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# AI-relevant regulatory precedents

A systematic search across all federal agencies

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# Abstract

We undertake a systematic search for potential case studies relevant to advanced AI regulation in the United States—the first such case study selection exercise yet conducted. Relevant case studies that we identify include (among others): the Environmental Protection Agency (EPA); various financial regulators, for example, the Federal Reserve System (“the Fed”) and the Securities and Exchange Commission (SEC); the Office of Commercial Space Transportation (FAA / AST); and regulatory functions within the Department of Energy (DOE) and Department of Defense (DOD). We identified relevant agencies using quantitative measures of five variables that seem relevant to AI regulation: (1) intensiveness; (2) expertise; (3) enforcement against powerful companies; (4) use of risk-assessments; and (5) focus on / analysis of uncertain phenomena. For variables 1, 4, and 5, we also gathered results at the level of individual regulations. Note that the intent of this piece is to suggest case studies that researchers or policymakers could examine further. These findings should not be interpreted as endorsements of these regulatory approaches in the context of advanced AI nor as definitive rankings of cases on the five variables.

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# Executive Summary

Governments are beginning to move quickly on AI regulation (e.g., see [White House, 2023](#); [EU AI Act, 2024](#); [UK DSIT, 2024](#)). However, many regulatory design considerations remain open—especially regarding how to set up a comprehensive regulator or group of regulators for *advanced* AI systems (see [UK DSIT, 2024](#), Box 5).

Case studies of non-AI regulations may be useful here. To that end, we use established case study selection methods ([Gerring, 2006](#), p. 103) to systematically identify relevant case studies that other researchers could examine. First, we used a literature review to select and operationalize six variables that seemed especially relevant to an AI regulator. We then gathered quantitative data for each variable, covering all US agencies on which we could find data for a given variable.<sup>1</sup> For several variables, we also gathered data on all individual US *regulations* in the Code of Federal Regulations (CFR).

The variables we examined and our operationalizations of them are as follows:

1. **Intensiveness:** the level of restrictions imposed by a given agency or regulation.<sup>2</sup> Here, we used the metric “RegData” from Al-Ubaydli and McLaughlin ([2015](#)), capturing the number of terms implying a restriction under US law per agency / regulation in the Code of Federal Regulations. (See [methods section](#); see [results section](#).)
2. **Expertise:** the extent to which the agency draws on expert knowledge. We operationalized this variable in terms of the proportion of agency employees with a doctoral qualification or higher. (See [methods section](#); see [results section](#).)
3. **Enforcement:** the extent to which agencies enforce their regulations against powerful companies. We looked at the 1,000 largest fines imposed by each agency since the year 2000 and pulled out all said fines that matched current S&P 500 companies. We

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<sup>1</sup> We focus on the United States because it seems most relevant to advanced AI regulation. For example, the “frontier” AI companies from which the UK government [requested safety policies](#) ahead of its AI summit last year were Google DeepMind, Anthropic, OpenAI, Microsoft, Amazon, and Meta. The US seems more important than other jurisdictions to the regulation of said companies.

We expect that, for institutional and cultural reasons, US regulators in other domains will (on the margin) contain more relevant lessons for US AI regulation than will non-US regulators in other domains. The ideal would have been to conduct a study spanning (for example) the US, UK, and EU, but practical considerations prohibited that.

<sup>2</sup> There is some evidence that intensiveness thus defined tracks well to safety performance, with higher intensiveness resulting in better safety performance ([Jones, 2008](#), pp. 1-2). However, it is also possible to have too much intensiveness (i.e., to over-regulate), so we do not mean to suggest that more intensive regulations are always “better.”

then developed a composite measure capturing both the aggregate value of all fines in our data against current S&P 500 companies and the number of said fines that crossed two thresholds for fine size. (See [methods section](#); see [results section](#).)

4. **Risk-assessment:** the extent to which a given agency or regulation requires either agency staff or regulated parties to conduct risk-assessments. We operationalized this variable in terms of the number of times that terms relating to risk-assessment appear per agency or regulation in the CFR. (See [methods section](#); see [results section](#).)
5. **Uncertainty-assessment:** the extent to which a given agency or regulation focuses on phenomena subject to uncertainty *and* explicitly requires agency staff to assess said uncertainty. We operationalized this variable in terms of the number of times that terms relating to uncertainty-assessment appear per agency or regulation in the CFR. (See [methods section](#); see [results section](#).)
6. **Focus on tail-risks:** the extent to which a given agency or regulation explicitly focuses on tail-risks, that is low-probability high-consequence risks. We operationalized this variable in terms of the number of times that terms relating to tail-risk appear per agency or regulation in the CFR. **However, we discarded our quantitative data for this variable as we were unable to obtain valid results** (see [methods section](#); see [results section](#).)

Note that for two of the variables (“expertise” and “enforcement”), we were only able to obtain agency-level (not regulation-level) data. **After we gathered data for each variable, we developed two composite measures aggregating across both agencies (all five variables) and regulations (for the “intensiveness,” “risk-assessment,” and “uncertainty-assessment” variables only).** (See [methods section](#); see [results section](#).)

We also conducted five expert interviews to triangulate our findings. They provide indicative (though, due to the low sample size, not conclusive) evidence in favor of the operationalizations of our variables. (For more information, see the ends of the respective [results sections](#) for each variable.)

There are various limitations to our analysis (see the [methods](#) section for examples), so we think that the fact that one agency or regulation scores higher than another on a given variable should not be taken as definitive proof that said agency or regulation scores more highly on that variable in reality. However, we think that our results are adequate for exploratory purposes such as case study selection—for example, our interviews indicate that the results largely match experts’ intuitions.

Table 1 (below) presents our high-level findings. We detail regulatory agencies that score in the top 5% on our aggregate measure.<sup>3</sup> We then list, for each high-scoring agency, its top-scoring regulation (though this is for illustrative purposes—there are multiple high-scoring regulations for each agency). The [discussion](#) section lists further high-scoring regulations for each agency.

Readers can see a full list of agencies and regulations, ordered by score (highest-lowest), [here](#) and [here](#), respectively. Readers who want a more manageable list of high-scoring individual regulations (not listed by regulator) should refer to [Table 14](#).

Note that Table 1 uses percentile ranks because they are intuitively easy to understand. However, because percentile ranks merely illustrate the *ordering* of agencies or regulations rather than the magnitude of the differences between them, the use of percentile ranks flattens substantial differences between highly ranked agencies in some cases. If we use min-max normalization rather than percentile ranks, the Environmental Protection Agency (EPA), for example, scores twice as highly as the next-highest scoring agency on aggregate. See column J (in the [agency-level spreadsheet](#)) and column H (in the [regulation-level spreadsheet](#)) for the final results interpreted as min-max scores.<sup>4</sup>

*Table 1: Selected high-scoring regulatory agencies (95th percentile or above)*

<p><i>Highest-scoring agencies (95th percentile or above on our aggregate variable)</i></p>	<p><i>Percentiles on different variables</i></p>	<p><i>Highest-scoring regulation for that agency</i></p> <p><i>(This column is purely for illustrative purposes—there are many high-scoring regulations for each agency to choose from. See the <a href="#">discussion</a> for more examples.)</i></p>
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<sup>3</sup> We exclude agencies which score highly in our [data](#) but do not perform any regulatory functions, such as the National Science Foundation, as well as agencies that mostly seem to score highly because of their non-regulatory functions, such as the Department of Health and Human Services.

<sup>4</sup> A min-max score is a normalized value between 0 and 1; the lowest and highest values in a distribution always take on min-max scores of 0 and 1, respectively. In cases where the highest score is significantly larger than all other scores, for example in an exponential distribution, the vast majority of values will take on low-seeming scores, even if those scores are still high relative to the mean. This is the case for most of our variables - for example, on our composite variable, EPA has a score of 1 while the next-highest scoring agency, the Fed, has a score of 0.54, meaning that EPA scores nearly twice as highly as the Fed. However, the Fed's score of 0.54 is still nearly twenty times higher than the *mean* min-max score, which is 0.03.

<p>Environmental Protection Agency (EPA)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 100  Expertise: 96  Enforcement: 98  Risk-assessment: 99  Uncertainty-assessment: 100  <i>Overall: 100</i></p>	<p><a href="#">Title 40, Part 63</a>: National Emission Standards for Hazardous Air Pollutants</p>
<p>Federal Reserve System (“the Fed”)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 93  Expertise: 99  Enforcement: 86  Risk-assessment: 100  Uncertainty-assessment: 97  <i>Overall: 100</i><sup>5</sup></p>	<p><a href="#">Title 12, Part 217</a>: Capital Adequacy (of financial institutions covered by the Fed)</p>
<p>Securities and Exchange Commission (SEC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 96  Expertise: 73  Enforcement: 100  Risk-assessment: 97  Uncertainty-assessment: 100  <i>Overall: 99</i></p>	<p><a href="#">Title 17, Part 240</a>: General Rules and Regulations, Securities Exchange Act of 1934</p>
<p>Office of the Comptroller of the Currency (OCC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 82  Expertise: N/A  Enforcement: 94  Risk-assessment: 100  Uncertainty-assessment: 95  <i>Overall: 99</i></p>	<p><a href="#">Title 12, Part 3</a>: Capital Adequacy Standards (for financial institutions covered by OCC)</p>
<p>Federal Housing Finance Agency (FHFA)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 71  Expertise: 93  Enforcement: 96  Risk-assessment: 97  Uncertainty-assessment: 96  <i>Overall: 99</i></p>	<p><a href="#">Title 12, Part 1240</a>: Capital Adequacy of Enterprises</p>

<sup>5</sup> Of course, there cannot be more than one regulation in exactly the 100th percentile—the fact that multiple regulators are listed as being in the 100th percentile is due to rounding.

<p>Commodity Futures Trading Commission (CFTC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 88  Expertise: 83  Enforcement: 88  Risk-assessment: 99  Uncertainty-assessment: 98  <i>Overall: 99</i></p>	<p><a href="#">Title 17, Part 23</a>: Swap Dealers and Major Swap Participants</p>
<p>Office of Commercial Space Transportation, Federal Aviation Administration (FAA/AST)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 75  Expertise: N/A  Enforcement: N/A <sup>6</sup>  Risk-assessment: 98  Uncertainty-assessment: 99  <i>Overall: 98</i></p>	<p><a href="#">Title 14, Part 417</a>: Launch Safety</p>
<p>Federal Deposit Insurance Corporation (FDIC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 85  Expertise: 79  Enforcement: 58  Risk-assessment: 99  Uncertainty-assessment: 95  <i>Overall: 98</i></p>	<p><a href="#">Title 12, Part 324</a>: Capital Adequacy of FDIC-Supervised Institutions</p>
<p>Nuclear Regulatory Commission (NRC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 97  Expertise: 88  Enforcement: 48  Risk-assessment: 98  Uncertainty-assessment: 98  <i>Overall: 98</i></p>	<p><a href="#">Title 10, Part 50</a>: Domestic Licensing of Production and Utilization Facilities</p>
<p>Federal Railroad Administration (FRA)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 91  Expertise: N/A  Enforcement: 34  Risk-assessment: 98  Uncertainty-assessment: 97  <i>Overall: 97</i></p>	<p><a href="#">Title 49, Part 236</a>: Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances</p>

<sup>6</sup> Although FAA / AST is part of FAA, which comes in at the 78th percentile on the enforcement variable (see overleaf).



<p>Food and Drug Administration (FDA)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 98</p> <p>Expertise: N/A <sup>7</sup></p> <p>Enforcement: 90</p> <p>Risk-assessment: 95</p> <p>Uncertainty-assessment: 0</p> <p><i>Overall: 97</i></p>	<p><a href="#">Title 21, Part 101</a>: Food Labeling</p>
<p>Federal Communications Commission (FCC)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 99</p> <p>Expertise: 89</p> <p>Enforcement: 82</p> <p>Risk-assessment: 75</p> <p>Uncertainty-assessment: 0</p> <p><i>Overall: 96</i></p>	<p>[None seem intuitively relevant to AI, but it could still be interesting to look at overall agency setup]</p>
<p>Department of Energy (DOE)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 97</p> <p>Expertise: 85</p> <p>Enforcement: 16 <sup>8</sup></p> <p>Risk-assessment: 95</p> <p>Uncertainty-assessment: 99</p> <p><i>Overall: 96</i></p>	<p><a href="#">Title 10, Part 430</a>: Energy Conservation Program for [non-automobile] Consumer Products</p>
<p>Federal Aviation Administration (FAA)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 98</p> <p>Expertise: N/A</p> <p>Enforcement: 78</p> <p>Risk-assessment: 94</p> <p>Uncertainty-assessment: 98</p> <p><i>Overall: 96</i></p>	<p><a href="#">Title 14, Part 25</a>: Airworthiness Standards: Transport Category Airplanes</p>
<p>U.S. Coast Guard (USCG)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 100</p> <p>Expertise: N/A</p> <p>Enforcement: 40</p> <p>Risk-assessment: 87</p> <p>Uncertainty-assessment: 0</p> <p><i>Overall: 96</i></p>	<p><a href="#">Title 46, Part 160</a>: Lifesaving Equipment (specifications, approval, production)</p>

<sup>7</sup> Although FDA is part of the Department of Health and Human Services, which comes in at the 99th percentile on the expertise variable.

<sup>8</sup> DOE is very large, and many of its functions are not regulatory, which may account for its low score on the enforcement variable.

<p>Department of Defense (DOD)</p> <p><a href="#">(Read more)</a></p>	<p>Intensity: 97</p> <p>Expertise: 77</p> <p>Enforcement: N/A</p> <p>Risk-assessment: 95</p> <p>Uncertainty-assessment: 95</p> <p><i>Overall: 95</i></p>	<p><a href="#">Title 32, Part 218</a>: Guidance for the Determination and Reporting of Nuclear Radiation Dose for DOD Participants in the Atmospheric Nuclear Test Program</p>
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Ultimately, any of the above agencies could make strong case studies, and we leave researchers to choose the cases most relevant to their particular questions. Below, we list some findings that we think are notable.

First, EPA scores extremely highly, coming in at the 95th percentile or above for each of our five quantitative variables. [\(Read more\)](#)

- As noted above, the use of percentile ranks obscures the differences in scores between EPA and other regulators—when we use min-max normalization, EPA scores twice as highly as the next-highest scoring agency on aggregate (see column J in [this spreadsheet](#)).
- If researchers are interested in examining specific standards, we think that any high-scoring EPA regulations (search “environmental protection agency” [here](#)) would make good candidates for case studies. The [discussion section](#) outlines the top three regulations in greater detail.
- Our qualitative interviewees also noted that many EPA regulations (for example, on potentially carcinogenic pollutants) deal with highly uncertain or infrequent risks—these risks may be more relevant to advanced AI regulations.

Second, multiple financial regulators also score very highly. Although a past case study for advanced AI regulation has examined the general structure of financial supervision in the United States (Groch-Begley, 2024, forthcoming), our research suggests specific financial regulators that it could be useful to look into in greater depth. [\(Read more\)](#)

Some other agencies that seem to score highly from the above table, and on which there have not (to our knowledge) yet been case studies pertaining to advanced AI regulation, include:

- The Office of Commercial Space Transportation within the Federal Aviation Administration (FAA / AST) [\(Read more\)](#)

- The Federal Railroad Administration (FRA) ([Read more](#))
- The Federal Communications Commission (FCC) ([Read more](#))
- Regulatory functions within the Department of Energy (DOE) ([Read more](#))<sup>9</sup>
- The US Coast Guard (USCG) ([Read more](#))
- Regulatory functions within the Department of Defence (DOD) ([Read more](#))

Of the above-listed agencies, the following seem particularly relevant to AI regulation:

- Commercial space transportation regulations within FAA / AST ([Read more](#))
- DOE regulations, for example safety standards for DOE nuclear facilities (including nuclear weapons facilities) ([Read more](#))
- DOD regulations, for example around nuclear radiation dosage or the security of classified information ([Read more](#))

The remainder of this report proceeds as follows:

- A [brief outline](#) of relevant literature that we used to select our variables
- Our [methods](#) for obtaining both our variable and aggregate-level results
- Our [results](#) (both variable and aggregate-level), with minimal commentary
- A [discussion](#) of our results, including profiles of relevant agencies and brief descriptions of the top three most relevant regulations for each agency
- A brief [conclusion](#)

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<sup>9</sup> The Departments of Energy and Defense are significantly larger than the other agencies detailed in this paper, and most of their functions are not regulatory functions; however, most of the data used in this paper (i.e., all of the data for variables 1, 3, 4 and 5) pertains only to their regulatory functions.

# Background and variable selection

In an area of high regulatory uncertainty such as AI, examining precedents from other domains seems essential to ensure good regulatory design. Several authors have drawn lessons from non-AI case studies for AI regulation in general, without any particular focus on advanced AI (e.g., [Petit and De Cooman, 2020](#); [Wu and Liu, 2023](#)). Others have suggested that case studies of other domains could improve regulatory design considerations for advanced AI (e.g., [Anderjung et al., 2023](#), p. 21).

Though some examples of individual case studies for advanced AI have been produced (e.g., [Stein and Dunlop, 2023](#); [Anderson-Samways and Acharya, 2023](#); [Henninger, 2023](#); [Stewart, 2023](#); Simpson and Trager, 2024, forthcoming), such case studies have largely been selected on the basis of researchers' intuitions. However, there is potentially a very wide range of relevant case studies. As a result, even if the individual case studies themselves are strong, the lack of a systematic approach to case study selection—which is strongly recommended by case study methodologists ([Gerring, 2006](#), p. 87)—means that key regulatory design considerations are probably missing.

To that end, we attempt a systematic case study selection exercise, using the method for selecting “extreme” (i.e., high-scoring) case studies suggested by Gerring ([2006](#), p. 89) (see the “[overall approach](#)” subsection in our methods section). That process involves coming up with variables of interest—i.e., variables that we think seem especially relevant to AI regulation—and then gathering quantitative information on potential case studies using those variables of interest. This method provides a crucial foundation for future case study research, because other researchers can investigate the identified case studies in depth using established research methods ([Gerring, 2006](#)).

We selected our variables based on our knowledge of past case studies conducted to inform advanced AI regulation, including our own research (e.g. [Stein and Dunlop, 2023](#); [Anderson-Samways and Acharya, 2023](#); [Henninger, 2023](#); [Stewart, 2023](#); Simpson and Trager, 2024, forthcoming). These case studies are all from think tanks; academic studies have not yet been conducted. From these case-studies, we then pulled out six variables that seem particularly relevant to advanced AI regulation. Those six variables are outlined and defined in the following section.

# Methods

## Overall approach

We follow the case study selection method suggested by Gerring ([2006](#)) for discovering “extreme” cases, namely cases that display unusual (in this case, unusually high) values on the variable of interest ([Gerring, 2006](#), p. 89). We use this method because we are interested in agencies—and ideally specific regulations—that score exceptionally highly on our variables compared to other agencies or regulations.

There are no hard-and-fast rules for determining what counts as an “extreme” value on a given distribution. For normally distributed data, a value more than two standard deviations away from the mean is often considered extreme, meaning that the value falls outside of 95% of the distribution ([Gerring, 2006](#), p. 103). Our data is not normally distributed. In fact, it takes on a variety of distributions; figuring out different cut-off points for extremeness for each one would be a complicated task. For the sake of simplicity, and drawing from the norm for normal distributions, we consider any value that falls in the 95th percentile or above “extreme.” Ultimately, this cut-off point is arbitrary. Different researchers may wish to use different cut-off points.

We triangulated our quantitative results using five qualitative interviews, each with different experts with broad comparative knowledge spanning across all U.S. federal regulations (see [below](#)). We conducted said interviews to gain a rough assessment of validity for both the conceptual definitions of each variable and for the predictions made by the actual results. Given the low sample size, we do not think that the qualitative interviews provide much more than indicative evidence of predictive validity. Case studies themselves are likely to provide more substantial evidence. Our results aim to suggest some case studies that researchers could conduct.

## Variables on which we used pre-existing data

### Methods specific to variable 1 (“intensity”)

The first variable we examine is regulatory *intensity*—the “heaviness” or the “lightness” of the requirements imposed by a particular agency or regulation. We operationalize this variable in terms of the aggregate number of regulatory restrictions per agency and per regulation. There is some evidence that intensity thus defined tracks well to safety performance. For instance, examining US environmental regulations, Jones ([2008](#), pp. 1-2) finds that “highly regulated

[facilities] exhibit more intense environmental management practice implementation and greater pollution prevention activity than lightly regulated facilities.”<sup>10</sup>

We employ the metric “RegData” developed by Al-Ubaydli and McLaughlin (2015), available to download on the website [QuantGov](#). RegData compares each federal agency and individual regulation by the number of times that modal verbs implying a binding constraint (restriction) under US law, such as “shall” or “must,” appear in individual regulations in the Code of Federal Regulations (CFR). The CFR is the formal codification of the United States’ regulations. Each CFR regulation falls under the purview of a federal agency. (There are generally multiple CFR regulations per agency).

We appreciate that higher regulatory intensiveness can be a negative as well as a positive phenomenon. We strongly concur with concerns about the outsized impact that compliance with large numbers of restrictions may have on smaller businesses - especially because it is advanced models (developed by the largest AI companies) which pose the largest risks ([Anderljung et al., 2023](#), 14).

To that end, we also employ two other variables—“risk-based regulation” and “enforcement on powerful businesses” (both outlined below)—to capture the idea that AI regulations should be proportional to both risk and company size. We would moreover note that in the environmental domain for example, the most heavily regulated facilities are large companies ([Jones, 2008](#), pp. 1-2), and we think that a similar distribution of restrictiveness should apply to AI. Even if more intensive regulations are restricted to larger companies, however, higher intensiveness will not always be better. Ultimately, intensiveness is just one variable that seems correlated with safety performance and therefore may yield useful case studies. It would probably be damaging if intensiveness was pursued as an end-in-itself.

Finally, we note that Al-Ubaydli and McLaughlin’s data on regulatory restrictiveness is only a proxy for regulatory intensity: it does not capture, for example, whether restrictions are actively enforced. (Though we have developed another variable on enforcement, outlined [below](#), it is not granular enough to capture whether *individual* restrictions are effectively enforced.)

During our qualitative interviews, we asked experts to list all federal regulations that they thought were particularly “intensive or thorough... for example, regulations that impose many regulatory requirements on regulated parties.” These interviews provided some indicative, but

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<sup>10</sup> Regulatory intensity is sometimes used as a synonym for regulatory *burden*, defined as “cost of compliance with... federal paperwork regulations” ([Kalmenovitz, 2022](#), abstract). That is not the definition we employ here - we are interested in the restrictiveness of regulations, not their cost, because the former seems more closely related to high safety performance.

certainly not conclusive, evidence in favor of our operationalization of this variable—see the end of the [results section](#) for this variable.

## Methods specific to variable 2 (“expertise”)

The second variable we examined was the relative use of *expertise* per regulator. We operationalized this variable in terms of the proportion of employees per federal agency with a doctoral degree or higher.

We looked at the latest version (March 2023) of the Office of Personnel Management’s (OPM’s) [FedScope](#) database, which contains agency-level data on both the total number of employees and the number of employees with an education level of “doctorate” or “post-doctorate.” (No education level higher than that is listed.) We then divided the latter by the former to obtain a proportion for each agency.

One limitation of this data is it does not capture the extent to which the agency draws on *external* expertise, for example via expert panels.

We also interviewed our five regulatory experts about the use of expertise per regulator—including their use of *external* expertise. These interviews provided some indicative but not conclusive evidence in favor of our operationalization of this variable—see the end of the [results section](#) for this variable.

## Methods specific to variable 3 (“enforcement”)

Our third variable aims to capture the extent to which agencies enforce their regulations against powerful businesses. We operationalized “powerful businesses” as “current S&P 500 companies.” We then downloaded the top 1000 fines levied by each agency since 2000 (against all companies, not just the S&P 500) and picked out those fines levied against companies on the current S&P 500 list. Finally, we developed a composite measure capturing: the aggregate dollar value of fines in our data against current S&P 500 companies; and the number of individual fines in our data levied against current S&P 500 companies that crossed two given thresholds for fine size.

We used the database [Violation Tracker](#) produced by Good Jobs First, a nonprofit, which gathers data on all penalties above \$5,000 levied by over 400 federal, state, and local regulatory agencies since 2000. We limited our search to federal agencies and downloaded data on the 1,000 largest fines for each federal agency since 2000. (In cases where an agency had levied less than 1,000 fines total, we downloaded all of said agency’s fines data.) For one of the agencies—the Employee Benefits Security Administration—our data covers only the largest

914 fines, as the following ~1,800 fines are all the same in terms of dollar value, and we could not determine a principled way to sample from them.

We matched the company names provided for each fine with a list of the S&P 500 as of January 2024 and extracted all fines on S&P 500 companies. We then calculated the size of the fine on the company as a proportion of its market capitalization at the time of the fine.

Finally, we explored the data and came up with a composite measure consisting of three indices that seem to capture different aspects of agency activeness when it comes to levying penalties against S&P 500 companies. Those indices were:

1. **The number of fines above \$30M.** This measure represents the top ~10% of fines in our data by dollar value (converted to 2023 dollars using an inflation index).
2. **The number of fines above 0.1% of a given company's market capitalization.** This measure represents the top ~90% of values in our dataset (which could also be a reasonable threshold to use, because our dataset is already only a subset of fines against S&P 500 companies, i.e., all of those that appeared when we downloaded the top 1000 fines by each agency against any company).
3. **The total \$ value of the fines in our data against S&P 500 companies in 2023 dollars.**

These indices are highly correlated with one another (from .66 to .98 as Pearson correlations and from .87 to .92 as Spearman's rank correlations).

We then aggregated these indices into a composite measure. As the measures all used different scales, we first min-max normalized the values from 0 to 100. We used min-max normalization, rather than conversion to a percentile rank, to preserve the relative differences between the data points. Finally, we took the mean of the normalized scores.

Again, there are limitations to our measure. Perhaps the most obvious is that our data captures fines levied against *current* S&P 500 companies, even in cases where those companies were not on the S&P 500 at the time the fine was levied, and excludes companies that *were* on the S&P 500 at the time a fine was levied but have since dropped out. Nonetheless, we think that our data is probably adequate for exploratory purposes such as case study generation. The current market capitalization of a given company in our dataset is rarely (three cases out of 3900) more than one order of magnitude above the market capitalization of said company at the time the fine was levied, and in no cases more than two orders of magnitude. That is the case even when we have not adjusted for inflation (which would make past market capitalizations larger, relatively speaking). Given that the current market capitalizations of these



companies are hundreds of billions or trillions of dollars, one order of magnitude's difference is not enough to disqualify a company as being "large" or "powerful."

A second limitation is that "enforcement" is broader than simply penalties levied. For example, the FDA "generally does not use dollar penalties but instead compels companies to suspend sales of dangerous products" ([Good Jobs First, 2024](#), see the section "Details of the Data"). However, Violation Tracker understandably excludes such data, as it would not be comparable to the other data in the dataset ([Good Jobs First, 2024](#), see the section "Details of the Data"). Unfortunately, data which captures enforcement in a more multifaceted way is not available.

Our qualitative interviews provided *some* indicative evidence in favor of our operationalization of this variable, although the evidence is far from conclusive and, in fact, seems weaker than for the variables previously discussed, which again suggests to us that this variable should not be used for falsification purposes. (See the end of the [results section](#) for this variable.)

## Variables for which we generated our own data

For our remaining three variables, we generated data ourselves. We did so using quantitative content analysis ("text-mining") techniques. That involves searching a group of texts for a long list of key terms intended to capture a given variable and then comparing those texts by how frequently the terms show up. A higher overall number of key terms indicates a higher value on the variable of interest.

In this case, the texts we compare are individual Parts of the Code of Federal Regulations (CFR). Each Part corresponds to a different regulation. The three variables we examine are:

- Variable 4: The extent to which a given agency or regulation requires either agency staff or regulated parties to conduct risk-assessments.
- Variable 5: The extent to which the regulation in question deals with phenomena subject to uncertainty and explicitly attempts to analyze or quantify said uncertainty.
- Variable 6: The extent to which the regulation in question explicitly deals with "tail-risks," that is low-probability high-consequence risks.

Our process for generating a reliable list of key terms followed the below steps suggested by Short et al. ([2009](#), p. 327), considered a best-practice method by Kimberly Neuendorf in *The Content Analysis Guidebook*, the most up-to-date content analysis research methods textbook

([Neuendorf, 2017](#), p. 129). However, we sometimes had to make our own judgments as to how to operationalize each step of our project.

*Deriving an initial list of key terms using theory and the literature:*

1. We first came up with definitions of the variables of interest (as outlined above).
2. We then assessed the dimensionality of each variable, namely the extent to which each variable could be said to correspond to a single concept. We originally used a single variable—“uncertain risks”—to capture variables 2 and 3. However, after an assessment of dimensionality, we realized that there were two different variables we were interested in (“*uncertain* probability” vs. “*low* probability”), so we decided to split them.
3. We then used the concepts of interest to derive an initial list of key terms. That firstly involved looking for terms in key texts in the literature<sup>11</sup> that corresponded to the concepts of interest. A full list of said texts is available in [Appendix 1](#). We then supplemented those key terms with other key terms using our intuition. Using the *Oxford American Writer’s Thesaurus*, we expanded that list by considering an exhaustive set of synonyms for each term. Finally, we developed variations on each term in the list—for example, a variation on “risk-assessment” would be “assessment of the risk.”
4. Next, we asked two regulatory studies experts (one with a background in quantitative content analysis, another with a background in cross-agency risk-management practices at the Office of Management and Budget) to rate each “main” term (such as “risk-assessment”—but not variations such as “assessment of the risk”). We asked the experts to rate the term with a “Y” if they thought it indeed captured the variable in question and with an “N” if they thought it did not. The full transcript of our request is provided in [Appendix 2](#). After analyzing the results, we decided to report two interrater reliability coefficients, Krippendorff’s alpha and Gwet’s AC1:

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<sup>11</sup> We identified key texts by:

1. Searching for “risk-based regulation,” “regulation under uncertainty,” and “tail-risk regulation” (and synonyms of those terms) in Google and Google Scholar and looking at the first page of results. We then pulled out papers that seemed relevant to regulations in general, rather than regulations of a specific industry (which could skew the results).
2. Repeating the same process as in 1., but combined with the search term “United States”.
3. Repeating the same process as in 1. and 2., but combined with the search terms “terminology,” “terms,” and “keywords.”

- a. We first used Krippendorff's alpha, a commonly used coefficient for nominal data ([Feng, 2015](#), p. 16; [Neuendorf, 2017](#), p. 173). The coefficient essentially tests for the amount of agreement between raters, correcting for the fact that a certain amount of agreement will be expected by chance.
- b. However, for variable 4 (the risk-assessment variable), we found that both experts more-or-less wrote "Y" for every single key term, meaning that the base-rate for chance agreement was very high. This finding meant that Krippendorff's alpha indicated low agreement, even though the experts agreed on practically every term. That is a common problem ([Feng, 2015](#), p. 16).
- c. To address that problem, we followed the steps suggested by Feng ([2015](#), pp. 16-17), who provides a decision-tree for selecting interrater reliability coefficients. Firstly, as Krippendorff ([2011](#), p. 108) himself recommends, we gathered more data by asking a third regulatory studies expert (this time an academic with expertise in risk-based regulation) to code variable 1. However, that did not shift the alpha. Following Feng's advice, we therefore decided to also report a separate measure, Gwet's AC1. Like Krippendorff's alpha, the AC1 accounts for chance disagreement, but unlike the alpha it corrects for the uneven base-rate problem identified above and is well-suited for variables where the coding task is very easy (which, in this case, it was - a simple assigning of a binary value).
- d. For transparency and consistency purposes, we report both the alpha and the AC1 for each variable (see subsections on methods specific to the individual variables below). However, we think the AC1 is much more appropriate to variable 4 (which has an uneven base-rate), while either the alpha or the AC1 is appropriate to our other variables.

*Supplementing our initial key terms using a frequency list:*

5. We supplemented our initial list of key terms using words drawn from the text itself, the Code of Federal Regulations (CFR). To do that, we first generated a list of the ~2000 most frequent terms of 1-4 words each in the CFR.
6. Next, we identified definitions of the constructs of interest to guide word selection. That process was straightforward; we simply used the same definitions as stated in step 1 above.

7. The lead author then wrote “Y” next to any key terms in the frequency list that he thought corresponded to variables 4, 5 or 6, and “N” next to those that he thought did not correspond to variables 4, 5 or 6. We asked one of the experts from step 4 above to do the same. Our instructions were the same as for step 4.
8. We then compared the ratings between the lead author and the experts [here](#).<sup>12</sup>

#### *Refinement and finalization of word lists*

9. We refined and finalized our list of terms. We deleted any of our initial terms that raters agreed should *not* be on the list and supplemented them with any terms from step 5 that raters agreed *should* be on the list (there were only four of the latter, all for variable 4). We then piloted the list of key terms on the CFR to assess “semantic validity” — i.e., rooting out instances where terms yielded false positives.<sup>13</sup> We resolved such instances by introducing a disambiguation rule or cutting the term entirely. At that point, our list of terms was complete. The final list contained around 20 “main” terms per variable (although anywhere between 50 and 120 when variations on the main terms are included). Readers can view the final list [here](#).

We searched for our key terms in the CFR using Python, as computer-implemented techniques are far faster and more reliable than human searching ([Short et al., 2009](#), p. 327). Because we wanted information comparing *all* regulations in the CFR on our variables of interest, we searched across the whole of the CFR rather than taking samples (i.e., we effectively conducted a “census”), which also avoids issues of external validity related to appropriate sampling ([Short et al., 2009](#), p. 327).

Finally, as with our other variables, we conducted a loose assessment of the predictive validity of the final results via qualitative interviews. The implications were different for different variables; see the subsections on methods specific to each variable below.

Once again, there are limitations to our approach. The most important of these - which three of our expert interviewees mentioned - is that the frequency of key terms for each variable in the

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<sup>12</sup> We tested for interrater reliability, but found the results to be relatively uninformative, because the exceedingly high proportion of “N” responses in both raters’ answers meant that Krippendorff’s alpha was very low while Gwet’s AC1 was very high (due to the base-rate problem outlined in 4b above). This time, however, that was the case for all three variables, suggesting that the coefficient results were the function of the task rather than the actual reliability of the variable. We do not consider that much of a problem, because the main object of this task was to look for key terms that both experts agreed should be included (which does not require an interrater reliability assessment for the entire variable).

<sup>13</sup> For example, our term “rate risk”, intended to capture variable 4 (risk-assessment), picked up “interest rate risk” in the CFR, which does not clearly correspond to risk-assessment.

CFR is not necessarily a good indicator of day-to-day agency practices. To get an indication of the latter, we would need to analyze the Federal Register, which is far longer and provides more granular information on agency practices. We offer two replies:

- Future research could attempt to analyze the Federal Register, and we would be very interested to see such research. Practically speaking, while a relatively clean version of the CFR is easy to generate, generating a reliable sample of the Federal Register is relatively speaking very difficult, hence why we did not attempt it here.
- On a more positive note, our qualitative interviews and the pre-existing literature provide some indicative evidence that—at least for variables 4 and 5—our results are reasonably intuitive (see the ends of the respective results sections for each variable). Given that the primary aim of this research is to generate a long list of *potential* case studies for others to look into rather than to generate highly reliable data that can be used for falsification purposes, we think that our results clear the bar.

Below we provide some information specific to the data-generation for our variables on risk-assessment, uncertainty, and tail-risks respectively—including our list of keywords for each variable and our assessment of the reliability of each variable. Overall, we believe that:

- Our risk-assessment variable is highly reliable;
- Our uncertainty variable is less reliable but still probably performs better than chance (which seems sufficient for case study selection purposes);
- Our tail-risk variable is highly unreliable and should not be used by researchers, including case study researchers. We therefore discard our text-mining results for the tail-risk variable (though we keep our qualitative interview results).

The reasoning behind each of those claims is outlined in the following sections.

## Methods specific to variable 4 (“risk-assessment”)

Our risk-assessment variable contains 23 “main” key terms. They are: *risk-assessment\**; *risk-management*; *risk-analys\**; *risk prioritization*; *risk evaluation\**; *risk-rating\**; *risk-appraisal\**; *risk-estimat\**; *risk-quantification\**; *risk-calculation\**; *risk-approximation\**; *risk-measurement\**; *risk-computation\**; *risk-proportiona\**; *risk-commensurate*; *risk-based*; *risk-weigh\**; *risk-inform\**; *risk-level\**; *significant risk threshold\**; *unreasonable risk threshold\**; *risk-benefit*; and *safety-analys\**. There are also multiple variations on each main term.

As reported above, we initially used Krippendorff’s alpha to test interrater reliability for this variable. However, the high base-rate of “Y” responses led to low results on the alpha despite strong interrater agreement. As recommended by Feng (2015, p. 17) and Krippendorff (2011, p. 108), we gathered more data to see if this significantly changed the alpha value. It did not. Following the decision rules outlined in Feng (2015, p. 16-17), we concluded that Gwet’s AC1 was a more appropriate index than Krippendorff’s alpha. For transparency and consistency purposes though, we report both here. The reported values are from *after* we introduced the third coder; the results from beforehand are [here](#).

*Table 2: Interrater reliability coefficients for variable 4*

Method	Coefficient	Standard Error	95% confidence interval	P-value
Gwet’s AC1	0.863	0.071	(0.716,1)	2.81e-11
Krippendorff’s Alpha	-0.048	0.032	(-0.115,0.018)	9.29e-01
Percent Agreement	0.879	0.056	(0.762,0.995)	2.33e-13

Given the appropriateness of AC1 to our risk-assessment variable, we think that the above results indicate that said variable is highly reliable. For context, Landis and Koch (1977, p. 165) consider values of 0.81 - 1 to indicate “Almost perfect” reliability and values of 0.61 - 0.8 to indicate “Substantial” reliability. Our 95% CI suggests that our measure is somewhere between the two, although likely in the “Almost perfect” range.<sup>14</sup>

Our qualitative interviews once again provided some indicative but not conclusive evidence in favor of our operationalization of this variable—see the end of the [results section](#) for this variable.

## Methods specific to variable 5 (“uncertainty”)

Our uncertainty variable contains 24 “main” key terms. They are: *uncertainty-analysis\**; *uncertainty-assessment\**; *uncertainty-evaluation\**; *uncertainty-rating\**; *uncertainty-appraisal\**; *uncertainty-estimat\**; *uncertainty-quantification\**; *uncertainty-calculation\**; *uncertainty-approximation\**; *uncertainty-measurement\**; *uncertainty-computation\**;

<sup>14</sup> Landis and Koch’s benchmark originally pertained to a different coefficient, Cohen’s kappa, but said benchmark equally applies to both Krippendorff’s alpha and Gwet’s AC1 - for example, Gwet’s own website includes the Landis-Koch benchmark as its primary benchmarking method for both AC1 and alpha ([Gwet, 2024](#), see the “Options” tab).

*uncertainty-level\**; *uncertainty threshold\**; *sensitivity analys\**; *probabilistic analys\**; *break-even analys\**; *threshold analys\**; *scenario analys\**; *scenario plan\**; *Monte Carlo*; *event tree\**; *fault tree\**; *probability tree\**; and *value of information*. Again, there are multiple variations on each main term.

Regarding interrater reliability, we again report both Gwet’s AC1 and Krippendorff’s alpha for this variable below. Either could be appropriate, depending on whether one interprets the [coding task](#) as relatively easy (AC1) or more difficult (alpha). We think that the task was relatively easy, but leave readers to make up their minds.

*Table 3: Interrater reliability coefficients for variable 5*

Method	Coefficient	Standard Error	95% confidence interval	P-value
Gwet’s AC1	0.381	0.161	(0.054,0.708)	1.19e-02
Krippendorff’s Alpha	0.288	0.165	(-0.047,0.623)	4.51e-02
Percent Agreement	0.667	0.079	(0.507,0.826)	2.59e-10

We think that the above results likely indicate sufficient reliability for case study selection purposes, though significantly weaker reliability than the risk-assessment variable. For context, Landis and Koch ([1977](#), p. 165) consider values of <0 to indicate “Poor” reliability, values of 0 - 0.2 to indicate “Slight” reliability, values of 0.21 - 0.4 to indicate “Fair” reliability, values of 0.41 - 0.60 to indicate “Moderate” reliability, and (again) values of 0.61 - 0.80 to indicate “Substantial” reliability. Depending on the coefficient adopted, our 95% CIs indicate anywhere between Poor/Slight and Substantial reliability, though likely Fair reliability. In any case, we think that this variable probably performs better than chance (indicated by any value above 0), which seems sufficient for exploratory purposes such as case study selection. However, the variable should not be taken as anything other than exploratory.

Our qualitative interviews provided *some* indicative evidence in favor of our operationalization of this variable, although the evidence is far from conclusive and (as with the “enforcement” variable) seems weaker than for other variables, which again suggests to us that this variable should not be used for anything other than exploratory purposes. See the end of the [results section](#) for this variable.

## Methods specific to variable 6 (“tail-risk”)

Our tail-risk variable contains 20 “main” key terms. They are: *tail-risk\**; *tail event\**; *fat tail\**; *black swan\**; *right tail\**; *left tail\**; *extreme risk\**; *extraordinary risk\**; *exceptional risk\**; *abnormal risk\**; *unprecedented risk\**; *unanticipated risk\**; *unpredict\* risk\**; *unforesee\* risk\**; *catastrophic risk\**; *emerg\* risk\**; *low probability high consequence*; *low probability high impact*; *low frequency high consequence*; and *low frequency high impact*. Again, there are multiple variations on each main term.

Regarding interrater reliability, we again report both Gwet’s AC1 and Krippendorff’s alpha for this variable below. Once again, either is plausibly appropriate.

*Table 4: Interrater reliability coefficients for variable 6*

Method	Coefficient	Standard Error	95% confidence interval	P-value
Gwet’s AC1	-0.023	0.214	(-0.463,0.418)	5.41e-01
Krippendorff’s Alpha	-0.116	0.190	(-0.508,0.277)	7.25e-01
Percent Agreement	0.462	0.098	(0.260,0.663)	3.84e-05

These results indicate poor reliability, even for very exploratory purposes. The tail-risk variable likely performs no better than random chance. We therefore discard the text-mining version of the tail-risk variable from our results section (though we still include results from our qualitative interviews, in case they are useful).

Our qualitative interviews did not provide much evidence in favor of our operationalization of this variable, which once again suggests that we should discard it—see the end of the [results section](#) for this variable.

## Aggregation methods

To create agency-level aggregates across variables, we created a composite measure including all five variables on which we had quantitative data. To do that, we first min-max normalized the data for each variable (including the “enforcement” variable, which was already a *composite* of min-max scores) so that all of the data was on a common scale from 0 to 1. We then took the mean of the min-max scores for each agency across all variables and assigned a percentile rank to each final (mean) score.



Due to the differing data sources we used, some of our variables contain agencies (sometimes many agencies) not contained in other variables. That entails a risk that regulators which exhibit extremely high scores on one variable, but for which data is entirely missing for other variables, could score very highly overall. To mitigate that risk, we also include a column outlining the number of variables that contain the agency in question. In fact, it appears that the number of variables in which an agency appears is strongly positively correlated with the agency's overall score. Of the 21 regulators that score in the 95th percentile or above (our threshold for high-scoring agencies), 10 appear in all five variables, nine appear in four variables, and two appear in three variables.

A related problem is that because the aggregate variable is essentially the mean of only five variables (or less, in cases where there is missing data), it is occasionally the case that an exceptionally high score on one variable drags up the aggregate score despite low to average scores on the other variables. For example, the National Science Foundation (NSF) appears in the 99th percentile on aggregate due to its high score on the "expertise" variable, despite exhibiting low scores on the other three variables on which we possess data. Most of these "outlier agencies," such as NSF, are excluded from our "discussion" section ([below](#)). However, that is only because the discussion section excludes agencies that do not perform a regulatory function or that seem to score highly only because of their non-regulatory functions, and that exclusion criterion happens to overlap with outlier agencies. We do not *deliberately* try to exclude outlier agencies—attempting to come up with a definition of an "outlier" in our data would have been complex and arbitrary.

Our data and process for creating agency-level aggregates can be seen online [here](#).

To create regulation-level aggregates across variables, we followed the same process, except restricting ourselves to those three variables on which we have regulation-level data. Again, the fact that there is some missing data does not appear to skew the results—all of the 28 regulations that scored in the 99.9th percentile or above (our threshold for high-scoring agencies) appeared in all three variables. However, once again, our results are sometimes unavoidably skewed by outliers (in fact, this is more frequent than for agencies, as we are now aggregating only across three variables, not five. As a result, we do not exclude regulations that seem skewed by outliers from the "discussion" section<sup>15</sup>).

Our data and process for creating regulation-level aggregates can be seen online [here](#).

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<sup>15</sup> Though we think that is not too much of a problem, because the lower number of variables used in the regulation-level composite (three) compared to the agency-level composite (five) also means that skewness is less of a concern - a case that performs exceptionally well on one out of three variables should be treated with proportionally less skepticism than a case that performs exceptionally well on one out of five variables.

## Qualitative interviews

As previously noted, we also conducted five expert interviews to triangulate our results.

Some of our interviewees requested to be anonymized, so we anonymized all of them for the sake of consistency. The interviewees were a combination of academic specialists in regulatory studies and former officials from regulatory agencies such as the Office of Management and Budget (OMB). All interviewees had cross-cutting knowledge of regulatory agencies—for example, having published books that cover multiple agencies or having worked for an institution (such as OMB) that is responsible for auditing multiple agencies. All interviewees had decades of experience writing on, or working for, regulatory agencies.

During the interviews, we asked experts to verbally list all examples that came to mind of high-scoring agencies on each of our variables of interest. The full template for our qualitative interviews can be found in [Appendix 3](#). After the interviews were completed, we noted the number of interviewees who mentioned a given agency for each variable (to get a rough sense of which agencies came up most for individual variables). We also noted the number of variables for which a given agency was mentioned by at least one interviewee (to get a rough sense of which agencies came up across many variables).

The purpose of the interviews was to give readers a loose impression of the validity of our quantitative results—both their conceptual validity (namely, whether our operationalization of each quantitative variable makes sense) and their predictive validity (namely, the extent to which our quantitative data seems to actually capture reality). We do that by simply listing, in the results section for each variable, all of the agencies that interviewees mentioned (ranked from highest to lowest in terms of the number of interviewees that mentioned them). We then note the percentiles in which each agency mentioned landed in our quantitative results. We use our judgment to interpret what that means for the validity of our quantitative results, although readers can make up their minds on that question.

For each variable, single interviewees often mentioned more than one agency. Conversely, interviewees sometimes did not mention any agencies for a given variable—with one interviewee, we did not manage to get through all of the variables, while occasionally, interviewees could not think of agencies that scored highly on a given variable (although this was rare).

# Results

## Section introduction

The following section identifies both agencies and regulations that exhibit high scores on our variables of interest—both on individual variables and [across all variables](#).

By “high-scoring” agencies and regulations, we mean those that exhibit an “extreme” (i.e., extremely high) value relative to other values in our data. As outlined in the [methods section](#), we suggest that any value above the 95th percentile (for either agencies or regulations) can be considered extreme, although ultimately this decision is arbitrary.

Consistent with the above definition of extremeness, in this section we present all agency-level data that falls above the 95th percentile. However, for *regulation*-level data, using the 95th percentile or above yields hundreds of potential case studies, which is unmanageable for presentation purposes. Thus, for the purposes of presentation alone, we use a cutoff point of the 99.9th percentile for regulation-level data in this section (though we return to using a 95th percentile cutoff in our “discussion” section).

These thresholds are imposed for convenience, and researchers may apply different thresholds to our raw data if they wish.

## Results for variable 1 (“intensity”)

As discussed earlier in this report, the regulatory intensity variable compares both agencies and individual regulations in terms of the aggregate number of restrictions per agency or regulation in the Code of Federal Regulations (CFR). It draws directly on data from Al-Ubaydli and McLaughlin (2015), available on the website [QuantGov](#), which counts the number of times that words implying an obligation under U.S. law (“shall,” “must,” etc.) appear in individual Parts of the CFR (which each correspond to an individual regulation, under the authority of a given regulator).

The below tables summarize the highest-scoring agencies and regulations on the intensity variable, respectively:

*Table 5: High-scoring **agencies** on the “intensity” variable (95th percentile or above)*

Agency name	Restrictions (sum)
Environmental Protection Agency	4,823,377
Internal Revenue Service	2,930,722
Coast Guard	2,063,060
Agricultural Marketing Service	1,615,540
Occupational Safety and Health Administration	1,414,024
Federal Communications Commission	1,184,725
Food and Drug Administration	945,869
Federal Aviation Administration	922,833
General Services Administration	916,018
Pipeline and Hazardous Materials Safety Administration	687,605
Department of Defense	676,837
Department of Energy	630,793
Nuclear Regulatory Commission	597,188
Federal Housing Administration	592,882
Securities and Exchange Commission	583,470
Animal and Plant Health Inspection Service	565,675
Department of Transportation	540,670
Food and Nutrition Service	501,408
Federal Energy Regulatory Commission	498,249

*Table 6: High-scoring **individual regulations** on the “intensity” variable (99.9th percentile or above)*

Regulation (CFR Part and title)	Agency responsible for regulation	Restrictions (sum)
Title 40, Part 63: National Emission Standards for Hazardous Air Pollutants	Environmental Protection Agency	869,370

Title 29, Part 1910: Occupational Safety and Health Standards	Occupational Safety and Health Administration	750,898
Title 40, Part 60: Standards of Performance for New Stationary Sources [of air pollution]	Environmental Protection Agency	405,415
Title 40, Part 86: Control of Emissions from New and In-Use Highway Vehicles and Engines	Environmental Protection Agency	332,107
Title 29, Part 1926: Safety and Health Regulations for Construction	Occupational Safety and Health Administration	319,674
Title 49, Part 178: Specifications for Packagings [used for the transportation of hazardous materials in commerce]	Pipeline and Hazardous Materials Safety Administration	222,057
Title 17, Part 240: General Rules and Regulations, Securities Exchange Act of 1934	Securities and Exchange Commission	214,132
Title 26, Part 301: Internal Revenue Service: Procedure and Administration	Internal Revenue Service	206,489
Title 46, Part 160: Lifesaving Equipment	Coast Guard	203,556
Title 40, Part 52: Approval and Promulgation of Implementation Plans [for EPA air programs]	Environmental Protection Agency	193,797
Title 41, Part 101: Federal Property Management Regulations	General Services Administration	177,648
Title 49, Part 571: Federal Motor Vehicle Safety Standards	National Highway Traffic Safety Administration	164,984
Title 48, Part 52: Solicitation Provisions and Contract Clauses [under Federal Acquisition Regulations]	General Services Administration	157,415
Title 49, Part 173: Shipments - General Requirements for Shipments and Packagings	Pipeline and Hazardous Materials Safety Administration	156,858
Title 47, Part 73: Radio Broadcast Services	Federal Communications Commission	128,506
Title 14, Part 25: Airworthiness Standards: Transport Category Airplanes	Federal Aviation Administration	125,251
Title 26, Part 31: Employment Taxes and Collection of Income Tax at Source	Internal Revenue Service	123,885

Title 9, Part 113: Standard Requirements [for Viruses, Serums, Toxins, and Analogous Products; Organisms and Vectors]	Animal and Plant Health Inspection Service	122,060
Title 40, Part 51: Requirements for Preparation, Adoption, and Submittal of Implementation Plans [for EPA air programs]	Environmental Protection Agency	116,718
Title 40, Part 80: Regulation of Fuels and Fuel Additives	Environmental Protection Agency	114,390
Title 47, Part 1: Practice and Procedure [general rules for FCC]	Federal Communications Commission	109,149
Title 30, Part 75: Mandatory Safety Standards—Underground Coal Mines	Mine Safety and Health Administration	101,613
Title 12, Part 226: Truth in Lending (Regulation Z)	Federal Reserve System	101,275
Title 7, Part 273: Certification of Eligible Households [under the Supplemental Nutrition Assistance and Food Distribution Program]	Food and Nutrition Service	97,795
Title 7, Part 1755: Telecommunications Policies on Specifications, Acceptable Materials, and Standard Contract Forms	Rural Utilities Service > Rural Development	97,495
Title 30, Part 250: Oil and Gas and Sulphur Operations in the Outer Continental Shelf	Bureau of Safety and Environmental Enforcement	96,766
Title 29, Part 1915: Occupational Safety and Health Standards for Shipyard Employment	Occupational Safety and Health Administration	96,730

The full results for this variable can be seen online [here](#).

Meanwhile, our interviewees named the following agencies as “particularly intensive or thorough”:

- The Food and Drug Administration (FDA) (2 interviewees);
- The Environmental Protection Agency (EPA) (1 interviewee);
- The Federal Aviation Authority (FAA) (1 interviewee);
- The National Highway Traffic Safety Administration (NHTSA) (1 interviewee);
- The Office of the Comptroller of Currency (OCC) (1 interviewee).

Of the above agencies, EPA, FAA, and FDA all fall above the 95th percentile of the data we used for this variable, while NHTSA falls in the 89th percentile and OCC in the 81st.

## Results for variable 2 (“expertise”)

The “expertise” variable is defined in terms of the proportion of employees per federal agency with a doctoral degree or higher.

The below table summarizes the highest-scoring agencies on the expertise variable (we did not have regulation-level data on this variable):

*Table 7: High-scoring agencies on the “expertise” variable (95th percentile or above)*

Department / Agency	% of employees with doctorate or higher
National Science Foundation	37.44%
Department of Health and Human Services	20.81%
Federal Reserve System	19.22%
National Foundation on the Arts and the Humanities	14.41%
National Aeronautics and Space Administration	13.92%
Defense Nuclear Facilities Safety Board	13.16%
Environmental Protection Agency	12.80%

(The National Science Foundation and the National Foundation on the Arts and the Humanities are not regulatory agencies, so they should plausibly be discounted. The National Aeronautics and Space Administration is also not entirely a regulator, though it does perform some limited regulatory functions - for example, regarding space flight).

The full results for this variable can be seen online [here](#).

Meanwhile, our interviewees named the following agencies as making particularly strong use of expertise (both internal and external):

- The Environmental Protection Agency (EPA) (3 interviewees)
- The Food and Drug Administration (FDA) (2 interviewees)

Of those agencies, EPA falls above the 95th percentile of the data we used for this variable. Our data does not include granular enough information to capture the proportion of employees with doctorates at FDA specifically. However, FDA falls within the Department of Health and Human Services, which does appear above the 95th percentile.

## Results for variable 3 (“enforcement”)

The “enforcement” variable is a composite measure that ranks regulators by their activeness in levying fines against large companies. We downloaded the highest 1000 fines from each agency since 2000, pulled out fines that match with companies on the current S&P 500 list, and then calculated both the aggregate of said fines and the number of fines that crossed two different thresholds in terms of fine size. We then converted those figures into a single overall composite score. See the [methods section](#) for more information.

The table below summarizes the highest-scoring agencies on the enforcement variable (we do not have regulation-level data on this variable). We provide the individual indices that went into the composite measure, as well as the overall composite measure itself. Only three agencies (the top three below) scored above the 95th percentile on the overall composite measure. Two more scored in the 95th percentile or above for one of the three indices; we include them here to give a slightly broader sense of potentially high-scoring agencies. Agencies are ordered by their score on the composite measure (highest-lowest). The symbol \* indicates that the agency scored above the 95th percentile on a given measure.

*Table 8: High-scoring agencies on the “enforcement” variable (95th percentile or above for each index)*

Agency	Sum of fines on current S&P 500 companies in our data	Number of fines over \$30M on current S&P 500 companies in our data	Number of fines over 0.1% of market cap of current S&P 500 companies in our data	Overall composite score (mean of values after min-max normalization)
Securities and Exchange Commission	2.20E+10 *	118 *	80 *	85.3 *
Environmental Protection Agency	3.68E+10 *	52 *	50 *	66.7 *



Federal Housing Finance Agency	3.94E+10 *	12	12	41.7 *
Office of the Comptroller of Currency	1.62E+10	39 *	21	33.5
Consumer Financial Protection Bureau	1.13E+10	32	22 *	27.7

The full results for this variable can be seen online [here](#).

Meanwhile, our interviewees named the following agencies as being particularly good at enforcement:

- The Environmental Protection Agency (EPA) (3 interviewees)
- The Department of Transportation (DOT) (3 interviewees)
- The Food and Drug Administration (FDA) (2 interviewees)
- The US Department of Agriculture (USDA) (1 interviewee)
- *Possibly* the Occupational Safety and Health Administration (1 interviewee)—although another explicitly named OSHA as being bad at enforcement.

Of the above agencies, only EPA falls above the 95th percentile for any of our measures (including the composite measure). FDA comes in at the 90th percentile. However, DOT comes in at only the 36th percentile, while USDA comes in at the 4th percentile. OSHA comes in at the 42nd percentile. Overall, these results are a good reason for researchers to treat this variable with some skepticism, although we still think that it is probably sufficient for exploratory purposes such as case study selection.

## Results for variable 4 (“risk-assessment”)

As discussed earlier in this report, the “risk-assessment” variable is defined as the extent to which a given agency or regulation requires either agency staff or regulated parties to conduct risk-assessments. We operationalized this variable via a quantitative content analysis, counting the number of relevant key terms (of 1-4 words each) that appear in each Part of the Code of Federal Regulations.

The below tables summarize the highest-scoring agencies and regulations on the risk-assessment variable, respectively:

*Table 9: High-scoring **agencies** on the “risk-assessment” variable (95th percentile or above)*

Agency name	Count (sum)
Federal Reserve System	1,165
Office of the Comptroller of Currency	714
Federal Deposit Insurance Corporation	694
Environmental Protection Agency	409
Commodity Futures Trading Commission	405
Nuclear Regulatory Commission	392
Federal Railroad Administration	389
Commercial Space Transportation > Federal Aviation Administration	362
Farm Credit Administration	340
Federal Housing Finance Agency	329
Securities and Exchange Commission	217
Centers For Medicare & Medicaid Services	210
Department of Housing and Urban Development	143
Animal and Plant Health Inspection Service	140
National Credit Union Administration	140
Department of Defense	127

*Table 10: High-scoring **individual regulations** on the “risk-assessment” variable (99.9th percentile or above)*

Regulation (CFR Part and title)	Agency responsible for regulation	Count (sum)
Title 12, Part 324: Capital Adequacy of FDIC-Supervised Institutions	Federal Deposit Insurance Corporation	549
Title 12, Part 217: Capital Adequacy of Bank Holding Companies, Savings and Loan	Federal Reserve System	542

Holding Companies, and State Member Banks (Regulation Q)		
Title 12, Part 3: Capital Adequacy Standards [for national banks and Federal savings associations]	Office of the Comptroller of Currency	520
Title 14, Part 417: Launch Safety [for commercial space transportation]	Commercial Space Transportation > Federal Aviation Administration	235
Title 12, Part 1240: Capital Adequacy of Enterprises	Federal Housing Finance Agency	232
Title 12, Part 225: Bank Holding Companies and Change in Bank Control (Regulation Y)	Federal Reserve System	200
Title 12, Part 628: Capital Adequacy of [Farm Credit] System Institutions	Farm Credit Administration	199
Title 49, Part 222: Use of Locomotive Horns at Public Highway-Rail Grade Crossings	Federal Railroad Administration	182
Title 17, Part 240: General Rules and Regulations, Securities Exchange Act of 1934	Securities and Exchange Commission	167
Title 12, Part 252: Enhanced Prudential Standards (Regulation YY) [for certain bank holding companies, foreign banking organizations, and nonbank financial companies supervised by the Federal Reserve Board]	Federal Reserve System	166
Title 10, Part 50: Domestic Licensing of [nuclear] Production and Utilization Facilities	Nuclear Regulatory Commission	140
Title 24, Part 35: Lead-Based Paint Poisoning Prevention in Certain Residential Structures	Department of Housing and Urban Development	134
Title 40, Part 702: General Practices and Procedures [under the Toxic Substances Control Act]	Environmental Protection Agency	127
Title 10, Part 52: Licenses, Certifications, and Approvals for Nuclear Power Plants	Nuclear Regulatory Commission	104
Title 17, Part 23: Swap Dealers and Major Swap Participants	Commodity Futures Trading Commission	103

Title 12, Part 652: Federal Agricultural Mortgage Corporation Funding and Fiscal Affairs	Farm Credit Administration	86
Title 32, Part 61: Family Advocacy Program (FAP) (for addressing child abuse and domestic abuse)	Department of Defense	80
Title 17, Part 1: General Regulations Under the Commodity Exchange Act	Commodity Futures Trading Commission	79
Title 49, Part 236: Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances	Federal Railroad Administration	74

The full results for this variable can be seen online [here](#) (by agency) and [here](#) (by regulation).

Meanwhile, our interviewees named the following agencies as being particularly “risk-based,” namely making heavy use of risk-assessments:

- The Environmental Protection Agency (EPA) (5 interviewees)
- The Food and Drug Administration (FDA) (4 interviewees)
- The Occupational Safety and Hazards Administration (OSHA) (3 interviewees)
- The Nuclear Regulatory Commission (NRC) (2 interviewees)
- The Department of Transportation (DOT) (2 interviewees)
- The Department of Homeland Security (DHS) (1 interviewee)
- The Department of Energy (DOE) (1 interviewee)
- The Securities and Exchange Commission (SEC) (1 interviewee)
- The Federal Reserve (Fed) (1 interviewee)

Of the above agencies, EPA, NRC, SEC, and the Fed all fall above the 95th percentile of our data. FDA falls one place outside, in the 94th percentile. OSHA and DHS both fall in the 91st percentile. DOT falls only in the 77th percentile, although two DOT sub-agencies (the Federal Railroad Administration and the Office of Commercial Space Transportation in FAA) fall above the 95th percentile.

## Results for variable 5 (“uncertainty”)

As discussed earlier in this report, the “uncertainty” variable is defined as the extent to which the agency or regulation in question deals with phenomena subject to uncertainty and explicitly

attempts to analyze or quantify said uncertainty. Again, we operationalized this variable via a quantitative content analysis, counting the number of relevant key terms (of 1-4 words each) that appear in each Part of the Code of Federal Regulations.

The below tables summarize the highest-scoring agencies and regulations on the uncertainty variable, respectively:

*Table 11: High-scoring **agencies** on the “uncertainty” variable (95th percentile or above)*

Agency name	Count (sum)
Environmental Protection Agency	94
Securities and Exchange Commission	33
Bureau of Land Management	18
Commercial Space Transportation > Federal Aviation Administration	18
Department of Energy	17
Commodity Futures Trading Commission	16
Federal Aviation Administration	14
Nuclear Regulatory Commission	14
Federal Reserve System	11
Agricultural Marketing Service	10
Federal Railroad Administration	10
Rural Utilities Service > Rural Development	9
Bureau of Industry and Security	8
Federal Housing Finance Agency	8
Office of the Comptroller of Currency	7
Federal Deposit Insurance Corporation	7

*Table 12: High-scoring **individual regulations** on the “uncertainty” variable (99.9th percentile or above)*

Document reference	Agency name	Count (sum)
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Title 40, Part 58: Ambient Air Quality Surveillance	Environmental Protection Agency	31
Title 17, Part 240: General Rules and Regulations, Securities Exchange Act of 1934	Securities and Exchange Commission	19
Title 43, Part 3170: Onshore Oil and Gas Production	Bureau of Land Management	17
Title 17, Part 229: Standard Instructions for Filing Forms Under Securities Act of 1933, Securities Exchange Act of 1934 and Energy Policy and Conservation Act of 1975—Regulation S-K	Securities and Exchange Commission	14
Title 14, Part 417: Launch Safety [for commercial space transportation]	Commercial Space Transportation > Federal Aviation Administration	14
Title 14, Part 25: Airworthiness Standards: Transport Category Airplanes	Federal Aviation Administration	14
Title 40, Part 63: National Emission Standards for Hazardous Air Pollutants	Environmental Protection Agency	13
Title 17, Part 23: Swap Dealers and Major Swap Participants	Commodity Futures Trading Commission	11
Title 7, Part 990: Domestic Hemp Production Program	Agricultural Marketing Service	10
Title 40, Part 52: Approval and Promulgation of Implementation Plans [for EPA air programs]	Environmental Protection Agency	10
Title 10, Part 430: Energy Conservation Program for Consumer Products	Department of Energy	10
Title 40, Part 60: Standards of Performance for New Stationary Sources [of air pollution]	Environmental Protection Agency	9
Title 40, Part 51: Requirements for Preparation, Adoption, and Submittal of Implementation Plans [for EPA air programs]	Environmental Protection Agency	9
Title 7, Part 1710: General and Pre-Loan Policies and Procedures Common to Electric Loans and Guarantees	Rural Utilities Service > Rural Development	8

Title 49, Part 236: Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances	Federal Railroad Administration	8
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The full results for this variable can be seen online [here](#) (by agency) and [here](#) (by regulation).

Compared to the previous variables, the number of data points here is very small, so researchers should treat the above results with greater caution (at least those towards the lower end). As emphasized in the methods section, these results are not adequate for falsification purposes but seem sufficient for case study selection purposes.

Meanwhile, our interviewees named the following agencies as dealing particularly well with uncertainty:

- The Environmental Protection Agency (EPA) (2 interviewees)
- The Food and Drug Administration (FDA) (2 interviewees)
- The Federal Aviation Administration (FAA) (1 interviewee)
- The Department of Homeland Security (DHS) (1 interviewee)
- The Department of Energy (DOE) (1 interviewee)

Of the above agencies, EPA, FAA, and DOE all fall above the 95th percentile, but DHS and FDA come in at the 0th percentile—namely, with no relevant key terms at all. Again, that should give us greater uncertainty with respect to this variable—although it still seems useful for case study selection purposes.

## Results for variable 6 (“tail-risks”)

As discussed earlier in this report, the “tail-risk” variable is defined as the extent to which the agency or regulation in question explicitly deals with “tail-risks,” that is low-probability high-consequence risks.

As noted in the subsection “[Methods specific to variable 6](#),” we discard our quantitative content analysis results on the tail-risk variable, as we think they are highly unreliable. Researchers should not use these results even for exploratory purposes such as case study selection. They are nonetheless provided in [Appendix 4](#) for transparency.

However, we do report our findings from the qualitative interviews here. When we asked our interviewees about regulators or regulations that “explicitly attempt to gain high assurance against tail-risks,” they replied (variously) as follows:

- No agencies explicitly try to deal with tail-risks. (2 interviewees)
  - One of our interviewees listed several examples of tail-risks—asteroid strikes, unusually large tsunamis, solar storms, and large pandemics—and said that it seemed that the federal government has generally been poor at handling these (as evidenced, for example, by its lack of preparedness for Covid-19).
  - Another interviewee stated that their sense was that few or even no U.S. regulators really try to think carefully about tail-risks. This phenomenon held even for organizations whose mandates would, in theory, cover tail-risks. For example, risk-assessments by OMB’s Interagency Working Group on climate change tended to focus on median or mean risks but neglected catastrophic risks (e.g., [Masur and Posner, 2011](#), p. 1596).
- The Environmental Protection Agency (EPA) (2 interviewees)
- The Department of Homeland Security (DHS) (1 interviewee)
- The Nuclear Regulatory Commission (NRC) (1 interviewee)

It is interesting that two out of our five interviewees thought that no agencies deal well with tail-risks, whereas others believed that they could identify agencies that deal well with tail-risks. Coupled with our inability to generate reliable quantitative data on this variable, we think this discrepancy between interviewees could be a sign that data on agencies or regulations that deal well with tail-risks could be very hard to come by or very difficult to generate.

Due to the unclear validity of our quantitative and qualitative results, we do not discuss this variable further or include it in our aggregate results.

## Aggregate results

Our aggregate results (as noted in the [methods section](#)) consist of two composite variables—one agency-level and one regulation-level. The agency-level composite consists of the five variables on which we gathered agency-level quantitative data (“intensity,” “expertise,” “enforcement,” “risk-assessment,” and “uncertainty”), while the regulation-level composite consists of the three variables on which we obtained quantitative data (“intensity,” “risk-assessment,” and “uncertainty”).

The below tables summarize the highest-scoring *agencies* and *regulations* across our data, respectively.



Table 13 (below) outlines the highest-scoring agencies. Agencies are ordered by their score on the composite measure (highest-lowest). The symbol \* indicates that the agency scored above the 95th percentile.

*Table 13: High-scoring agencies on aggregate across our variables (95th percentile or above)*

Agency name	Intensity	Expertise	Enforcement against powerful companies (NB this is a composite variable consisting of three metrics)			Risk-assessment	Uncertainty-assessment
	Count of restrictions	% Employees with a doctorate or higher	Sum of fines since 2000 - current S&P 500 companies	Fines over \$30M since 2000 - current S&P 500 companies	Fines over 0.1% of market cap since 2000 - current S&P 500 companies	Count of related terms	Count of related terms
Environmental Protection Agency	4,823,377 *	12.80% *	3.68E+10 *	52 *	50 *	409 *	94 *
Federal Reserve System	400,042	19.22% *	3,920,739,529	18	11	1165 *	11 *
Securities and Exchange Commission	583,470 *	2.99%	2.20E+10 *	118 *	80 *	217 *	33 *
Office of the Comptroller of Currency	153,750	#N/A	1.62E+10	39 *	21	714 *	7 *

National Science Foundation	62,554	37.44% *	#N/A	#N/A	#N/A	1	0
Federal Housing Finance Agency	63,270	9.77%	3.94E+10 *	12	12	329 *	8 *
Commodity Futures Trading Commission	248,312	5.33%	4,125,314,334	23	12	405 *	16 *
Internal Revenue Service	2,930,722 *	#N/A	3,380,080,000	1	1	49	1
Commercial Space Transportation > Federal Aviation Administration	85,784	#N/A	#N/A	#N/A	#N/A	362 *	18 *
Federal Deposit Insurance Corporation	196,908	4.49%	290,050,101	2	2	694 *	7 *
Nuclear Regulatory Commission	597,188 *	8.15%	55,334,145	1	1	392 *	14 *
Agricultural Marketing Service	1,615,540 *	#N/A	#N/A	#N/A	#N/A	1	10 *

Department of Health and Human Services	378,086	20.81% *	26,395,425	0	0	73	0
Federal Railroad Administration	310,694	#N/A	38,256,532	0	0	389 *	10 *
Food and Drug Administration	945,869 *	#N/A	1.04E+10	18	8	116	0
Federal Communications Commission	1,184,725 *	8.23%	1,958,645,807	11	7	4	0
Department of Energy	630,793 *	6.35%	5,357,784	0	0	90	17 *
Federal Aviation Administration	922,833 *	#N/A	460,453,085	4	7	63	14 *
Coast Guard	2,063,060 *	#N/A	51,825,200	1	0	17	0
National Aeronautics and Space Administration	273,161	13.92% *	#N/A	#N/A	#N/A	5	0

Department of Defense	676,837 *	4.11%	#N/A	#N/A	#N/A	127 *	6
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Meanwhile, Table 14 (below) outlines the highest-scoring regulations on aggregate (across the three variables on which we possess regulation-level data). Again, agencies are ordered by their score on the composite measure (highest-lowest). The symbol \* indicates that the agency or regulation scored above the 99th percentile on the individual measure in that column.

*Table 14: High-scoring individual regulations on aggregate across our variables (99.9th percentile or above)*

Regulation (CFR Part and title)	Agency name	Intensity	Risk-assessment	Uncertainty-assessment
Title 40, Part 63: National Emission Standards for Hazardous Air Pollutants	Environmental Protection Agency	869,370 *	23	13 *
Title 40, Part 60: Standards of Performance for New Stationary Sources [of air pollution]	Environmental Protection Agency	405,415 *	0	9 *
Title 17, Part 240: General Rules and Regulations, Securities Exchange Act of 1934	Securities and Exchange Commission	214,132 *	167 *	19 *
Title 40, Part 58: Ambient Air Quality Surveillance	Environmental Protection Agency	20,777	2	31 *
Title 12, Part 3: Capital Adequacy Standards [for national banks and Federal savings associations]	Office of the Comptroller of Currency	18,049	520 *	6
Title 12, Part 217: Capital Adequacy of Bank Holding Companies, Savings and Loan Holding Companies, and State Member Banks (Regulation Q)	Federal Reserve System	12,834	542 *	6
Title 14, Part 417: Launch Safety [for commercial space transportation]	Commercial Space Transportation > Federal Aviation Administration	55,110	235 *	14 *
Title 12, Part 324: Capital Adequacy Standards [for national banks and Federal savings associations]	Federal Deposit Insurance Corporation	10,464	549 *	6

Title 29, Part 1910: Occupational Safety and Health Standards	Occupational Safety and Health Administration	750,898 *	25	1
Title 40, Part 86: Control of Emissions from New and In-Use Highway Vehicles and Engines	Environmental Protection Agency	332,107 *	0	3
Title 40, Part 52: Approval and Promulgation of Implementation Plans [for EPA air programs]	Environmental Protection Agency	193,797 *	2	10 *
Title 40, Part 51: Requirements for Preparation, Adoption, and Submittal of Implementation Plans [for EPA air programs]	Environmental Protection Agency	116,718 *	0	9 *
Title 17, Part 229: Standard Instructions for Filing Forms Under Securities Act of 1933, Securities Exchange Act of 1934 and Energy Policy and Conservation Act of 1975—Regulation S-K	Securities and Exchange Commission	33,625	7	14 *
Title 12, Part 225: Bank Holding Companies and Change in Bank Control (Regulation Y)	Federal Reserve System	27,544	200 *	1
Title 12, Part 252: Enhanced Prudential Standards (Regulation YY) [for certain bank holding companies, foreign banking organizations, and nonbank financial companies supervised by the Federal Reserve Board]	Federal Reserve System	4,584	166 *	1
Title 17, Part 23: Swap Dealers and Major Swap Participants	Commodity Futures Trading Commission	5,445	103 *	11 *
Title 43, Part 3170: Onshore Oil and Gas Production	Bureau of Land Management	5,127	0	17 *
Title 14, Part 25: Airworthiness Standards: Transport Category Airplanes	Federal Aviation Administration	125,251 *	1	14 *
Title 10, Part 50: Domestic Licensing of [nuclear] Production and Utilization Facilities	Nuclear Regulatory Commission	86,969	140 *	5
Title 10, Part 430: Energy Conservation Program for Consumer Products	Department of Energy	60,253	0	10 *
Title 49, Part 236: Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of	Federal Railroad Administration	25,894	74	8 *

Signal and Train Control Systems, Devices, and Appliances				
Title 29, Part 1926: Safety and Health Regulations for Construction	Occupational Safety and Health Administration	319,674 *	7	0
Title 7, Part 1710: General and Pre-Loan Policies and Procedures Common to Electric Loans and Guarantees	Rural Utilities Service > Rural Development	9,704	2	8 *
Title 12, Part 628: Capital Adequacy of [Farm Credit] System Institutions	Farm Credit Administration	1,300	199 *	0
Title 49, Part 222: Use of Locomotive Horns at Public Highway-Rail Grade Crossings	Federal Railroad Administration	7,248	182 *	0
Title 7, Part 990: Domestic Hemp Production Program	Agricultural Marketing Service	612	0	10 *
Title 12, Part 1240: Capital Adequacy of Enterprises	Federal Housing Finance Agency	387	232 *	5

The full aggregate results can be seen online [here](#) (across agencies) and [here](#) (across regulations).

It is unfortunate that we could not gather regulation-level data on the expertise variable and the enforcement variable. We would note that several of the regulations identified above fall under agencies that we previously identified as scoring highly on either the expertise variable (the Environmental Protection Agency) or the enforcement variable (the Environmental Protection Agency, the Securities and Exchange Commission, the Federal Housing Finance Agency, and the Office of the Comptroller of the Currency). “Scoring highly” simply means that the agency crossed our (arbitrary) 95th-percentile threshold, so other agencies under which the above regulations fall might score highly according to different thresholds.

Given the limitations of the enforcement variable and the uncertainty variable, we think that these composite variables should also only be used for exploratory purposes such as case study selection. That is further evidenced by the fact that a couple of the above-mentioned regulations (“Domestic Hemp Production Program” and “Use of Locomotive Horns at Public Highway-Rail Grade Crossings”) seem amusingly irrelevant to AI regulation, though overall we think that our results seem quite intuitive.

We did not ask our interviewees which agencies or regulations they thought seemed most relevant on aggregate. However, the following regulators were mentioned by interviewees in relation to multiple variables:

- The Environmental Protection Agency (EPA) (mentioned with respect to all six variables we looked at. One interviewee spontaneously said: “EPA is just the best at risk regulation, period.”)
- The Food and Drug Administration (FDA) (five variables)
- The Department of Homeland Security (DHS) (two variables)
- The Department of Energy (DOE) (two variables)
- The Federal Aviation Authority (FAA) (two variables)
- The Nuclear Regulatory Commission (NRC) (two variables)
- The Occupational Safety and Hazards Administration (OSHA) (two variables)
- The Department of Transportation (DOT) (two variables)

Of the above agencies, EPA, FDA, DOE, and NRC all fall in the 95th percentile or above. OSHA comes in at the 94th percentile, DHS at the 85th percentile, and DOT at the 84th percentile. For some reason, individual financial regulators (which score highly on our aggregate quantitative measures) were not mentioned by interviewees in relation to more than one variable, although that may simply be down to the limited number of qualitative interviews that we conducted.

# Discussion

## Overview

In this section, we select agencies that score highly according to our aggregate agency-level results. (We discard agencies that do not perform a regulatory function, such as the National Science Foundation, as well as agencies that mostly seem to score highly because of their non-regulatory functions, such as the Department of Health and Human Services.) We briefly outline the agency and describe some of its relevant-seeming activities. For each agency, we then list and briefly describe three of the highest-scoring regulations associated with that agency. (On rare occasions, we skip high-scoring regulations if they do not seem intuitively relevant; we provide a note where we do that.)

We do not discuss regulations that fall outside of the top-scoring agencies, even if they score highly on our regulation-level results as reported in Table 14. We omit these regulations from discussion because our regulation-level results only cover a subset of variables (“intensity,” “risk-assessment,” and “uncertainty-assessment”), whereas the agency-level results cover all five variables on which we possess quantitative data. Thus, starting with high-scoring agencies and then selecting high-scoring regulations on that basis seems reasonable to us. If readers would like a short, unfiltered list of top-scoring regulations, they can refer to Table 14 above.

Although for presentation purposes the previous section listed only regulations above the 99.9th percentile, for the purposes of this section we again consider any regulation high-scoring if it scores above the 95th percentile, consistent with our agency-level threshold. That is partially because some of the highest-scoring agencies do not contain any regulations above the 99.9th percentile, but all of the highest-scoring agencies contain regulations above the 95th percentile (and the 95th percentile seems like a justifiable threshold for extremeness, as previously discussed).

For regulators, we use the Federal Regulatory Directory ([2016](#)) as our source; for individual regulations, we use a combination of the Code of Federal Regulations (CFR), agency websites, and occasionally third-party sources.

## Environmental Protection Agency (EPA)

EPA falls in the 95th percentile or above for every one of the five quantitative variables analyzed in this study—“intensiveness,” “expertise,” “enforcement” (for all three measures), “risk-assessment,” and “uncertainty-assessment.” It falls in the top (100th) percentile overall.



EPA is responsible for various regulatory domains, including air quality, water quality, the disposal of hazardous wastes, and the control of chemical substances, including pesticides and radioactive waste. Activities in those domains include setting standards, issuing permits, and canceling or suspending product registrations if they pose a current or potential risk to humans, animals, or the environment ([Federal Regulatory Directory, 2016](#), pp. 67-68).

The three highest-scoring regulations in our data for EPA are:

- [Title 40, Part 63](#): National Emission Standards for Hazardous Air Pollutants (100th percentile). These standards fall under the Clean Air Act and cover pollutants that cause (or are suspected to cause) cancer, other serious health damages, or environmental damages ([EPA, 2024a](#), first paragraph).
- [Title 40, Part 60](#): Standards of Performance for New Stationary Sources [of air pollution] (100th percentile). These standards also fall under the Clean Air Act; their main purpose is to ensure “that the best demonstrated emission control technologies are installed as industrial infrastructure is modernized” ([EPA, 2024b](#), first paragraph).
- [Title 40, Part 58](#): Ambient Air Quality Surveillance (100th percentile). Again, these requirements fall under the Clean Air Act and stipulate measures for reporting data on outdoor air quality and related information ([CFR, 2024a](#), sec. 58.2).

There are, however, around 75 other EPA regulations that fall in the 95th percentile or above; they can be found by searching “environmental protection agency” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Federal Reserve System (“The Fed”)

The Fed falls in the 95th percentile or above for three out of our five variables—“expertise,” “risk-assessment,” and “uncertainty-assessment.” It falls in the 93rd percentile for the “intensiveness” variable and the 86th percentile for the “enforcement” variable. It comes in at the 99th percentile overall (after normalization).

The Fed has overall responsibility for federal monetary policy, so it performs many functions aside from regulation. In its regulatory role, it has oversight of bank holding companies, state-chartered banks that have joined the Federal Reserve System, foreign activities by U.S. banks, and U.S.-based operations of foreign-owned banks. Regulatory functions include granting licenses, establishing security standards, and authorizing the

removal of employees who violate the law ([Federal Regulatory Directory, 2016](#), p. 206-207).

The three highest-scoring regulations in our data for the Fed are:

- [Title 12, Part 217](#): Capital Adequacy of Bank Holding Companies, Savings and Loan Holding Companies, and State Member Banks (Regulation Q) (100th percentile). This regulation “establishes minimum capital requirements and overall capital adequacy standards” for the financial institutions mentioned in the regulation title ([CFR, 2024b](#), sec. 217.1(a)).
- [Title 12, Part 225](#): Bank Holding Companies and Change in Bank Control (99.9th percentile). This Part regulates “the acquisition of control of banks by companies and individuals” ([CFR, 2024c](#), sec. 225.1(b)).
- [Title 12, Part 252](#): Enhanced Prudential Standards (Regulation YY) (99.9th percentile). This Part establishes standards for bank holding companies and foreign banking organizations with consolidated assets of  $\geq$ \$50bn. Said standards include “risk-based and leverage capital requirements, liquidity standards, requirements for overall risk management (including establishing a risk committee), stress-test requirements, and a 15-to-1 debt-to-equity limit for companies that... pose a grave threat to financial stability” ([GAO, 2014](#), see “Highlights” section).

There are, however, around 15 other Fed regulations that fall in the 95th percentile or above; they can be found by searching “federal reserve system” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Securities and Exchange Commission (SEC)

The SEC falls in the 95th percentile or above for four out of our five variables (“intensiveness,” “enforcement” [all three measures], “risk-assessment,” and “uncertainty-assessment”). It falls in the 72nd percentile on the “expertise” variable. It falls in the 99th percentile overall after normalization.

The SEC is responsible for regulating securities markets and protecting investors, both via enforcement actions and via “public disclosure of information about corporate activities and securities transactions” ([Federal Regulatory Directory, 2016](#), p. 339). Responsibilities include: investigating violations of securities laws, such as securities fraud; requiring periodic reports from companies whose securities are listed with the SEC; and requiring

securities brokers, dealers, and investment advisers to register with the SEC and abide by its regulations ([Federal Regulatory Directory, 2016](#), p. 339-340).

The three highest-scoring regulations in our data for the SEC are:

- [Title 17, Part 240](#): General Rules and Regulations, Securities Exchange Act of 1934 (100th percentile). That Act established the SEC and governs the buying and selling of securities. Companies listed on US stock exchanges must register any listed securities and adhere to various periodic reporting requirements regarding their financial information ([Kenton, 2023](#), see the section “Understanding the Securities Exchange Act of 1934”).
- [Title 17, Part 229](#): Standard Instructions for Filing Forms Under Securities Act of 1933, Securities Exchange Act of 1934, and Energy Policy and Conservation Act of 1975—Regulation S-K (99.9th percentile). This regulation states the requirements for SEC registration statements ([CFR, 2024d](#), sec. 229.10(a)).
- [Title 17, Part 270](#): Rules and Regulations, Investment Company Act of 1940 (99.4th percentile). That Act requires companies that invest and trade in securities (and whose own securities are public) to report on their financial condition and investment procedures ([SEC, 2020](#), see the section “Investment Company Act of 1940”).

There are, however, seven other SEC regulations that fall in the 95th percentile or above; they can be found by searching “securities and exchange commission” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Office of the Comptroller of the Currency (OCC)

The OCC falls in the 95th percentile or above for two out of our five variables—“risk-assessment” and “uncertainty-assessment.” It falls in the 81st percentile for the “intensiveness” variable and the 94th percentile for the “enforcement” variable (data on the “expertise” variable was not available). It comes in at the 99th percentile overall after normalization.

The OCC grants charters (licenses) to “national banks”, supervises and examines said banks (including taking enforcement actions against them if they violate regulations), regulates the foreign activities of its chartered national banks, and issues charters to foreign banks that wish to operate in the US (if those foreign banks operate like national banks). The OCC rates banks from 1-5 (healthy-troubled); banks rated 3,4 or 5 are subject to extra supervisory actions, “including removal of officers, negotiation of

agreements to change existing bank practices, and issuance of cease-and-desist orders to prevent further deterioration” ([Federal Regulatory Directory, 2016](#), p. 839).

The three highest-scoring regulations in our data for the OCC are:

- [Title 12, Part 3](#): Capital Adequacy Standards [for national banks and Federal savings associations] (100th percentile). This regulation “establishes minimum capital requirements and overall capital adequacy standards for national banks and Federal savings associations” ([CFR, 2024e](#), sec. 3.1(a)).
- [Title 12, Part 30](#): Safety and Soundness Standards (99.6th percentile). This Part establishes procedures via which OCC can require financial institutions to submit compliance plans if they fail to meet OCC’s safety and soundness standards ([CFR, 2024f](#), sec. 30.2(a)).
- [Title 12, Part 6](#): Prompt Corrective Action (99th percentile). Section 38 of the Federal Deposit Insurance Act outlines “supervisory actions for insured depository institutions that are not adequately capitalized;” this Part defines the capital and asset levels that correspond to said actions ([CFR, 2024g](#): sec. 6.1(a)).

There are, however, six other OCC regulations that fall in the 95th percentile or above; they can be found by searching “comptroller of the currency” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Other financial regulators

Financial regulators, in general, score highly on our variables. There are three other financial regulators that come above the 95th percentile in our data:

- The Federal Housing Finance Agency (FHFA) which regulates the mortgage industry. FHFA scores above the 95th percentile on three of our five variables (“risk-assessment,” “uncertainty-assessment,” and “enforcement”), in the 71st percentile for the “intensiveness” variable, and in the 93rd percentile for the “expertise” variable. It comes in at the 99th percentile overall after normalization.
  - The top-scoring regulation for FHFA is [Title 12, Part 1240](#): Capital Adequacy of Enterprises (99.8th percentile). There are five other FHFA regulations in the 95th percentile or above (see [here](#)).
- The Commodity Futures Trading Commission (CFTC), which regulates commodity futures and options markets. CFTC scores above the 95th percentile on two of

our five variables (“risk-assessment” and “uncertainty- assessment”), in the 87th percentile for the “intensiveness” variable, the 82nd percentile for the “expertise” variable, and the 88th percentile for the “enforcement” variable. It comes in at the 98th percentile overall after normalization.

- The top-scoring regulation for CFTC is [Title 17, Part 23](#): Swap Dealers and Major Swap Participants (99.9th percentile). There are ten other CFTC regulations in the 95th percentile or above (see [here](#)).
- The Federal Deposit Insurance Corporation (FDIC), which regulates a large number of insured commercial banks. FDIC scores above the 95th percentile on two of our five variables (“risk-assessment” and “uncertainty- assessment”), in the 84th percentile on the “intensiveness” variable, the 78th percentile on the “expertise” variable, and the 58th percentile on the “enforcement” variable. It comes in at the 97th percentile overall after normalization.
  - The top-scoring regulation for FDIC is [Title 12, Part 324](#): Capital Adequacy of FDIC-Supervised Institutions (100th percentile). There are nine other FDIC regulations in the 95th percentile or above (see [here](#)).

In order to give a broader picture of the space of possible case studies outside of financial regulators, we do not discuss them further here. However, we note that the above cases would, in our view, be equally valid choices for case studies as any of the remaining agencies.

## Office of Commercial Space Transportation, Federal Aviation Administration (FAA / AST)

FAA / AST comes in at the 95th percentile or above for two of our five variables (“risk-assessment” and “uncertainty- assessment”). It scores in the 74th percentile for the “intensiveness” variable. (Data on the “expertise” and “enforcement” variables were not available.<sup>16</sup>) It comes in at the 98th percentile overall after normalization.

FAA / AST regulates commercial rocket launch operations to ensure both public safety and compliance with international law. Its activities include issuing licenses for commercial launches ([Federal Regulatory Directory, 2016](#), p. 785).

The three highest-scoring regulations in our data for FAA / AST are:

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<sup>16</sup> However, we would note that data is available on the “enforcement” variable for FAA overall - see below.

- [Title 14, Part 417](#): Launch Safety (100th percentile). This part outlines the responsibilities attendant on operators conducting a launch of an expendable launch vehicle licensed under Title 14, Part 415 (see below), as well as stipulations for maintaining said license. Responsibilities include conducting a flight safety analysis ([CFR, 2024h](#), sec. 417.1(a) and table of contents).
- [Title 14, Part 450](#): Launch and Reentry License Requirements (99.8th percentile). This part “prescribes requirements for obtaining and maintaining a license to launch, reenter, or both launch and reenter, a launch or reentry vehicle” ([CFR, 2024j](#), sec 450.1).
- [Title 14, Part 415](#): Launch License (99.1st percentile). This part “prescribes requirements for obtaining a license to launch an expendable launch vehicle and post-licensing requirements with which a licensee must comply to remain licensed.” Requirements include a review of the launch’s impacts on US national security interests, public safety, and the environment ([CFR, 2024j](#), sec. 415.1(b) and table of contents).

There are two other FAA / AST regulations that fall in the 95th percentile or above; they can be found by searching “commercial space transportation” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Nuclear Regulatory Commission (NRC)

NRC comes in at the 95th percentile or above on three of our five variables (“intensity,” “risk-assessment,” and “uncertainty-assessment”). It scores in the 87th percentile on the “expertise” variable, although it scores in only the 48th percentile on the “enforcement” variable. Nonetheless, it comes in at the 97.5th percentile overall after normalization.

NRC regulates the nuclear energy industry. Its activities include licensing the construction and operation of nuclear power plants as well as “the possession, use, transportation, handling, packaging, and disposal of nuclear materials” and the export and import of said materials ([Federal Regulatory Directory, 2016](#), p. 437). It then regulates licensees, including establishing and enforcing physical security measures ([Federal Regulatory Directory, 2016](#), p. 437).

The three highest-scoring regulations in our data for NRC are:

- [Title 10, Part 50](#): Domestic Licensing of Production and Utilization Facilities (99.9th percentile). This part outlines licensing requirements for organizations that wish to

construct or operate nuclear power plants and other nuclear facilities ([CFR, 2024k](#), sec. 50.1).

- [Title 10, Part 52](#): Licenses, Certifications, and Approvals for Nuclear Power Plants (99.8th percentile). This regulation “governs the issuance of early site permits, standard design certifications, combined licenses, standard design approvals, and manufacturing licenses for nuclear power facilities” ([CFR, 2024l](#), sec. 52.0(a)).
- [Title 10, Part 74](#): Material Control and Accounting of Special Nuclear Material (99.8th percentile). This Part outlines requirements for the management and accounting of fissile materials at stationary facilities as well as for documenting the transfer of fissile material ([CFR, 2024m](#), sec. 74.1(a)).

There are, however, roughly fifteen other NRC regulations that fall in the 95th percentile or above; they can be found by searching “nuclear regulatory commission” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Federal Railroad Administration (FRA)

FRA comes in at the 95th percentile or above for two of our five variables (“risk-assessment” and “uncertainty-assessment”). It scores in the 90th percentile on the “intensiveness” variable, although only the 34th percentile on the “enforcement” variable. (We do not possess data on FRA for the “expertise” variable.) It comes in at the 96th percentile overall after normalization.

FRA is responsible for the safety of US railroad transportation. Its main regulatory division is the Office of Railroad Safety (ORS). FRA regulatory domains include “locomotives, signals, train safety appliances, power brakes... and transportation of dangerous articles by railway” ([Federal Regulatory Directory, 2016](#), p. 798).

The three highest-scoring, relevant-seeming regulations in our data for FRA are as follows (we skip over the actual second-highest—Title 49, Part 229: Use of Locomotive Horns at Public Highway-Rail Grade Crossings—as it seems intuitively irrelevant):

- [Title 49, Part 236](#): Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances (99.9th percentile). (We think that the title of this regulation is relatively self-explanatory!)
- [Title 49, Part 229](#): Railroad Locomotive Safety Standards (99.6th percentile). This part outlines standards for all non-steam locomotives, including standards on

inspections and tests, safety requirements, and crashworthiness design requirements ([CFR, 2024n](#), sec. 229.1(a) and table of contents).

- [Title 49, Part 270](#): Safety System Program (99.3rd percentile). This regulation requires select passenger rail operators to establish programs for systematically evaluating and managing railroad safety risks to reduce “the number and rates of railroad accidents, incidents, injuries, and fatalities” ([CFR, 2024o](#), sec. 270.1(a)).

There are, however, ten other FRA regulations that fall in the 95th percentile or above; they can be found by searching “federal railroad administration” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Food and Drug Administration (FDA)

FDA scores above the 95th percentile for the “intensiveness” variable. It scores in the 90th percentile for the “enforcement” variable and in the 94th percentile for the “risk-assessment” variable, although it comes in at the 0th percentile (i.e., there were zero relevant key terms) on the “uncertainty-assessment” variable and we don’t possess data for it on the “expertise” variable. We *do*, however, possess data for the “expertise” variable on its parent agency, the Department of Health and Human Services (HHS), which scores above the 95th percentile on the expertise variable. FDA comes in at the 97th percentile overall after normalization.

The domains under FDA’s purview that are most relevant to AI are probably drugs, biologics, and medical devices. In those domains, FDA’s activities include: setting standards for development, manufacturing, and experimentation; inspecting and licensing manufacturers; requiring premarket testing of new products; and recalling or seizing any products that violate regulations ([Federal Regulatory Directory, 2016](#), p. 265-266).

The three highest-scoring, relevant-seeming regulations in our data for FDA are as follows (we omit the third-highest scoring, Title 21, Part 440: Penicillin Antibiotic Drugs, because it is reserved—meaning that the agency has not made the regulation publicly available).

- [Title 21, Part 101](#): Food Labeling (99.1st percentile). These regulations cover the labeling of foodstuffs for human consumption, including safety-related information ([CFR, 2024p](#), table of contents).
- [Title 21, Part 201](#): [Drug] Labeling (98.3rd percentile). These regulations cover the labeling of drugs for human use, including safety and environmental information ([CFR, 2024q](#), table of contents).



- [Title 21, Part 866](#): Immunology and Microbiology Devices (97.9th percentile). This Part classifies immunology and microbiology devices for human use that are in commercial circulation, including for the purposes of premarket approval ([CFR, 2024r](#), sec. 866.1(a) and sec. 866.1(b)).

There are, however, 20 other FDA regulations that fall in the 95th percentile or above; they can be found by searching “food and drug administration” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Federal Communications Commission (FCC)

The FCC scores above the 95th percentile on the “intensiveness” variable. It scores in the 89th percentile on the “expertise” variable, the 82nd percentile on the “enforcement” variable, and the 75th percentile on the “risk-assessment” variable, although it comes in at the 0th percentile on the “uncertainty-assessment” variable (i.e., there were no relevant key terms). It comes in at the 96th percentile overall after normalization.

The FCC has oversight over all radio, television, wire, cable, and satellite communications (both intra-national and overseas). Its activities include licensing and regulating all commercial services that employ radio waves; setting safety standards for the use of the radio spectrum in land, sea, and air; and regulating common carriers of telegraph, telephone, and satellite communications ([Federal Regulatory Directory, 2016](#), p. 122).

None of the specific regulations from FCC that we identify seem intuitively relevant to AI, perhaps because none of them score highly on the risk-assessment or uncertainty-assessment variables. Nonetheless, case studies researchers may wish to examine the FCC as a model overall.

## Department of Energy (DOE)

DOE scores above the 95th percentile on the “intensiveness” and “uncertainty-assessment” variables, in the 84th percentile for the “expertise” variable, and in the 94th percentile for the “risk-assessment” variable, although only in the 16th percentile on the “enforcement” variable. It comes in at the 96th percentile overall after normalization.

DOE is a huge department, and describing its various functions would be difficult here. However, DOE’s main regulatory offices all seem potentially relevant to AI: the Office of Environment, Health, Safety, and Security (EHSS), responsible for ensuring the compliance of DOE nuclear facilities with environmental regulations and safety standards;

the Office of Environmental Management (EM), responsible for environmental compliance in legacy DOE nuclear weapons sites; and the Office of Fossil Energy, which performs some regulatory functions relating to fossil fuels (for example, import and export authorizations) ([Federal Regulatory Directory, 2016](#), p. 606-613).

The three highest-scoring regulations in our data for DOE are:

- [Title 10, Part 430](#): Energy Conservation Program for [non-automobile] Consumer Products (99.9th percentile). This regulation covers “testing, labeling, and enacting energy conservation standards, as well as product certification and enforcement. These standards are meant to reduce energy demand and increase energy efficiency. The standards also help reduce greenhouse gas emissions by reducing energy demand and use” ([EELP, 2024](#), see the section “Why it Matters”).
- [Title 10, Part 830](#): Nuclear Safety Management (99.6th percentile). This Part “governs the conduct of DOE contractors, DOE personnel, and other persons conducting activities... that affect, or may affect, the safety of DOE nuclear facilities.” That includes both nuclear reactors and “nonreactor facilities,” such as nuclear weapons facilities. ([CFR, 2024t](#), secs. 830.1 and 830.2(a)).
- [Title 10, Part 431](#): Energy Efficiency Program for Certain Commercial and Industrial Equipment (99.6th percentile). This Part establishes energy efficiency standards for equipment including electric motors, fridges, heating products, and distribution transformers. ([CFR, 2024u](#), table of contents).

There are, however, nine other DOE regulations that fall in the 95th percentile or above; they can be found by searching “department of energy” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Federal Aviation Administration (FAA)

FAA scores above the 95th percentile on the “intensiveness” and “uncertainty-assessment” variables, in the 78th percentile on the “enforcement” variable, and in the 93rd percentile on the “risk-assessment” variable. Data was not available for the “expertise” variable. It comes in at the 95th percentile overall after normalization.

FAA is responsible for everything related to civil aviation. Its activities include setting and enforcing standards in the following areas: aircraft manufacturing, maintenance, and operation; the licensing and training of employees; airport security; air traffic control; and noise and exhaust emissions. It also undertakes safety inspections of commercial aircraft ([Federal Regulatory Directory, 2016](#), p. 783).

The three highest-scoring regulations in our data for FAA are:

- [Title 14, Part 25](#): Airworthiness Standards: Transport Category Airplanes (99.9th percentile). This regulation establishes airworthiness requirements for the issuance of “type certificates” for transport category (i.e., large commercial) airplanes ([CFR, 2024v](#), sec. 25.1(a)). Type certificates are essentially FAA approvals that an airplane’s design meets the applicable standards ([FAA, 2022](#), see the section “Certification”).
- [Title 14, Part 121](#): Operating Requirements: Domestic, Flag, and Supplemental Operations (99.6th percentile). This regulation outlines a variety of requirements for both national and international US flight operations, including safety and technical requirements ([CFR, 2024w](#), see contents section).
- [Title 14, Part 23](#): Airworthiness Standards: Normal Category Airplanes (99.5th percentile). This regulation establishes airworthiness requirements for the issuance of type certificates (see above definition) for “normal” (i.e., smaller) airplanes ([CFR, 2024x](#), sec. 23.2000(a)).

There are, however, around 15 other FAA regulations that fall in the 95th percentile or above; they can be found by searching “federal aviation administration” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## U.S. Coast Guard (USCG)

USCG scores above the 95th percentile on the “intensiveness” variable and in the 87th percentile on the “risk-assessment” variable, although it only scores in the 40th percentile on the “enforcement” variable and the 0th percentile on the “uncertainty-assessment” variable (i.e., there were no relevant key terms). Data was not available for the “expertise” variable. It comes in at the 95th percentile overall after normalization.

USCG is the main federal agency charged with maritime law enforcement. Its activities include setting safety standards for vessels, setting licensing requirements for merchant marine personnel, and enforcing water pollution regulations through boarding and examining vessels carrying hazardous substances such as oil. It also manages homeland security in U.S. maritime space. ([Federal Regulatory Directory, 2016](#), p. 658).

The three highest-scoring, relevant-seeming regulations in our data for USCG are as follows (we omit the third-highest scoring, Title 46, Part 146 on “Dangerous Cargoes,” because it is reserved):

- [Title 46, Part 160](#): Lifesaving Equipment (99.8th percentile). This regulation stipulates “characteristics,” “approval procedures,” and “production oversight requirements” for lifesaving equipment (life-jackets, ladders, floats, flares, etc.) ([CFR, 2024y](#), sec. 160.001-1(a) and table of contents).
- [Title 33, Part 117](#): Drawbridge Operation Regulations (99.6th percentile). This regulation covers operating requirements for drawbridges—namely “a bridge... that is intended to be opened for the passage of waterway traffic”—including safety requirements ([CFR, 2024z](#), sec. 117.4).
- [Title 46, Part 56](#): Piping Systems and Appurtenances (99.6th percentile). This regulation outlines requirements for ships’ and barges’ piping systems and their auxiliary physical components (“appurtenances”), including safety requirements. ([CFR, 2024aa](#), sec. 56.01-1(a)).

There are, however, around forty other USCG regulations that fall in the 95th percentile or above; they can be found by searching “coast guard” in [this spreadsheet](#), with reference to the percentile ranks in column H.

## Department of Defense (DOD)

DOD scores above the 95th percentile for the “intensiveness” and “risk-assessment” variables. It scores in the 76th percentile for the “expertise” variable and the 94th percentile for the “uncertainty-assessment” variable. Data was not available for the “enforcement” variable. It comes in at the 95th percentile overall after normalization.

DOD is the largest federal agency, so describing all of its regulatory functions here would be impossible. Those regulatory functions are also very diffuse, so we cannot even give an overview of DOD’s regulatory functions here. However, the three highest-scoring, relevant-seeming regulations in our data for DOD are as follows (we exclude several high-scoring regulations either because they do not seem intuitively relevant, for example medical programs for veterans, or because they are reserved or obsolete).

- [Title 32, Part 218](#): Guidance for the Determination and Reporting of Nuclear Radiation Dose for DOD Participants in the Atmospheric Nuclear Test Program (1945–1962) (99.8th percentile). This regulation outlines procedures for measuring and reporting to involved DOD personnel (now veterans) the radiation dose that they received when participating in the United States’ atmospheric nuclear weapons testing program ([CFR, 2024ab](#), sec. 218.1(a)).

- [Title 32, Part 154](#): Department of Defense Personnel Security Program Regulation (99.8th percentile). This regulation establishes requirements to ensure that DOD's hiring and employment procedures, as well as procedures for granting personnel, contractors, and affiliates access to classified information, are "clearly consistent with the interests of national security" ([CFR, 2024ac](#), sec. 1541(a)).
- [Title 32, Part 117](#): National Industrial Security Program Operating Manual (97.1st percentile). This regulation establishes policies, responsibilities, requirements, and procedures "for the protection of classified information that is disclosed to, or developed by contractors of the U.S. Government" ([CFR, 2024ad](#), sec. 117(a)).

None of the other high-scoring DOD regulations seem especially relevant.

# Conclusion

In this report, we conducted a systematic case study selection exercise for AI-relevant regulatory precedents in the United States. We believe that our results clear the bar for case study selection and, because of their depth, could provide a broad foundation for case study scholarship relating to the regulation of advanced AI. However, they should not be taken as “definitive” results that can be used for purposes less exploratory than case study selection.

Some case studies for advanced AI regulation that our research has highlighted, and which so far seem neglected in the literature, include regulations from the Environmental Protection Agency (EPA), regulations from specific financial regulators (particularly capital adequacy standards), regulations from the Office for Commercial Space Transportation (FAA / AST), regulations from the Department of Energy (DOE) (for example of DOE nuclear facilities, including weapons facilities), and regulations from the Department of Defense (DOD) (for example around classified information and nuclear radiation dosage).

Other potentially relevant and neglected agencies include the Federal Railroad Administration (FRA), the Federal Communications Commission (FCC), and the US Coast Guard (USCG).

Agencies that *have* been the subject of case studies in the grey literature, but which would still be useful to gain (for example) academic case studies on, include the Nuclear Regulatory Commission (NRC) (see Simpson and Trager, 2024, forthcoming), the Federal Aviation Administration (see Simpson and Trager, 2024, forthcoming) and the Food and Drug Administration (FDA) (see [Stein and Dunlop, 2023](#)).

However, ultimately researchers should examine our data themselves, for both [agencies](#) and [regulations](#). Others may wish (for example) to impose different cut-off points for “high-scoring” agencies or regulations. We simply hope that this study provides a basis for future research.

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# Bibliography

- Al-Ubaydli, O., & McLaughlin, P. A. (2017). RegData: A Numerical Database on Industry-Specific Regulations for all United States Industries and Federal Regulations, 1997–2012. *Regulation & Governance*, 11(1), 109–123.  
<https://doi.org/10.1111/rego.12107>
- Anderljung, M., Barnhart, J., Korinek, A., Leung, J., O’Keefe, C., Whittlestone, J., Avin, S., Brundage, M., Bullock, J., Cass-Beggs, D., Chang, B., Collins, T., Fist, T., Hadfield, G., Hayes, A., Ho, L., Hooker, S., Horvitz, E., Kolt, N., ... Wolf, K. (2023). *Frontier AI Regulation: Managing Emerging Risks to Public Safety* (arXiv:2307.03718). arXiv.  
<https://doi.org/10.48550/arXiv.2307.03718>
- Anderson-Samways, B., & Acharya, A. (n.d.). *Catching Bugs: The Federal Select Agent Program and Lessons for AI Regulation*. Institute for AI Policy and Strategy. Retrieved February 26, 2024, from <https://perma.cc/KF34-5XME>
- Baxter, J., Dillon-Merrill, R., & Raich, W. (2021, October 15). *Addressing Uncertainty in Regulatory Impact Analysis*. ASPE. <https://perma.cc/4M3E-PSDV>
- Buschmann, R. (2003). *Risk Assessment and Regulation in the Federal Government: A Brief Overview*. Congressional Research Service. <https://perma.cc/RSP8-88YV>
- CFR. (n.d.-a). *12 CFR Part 225—Bank Holding Companies and Change in Bank Control (Regulation Y)*. Retrieved March 8, 2024, from <https://www.ecfr.gov/current/title-12/part-225>
- CFR. (n.d.-b). *14 CFR Part 450—Launch and Reentry License Requirements*. Retrieved March 11, 2024, from <https://www.ecfr.gov/current/title-14/part-450>



CFR. (n.d.-c). *47 CFR Part 73—Radio Broadcast Services*. Retrieved March 12, 2024, from <https://www.ecfr.gov/current/title-47/part-73>

CFR. (2024k). *10 CFR Part 50—Domestic Licensing of Production and Utilization Facilities*. <https://www.ecfr.gov/current/title-10/part-50>

CFR. (2024l). *10 CFR Part 52—Licenses, Certifications, and Approvals for Nuclear Power Plants*. <https://www.ecfr.gov/current/title-10/chapter-I/part-52?toc=1>

CFR. (2024m). *10 CFR Part 74—Material Control and Accounting of Special Nuclear Material*. <https://www.ecfr.gov/current/title-10/part-74>

CFR. (2024u). *10 CFR Part 431—Energy Efficiency Program for Certain Commercial and Industrial Equipment*. <https://www.ecfr.gov/current/title-10/part-431>

CFR. (2024t). *10 CFR Part 830—Nuclear Safety Management*. <https://www.ecfr.gov/current/title-10/part-830>

CFR. (2024e). *12 CFR Part 3—Capital Adequacy Standards*. <https://www.ecfr.gov/current/title-12/part-3>

CFR. (2024g). *12 CFR Part 6—Prompt Corrective Action*. <https://www.ecfr.gov/current/title-12/part-6>

CFR. (2024f). *12 CFR Part 30—Safety and Soundness Standards*. <https://www.ecfr.gov/current/title-12/part-30>

CFR. (2024b). *12 CFR Part 217—Capital Adequacy of Bank Holding Companies, Savings and Loan Holding Companies, and State Member Banks (Regulation Q)*. <https://www.ecfr.gov/current/title-12/part-217>

CFR. (2024v). *14 CFR Part 25 -- Airworthiness Standards: Transport Category Airplanes*. <https://www.ecfr.gov/current/title-14/part-25>

- CFR. (2024w). *14 CFR Part 121 -- Operating Requirements: Domestic, Flag, and Supplemental Operations*. <https://www.ecfr.gov/current/title-14/part-121>
- CFR. (2024j). *14 CFR Part 415—Launch License*.  
<https://www.ecfr.gov/current/title-14/part-415>
- CFR. (2024h). *14 CFR Part 417—Launch Safety*.  
<https://www.ecfr.gov/current/title-14/part-417>
- CFR. (2024d). *17 CFR Part 229—Standard Instructions for Filing Forms Under Securities Act of 1933, Securities Exchange Act of 1934 and Energy Policy and Conservation Act of 1975—Regulation S-K*. <https://www.ecfr.gov/current/title-17/part-229>
- CFR. (2024p). *21 CFR Part 101—Food Labeling*.  
<https://www.ecfr.gov/current/title-21/part-101>
- CFR. (2024q). *21 CFR Part 201—Labeling*. <https://www.ecfr.gov/current/title-21/part-201>
- CFR. (2024r). *21 CFR Part 866—Immunology and Microbiology Devices*.  
<https://www.ecfr.gov/current/title-21/part-866>
- CFR. (2024a). *40 CFR Part 58—Ambient Air Quality Surveillance*.  
<https://www.ecfr.gov/current/title-40/part-58>
- CFR. (2024y). *46 CFR Part 160—Lifesaving Equipment*.  
<https://www.ecfr.gov/current/title-46/part-160>
- CFR. (2022na). *49 CFR Part 229—Railroad Locomotive Safety Standards*.  
<https://www.ecfr.gov/current/title-49/part-229>
- CFR. (2022nb). *49 CFR Part 270—System Safety Program*.  
<https://www.ecfr.gov/current/title-49/part-270>

- Coglianesi, C. (2019, July 8). *What Does Risk-Based Regulation Mean? | The Regulatory Review*. <https://perma.cc/NM64-UF67>
- (Eds.). (2016). *Federal Regulatory Directory: The Essential Guide to the History, Organization, and Impact of U.S. Federal Regulation*. CQ Press.  
<https://doi.org/10.4135/9781483384757>
- Environmental and Energy Law Program (EELP). (2024). *Energy Conservation Standards for Consumer Products—Harvard Law School*. <https://perma.cc/S6WK-MFUA>
- EPA. (2024a). *National Emission Standards for Hazardous Air Pollutants Compliance Monitoring* [Overviews and Factsheets]. <https://perma.cc/J78N-KCSA>
- EPA. (2024b). *Nonmetallic Mineral Processing: New Source Performance Standards (NSPS)* [Other Policies and Guidance]. <https://perma.cc/HF5K-KKLH>
- FAA. (2022). *Certification | Federal Aviation Administration*. <https://perma.cc/V4UP-DCWW>
- Feng, G. C. (2015). Mistakes and How to Avoid Mistakes in Using Intercoder Reliability Indices. *Methodology*, 11(1), 13–22. <https://doi.org/10.1027/1614-2241/a000086>
- GAO. (2014). *Federal Reserve System: Enhanced Prudential Standards for Bank Holding Companies and Foreign Banking Organizations | U.S. GAO*.  
<https://www.gao.gov/products/gao-14-544r>
- Gerring, J. (2006). *Case Study Research: Principles and Practices*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511803123>
- Good Jobs First. (2024a). *Violation Tracker*. <https://perma.cc/GZ9D-LV33>
- Good Jobs First. (2024b). *Violation Tracker: User Guide*.  
<https://violationtracker.goodjobsfirst.org/pages/user-guide>

Groch-Begley, H. (2024, forthcoming). *Understanding Financial Regulation as a Potential Model for AI Regulation*.

Gwet, K. L. (2024). *AgreeStat 360: Cloud-Based Interrater Reliability Analysis*.

<https://perma.cc/GT66-N2SJ>

Henninger, J. (2023). *Standards Case Study: Institutional Review Boards*. AI Impacts.

<https://perma.cc/84MW-UP29>

Jones, C. (2008). *What's Regulation Got to Do With It? : Examining the Impact of Regulatory Intensity on Environmental Management and Performance*. PhD thesis submitted to Portland State University.

[https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=7028&context=open\\_access\\_etds](https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=7028&context=open_access_etds)

Kalmenovitz, J. (2019). *Regulatory Intensity and Firm-Specific Exposure* (SSRN Scholarly Paper 3451344). <https://doi.org/10.2139/ssrn.3451344>

Kenton, W. (2023). *What Is the Securities Exchange Act of 1934? Reach and History*.

Investopedia. <https://perma.cc/E282-VLRR>

Krippendorff, K. (2011). Agreement and Information in the Reliability of Coding.

*Communication Methods and Measures*, 5(2), 93–112.

<https://doi.org/10.1080/19312458.2011.568376>

Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for

Categorical Data. *Biometrics*, 33(1), 159. <https://doi.org/10.2307/2529310>

Lee, B., Preston, F., & Green, G. (2012). *Preparing for High-impact, Low-probability Events:*

*Lessons from Eyjafjallajökull*. Chatham House. <https://perma.cc/BT4L-J37D>

Masur, J. S., & Posner, E. A. (2011). Climate Regulation and the Limits of Cost-Benefit Analysis. *California Law Review*, 99(6), 1557–1599.

<http://www.jstor.org/stable/41345440>

Masur, J. S., & Posner, E. A. (2015). *Unquantified Benefits and the Problem of Regulation Under Uncertainty* (SSRN Scholarly Paper 2646063).

<https://doi.org/10.2139/ssrn.2646063>

Neuendorf, K. A. (2017). *The Content Analysis Guidebook*. SAGE Publications, Inc.

<https://doi.org/10.4135/9781071802878>

OECD. (2021). *OECD Regulatory Policy Outlook 2021*. OECD.

<https://doi.org/10.1787/38b0fdb1-en>

Office of Management and Budget. (2003). *Circular A-4*. The White House.

<https://perma.cc/AA7V-7RVG>

Office of Personnel Management. (2024). *FedScope—Federal Workforce Data—OPM.gov*.

<https://perma.cc/PM87-QK3P>

SEC. (n.d.). *Investment | Laws and Rules*. Retrieved March 11, 2024, from

<https://perma.cc/3NGE-6ZB5>

Short, J. C., Broberg, J. C., Cogliser, C. C., & Brigham, K. H. (2010). Construct Validation Using Computer-Aided Text Analysis (CATA): An Illustration Using Entrepreneurial Orientation. *Organizational Research Methods*, 13(2), 320–347.

<https://doi.org/10.1177/1094428109335949>

Simpson, M., & Trager, R. (2024, forthcoming). *Cooperation in Safety-Critical Industries: Lessons for AI from Aviation and Nuclear (Working Paper)*.

- Stein, M., & Dunlop, C. (2023). *Safe Before Sale: Learnings from the FDA's Model of Life Sciences Oversight for Foundation Models*. <https://perma.cc/QH36-WBCM>
- Stewart, H. (2023). *Green Seal and SCS: A Case Study of the First Eco-Labeling Programs in the US*. AI Impacts. <https://perma.cc/49WB-DTU3>
- van der Heijden, J. (2019). *Risk Governance and Risk-Based Regulation: A Review of the International Academic Literature* (SSRN Scholarly Paper 3406998).  
<https://doi.org/10.2139/ssrn.3406998>
- Visconti, A. (2022, November 25). *What is Risk-Based Regulation?* Ascend Magazine Website. <https://perma.cc/MJ2F-WLFA>
- Whipple, C. G. (1986). Dealing With Uncertainty About Risk in Risk Management. In *Hazards: Technology and Fairness*. National Academies Press (US).  
<https://perma.cc/GN8M-UB5G>
- Yohe, G. W. (1984). Regulation Under Uncertainty: An Intuitive Survey and Application to Fisheries. *Marine Resource Economics*, 1(2), 171–192.  
<http://www.jstor.org/stable/42628853>

# Appendix 1: Literature used for initial generation of key terms

- For the risk-based regulation variable:
  - Chapter 6, “Risk-based regulation” of OECD. (2021). *OECD Regulatory Policy Outlook 2021*. OECD. <https://doi.org/10.1787/38b0fdb1-en>
  - Coglianesi, C. (2019, July 8). *What Does Risk-Based Regulation Mean?* | *The Regulatory Review*. <https://perma.cc/NM64-UF67>
  - van der Heijden, J. (2019). *Risk Governance and Risk-Based Regulation: A Review of the International Academic Literature* (SSRN Scholarly Paper 3406998). <https://doi.org/10.2139/ssrn.3406998>
  - Visconti, A. (2022, November 25). *What is risk-based regulation?* Ascend Magazine Website. <https://perma.cc/MJ2F-WLFA>
  - Buschmann, R. (2003). *Risk Assessment and Regulation in the Federal Government: A Brief Overview*. Congressional Research Service. <https://perma.cc/RSP8-88YV>
- For the uncertainty variable:
  - Whipple, C. G. (1986). Dealing With Uncertainty About Risk in Risk Management. In *Hazards: Technology and Fairness*. National Academies Press (US). <https://perma.cc/GN8M-UB5G>
  - The “intuitive survey” in Yohe, G. W. (1984). Regulation Under Uncertainty: An Intuitive Survey and Application to Fisheries. *Marine Resource Economics*, 1(2), 171–192. <https://doi.org/10.1086/mre.1.2.42628853>
  - Masur, J. S., & Posner, E. A. (2015). *Unquantified Benefits and the Problem of Regulation Under Uncertainty* (SSRN Scholarly Paper 2646063). <https://doi.org/10.2139/ssrn.2646063>
  - Baxter, J., Dillon-Merrill, R., & Raich, W. (2021, October 15). *Addressing Uncertainty in Regulatory Impact Analysis*. ASPE. <https://perma.cc/4M3E-PSDV>

- Office of Management and Budget. (2003). *Circular A-4*. The White House. <https://perma.cc/AA7V-7RVG>
- For the tail-risk variable:
  - Lee, B., Preston, F., & Green, G. (2012). *Preparing for High-impact, Low-probability Events: Lessons from Eyjafjallajökull*. Chatham House. <https://perma.cc/BT4L-J37D>
  - [We could not find any other sources on tail-risk focused regulation, which we take as another sign of the unreliability of this variable].



# Appendix 2: Transcript of interrater reliability instructions

- The exercise involves going through each term and marking Y if you agree and N if you disagree that it captures the variable in question, as well as adding any terms you can think of that we haven't included. (We're looking for terms that are commonly used *across* different regulatory agencies rather than those only used by specific individual agencies, as the latter would skew the results).
  - The purpose of that exercise is for us to assess intercoder reliability—the extent to which your assessment matches that of other experts we've asked.
- It seems like there are a lot of terms, but a large number of them (those in the indented hollow bullet points) are just variations on a single "master" term, so you should feel free to just mark Y / N for the master term.
- We'd recommend using snap judgment for each term and not spending too long thinking about each one. If you're uncertain about a given term, you should just go with whichever answer ("Y" or "N") you instinctively "lean" towards (even if it's only 55%-45%!).
- We think that this exercise shouldn't take more than 30 minutes.

# Appendix 3: Qualitative interview template

In this interview, I'm going to ask you for examples of regulators at the federal level in the United States that score exceptionally highly on six separate dimensions. For each question, please name as many examples as you can think of, including examples that might appear really obvious to you.

- Firstly, we're interested in regulations that seem particularly intensive or thorough, so for example regulations that impose many regulatory requirements on regulated parties. Are there any regulators that seem particularly intensive to you?
- Secondly, we'd like to know about regulations that draw significantly upon experts to inform regulatory decisions. That can mean either internal experts, so say employing people with PhDs in a relevant field, or external experts, so say drawing heavily on expert advisory committees. Do you think there are any regulators that are especially consistent at using experts to inform regulatory decisions?
- Thirdly, we'd like to know about regulators or regulations where enforcement is consistently strong. Are there any regulators that are especially consistent at enforcing their regulations?
- Fourthly, we're interested in the extent to which regulators or regulations are risk-based. Our working definition of risk-based is that regulators use risk-assessments, and those risk-assessments significantly affect their regulatory decisions. In your view, are there any regulators that are especially consistent at using risk-assessments in a way that significantly affects their regulatory decisions?
- Fifthly, we're interested in regulations that attempt high assurance against very uncertain risks, whether that uncertainty relates to their probability or how to characterize different outcomes. In your view, are there any regulators that seem exceptionally focused on gaining high assurance against very uncertain risks?
- Finally, we're interested in the extent to which regulations deal with tail-risks. By that we mean that regulations explicitly attempt to gain high assurance against risks of low probability but very high magnitude. Can you think of any regulators that seem exceptionally focused on gaining high assurance against tail-risks?

# Appendix 4: Quantitative results for variable 6 (“tail-risk”)

As mentioned in the above section on the [results for variable 6](#), the below results are invalid and should not be used even for exploratory purposes. We provide them here for transparency purposes only, as we think that the extremely low number of regulators identified is a further sign of the invalidity of these results and possibly a general difficulty with generating reliable data capturing this variable.

Because we think these results are invalid and should not be used for case study purposes, we do not impose thresholds for extremeness (e.g., 95% for agencies or 99.8% for individual regulations, as for the other variables), as we do not wish to give the impression that some agencies or regulations score “higher” than others in any meaningful sense. Instead, we simply report all agencies and regulations for which the count of our search terms was one or higher to give an impression of just how few agencies or regulations met this criterion.

*Table 15: Agencies which, in the Code of Federal Regulations, contained one or more search term on our (invalid) risk-assessment variable*

<i>Agency Name</i>	<i>Count (sum)</i>
Federal Crop Insurance Corporation	136
Farm Service Agency	8
Commodity Credit Corporation	3
Environmental Protection Agency	3
Department of Health and Human Services	2
Consumer Product Safety Commission	1
Department of Agriculture	1
Food and Drug Administration	1
General Services Administration	1
National Credit Union Administration	1
National Marine Fisheries Service & National Oceanic and Atmospheric Administration	1

Office of Management and Budget	1
Railroad Retirement Board	1

*Table 16: Individual regulations which, in the Code of Federal Regulations, contained 1 or more search term on our (invalid) risk-assessment variable*

<i>Regulation (CFR Part and title)</i>	<i>Agency responsible for regulation</i>	<i>Count (sum)</i>
Title 7, Part 457: Common Crop Insurance Regulations	Federal Crop Insurance Corporation	81
Title 7, Part 402: Catastrophic Risk Protection Endorsement	Federal Crop Insurance corporation	23
Title 7, Part 400: General Administrative Regulations (of the Federal Crop Insurance Corporation)	Federal Crop Insurance Corporation	22
Title 7, Part 407: Area Risk Protection Insurance Regulations	Federal Crop Insurance Corporation	10
Title 7, Part 760: Indemnity Payment Programs	Farm Service Agency	6
Title 40, Part 14: Employee Personal Property Claims	Environmental Protection Agency	3
Title 7, Part 1437: Noninsured Crop Disaster Assistance Program	Commodity Credit Corporation	2
Title 7, Part 764: Direct Loan Making	Farm Service Agency	1
Title 7, Part 762: Guaranteed Farm Loans	Farm Service Agency	1
Title 7, Part 15: Nondiscrimination [in Federally-Assisted Programs of the Department of Agriculture]	Department of Agriculture	1
Title 7, Part 1405: Loans, Purchases, and Other Operations	Commodity Credit Corporation	1
Title 50, Part 223: Threatened Marine and Anadromous Species	National Marine Fisheries Service & National Oceanic and Atmospheric Administration	1

Title 48, Part 28: Bonds and Insurance	General Services Administration	1
Title 45, Part 75: Uniform Administrative Requirements, Cost Principles, and Audit Requirements for HHS Awards	Department of Health and Human Services	1
Title 45, Part 34: Claims Filed Under the Military Personnel and Civilian Employees Act	Department of Health and Human Services	1
Title 21, Part 14: Public Hearing Before a Public Advisory Committee	Food and Drug Administration	1
Title 20, Part 362: Employees' Personal Property Claims	Railroad Retirement Board	1
Title 2, Part 200: Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards	Office of Management and Budget	1
Title 16, Part 1009: General Statements of Policy or Interpretation	Consumer Product Safety Commission	1
Title 12, Part 701: Organization and Operation of Federal Credit Unions	National Credit Union Administration	1

The full results for this variable can be seen online [here](#) (by agency) and [here](#) (by regulator), though again, we note that these results are invalid.