

# CHAPTER 3:

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## Unpacking the Forms of Regulation Affecting Agricultural Industries

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The Taxonomy of Regulatory Forms facilitates classification of regulations in a systematic manner by form—the particular policy mechanism used to achieve a desired end. In this chapter, we discuss an application of the Taxonomy to regulations affecting the agriculture sector. The objective of this chapter is to identify the forms these regulations take, examine their trends and patterns across agencies and over time, and create a unique dataset that enables econometric analysis of the impact of different regulatory forms.

Application of the Taxonomy involves analyzing regulations to identify the specific mechanisms they employ to achieve intended outcomes. For example, introducing tolerance levels for pesticide residues is a form of performance standard intended to reduce human exposure to pesticides. We identified a set of regulations that were most relevant to agriculture, and used qualitative coding techniques to generate a dataset that classifies regulations according to form. Specifically, we use the RegData<sup>1</sup> database created by the Mercatus Center at George Mason University to identify a sample of 709 parts in the Code of Federal Regulations (CFR) related to the crop and animal production industries defined in the North American Industry Classification System (NAICS). We then used content analysis to analyze and code the sample CFR parts into different regulatory forms.

We used the created dataset to conduct cross-sectional and longitudinal analyses to identify patterns and trends in the adoption of different regulatory forms across agencies and over time. We focused our agency-level analysis on regulations published by the U.S. Department of Agriculture (USDA), Environmental Protection Agency (EPA), and Food and Drug Administration (FDA), because these agencies are most relevant to agricultural regulations. It is worth noting that the patterns and trends presented in this chapter are representative of the selected sample, which includes regulations

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<sup>1</sup> Patrick A. McLaughlin and Oliver Sherouse, “RegData US 3.1 Annual (dataset),” QuantGov, accessed December 21, 2018. <https://quantgov.org/regdata-us/>.

estimated to be highly relevant to the selected industries according to RegData (i.e., our sample is not an exhaustive list of regulations affecting these industries).<sup>2</sup>

### I. Data

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We collected data from three main sources: CFR, NAICS and RegData. The CFR data included the regulatory text codifying federal rules; the NAICS coding system allowed for identification of relevant industries; we utilized metrics in RegData to identify CFR parts relevant to agriculture. The following sections explain each of the data sources in detail.

#### A. Code of Federal Regulations

The CFR is the codification of the general and permanent rules that federal executive departments and agencies publish in the Federal Register.<sup>3</sup> It provides a complete text of agency regulations organized by Title, Volume, Chapter and Part. Each title represents a subject area of federal regulation, such as agriculture, energy, and commercial practices. For example, Chapter I of Title 7 on Agriculture is associated with the Agricultural Marketing Service—located within USDA. We selected and analyzed our sample of regulations at the CFR part level, because a part contains rules on a single program or function that is likely to take a single or limited number of forms.

We referred to the digitized annual edition of the CFR as the source of regulatory text for CFR parts included in this study.<sup>4</sup> If a CFR part identified in RegData did not appear in the digitized annual edition of the CFR, we used the most recent year that was available in the HeinOnline database. The sample contains various titles related to animal and crop industries identified by NAICS code.

#### B. North American Industry Classification System

The U.S., Canadian and Mexican statistical agencies jointly developed NAICS codes for collection and publication of statistical data resulting in comparable economic estimates across jurisdictions. Federal agencies have adopted the NAICS classification system for use in regulatory purposes, such as developing regulatory flexibility analyses and economic analyses. It covers 20 sectors and 1,057 industries classified according to their production processes.<sup>5</sup> NAICS applies a hierarchical structure to identify relationships between industries. As shown in Table 1, hierarchical digit codes rank groups within Sector, Subsector, Industry Group, NAICS industry, and National Industry.

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<sup>2</sup> To test the robustness of our results to this sample of regulations, we applied our econometric analysis to a subset of CFR parts developed through expert judgment.

<sup>3</sup> U.S. National Archives and Records Administration, “About the Code of Federal Regulations,” National Archives. August 8, 2018, accessed December 21, 2018. <https://www.archives.gov/federal-register/cfr/about.html>.

<sup>4</sup> U.S. Government Publishing Office, “Code of Federal Regulations (Annual Edition).” Govinfo, accessed December 21, 2018. <https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR>.

<sup>5</sup> Executive Office of the President, “North American Industry Classification System,” Office of Management and Budget, accessed December 21, 2018. [https://www.census.gov/eos/www/naics/2017NAICS/2017\\_NAICS\\_Manual.pdf](https://www.census.gov/eos/www/naics/2017NAICS/2017_NAICS_Manual.pdf).

Table 1: Example of NAICS Classification

Groups	# of Digits	Code	Industry Name
<b>Sector</b>	2-digit	11	Agriculture, Forestry, Fishing and Hunting
<b>Subsector</b>	3-digit	111	Crop Production
<b>Industry Group</b>	4-digit	1111	Oilseed and Grain Farming
<b>NAICS Industry</b>	5-digit	11111	Soybean Farming
<b>National Industry</b>	6-digit	111110	Soybean Farming

Agricultural activities generally fall under NAICS 11, which includes crop production (111), animal production (112), forestry and logging (113), fishing, hunting and trapping (114), and support activities for agriculture and forestry (115). In this study, we focus on crop and animal production industries, covering most segments under NAICS 111, 112, and 115. As described in detail in the following Sampling Strategy section, we selected our sample based on 4-digit NAICS codes within these industries. Appendix A shows a list of NAICS industries covered.

### C. RegData 3.1

RegData is a dataset that quantifies federal regulations using text-analysis and machine-learning algorithms.<sup>6</sup> In 2012, the Mercatus Center released its first version of the dataset. RegData 3.1 is the latest version that includes regulations published in the CFR from 1970 through 2017.

RegData 3.1 provides three measures of regulation. First, it counts the total number of words in regulatory text to quantify the volume. Second, it counts five restrictive words “shall,” “must,” “may not,” “required,” and “prohibited” as proxies for binding constraints imposed on regulated entities. Third, it estimates the probability that a body of regulatory text is relevant to a particular NAICS industry at the 2-6 digit level using machine-learning algorithms.<sup>7</sup> For example, by analyzing the text in a CFR part, RegData might estimate that the part has an 80 percent chance of being relevant to oilseed and grain farming (NAICS 1111), and a 30 percent chance of being relevant to other crop farming (NAICS 1119). The probabilities for a CFR part do not add up to one because the relevance to each industry at each NAICS digit level is estimated individually. Hence, RegData allows us to identify the most relevant CFR parts to the industries of interest.

<sup>6</sup> McLaughlin and Sherouse 2018

<sup>7</sup> The estimates of industry relevance in RegData are accomplished by supervised learning. Simply speaking, the computer is first trained to learn about a set of regulations from the Federal Register that are known to be relevant to certain industries, and then analyzes the CFR text to estimate its probabilities to be relevant to each industry using the “knowledge” it has learned from the training document. For more information on their methodologies, see Al-Ubaydli, Omar and Patrick A. McLaughlin, “RegData: A Numerical Database on Industry-Specific Regulations for All US Industries and Federal Regulations, 1997-2012,” *Mercatus Working Paper*, 2014, <https://www.mercatus.org/system/files/McLaughlin-RegData.pdf>.

## II. Qualitative Coding

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### A. Sampling Strategy

We relied on the relevance estimates in RegData to identify the CFR parts relevant to animal and crop production industries. In that process, we found that estimates for 4-digit NAICS industries revealed a level of detail that was appropriately specific and accurate for our analysis. Using estimates for a higher level of industries would not separate crop and animal production from certain other industries; for example, NAICS 115 (support activities for agriculture and forestry) includes both support activities for crop and animal production and forestry. Using estimates for a greater than 4-digit NAICS industries would forego a certain level of accuracy, as we generally find that a relevance estimate becomes less accurate when it comes to a specific industry.<sup>8</sup> As a result, we narrowed the list of industries down to 12 NAICS 4-digit industries covering crop and animal production (Appendix A).

Because the relevance estimate in RegData is a continuous variable (i.e., probability between 0 and 1), we applied a single threshold of 0.2 to select relevant CFR parts. That is, a CFR part is included in the sample as long as it has a relevance estimate equal to or larger than 0.2 to any of the 12 industries in any year between 1970 and 2017 in RegData. We selected the threshold of 0.2 considering two factors. First, we needed a large enough sample size such that the sample CFR parts were representative of the regulations affecting these industries. Second, an unduly low threshold would generate a large sample but include too many irrelevant regulations. To balance the tradeoff, we tested several thresholds, including 0.5, 0.3, 0.2, and 98<sup>th</sup> percentile within each industry. Finally, we consulted subject-matter experts in USDA to evaluate the validity of the resulting samples.<sup>9</sup> As a result, we adopted the threshold of 0.2 and generated a sample of 714 unique CFR parts from RegData. However, we found that five parts among the 714 parts did not exist in CFR in the years indicated by RegData,<sup>10</sup> so we removed these from the sample, resulting in a sample of 709 CFR parts.

During our sampling process, we discovered a few limitations in relying on RegData to select the sample. First, the industry relevance metric does not always accurately measure the actual relevance. Some CFR parts are associated with a high relevance to one agricultural activity but have a very low

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<sup>8</sup> We consulted the developers of RegData at the Mercatus Center on this issue. Their explanation suggests that for certain industries, they might not have sufficient samples in the training document, such that the computer simply does not “know” enough about the relationship between the industry and relevant regulatory text.

<sup>9</sup> These subject matter experts identified several CFR parts identified by RegData for which relevance to agriculture is unclear. As discussed in the next chapter, we conducted robustness checks using this more refined data set.

<sup>10</sup> Initially RegData misidentified about 30 CFR parts in years when those parts were merely *Reserved* but not in use. After correcting the time periods in which the part existed between 1970 and 2017, we were still left with five parts that were identified by RegData but did not exist in CFR in any year between 1970 and 2017, which are: 3 CFR 5, 5 CFR 26, 7 CFR 2000, 21 CFR 1353, and 26 CFR 350. We excluded them from the sample. According to our discussion with the Mercatus Center, this type of error in RegData is mostly a result of inaccurate reading of CFR text by the programming software. This problem is more likely to occur to the CFRs published before 1996, as the reading of these CFRs is based on scanned hard copies.

relevance estimate to other agricultural sectors to which the CFR part is applicable. For example, RegData estimates 9 CFR 53 (Title 9, Part 53) on foot and mouth disease of livestock and poultry to be more relevant to aquaculture than cattle ranching and farming. Inaccuracy in the estimates also leads to identifying some irrelevant regulations as highly relevant as well as missing CFR parts likely to be relevant. For example, RegData shows an unduly high relevance value for a few parts in Title 5, which relates to regulating administrative personnel, to certain crop production activities. Second, RegData relies on CFR parts from different sources for computerized text analysis. The electronic CFR parts are available from 1996 onwards, and the CFR parts published prior to 1996 are scanned from hard copies. In the digitization process, some text is missing for 1996. This change is evident in some of the graphs shown in the descriptive analysis where the trend in CFR parts appears unusual between 1994 and 1997.

Although we recognize the aforementioned issues with RegData and the resulting sample, it is unlikely to bias our analysis because the errors are random. Measurement errors can bias statistical analyses in different directions if they are systematically correlated with the true value of the variable. For example, self-reported height and weight are often biased in a certain direction and thus could bias results in clinical practices and epidemiological studies.<sup>11</sup> However, when the errors are random (i.e., sometimes lower and sometimes higher than the true value), their mean will skew toward zero and thus not correlate with the true value.<sup>12</sup> In the case of the relevance estimates in RegData, the errors result from the computer's inaccurate "knowledge" about the relevance of a piece of regulatory text to an industry, which can sometimes lead to overestimates of the relevance (e.g., misreading phrases describing mortgage loans as relevant to agricultural loans) and sometimes underestimates of the relevance (e.g., misreading phrases describing inspection of eggs as not relevant to the chicken egg production industry). Therefore, the measurement errors in the relevance estimates in RegData are very likely to be random and uncorrelated with the true value. Nonetheless, random measurement errors could add more "noises" in a statistical analysis, leading to attenuation bias which reduces the likelihood of finding statistically significant results.

A desirable approach to select a sample of relevant regulations would be to survey individual firms within each industry over the U.S. to ask which regulations they need to comply with. However, this would require a vast amount of cost, time, and human resources, and could introduce different biases. As a check on the accuracy of RegData's relevance estimates, policy experts in USDA read through all the CFR parts identified by RegData in the sample and assessed whether each part is likely to affect

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<sup>11</sup> Mariana Seijo, Nicole Minckas, Gabriela Cormick, Daniel Comande, Agustin Ciapponi, and Jose M. Belizan. "Comparison of Self-reported and Directly Measured Weight and Height Among Women of Reproductive Age: a Systematic Review and Meta-analysis," *Nordic Federation of Societies of Obstetrics and Gynecology* 97 (2018): 429-439.

<sup>12</sup> Sholom Wacholder, "When Measurement Errors Correlate with Truth: Surprising Effects of Nondifferential Misclassification," *Epidemiology* 6, no. 2 (March 1995): 157-161.

crop and animal production.<sup>13</sup> This yielded a smaller sample of regulations, which we used to conduct robustness checks described in the next chapter. The econometric analysis supports the robustness of our approach. Given that human judgment can also generate errors, as there are no objective criteria for deciding whether a CFR part is applicable to an industry, we believe that relying on RegData's estimates to select the sample of agriculture-related regulations is the most defensible available approach for the purposes of our research.

### B. Coding Process

The Taxonomy of Regulatory Forms<sup>14</sup> defines the coding framework and structure we applied. We analyzed and coded CFR parts based on the most specific categories of regulatory forms in the Taxonomy (i.e., third-tier forms). A CFR part can include multiple third-tier forms because different requirements may be mentioned in various subparts. For example, 7 CFR 305 on Phytosanitary Treatments is associated with four regulatory forms: monitoring, reporting and verification (MRV), performance standards, permitting, and certification. In our approach, a CFR part could have maximum of five regulatory forms.

The coding team consisted of four coders who applied a consensus-coding approach for content analysis of the 709 CFR parts. For each part, two coders independently read and coded the regulatory text using the third-tier regulatory forms defined in the Taxonomy. The two coders then discuss the assigned codes to address discrepancies and reach an agreement. If the coders could not reach consensus, a third coder read and coded the CFR part independently, resulting in a consensus by a majority of coders.

One assumption we made in coding the regulations is that the forms of a CFR part do not change over time. That is, a CFR part with four regulatory forms in 2017 is assumed to also have four regulatory parts in 1970. When we analyzed the content of a CFR part, we referred to the version of the CFR in the latest year it existed. For example, 7 CFR 410 was published in the CFR between 1970 and 1991 and was removed in 1992, so we referred to the 1991 version of the CFR for content analysis of the part. In such cases where a CFR part was removed or relocated (i.e., the part number changed) in some year during the 1970-2017 period of our analysis, we can capture the change by combining the regulatory form with the word count of the part. However, when the content of a CFR part was amended, we assume that the regulatory forms it employs did not change. This assumes that a change in regulatory forms would usually result in substantial changes in the regulation, with a corresponding different part number. This was a necessary simplifying assumption that could be lifted if machine-learning tools were used to code the parts in all annual versions of CFR.

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<sup>13</sup> The USDA experts also identified some likely missing regulations that were not identified by RegData. However, these regulations were not included in our analysis for the sake of methodological consistency, because they were not a result of a systematic review of all regulations outside the sample. .

<sup>14</sup> See Chapter 2 of this report.



To assess consistency among coders, we used Cohen's kappa measure to assess inter-rater reliability. The agreement rate between the first two independent coders is 79.58 percent with a Kappa score of 0.60. As per the accepted scale,<sup>15</sup> the level of agreement for the first round of coding is moderate. The reliability improved as the two independent coders discussed the disagreements to reach consensus on final classifications.

Throughout the coding process, the team followed multiple steps to ensure reliability in qualitative coding. First, in the beginning of the process, the team, along with a former regulatory practitioner with deep knowledge of regulatory forms, separately coded a small, randomly selected subset of CFR parts as part of testing and training. The team discussed the issues emerging from the training to reach a consistent understanding of coding principles before starting to code our entire sample. Second, the team developed a codebook to further reduce arbitrariness in assigning codes. This codebook is attached as Appendix C to this chapter. We updated the codebook regularly to record the decision process and include examples on coding regulations with multiple interpretations. It specifies criteria to differentiate between similar regulatory forms such as permitting and licensing, and means-based and performance-based standards. These steps ensure that the qualitative coding is reliable and replicable.

### III. Descriptive Analysis

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Classifying regulations by form provides an understanding of the patterns and trends in regulatory actions adopted by different agencies over time. This section presents a summary of regulatory forms based on cross-sectional and longitudinal analyses. Cross-sectional analysis presents the prevalence of different regulatory forms in the sample of CFR parts and compares the prevalence across selected agencies. Longitudinal analysis shows changes in the forms of sample regulations from 1970 through 2017.<sup>16</sup>

#### A. Cross-sectional Analysis

##### 1. Overall Prevalence of Forms

The 709 CFR parts were classified by third-tier regulatory form; on average, a CFR part in our sample takes 1.6 regulatory forms. The majority of the CFR parts (432 parts, 61 percent) rely on only one form, and only one percent of the parts (7 parts) involve five forms. Figure 1 presents the ten most prevalent regulatory forms, both at the second and third tier, in the sample.<sup>17</sup> Command-and-control regulation is the most prevalent second-tier form in the sample regulations affecting crop and animal production, followed by transfer and administrative regulations. Command-and-control regulation

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<sup>15</sup> Mary L. McHugh, "Interrater Reliability: The Kappa Statistic," *BioChem Med* 22, no. 3 (2012): 276-282

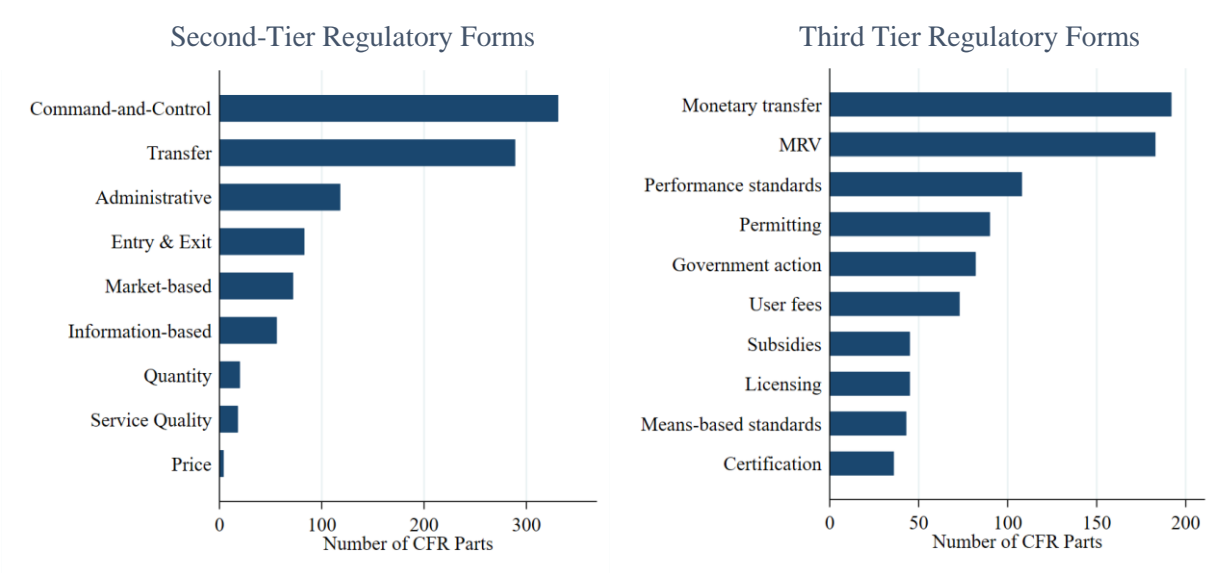
<sup>16</sup> As mentioned above, the forms of a CFR part only refer to the forms in the latest version of the part. Accordingly, the over-time trends only show changes in these forms.

<sup>17</sup> A complete list of regulatory forms is presented in Appendix B.

mostly takes the form of MRV, performance standards, and permitting at the third tier. Transfer is mostly attributable to monetary transfer, which takes first place among the third-tier forms.

Given the focus on agriculture, it is reasonable to find monetary transfer as the most prevalent form of regulation; it appears in nearly 200 CFR parts. Monetary transfer is defined as regulations requiring the government to offer financial support to certain entities such as farmers and ranchers. Examples include the Sugar Beet Disaster Program (7 CFR 1481) and Combined Crop Insurance (7 CFR 426). MRV requirements are the second most dominant regulatory form, appearing in 182 CFR parts. It is noteworthy that MRV is so prevalent partially because it is often a secondary form associated with other regulatory forms in a CFR part. For example, the Federal Seed Act regulations (7 CFR 201) mandate that entities maintain a complete record of the origin of seeds in addition to labeling and certification requirements.

Figure 1: The Most Prevalent Regulatory Forms



2. Cross-agency Comparison

Table 2 presents a list of the top five departments and agencies issuing regulations in the sample. Out of 709 CFR parts, nearly half of the parts are from USDA, followed by the Department of the Interior (DOI), Department of Health and Human Services (HHS), EPA, and the Department of Housing and Urban Development. Regulations associated with DOI mostly fall within the Bureau of Indian Affairs, the Bureau of Land Management, the Fish and Wildlife Service, and the Office of Surface Mining Reclamation and Enforcement. HHS is among the top five departments because FDA promulgates a substantial number of agriculture-related regulations.

USDA agencies issue most of the regulations in our sample. As presented in Table 2, the Agricultural Marketing Service (AMS), Federal Crop Insurance Corporation (FCIC), Commodity Credit Corporation (CCC), Animal and Plant Health Inspection Service (APHIS), and Farm Service Agency (FSA) have the largest number of CFR parts.



Table 2: Top Five Departments and Agencies Issuing Regulations in the Sample

Department	Number of CFR Parts	Agency	Number of CFR Parts
Department of Agriculture	337	Agricultural Marketing Service, USDA	65
Department of the Interior	106	Federal Crop Insurance Corporation, USDA	56
Department of Health and Human Services	48	Commodity Credit Corporation, USDA	47
Environmental Protection Agency	44	Animal and Plant Health Inspection Service, USDA	43
Department of Housing and Urban Development	34	Farm Service Agency, USDA	35

We also compare the regulatory forms most commonly used by USDA, EPA, and FDA in the dataset RegData identified, given their significance in regulating the agriculture sector. The three agencies use different forms of regulations, but command-and-control and entry-and-exit regulations are dominant across all three entities (Figures 2-4). Notably, transfer is the most prevalent regulatory form in USDA regulations but not in those of EPA or FDA, while information-based regulation is prevalent in regulations of both EPA and FDA but not in USDA.

Figure 2: The Most Prevalent USDA Regulatory Forms

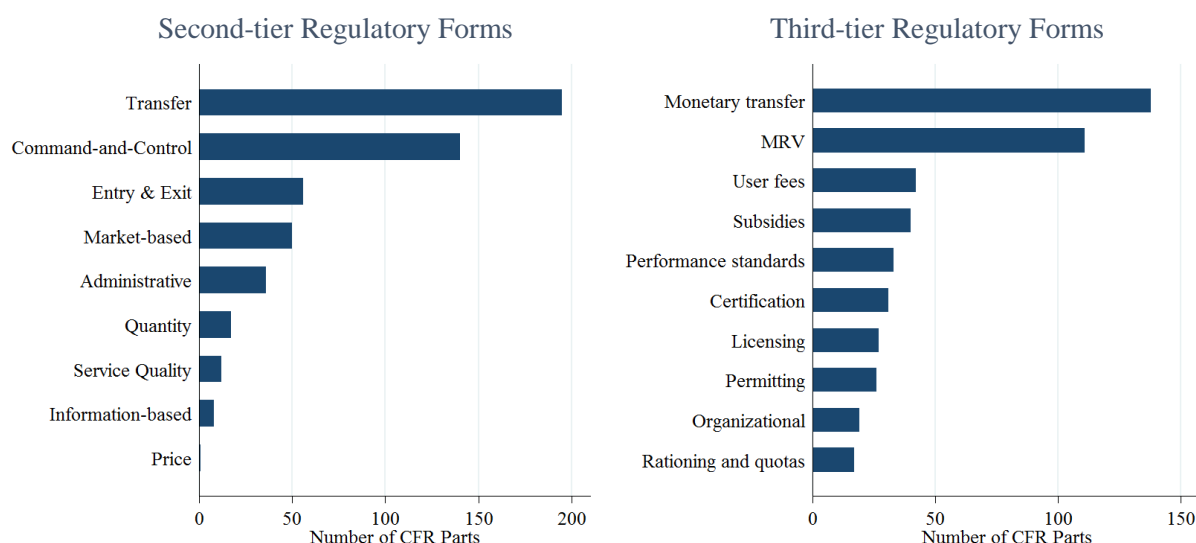


Figure 2 shows that USDA adopts diverse forms of regulation. Transfer, primarily monetary transfer, is the most prevalent form in the set of USDA regulations identified. User fees also contribute to the dominant place of transfers in USDA regulations, covering a large number of AMS regulations that authorize boards and committees for each commodity that provide research and promotion services in exchange for annual assessments from relevant handlers. Command-and-control regulation is a major form in USDA regulations because of prevalent MRV requirements in agricultural activities such as recordkeeping for pesticide use. In addition, subsidy is also a relatively prevalent form, as USDA issues regulations authorizing various subsidy programs for conservation practices. Unlike the overall

regulation trend (Figure 1), performance standards are not among the top three forms in USDA regulations.

Figure 3: The Most Prevalent EPA Regulatory Forms

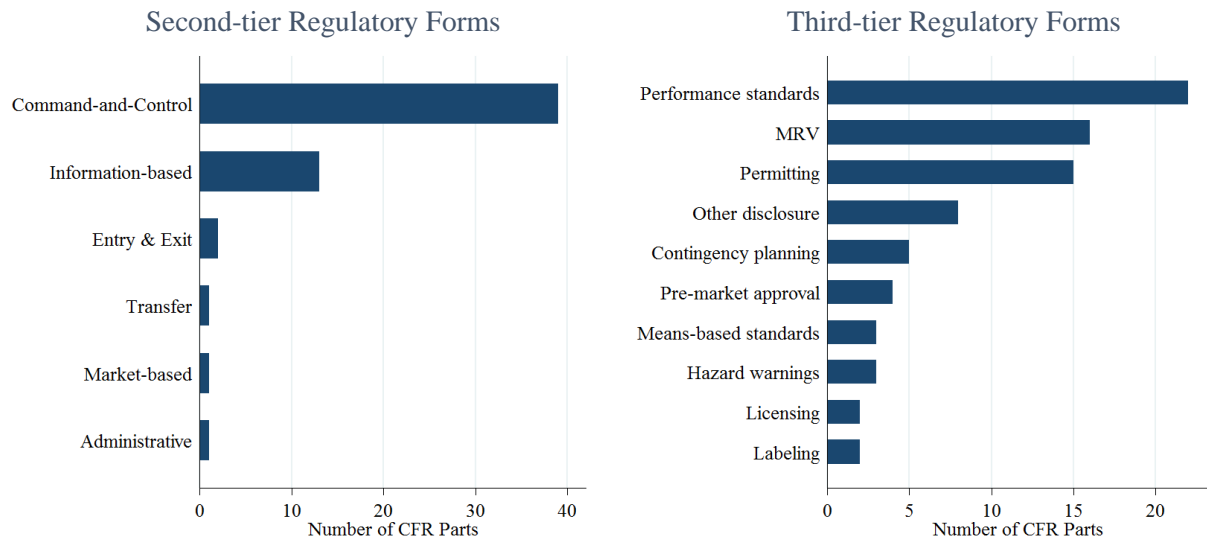
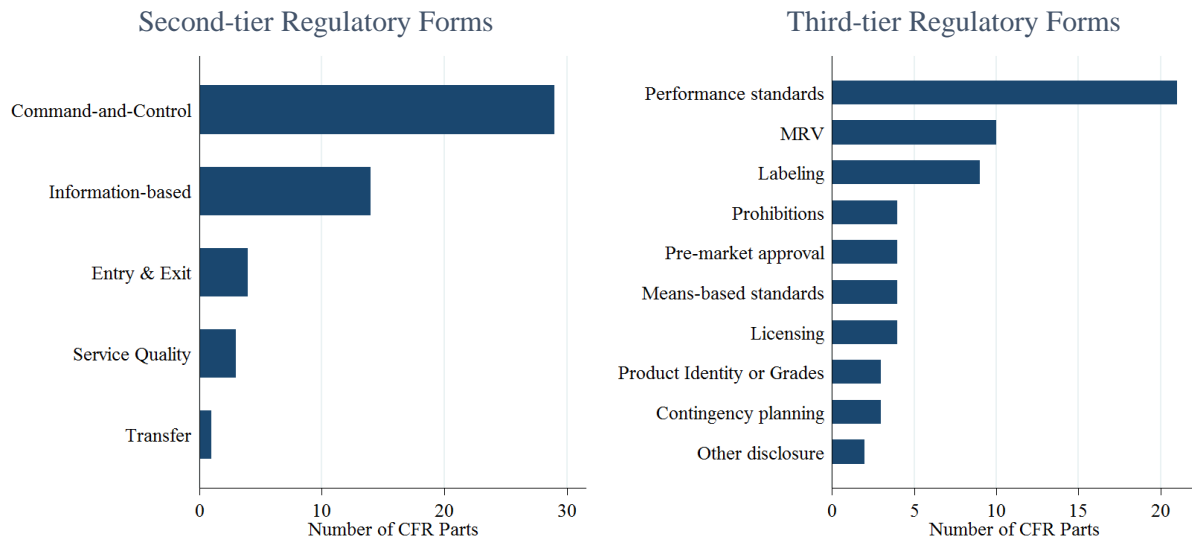


Figure 4: The Most Prevalent FDA Regulatory Forms



The primary forms in EPA regulations are command-and-control and information-based regulations (Figure 3). In particular, performance standards are the most common regulatory form, and labeling is the least. This is not surprising given that EPA’s agricultural regulations focus on setting standards for pesticide use, hazardous substances, and toxic pollutants. Permitting requirements are also common in EPA regulations, including National Pollutant Discharge Elimination System (NPDES), and Experimental Use Permits. MRV requirements often accompany these performance standards and permitting requirements.

Similar to EPA, FDA relies heavily on command-and-control and information-based regulations (Figure 4). It issues a large number of performance standards, mostly related to the use of food

additives, harvesting and packing produce, and residues of new animal drugs in food. MRV and labeling requirements also appear in the regulations related to the same issues.

The above analysis presents a summary of regulatory forms in the 709 sample CFR parts. However, some CFR parts were removed, amended, or added during the 1970-2017 period. A cross-sectional analysis does not capture these changes over time. Therefore, a longitudinal analysis is necessary to see how these regulatory forms evolved during the past few decades.

### B. Longitudinal Analysis

We combine the data on regulatory forms with total word counts in RegData 3.1 for longitudinal analysis. Specifically, we sum up the total word counts of all the CFR parts in our sample that take a regulatory form in a given year to measure the quantity of regulation of that form in that year, assuming that the forms taken by a regulation remain unchanged over time. We use the total word count as a measure rather than the number of CFR parts because word count can capture, to some extent, substantial amendments to the content of a CFR part. For example, if a CFR part was amended in a year, leading to a reduction of 500 words from 1,000 words, the word count can reflect the change but counting the number of CFR parts would not. Also, we use the total word count rather than the restrictive word count because the form of regulation may have a correlation with the use of restrictive words. For example, a market-based regulation is likely to have less restrictive words than a command-and-control regulation, so counting restrictive words associated with these two forms may systematically bias the comparison. In this section, we first examine the time trend of total regulation in the sample, and then compare the trends of different regulatory forms at first, second, and third tier.

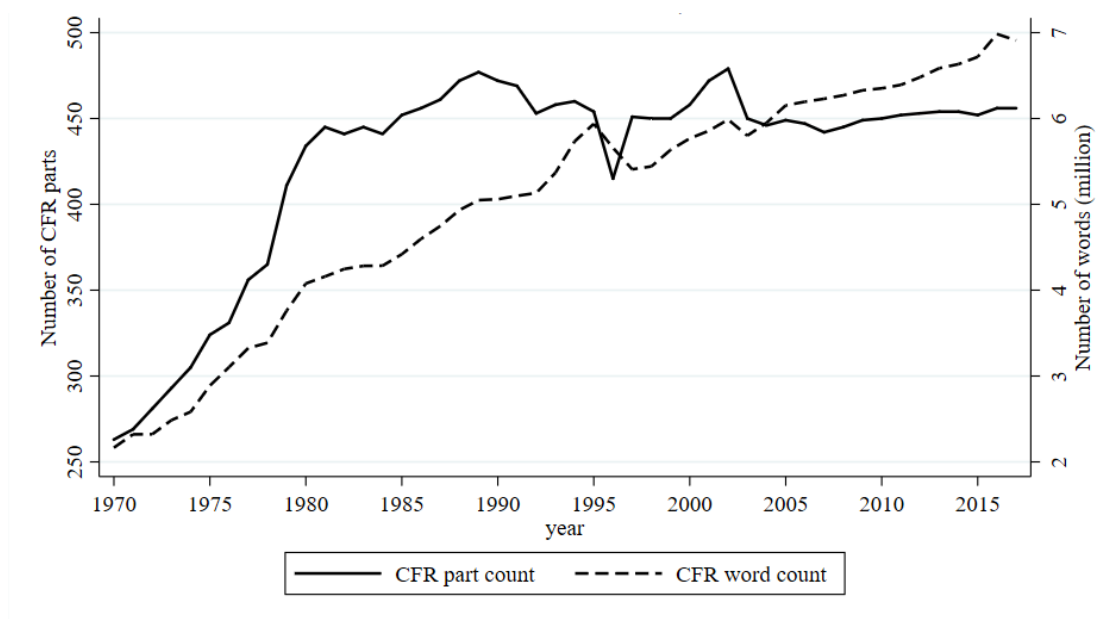
#### 1. Total regulation

Figure 5 shows the changes in the number of CFR parts and associated word counts during the 1970-2017 period. Only 263 of the 709 CFR parts existed in 1970; the number increased to 456 in 2017. Accordingly, the number of words increased from 2 million to 7 million. Although the number of CFR parts has not increased substantially since 1990, the word count has continued increasing over time. The number of CFR parts and words appear to decrease sharply in 1996, however, as mentioned above, we speculate that it reflects an error in the data source rather than an actual change in regulation, because the source of regulatory text in RegData changes from hard copies to digitalized editions for 1996 CFR and onward, whereas the digitized edition of the 1996 CFR is missing certain titles and parts.<sup>18</sup> In general, the time trend of all the sample regulations suggests that regulations affecting crop and animal production increased substantially over the 1970-2017 period.

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<sup>18</sup> U.S. Government Publishing Office. “Code of Federal Regulations (Annual Edition).” Govinfo, accessed December 21, 2018. <https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR>.

Figure 5: Overall Trend of Relevant Regulations



## 2. First-tier forms

In our analysis of first-tier forms, we compared economic, social, transfer, and administrative regulations. Given the overall increasing trend in the quantity of total regulation, the absolute quantity of each regulatory form also increased during the 1970-2017 period. To compare the trends between regulatory forms, we examine the change in the proportion of the word count associated with a regulatory form in the total word count of all the sample CFR parts, which indicates an increase or decrease in the relative reliance on the form in the regulations relevant to crop and animal production. When a CFR part has multiple forms, we attribute all the words in the part to each form it takes. Therefore, the percentages of all forms in a given year always exceed 100.

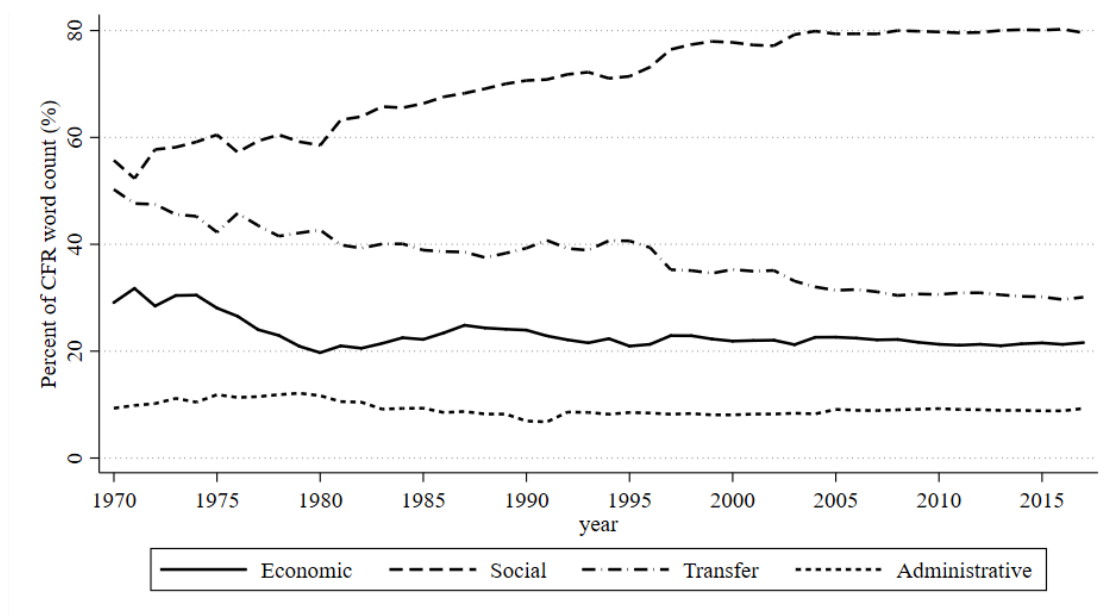
As shown in Figure 6, social regulations have accounted for a larger percentage of the total in recent years. The percentage of word counts related to social regulations increased by more than 24 percentage points between 1970 and 2017, whereas the percentage of word counts associated with economic regulations decreased by 8 percentage points in the same period. The word count related to transfer regulations decreased from 50 percent to 30 percent, while administrative regulations remained mostly constant during the time.

The trend is consistent with the overall regulatory development in recent U.S. history. Social regulations addressing issues related to public health, safety and the environment have increased, whereas economic regulations directly controlling price, quantities, or quality have decreased in many markets.<sup>19</sup> Further, the substantial decrease in transfer regulations cannot be separated from the

<sup>19</sup> Susan E. Dudley and Melinda Warren, “FY 2019 Regulators’ Budget: More for Homeland Security, Less for Environmental Regulation,” The George Washington University Regulatory Studies Center, May 2018, accessed

movement in agricultural policies. Transfer regulations mostly referred to USDA price and income support programs, which had been at the core of agricultural policy in the U.S. since 1933.<sup>20</sup> After the passage of the Food and Agricultural Act of 1965, agricultural policy started to move toward a more market-oriented direction, represented by reduced price supports, introduction of target prices and deficiency payments, and decoupled income supports.<sup>21</sup>

Figure 6: Economic, Social, Transfer, and Administrative Regulations



### 3. Second-tier forms

In our analysis of second-tier forms, we compare regulatory forms nested within economic and social regulations. This reveals the variation within the first-tier forms. Second-tier analysis only applies to economic and social regulations because transfer and administrative regulations have only one category at the second tier.

#### *Price, Quantity, and Entry-and-Exit Regulations*

As shown in Figure 7, entry-and-exit regulation is the primary form of economic regulation applied to crop and animal production. Approximately 15 percent of the sample CFR parts included an attempt to manage market entry and exit in 1970, and the proportion increased to nearly 20 percent during the time period. Regulations controlling quantities of goods related to crop and animal production existed in more than 10 percent of the sample regulations in 1970, but the proportion has decreased since

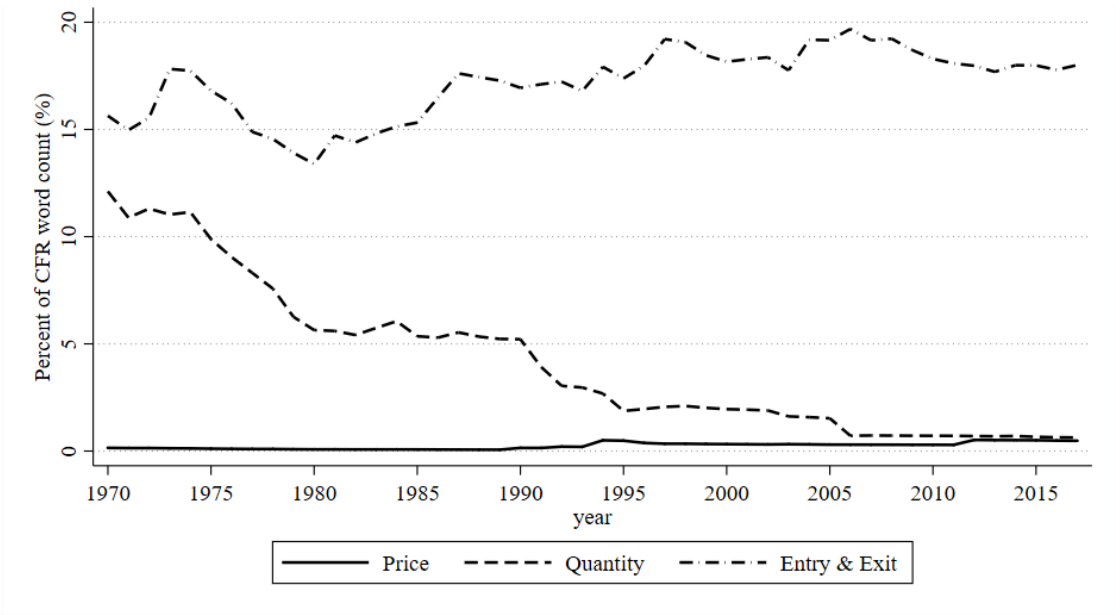
December 21, 2018, <https://regulatorystudies.columbian.gwu.edu/fy-2019-regulators-budget-more-homeland-security-less-environmental-regulation>

<sup>20</sup> Carolyn Dimitri, Anne Effland, and Neilson Conklin, "The 20th Century Transformation of U.S. Agriculture and Farm Policy," *Economic Information Bulletin* (June 2005), accessed December 21, 2018, <https://ageconsearch.umn.edu/bitstream/59390/2/eib3.pdf>.

<sup>21</sup> *Ibid.*

then—reaching a level close to zero in 2017 due to removal of the regulations controlling quantities of goods related to crop and animal production from our sample. Price regulation was not a primary form of economic regulation at any time during 1970-2017.

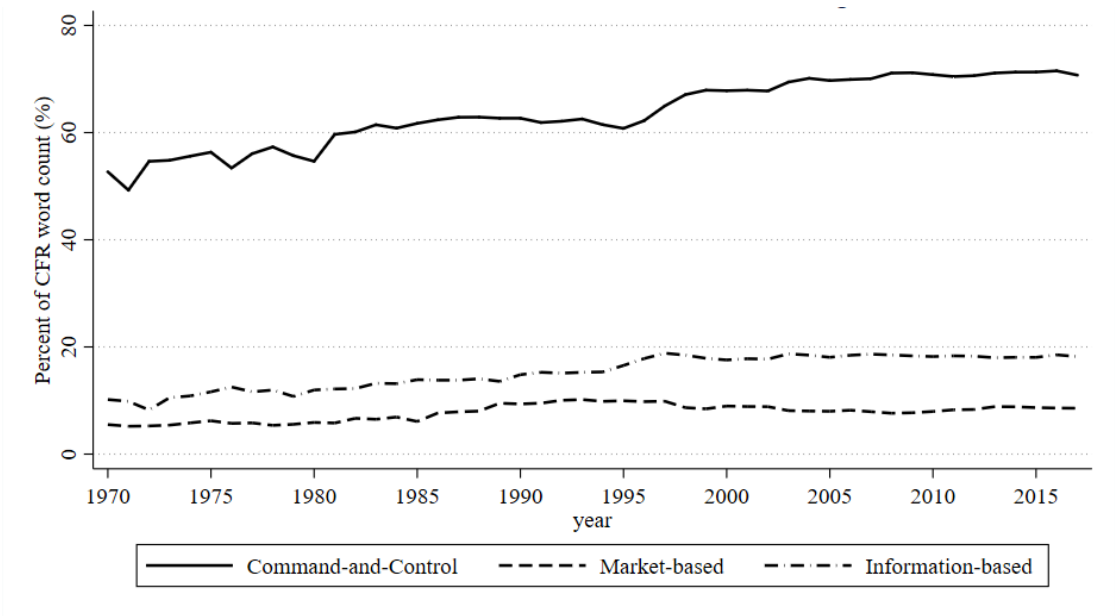
Figure 7: Price, Quantity, and Entry-and-Exit Regulations



*Command-and-Control, Market-based & Information-based Regulations*

Given that social regulation is the most prominent form of regulation, we analyze specific trends to identify variation between command-and-control, market-based, and information-based regulations.

Figure 8: Command-and-Control, Market-based, and Information-based Regulations





All the three forms of regulation reflect a slightly increasing trend (Figure 8). Command-and-control regulation is the primary form of social regulation and also the most prevalent form among all the sample CFR parts. The proportion of word counts associated with command-and-control regulation in all sample parts increased by 18 percentage points between 1970 and 2017. The proportion of information-based regulation increased by 8 percentage-points, and market-based regulation slightly increased by 3 percentage-points. Compared to the forms of economic regulation, all forms of social regulation experienced a more smooth and consistent trend.

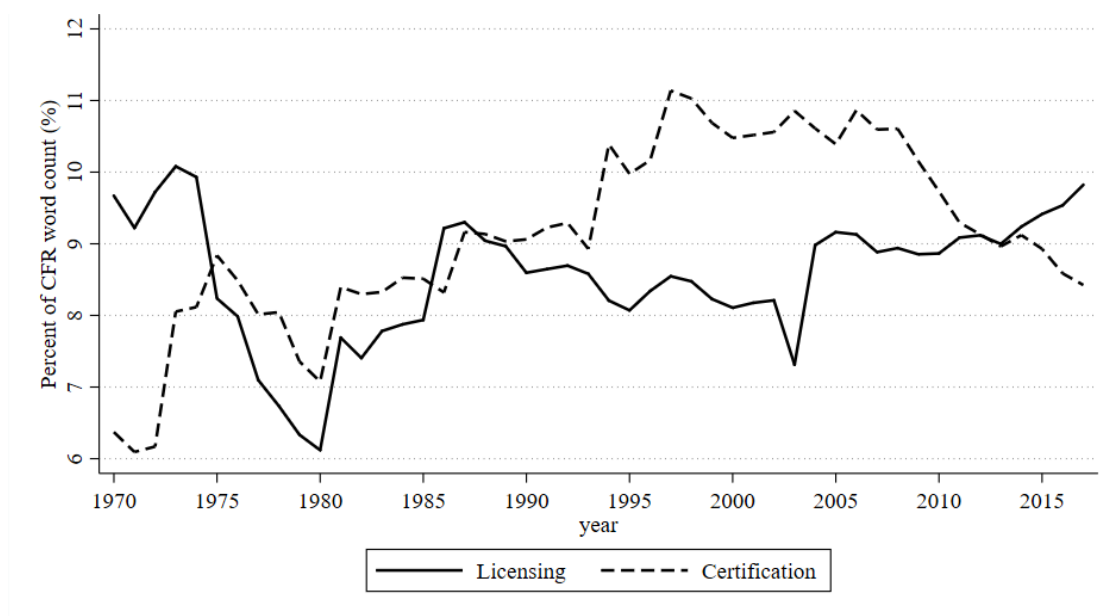
#### 4. Third-tier forms

In our analysis of third-tier forms, we compare the trends between similar regulatory forms. The most comparable regulatory forms include licensing and certification, performance and means-based standards, permitting and prohibition, and subsidies and monetary transfer. We also analyze changes in MRV requirements given its overall prevalence in the sample regulations, as well as voluntary regulations.

##### *Licensing & Certification*

Licensing and certification are two regulatory forms of entry-and-exit regulation. They are both prevalent forms in the sample regulations as shown in Figure 1. The two forms have some similarities in that they both require government approval of certain operations. Licensing requires an individual or a facility to be approved to practice a profession or operate a business, while certification requires products to be routinely approved to enter a market or transported. As shown in Figure 9, the percentage of word counts associated with the two forms fluctuated between 6 and 12 percent during the time period.

Figure 9: Licensing and Certification



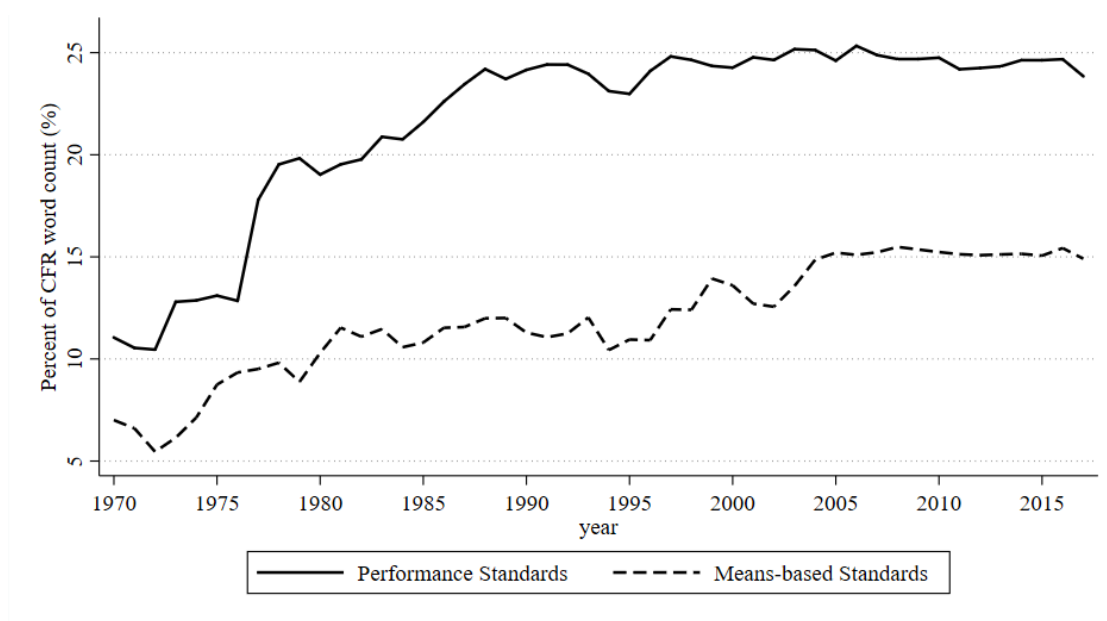
### *Performance & Means-based Standards*

Performance and means-based standards both presented an increasing trend over 1970-2017 in terms of the percentage of word counts in all sample CFR parts (Figure 10). Performance and means-based standards are different in terms of the discretionary powers given to regulated entities. Performance standards define the required outcomes without prescribing the means to achieve them, whereas means-based standards require regulated entities to follow specific procedures, methods or practices.

Performance standards increased from 11 percent to 24 percent from 1970 to 2017, and most of the increase occurred between 1970 and 1988. The biggest jumps occurred in 1973 and 1977, where word counts increased by 22 percent and 38 percent respectively compared to a previous year. Means-based standards increased from 7 percent to 15 percent at a relatively constant growth rate from 1970 to 2017.

In general, performance standards have consistently been a more prevalent form than means-based standards in regulating animal and crop production. The gap between the two was relatively small between 1970 and 1976 and started to expand following the substantial increase in performance standards in 1977. This gap continued to expand until 1996, and it started to close after that. Still, agencies rely more on performance standards than means-based standards in agricultural regulations today.

Figure 10: Performance and Means-based Standards

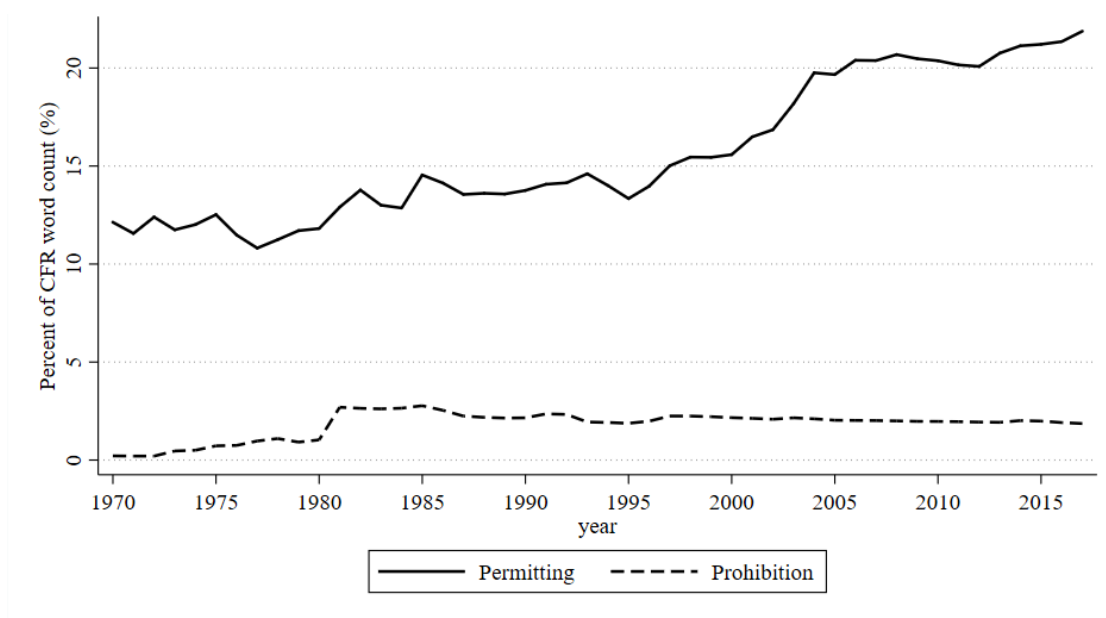


### *Prohibition & Permitting*

Permitting has been more common than prohibition (Figure 11). For permitting, the percentage of word counts increased considerably, reflecting a change from 12 percent to 22 percent between 1970 and 2017. The percentage of word counts related to prohibition remained mostly constant, except the

sudden increase in 1981 due to addition of two CFR parts in that year: 7 CFR 800, general regulations related to grain inspections, and 50 CFR 36, Alaska national wildlife refuges.

Figure 11: Permitting and Prohibition

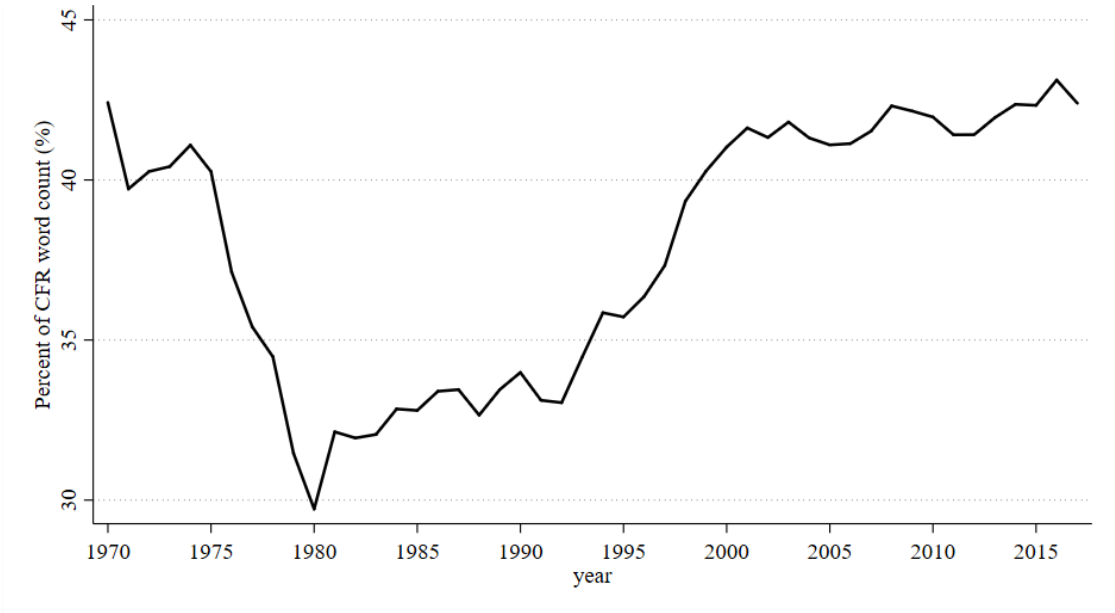


### Monitoring Verification and Reporting

MRV is one of the most common regulatory forms in our sample. As shown in Figure 12, around 30-40 percent of the sample regulations include an MRV requirement. The percentage of word counts related to MRV requirements experienced dramatic decreases and increases between 1970 and 2017. From 1970 to 1980, the percentage decreased from 42 percent to 30 percent.<sup>22</sup> After that, it started to increase slowly. In 2001, it regained its 1980 level and remained mostly constant since then.

<sup>22</sup> Note that it does not mean the amount of regulation containing MRV requirements decreased substantially during 1970-1980. The fact that we use the percentage of word count as a measure suggests the trend in the relative reliance on each form in the regulations relevant to crop and animal production, rather than the absolute level of regulation containing each form. In fact, the total word count in the regulations related to MRV requirements increased constantly over the period of 1970-2017. The percentage decreased between 1970 and 1980 mainly because the regulations not containing MRV requirements increased rapidly in terms of total word count during that period.

Figure 12: Monitoring, Reporting and Verification Requirements

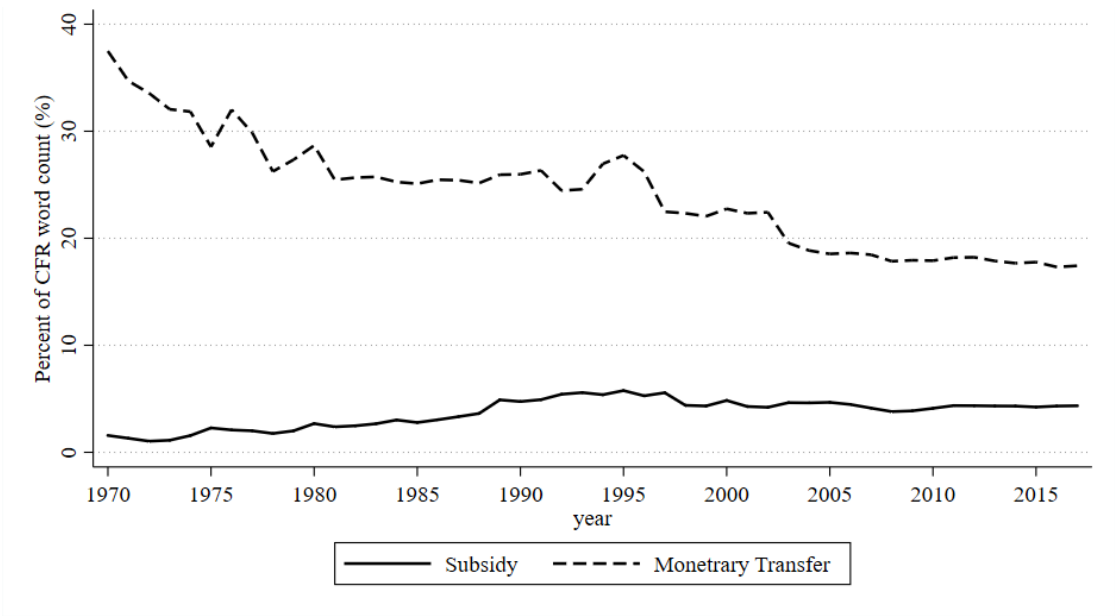


*Subsidies & Monetary Transfer*

In our Taxonomy, monetary transfers and subsidies are similar in the sense that regulated entities receive financial support from the government. However, subsidies are intended to incentivize certain behavior such as environmental conservation, while monetary transfers target a specific public need, such as disaster assistance for crop.

As shown in Figure 13, monetary transfer decreased continuously over the 1970-2017 time period, which is consistent with the overall trend of transfer regulation. The percentage of subsidies increased slightly from 1.6 percent to 4.4 percent.

Figure 13: Subsidies and Monetary Transfer

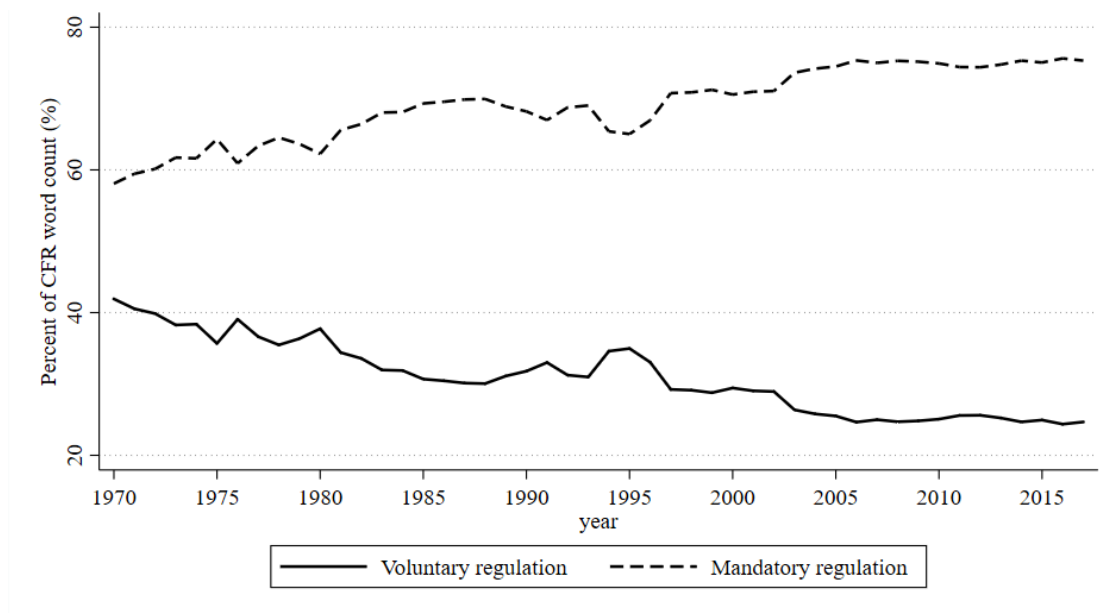


## 5. Voluntary Regulation

In addition to classifying each sample CFR part by the regulatory forms it takes, we also assessed whether the regulatory requirements included in the CFR part were voluntary or mandatory. For example, a part describing USDA's conservation programs can be considered voluntary because farmers have the freedom to choose whether to participate in these programs, although a strong incentive to participate may exist for some voluntary programs given the substantial co-benefit participation would bring.<sup>23</sup> On the other hand, a part describing pesticide tolerances is mandatory because compliance with tolerances is required for all relevant entities and noncompliance would lead to penalties.

Among the 709 sample CFR parts, nearly 65 percent (455 parts) contain mandatory regulatory requirements, and 35 percent (254 parts) include voluntary requirements. Incorporating the temporal changes in the corresponding parts, we see that the proportion of word counts associated with voluntary regulation decreased over the 1970-2017 period (Figure 14). This is mostly due to the shift in regulatory focus from transfer regulations to other regulatory forms in agricultural regulation as discussed above.

Figure 14: Voluntary and Mandatory Regulations



<sup>23</sup> Given the fact that U.S. farmers are highly dependent on the government's income and price support, the material incentives provided by certain "voluntary" programs, such as maintaining eligibility to receive income support payments or cost share programs for land improvements, are so strong that farmers are unlikely to opt out in order to maintain their business.

## IV. Conclusion

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In this chapter we discuss our approach for applying the Taxonomy of Regulatory Forms to regulations affecting crop and animal production. We analyze the text of a sample of relevant regulations to create a dataset that classifies each regulation according to the forms it takes. We then combine the dataset with the quantitative measure of regulation (i.e., total word count) in RegData to explore the cross-sectional and longitudinal trends in the prevalence of and reliance on each form of regulation.

The cross-sectional analysis indicates that command-and-control and transfer regulations are the most common second-tier regulatory forms. The prevalence of third-tier regulatory forms differs across agencies. Monetary transfer is the top regulatory form in USDA regulations, while performance standards are more prevalent in EPA and FDA regulations. However, MRV, a third-tier form classified under command-and-control regulation, is the dominant regulatory form of all three agencies' regulations.

We also conduct a longitudinal analysis to present the changes in reliance on each regulatory form, as measured by the percentage of words associated with a form in all sample regulations, across the three relevant agencies between 1970 and 2017. Trends in regulatory forms are consistent with the overall regulatory trends in the U.S., namely, an increasing emphasis on social regulation relative to economic regulation.<sup>24</sup> Specifically, we observe that the percentage of word count associated with social regulation increased, but there is a decline in the percentage of word count associated with economic and transfer regulations. Within social regulation, the largest increasing trend was in the reliance on command-and-control regulation, followed by information-based regulation. Further, we examine price, quantity, and entry-and-exit regulations to understand trends within economic regulation: only regulations related to quantities of goods experienced a substantial decrease. Lastly, we look at the third-tier regulatory forms to identify changes at a more specific level. We observe that the percentage of words associated with performance standards, means-based standards, permitting, and MRV regulations increased over time, while monetary transfer became a less common form during the 1970-2017 period.

Overall, the analysis provides an overview of the forms of agriculture-related regulations. In the next chapter we use the dataset to understand the association between crop productivity and different forms of regulation.

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<sup>24</sup> Dudley and Warren 2018.



## Appendix A: Relevant Crop and Animal Industries

3-Digit NAICS	NAICS Title	4-Digit NAICS	NAICS Title
111	Crop Production	1111	Oilseed and Grain Farming
		1112	Vegetable and Melon Farming
		1113	Fruit and Tree Nut Farming
		1114	Greenhouse, Nursery, and Floriculture Production
		1119	Other Crop Farming
112	Animal Production	1121	Cattle Ranching and Farming
		1122	Hog and Pig Farming
		1123	Poultry and Egg Production
		1124	Sheep and Goat Farming
		1129	Other Animal Production
115	Support Activities for Agriculture and Forestry	1151	Support Activities for Crop Production
		1152	Support Activities for Animal Production

## Appendix B: Frequency of Third-tier Forms of Regulations in Sample CFR Parts

Seq.	Form of Regulation	Frequency
1	Monetary transfer	192
2	Monitoring, reporting and verification	183
3	Performance standards	108
4	Permitting	90
5	Government action	82
6	User fees	73
7	Licensing	45
8	Subsidies	45
9	Means-based standards	43
10	Certification	36
11	Organizational	29
12	Bonds	26
13	Labeling	22
14	Knowledge transfer	20
15	Other disclosure	20
16	Rationing and quotas	18
17	Product Identity or Grades	17
18	Contingency planning	15
19	Prohibitions	15
20	Technology transfer	15
21	Definitions	9
22	Pre-market/pre-manufacture approval	9
23	Hazard warnings	6
24	Exemption	4
25	Pre-market notice	4
26	Antitrust	2
27	Benchmarking (or yardstick regulation)	2
28	Certificate of need	1
29	Marketable permits	1
30	Obligation to serve	1
31	Portfolio standards	1
32	Price ceiling/floor	1
33	Quality levels	1
34	Rate of return	1
35	Revenue cap	1
36	Rivalrous/exclusive permits	1
37	Taxes and fees	1

## Appendix C: Coding Q&A

*This appendix is part of the Codebook to record the important decision-making processes we used to code certain regulatory forms. This is to ensure the duplicability of the coding process.*

**Q1.** Almost all CFR parts include relevant definitions and government responsibilities, should we include the *Definitions* and *Government Action* forms in those CFR parts?

Examples: 7 CFR 7; 7 CFR 8

Answer: No. That is not what we intend to capture in the *Definitions* and *Government Action* forms. The three administrative forms (*Definitions*, *Government Action*, and *Organizational*) are to identify the CFR parts that do not create any direct burden for the public. In other words, we classify a CFR part as an administrative form if the part describes definitions, government actions, or organizational structures only, without mentioning any requirements for regulated entities.

**Q2.** If a CFR part does not describe any specific regulatory requirements but refers to another part (e.g. “this part adopts regulations/standards in [another CFR part]”), should we classify this part as the forms in the referred CFR?

Examples: 2 CFR 3000 adopts the OMB guidance in 2 CFR 180. The 2 CFR 3000 does not describe any specific requirements, but includes a brief introduction and multiple references to 2 CFR 180.

Answer: Yes. For instance, in the above example, we also refer to 2 CFR 180 to classify the part. However, this does not mean that we always read through the referred/linked CFR part(s). Many CFR parts contain references to other CFR parts. We decide on a case-by-case basis whether the requirements described in the referred part comprise a major regulatory form in this part.

**Q3.** Monitoring, reporting and verification (MRV) requirements are included in many regulations, should we always consider it as a regulatory form?

Examples: 6 CFR 27; 7 CFR 30; 7 CFR 46; 40 CFR 127

Answer: MRV requirements are generally used as a means of enforcement of other forms of regulation. We have reached a consensus to include the form *MRV* as long as the CFR part has specific language on MRV requirements. However, we try to capture the major forms of the regulation in addition to MRV requirements. We expect that *MRV* will often be accompanied by at least another regulatory form, which could be permitting, subsidies, etc.

**Q4.** How should we classify CFR parts describing administrative regulations, application procedures, appeal procedures, rules of practice, etc.?

Examples: 7 CFR 11; 7 CFR 202; 7 CFR 279; 7 CFR 614

Answer: Although these provisions are sometimes included in the same part as specific regulatory requirements or program details, they are in many cases listed in separate parts. To ensure consistency, we always refer to the specific regulations/programs for classification of these parts. The rationale is that, without the corresponding regulations/programs, applicants/participants/other regulated entities would not have to comply with the procedures described in these parts. For

example, if there is a CFR part that describes the appeals process for government decisions regarding eligibility for a subsidy program, we code as *Subsidies*—not as *Government Action*.

**Q5.** Do we classify regulatory requirements for agencies or government officials described in a CFR part?

Examples: 9 CFR 557 includes MRV requirements for program inspectors, not regulated entities; 50 CFR 36 includes information disclosure requirement for the agency, not regulated entities.

Answer: No. In general, a regulation always includes government responsibilities. Since our analysis is to examine the regulatory impacts on regulated industries, we do not focus on regulatory requirements for agencies or government officials. As mentioned in Q1, *Government Action* is used only if a CFR part describes government responsibilities only and does not create direct requirements for regulated entities.

**Q6.** What is the difference between *Licensing*, *Certification*, and *Permitting*?

Examples: *Licensing*: EPA licensing for pesticide applicators; *Certification*: 7 CFR 57, Inspection of Eggs; *Permitting*: NPDES and NEPA.

Answer: *Licensing* generally applies to CFR parts detailing occupational licensing or licenses for the kinds of services a professional may provide (e.g. what treatments require a doctor).

*Certification* is used in cases where a CFR part details a recurring need for approval on a case-by-case basis before a product is allowed to be marketed (e.g. routine inspection of produce or meat).

*Permitting* is used in cases where a prior determination to prohibit something was made, but there is a process for asking the government to permit the activity (usually context specific); for example, NEPA or permit granted for interstate movement of GMOs.

**Q7.** How do we classify performance/means-based standards associated with *Licensing* or *Permitting*?

Examples: 50 CFR 36; 50 CFR 622

Answer: When performance or means-based standards are listed as conditions for obtaining a permit or criteria for determining program eligibility, we do not classify them separately as a major form. However, if the CFR part specifies certain performance/means-based standards for licensed operators or permitted operations, we classify the forms separately (i.e., *Performance Standards* or *Means-based Standards*).

**Q8.** How do we classify regulations that define commodity standards and grades?

Examples: 7 CFR 28; 7 CFR 30; 7 CFR 52; 7 CFR 54

Answer: Regulations related to commodity standards and grades are classified as *Product Identity or Grades*.

**Q9.** What is the form of regulation for crop insurance programs?

Examples: 7 CFR 400; 7 CFR 402; 7 CFR 407; 7 CFR 457

Answer: Typically, crop insurance programs are classified as *Monetary Transfer*. Such programs are also often voluntary.

**Q10.** There are several farm loan programs and financial guarantees. How do we classify such regulations?

Examples: 7 CFR 761, 762, 763, 764

Answer: Disaster loans or any other types of loans for income support are classified as *Monetary Transfer*. However, if a loan program is intended to support conservation practices, it is classified as *Subsidies*. A CFR part may be classified as both *Monetary Transfer* and *Subsidies* based on the specific programs included in the regulation.

**Q11.** How do we classify cooperative agreements?

Examples: 7 CFR 550

Answer: Cooperative agreements are classified as *Technology Transfer*.

**Q12.** Some regulations establish commodity research and promotion boards (e.g., National Peanut Board) for various commodities. What are the criteria for classifying the form of regulation?

Example: 7 CFR 1216

Answer: We classify regulations related to commodity research and promotion boards as *User Fees* if the boards primarily collect “assessments” from domestic producers in exchange for promotion and research services. However, if the CFR part includes requirements that go beyond collecting a fee (e.g., setting marketing orders), then we classify further as appropriate according to categories specified in the taxonomy.

**Q13.** What is the difference between *Technology Transfer*, *Knowledge Transfer*, and *User Fees*?

Examples: 7 CFR 611; 7 CFR 612

Answer: If a part specifies that a fee/payment is required in exchange for agency services (either voluntary or mandatory), the part is classified as *User Fees*. If an agency is required to provide knowledge (e.g. technical information, brochures, data etc.) to the public for free, usually upon request, the part is classified as *Knowledge Transfer*. On the other hand, *Technology Transfer* tends to be performed through formal patenting and licensing.

**Q14.** If a CFR part is about grants given to states for implementing certain programs, do we classify it as a *Transfer*?

Answer: For grants provided to states and territories to implement certain programs, we identify the form(s) of the programs for which the fund is used, whenever possible. In many cases, grant funds are used as *Subsidies*, *Monetary Transfer*, or *Technology Transfer*.

**Q15.** What is the difference between *Performance Standards* and *Means-based Standards*?

Examples: 16 CFR 1500; 21 CFR 4; 21 CFR 112

Answer: If a regulation prescribes specific procedures, methods, or practices to be performed, it is classified as *Means-based Standards*; examples include CPSC’s animal testing policy (16 CFR 1500) and FDA’s standards for the growing, harvesting, packing, and holding of produce for human consumption (21 CFR 112). On the other hand, if a regulation specifies outcomes to be achieved or avoided without specifying how firms meet the outcome, then it is classified under

*Performance Standards*, even if the outcome itself was determined based on what available technology could achieve.

**Q16.** How do we classify environmental impact consideration required for agency actions (e.g. NEPA)?

Examples: 18 CFR 707; 21 CFR 25; 24 CFR 55

Answer: According to NEPA, agencies are required to consider environmental impacts in their actions (e.g. spending money or making a permitting decision). Although it looks like a requirement for the agency, it actually implies significant regulatory burden for the affected entities and their projects. So, the part is classified as the form of NEPA requirements, i.e., *Permitting*.

**Q17.** What is the form of registration requirements?

Examples: 21 CFR 207; 27 CFR 18

Answer: We typically classify registration as *MRV*.

**Q18.** Some regulations include training requirements for regulated entities. How do we assess the form of regulation for such requirements?

Examples: 30 CFR 254

Answer: If the purpose of the training requirement is to prepare for and respond to potential hazards (e.g., oil spill), we classify it as *Hazard Warning*. If the training requirement is for obtaining a license or permit, we classify it as *Licensing* or *Permitting*.