—that is, Congress would set a return requirement of \bar{r}^C that is actually below the executive's standard for uncorrelated investments r^E in Figure 1. The reason is that the executive's expertise about correlated investments is not expected to be valuable to Congress, and the executive's standard is perceived as too stringent given the preference difference.

Overall, then, we have the following testable hypotheses:

- (1) Congress delegates regulation with more discretion to the executive when
 - a. The policy preferences between Congress and the executive become more similar,

- b. Firms' investment risks become more uncertain, and
 - c. The costs for Congress to bail out financial firms become more severe.
- (2) The more Congress cares about bailout costs, the higher are
- a. Congress's preferred level of regulation,
 - b. The executive's discretion and regulation, and
 - c. Overall levels of regulation.

Financial Regulation Laws as Data

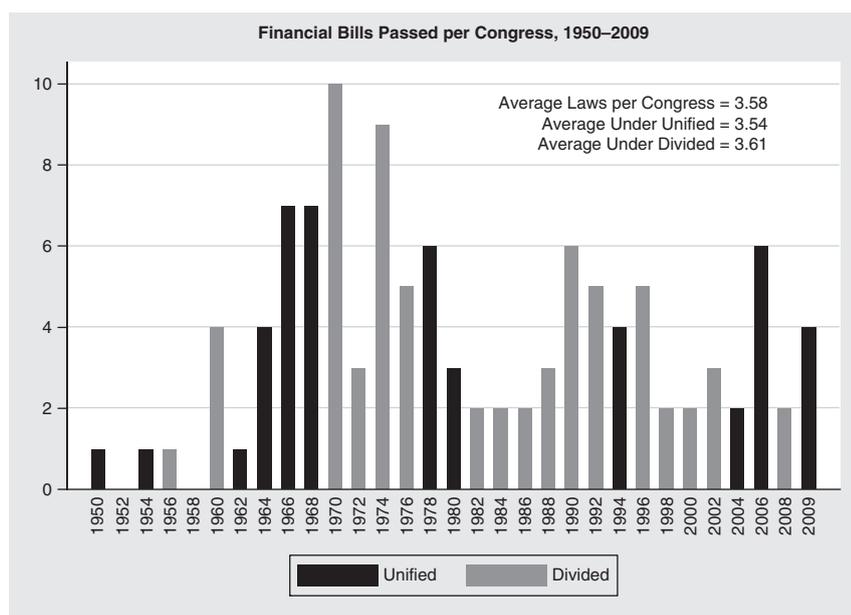
To test the hypotheses that policy conflict and financial risk impact the amount of authority delegated to executive agencies and in turn the stringency of financial market regulation, we construct a database of all financial regulation laws since 1950. To do so, we identify the relevant legislation mentioned in *Congressional Quarterly's* (CQ) policy trackers for the categories of Banking, Savings and Loan Industry, Federal Reserve, Stock Market and Financial Services, Insurance, and Mortgages. We also review a comprehensive survey of banking law⁹ as well as the Web sites of the federal banking regulators. Finally, we include recent laws, not available in CQ, where THOMAS' "Legislation in Current Congress" provides summaries of post-2005 financial laws.¹⁰ This process yields 121 federal laws enacted from 1950 to 2010 that regulate the banking and financial services sector.

The distribution of laws by Congress is illustrated in Figure 2. The figure shows that, on average, Congress enacts approximately three and a half financial regulation laws each congressional term. The graph also denotes when the executive and legislative branches were controlled by the same political party (Unified) and when this was not the case (Divided). Periods of unified and divided government are shown in different colors. At first blush, the figure does not indicate the influence of partisan factors in passing financial laws; the average number of laws per Congress is almost identical under times of unified and divided partisan control.

The unit of analysis is an individual law, which specifies the rules, producers, and institutional architecture that regulate the actions of financial market participants. From *Congressional Quarterly* summaries of these laws, we coded the major provisions of each statute.¹¹ The average corpus of text of each legislative summary is 6,278 words. Over time, these statutes have become more complex: the laws contained 19.3 provisions each, on average, but this number has risen to 31.0 in the past two decades.¹²

From the previous theoretical discussion, the key variable of interest is the amount of discretionary authority Congress delegates to regulatory agencies to set banking and financial services policy. To construct

Figure 2: Number of Financial Regulation Laws



this index, we read through the legal summaries and collected the following data for each law:¹³

- (1) The number of major provisions that delegated authority to executive branch actors;
- (2) The administrative procedures that constrain regulators' use of this authority, such as time limits, spending limits, consultation requirements, and whether the consent of other actors is required before regulatory actions can become final; and
- (3) A list of the agencies receiving regulatory authority, including the location of those agencies in the executive hierarchy: the executive office of the president, the cabinet, regulatory agencies, independent regulatory commissions, or government corporations.

From this information, we calculate a number of variables on a per-law basis. First, the delegation ratio is defined as the number of provisions in a bill that delegate authority, as a percent of the total number of provisions. In the database, each law contains an average of 27 provisions of which 11 delegate substantive authority to four executive agencies. The average delegation ratio across all laws then is 0.41 or 11/27.

Second, the constraint index measures the degree to which administrative procedures limit regulators' discretionary authority. We specify 14 distinct procedural constraints associated with the delegation of authority and note every time one appears in a law. Including all 14 categories in our analysis is unwieldy, so we investigate the feasibility of using principal components analysis to analyze the correlation matrix of constraint categories. As only one factor was significant, first dimension factor scores for each law were calculated, converted to the [0, 1] interval, and termed the constraint index. Each law on average contained three constraints of the possible 14, yielding an overall constraint ratio of 0.21.

Third, from these data, we calculate an overall discretion index, as the delegation ratio minus the constraints ratio.¹⁴ As an illustration of the way the discretion index is constructed, let us consider the Dodd-Frank Wall Street Reform and Consumer Protection Act (Pub. L. 111-203). The law contains 636 provisions of which 314 delegate authority to 46 executive agencies, yielding a delegation ratio of 0.5. The legal

summary also indicated ten procedural constraints out of a possible 14, yielding a constraint index of 0.7 (10/14). Combining delegation and constraints ratios produces a discretion index of $0.5 \star (1 - 0.7) = 0.1$. The more discretion an agency has to set policy, the greater the leeway it has to regulate market participants. Lower levels of agency discretion are associated with less stringent regulation.

To verify the robustness of our estimates and confirm that our choice of aggregation methods for constraints does not unduly impact our discretion measure, Figure 3 shows the average discretion index each year calculated four different ways. As the time series patterns are almost identical, our choice of method number four (continuous factors, first dimension) is not crucial to the analysis that follows.

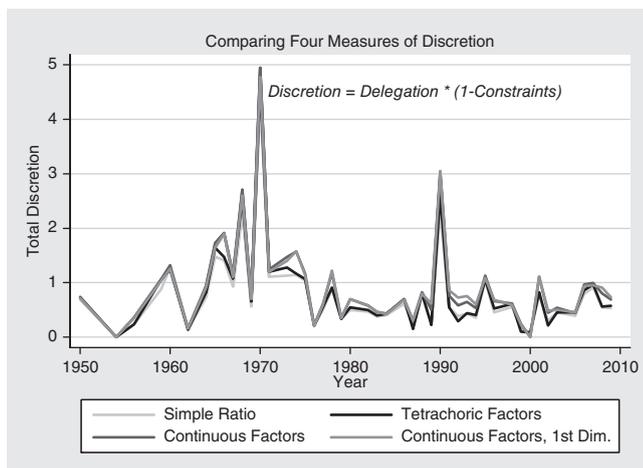
Fourth, we code each of the regulatory agencies explicitly mentioned in the laws. The average number of regulators named in each law shows the extent to which policy setting authority is divided across executive branch actors. Finally, the autonomy of regulators is measured by the relative mix of independent regulatory actors receiving authority, for example, Securities and Exchange Commission, as opposed to actors and executive agencies under more direct presidential control, for example, the US Treasury Department.

Data Trends

What do the data tell us? As illustrated in Figure 4, the trend in recent decades has been for Congress to give executive branch actors less discretion to regulate financial markets. Since the Great Society era of the 1960s, and on into the early 1970s, the total amount of new executive branch authority to regulate the financial sector has generally declined.¹⁵ The exceptions are a few upticks in discretion that coincide with the aftermaths of well-publicized financial crises and scandals, including the Savings and Loan crisis, the Asian crisis, and the Enron scandal.

Otherwise, the government has been given steadily less authority over time to regulate financial firms, even as innovations in that sector have made the need for regulation greater than ever, and even as the importance of the financial sector in the national economy has greatly increased. Figure 4 also shows the size of the finance services sector as a percentage of GDP,

Figure 3: Four Measures of Executive Discretion

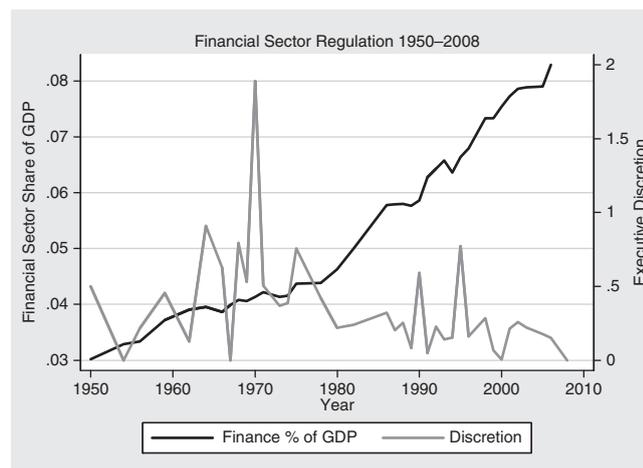


which has risen from 3 percent in 1950 to more than 8 percent in 2008. As industries innovate, new challenges arise, and older forms of regulation may no longer be sufficient to address current marketplace conditions. Yet new laws have given executive branch actors less discretionary authority than before to address these rapidly evolving issues.

What has caused this decrease in discretion? As shown in Figure 5, the amount of authority delegated to oversee the financial sector has remained fairly constant over time, perhaps decreasing slightly in the past decade. The trends in Figure 5, though, are due mainly to a large and significant increase in the number of constraints placed on the regulators' use of this authority. In addition, we find that the number of actors receiving authority has risen significantly over the time period studied, as also shown in Figure 5. And the location of these agencies in the executive hierarchy has changed as well, away from more independent agencies to those more directly under the president's control.

We compare the distribution of the discretion index for laws that regulated the financial industry overall, and laws that deregulated. We would expect from the predictions that laws that regulate the banking and financial services industry would delegate more discretionary authority to executive agencies, and Figure 6 shows that this is indeed the case. The average discretion index for the 31 laws that deregulate is 0.29, as

Figure 4: Discretion and Finance over Time



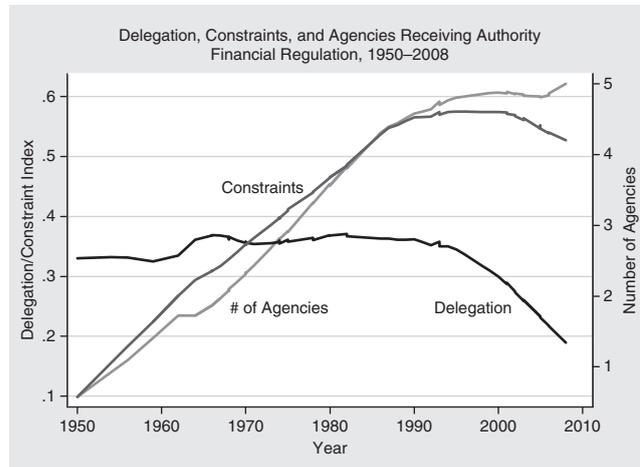
opposed to 0.36 for the 85 laws that regulate (five laws neither regulated nor deregulated, but rather clarified or qualified a provision in an earlier law).”

Finally, we investigated the impact of this changed regulatory structure on overall market performance, statistically analyzing the impact of greater agency discretion on yearly changes in the Dow Jones Industrial Average and on the number and size of bank failures. We found, somewhat surprisingly, that financial markets react positively to higher levels of regulation. The Dow Jones average was half a percent higher, on average, in years in which Congress gave executive actors authority to regulate financial institutions, as compared to years in which no authority was given. Furthermore, the number and size of bank failures decreased significantly following regulatory reform.

Big Data and Financial Regulation Laws

So far, the analysis has focused on the determinants of banking and financial services laws, specifically, the impact of policy conflict and market uncertainty on the level of discretion regulators have to set policy. In reality, assigning simple numbers to the amount of discretion is not a simple undertaking. Congress sets regulation through complex legal text. Categorizing and labeling multiple types of policy features for each legal document increases the chance of inter-coder discrepancies. Moreover, identifying the best interactions among manually coded features to predict regulatory discretion is prone to omissions.

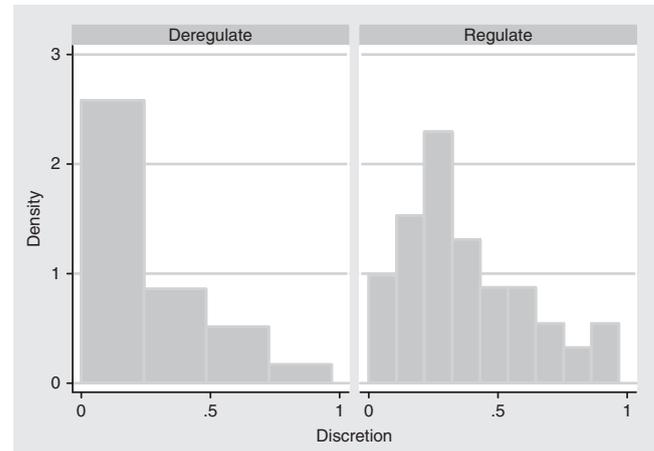
Figure 5: Delegation, Constraints, and Agencies over Time



The technical challenge of analyzing legal texts and regulatory rules can once again be illustrated by the Dodd-Frank Act, which regulates the activities financial institutions can undertake and the regulatory design itself. If data annotators, trained in political economy theories, would read and code the provisions based on the rulebook provided, the coders would have to read 30,000 words—the length of many novels.¹⁶ Unlike masterpieces in literature, however, legislation is written in dry, complex legal language and exhibits painstaking detail, which makes coding prone to subjective and inconsistent interpretation. Consequently, there is the possibility that data annotators will introduce various kinds of noise when coding laws.

Machines and programs are less likely to create the specific kinds of noise that human encoders may cause. O’Halloran, Maskey, McAllister, Park, and Chen discuss and use Natural Language Processing (NLP) and Machine Learning (ML) techniques to analyze the raw texts of the financial regulation database.¹⁷ They provide a complementary analysis to traditional observational studies. Their methods can process large quantities of documents and represent the text in feature vectors, taking into account words, phrases, syntax, and semantics. These feature vectors can be easily paired with predefined policy features specified in the manual coding, thereby enabling researchers to build better predictive models.

Figure 6: Distribution of Discretion—Regulatory and Deregulatory Laws



O’Halloran, *et al.*,¹⁸ provide an overview of the many different ways to encode text. Examples include:

- **Bag of Words:** A bag of words model represents text as a feature vector, in which each feature is a word count or weighted word count.
- **Tag Sequences:** Sentences or chunks of text are tagged with various information, such as Parts of Speech (POS) tags or Named Entities (Nes), which can be used to further process the text.
- **Graphs:** Documents or paragraphs of the documents can be represented in graphs in which nodes can model sentences, entities, and paragraphs, and connections represent relations between them.
- **Logical Forms:** A sequence of words can be mapped into an organized structure that encodes the semantics of the word sequence.

These methods can be applied to represent various forms of text, thereby allowing machines programmed with specified algorithms to extract additional information from the words (surface forms) of the documents. Depending on the problem being addressed, one or more of these methods can be applied. For example, O’Halloran, *et al.*, use various classification algorithms to classify legal text into different categories of discretion.¹⁹ They find that a feature selection model that combines computer-generated features with manually coded variables performs best.

The advantages of analyzing predictive models of agency discretion by employing advanced data science methods are the following:

- The analysis is not limited by the amount of data that can be processed.
- The analysis is not limited to a handful of coding rules to quantify each law for building the discretion model.
- The analysis can take account of the raw text of the law to explore word combinations, as well as syntactic and dependency relations, and identify other sets of features that otherwise would be difficult to encode manually.
- The analysis can optimize model complexity and predictive capacity to obtain the optimal model for predicting agency discretion.

Figure 7 provides a comparison of observational methods and data science techniques along four criteria: coding legislation, structuring datasets, analysis, and internal validity. The overview illustrates the shortcomings of manual, rules-based coding methods and the way these new methods can enhance observational studies. In sum, computational analysis helps lessen error, reduce variance, find additional variables and patterns (data features), and improve the predictive power of models.

NLP and ML techniques can analyze extensive text-based data to test theories of policymaking and regulatory design. These computational methods provide potential improvements over manual coding from a set of defined rules. Yet these computational models rely on the critical data and hypotheses initially produced by subject matter experts to inform or “seed” the model and train complex algorithms. Therefore, data science techniques can be seen as a complement to observational studies and theoretical analysis.

Conclusion

The analysis provides a method to resolve one of the key current public policy debates: how to design the regulatory structure to ensure well-functioning banking and financial services markets. The dynamics of regulatory design reflect policy conflict and the uncertainty over market outcomes. Our research strategy adopts more than one technique of data collection and can thereby improve the validity of analyzing high

dimensional datasets commonly found in financial regulation studies. The practical implications of the analysis are manifold.

On a substantive level, our findings fall into a middle ground between the two theories outlined at the beginning of this article: Congress has indeed continued to regulate the financial sector, but it has also systematically decreased regulators’ discretion, hampering their ability to keep up with developments and innovations in these markets.

Many have argued against more stringent regulation of financial markets, saying that greater regulation would decrease market performance by stifling innovation and inducing companies to relocate abroad to more regulatory-friendly venues. But our findings show that, in fact, stock market indices are broadly higher following regulatory reform. The conclusion is that well-designed regulation can help markets perform better: a well-functioning banking and financial services system is the foundation upon which successful markets are built.

Overall, then, the current morass of regulation creates a web of interlocking and conflicting mandates, making it difficult for regulators to innovate the rules and standards governing the financial industry, while at the same time opening regulatory agencies to industry capture. The problem is not lack of regulation but that regulators have less discretion. Modern financial laws delegate less, constrain more and split authority across more agencies than their predecessors. This has created a situation in which many areas of financial activity are heavily regulated by the federal government, but those charged with oversight are hamstrung by overlapping jurisdictions, the need for other actors to sign off on their policies, or outright prohibitions on regulatory actions by Congress. The current system is, in many ways, designed to be ineffective.

On a methodological level, The analytical techniques developed enable governments and financial market participants alike to: (1) automatically score policy choices and link them to various indicators of financial sector performance; (2) simulate the impact of various policies or combinations of policy under varying economic and political conditions; and (3) detect the rate of change of market innovation by comparing

Figure 7: Comparison of Observational Studies and Machine Learning

	Observational Study		Machine Learning	
	Process	Disadvantages	Process	Disadvantages
Coding	Coding rules	Labor and time costs	Natural language processing	Efficiency and consistency
	Human coders	Coding bias	Data can be words, semantic units, relations, data structure	Detection of implicit/latent factors
	Checking consistency			
Analysis	Hypothesis testing	Number of hypotheses	Various Naive Bayes Models	No limited by data amount
	Regression analysis	Number of variables	Comparing model accuracies	Optimization of complexity
	Correlations on variables	Scaling and sensitive to outliers	Comparison with human coding	Flexibility beyond coding rules
Internal Validity	<i>Low</i>	Missing underlying structure	<i>High</i>	No functional form
	Panoply of variables in single analysis	Missing important variables	Analysis of words, relations, semantic, dependencies	Low generalization errors
		Imposed functional form		No overfitting

trends of policy efficacy overtime. The analysis will help governments to better evaluate the effect of the policy choices they confront, as well as assist business communities to better understand the impact of those choices on the competitive environment they face.

Notes

1. For early work in this area, see, for example, McCubbins, Mathew D. and Thomas Schwartz. "Congressional Oversight Overlooked: Police Patrols versus Fire Alarms." *American Journal of Political Science* 28, No. 1: 165-179 (1984); McCubbins, Mathew, Roger Noll and Barry Weingast. Administrative Procedures as Instruments of Political Control. *Journal of Law, Economics and Organization* 3: 243-277 (1987); McCubbins, Mathew D., Roger Noll and Barry Weingast. "Structure and Process, Politics and Policy: Administrative Arrangements and the Political Control of Agencies." *Virginia Law Review* 75: 431-482 (1989); and Epstein, David and Sharyn O'Halloran. "Administrative Procedures, Information, and Agency Discretion: Slack vs. Flexibility." *American Journal of Political Science* 38: 697-722 (1994).
2. Epstein, David and Sharyn O'Halloran. *Delegating Powers*. New York: Cambridge University Press (1999).
3. Excellent technical work on the optimal type of discretion to offer agencies is provided by Melumad, Nahum D., and Toshiyuki Shibano. "Communication in settings with no transfers." *RAND Journal of Economics* 22(2): 173-198 (1991); Alonso, Ricardo and Niko Matouschek. "Optimal Delegation." *Review of Economic Studies* 75: 259-293 (2008)., and Gailmard, Sean. "Multiple Principals and Oversight of Bureaucratic Policy-Making." *Journal of Theoretical Politics* 21(2): 161-186 (2009). A series of studies examines the politics of delegation with an executive veto (Volden, Craig. "A Formal Model of the Politics of Delegation in a Separation of Powers System." *American Journal of Political Science* 46(1): 111-133 (2002).); civil service protections for bureaucrats (Gailmard, Sean and John

W. Patty. "Slackers and Zealots: Civil Service, Policy Discretion, and Bureaucratic Expertise." *American Journal of Political Science* 51(4): 873-889 (2007); Gailmard, Sean and John Patty. "Formal Models of Bureaucracy." *Annual Review of Political Science* 15: 353-377 (2012), and executive review of proposed regulations (Wiseman, Alan E. "Delegation and Positive-Sum Bureaucracies." *The Journal of Politics* 71(3): 998-1014 (2009).), among others. See also Bendor, Jonathon and Adam Meirowitz. "Spatial Models of Delegation." *American Political Science Review* 98(2): 293-310 (2004) for contributions to the spatial model of delegation and Volden, Craig and Alan Wiseman. "Formal Approaches to the Study of Congress." In Eric Schickler and Frances Lee, eds. *Oxford Handbook of Congress*. Oxford: Oxford University Press pp. 36-65 (2011) for an overview of the development of this literature.

4. Morgan, Donald. "Rating Banks: Risk and Uncertainty in an Opaque Industry." *American Economic Review* 92(4): 874-888 (2002).
5. Maskin and Tirole (Maskin, Eric and Jean Tirole. "The Politician and the Judge: Accountability in Government." *American Economic Review* 94(4): 1034-1054 (2004).) and Alesina and Tabellini (Alesina, Alberto and Guido Tabellini. "Bureaucrats or Politicians? Part I: A Single Policy Task." *American Economic Review* 97(1): 169-179 (2007)) also emphasize the benefits of delegation to bureaucrats and other non-accountable officials.
6. For formal proofs of these propositions, the reader is referred to O'Halloran, Sharyn, Geraldine McAllister, and Kaiping Chen. "Delegation and the Regulation of Finance in the United States Since 1950." Working Paper: Columbia University (2014).
7. Groll, Thomas, O'Halloran, Sharyn and McAllister, Geraldine. "Delegation and the Regulation of Financial Markets" mimeo (2015).
8. The argument is quite intuitive: When the financial system experiences a shock, then constituents are more likely to hold the president and the executive accountable than any

-
- individual member of Congress. A similar argument is made in trade policy as constituents hold the president and the executive more accountable for the overall economic conditions, which explains more free-trade oriented positions by the executive than Congress. O'Halloran, Sharyn. *Politics, Process and Trade Policy*. Ann Arbor: University of Michigan Press (1994).
9. Macey, Jonathan R., Geoffrey P. Miller, and Richard Scott Carnell. *Banking Law and Regulation*. New York: Aspen Publishers (2001).
 10. The Library of Congress's THOMAS database was available at thomas.loc.gov. It has been replaced by www.congress.gov.
 11. In three cases CQ summaries were unavailable; for these laws we used summaries from the Library of Congress's THOMAS system, available at <https://www.congress.gov/>, last accessed Dec. 4, 2015.
 12. We eliminated mortgage laws unless they focused on financial regulation design. Mortgage lending undoubtedly played a major role in the financial crisis of 2008. However, this legislation differs from legislation impacting the regulation of a financial institution and, therefore, we excluded those laws that addressed primarily housing and mortgage lending that do not also define rules governing financial institutions.
 13. See O'Halloran, Sharyn, Maskey, Sameer, McAllister, Geraldine, Park, David K., Chen, Kaiping Data Science and Political Economy: Application to Financial Regulatory Structure. Forthcoming in *Big Data and Political Economy* edited by Howard Rosenthal. Russell Sage Press (2015) for detailed coding rules used to compile the financial regulation database.
 14. Discretion depends on the amount of authority delegated (D) and the administrative procedures that constrain (C) regulators' actions. For a given law, then, if the delegation ratio is D and the constraint index is C, both lying between 0 and 1, then total discretion is defined as $D \star (1-C)$ —that is, the amount of unconstrained authority delegated to executive actors. For a detailed discussion of this measure and its robustness see O'Halloran *et al.*, *supra* n.13 .
 15. The spike in the graph from 1970 is instructive, as it was that year when Congress reacted to the last sea change in the nature of financial transactions. The 1960s had seen the rise of credit cards as a method of payment, credit unions as substitutes for traditional banks, and bank holding companies as a new form of financial organization. The laws passed in 1970 addressed each of these new phenomena, with the result that no wave of failures, panics, or defaults took place. It is a measure of the success of these laws that one hardly remembers them now; because Congress responded proactively to new regulatory challenges, market innovation did not lead to market failure.
 16. A quick Google search reveals that Robert Dahl's "Charlie and the Chocolate Factory," Charles Dickens' "A Christmas Carol," George Orwell's "Animal Farm," and John Steinbeck's "Of Mice and Men" have similar word counts of approximately 30,000 words. The authors would like to forego having to conduct a word count themselves.
 17. O'Halloran *et al.*, *supra* n.13
 18. *Id.*
 19. *Id.*