Is Regulatory Rulemaking State-Contingent? An Empirical Analysis

Lint Barrage*

PRELIMINARY AND INCOMPLETE.

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Abstract

A fundamental question in macroeconomics is how monetary and fiscal policy should be designed to respond to economic fluctuations. Recently, however, an interest has also emerged in whether and how other types of policies - such as environmental regulations - should be made contingent on economic conditions. This literature has often disagreed about the extent to which state-contingent regulations are realistically possible. Taking a positive approach, this paper thus asks: To which extent is regulatory rulemaking already state-contingent? The core analysis takes advantage of a unique feature of the U.S. aviation safety system to overcome the usual identification problem of counterfactual regulatory burdens. The main [preliminary] result is that I find evidence of state-contingent rulemaking on the extensive margin: A one-standard deviation increase in the air transport industry growth rate (+8%) increases the odds that the Federal Aviation Administration (FAA) implements a new air safety recommendation issued the following year by a factor of around 1.2, and is estimated to increase the aggregate share of safety recommendations implemented by 2-3 percentage points. In addition, I study suggestive evidence from other areas of regulation and find patterns tentatively consistent with state-contingent regulatory behavior. For example, proposed regulations appear significantly more likely to be subject to additional government scrutiny during economic downturns.

1 Introduction

One of the must fundamental questions in macroeconomics is how monetary and fiscal policy should be designed to respond to economic fluctuations. Recently, an interest has also emerged

*University of Maryland, AREC. Contect email: lbarrage@umd.edu. I thank Roberton Williams and Kieran Walsh for insightful comments, and Davide Cerruti for excellent research assistance.

in whether and how other types of policies should be made contingent on economic conditions. Much of this literature has focused on environmental regulations. Heutel (2012) solves for optimally state-contingent carbon emissions taxes and quotas in an real business cycles (RBC) model. He finds that the welfare benefits of making these policies state-contingent are close to $1 billion per year in consumption equivalent (2005 US$).[1] Other recent work on environmental regulations in an RBC framework has often focused on comparing different non-state-contingent policy instruments (see, e.g., Fischer and Springborn, 2011; Angelopoulos et al., 2010; and Dissou and Karnizova, 2012). More broadly speaking, an extensive literature in environmental economics has studied instrument choice under abatement cost uncertainty, as in the seminal paper by Weitzman (1974). A motivating assumption in much of this literature is that policy instruments are not or cannot be made state-contingent. For example, Pizer and Newell (2003) argue that "state-contingent policies [...] would be of little if any practical use."[2] Indeed, salient recent policy examples, such as the European Union's two-year struggle to adjust available permits in its Greenhouse Gas Emissions Trading Scheme to respond to the oversupply created by the 2008 economic crisis,[3] could be viewed as evidence for this argument.

This paper thus investigates the state-contingency of regulations from a *positive* and *empirical* perspective. While it is true that emissions taxes and quotas observed in practice are rarely made *explicitly* state-contingent, this paper will study whether regulators can and do adjust the overall burden of regulation along other margins in response to economic shocks.

A fundamental challenge in identifying the effects of shocks on regulatory outcomes is the construction of an appropriate counterfactual of regulations in the absence of the shock (Kahn, 2007). For example, in seeking to study the cyclicality of legislative rulemakings, both the introduction of bills into Congress and the likelihood of their passing may be endogenous to economic conditions. In order to address this issue, the main part of this paper takes advantage of the unique regulatory framework for aviation safety in the United States, where the National Transportation Safety Board's (NTSB) mandate is to issue safety recommendations without regard to their potential economic costs, whereas the Federal Aviation Administration (FAA) is charged with turning these recommendations into rule-makings based on cost-benefit considerations. As

[1] This analysis compares welfare with the optimally state-contingent emissions to a policy that simply fixes emissions at their steady-state level.

[2] There are also large bodies of research in macroeconomics, and to a lesser extent in environmental economics, about the potential costs of allowing regulators to adjust policies ex-post, rather than commiting to them ex-ante, when optimal policies are time-inconsistent. For monetary policy, see, e.g., the classic paper by Kydland and Prescott (1977). Environmental applications often concern regulators learning about firms' abatement costs or responding to endogenous investment in cleaner technology (see, e.g., Tauri and Polasky, 2005). However, it should be emphasized that the question of rules versus discretion differs from the issue of state-contingent policies, as regulations can be designed as state-contingent rules (i.e., to respond to shocks in a pre-determined way).

[3] See, e.g., Wall Street Journal press coverage of December 10, 2013. URL: [http://online.wsj.com/article/BT-CO-20131210-702282.html?dsk=y]

a result, there exists a stream of potential regulations that depends predominantly on results from the NTSB's ongoing investigations, and is thus arguably exogenous to economic conditions. The core analysis of this paper thus studies how the FAA's responses to NTSB recommendations fluctuate based on aggregate- and industry-specific conditions. The results imply that aviation regulation is partly state-contingent on the extensive margin: A one-standard deviation decrease in the real air transport industry growth rate (-8%) is estimated to decrease the fraction of NTSB recommendations that will be fully implemented by the FAA by $2-3$ percentage points.

This paper further considers broader evidence from other areas of regulation. Due to the identification challenge discussed above, this evidence is only suggestive. I nonetheless find additional tentative evidence of state-contingent rule-making, such as a positive association between the amount of regulation pertaining to agriculture and animals contained in the Code of Federal Regulations and the lagged farming industry growth rate. I also find that proposed new regulations in the United States are significantly more likely to be subject to additional government cost-benefit scrutiny during economic downturns. In sum, the findings of this paper thus provide tentative evidence that there are multiple margins along which regulators can and do - in some cases - adjust rulemakings based on the state of the economy.

1.1 Related Literature

The motivation for this paper is based to a large extent in the literature on the costs and benefits of (non)-state contingent environmental regulations discussed above (e.g., Heutel, 2012; Fischer and Springborn, 2011; Angelopoulos et al., 2010; and Dissou and Karnizova, 2012; Weitzman, 1974; Pizer and Newell, 2003; etc.). The analysis itself relates to several other areas of the literature.

First, a number of recent empirical studies have explored the effects of different kinds of shocks on legislative voting.[4] Kahn (2007) studies the impact of environmental catastrophes on U.S. congressional voting in favor of risk regulations. Tanger, Zeng, Morse, and Laband (2011) explore whether and how U.S. congressional representatives' environmental leanings (League of Conservation Voters environmental scorecards) change with macroeconomic conditions. Lopez and Ramirez (2008) explore the impacts of economic fluctuations on congressional representatives' voting patterns.[5] Lyon and Yin (2010) study states' adoption of renewable energy portfolio standards and find that higher unemployment is significantly and negatively associated with the probability of adoption this environmental policy.

[4]For positive theoretical work on the impacts of business cycles on policy, see, e.g., Barseghyan, Battaglini, and Coate (2013) on fiscal policy outcomes in a political economy model.

[5]A remarkably consistent finding across these studies is that the shocks considered have heterogeneous impacts on the behavior of Democratic and Republican politicians. In my analysis, I will thus control for political party in the Executive.

Second, there is a long-standing positive and empirical literature on levels of regulations as well as regulatory agency behavior (see, e.g., Mulligan and Shleifer, 2005; Cropper, Evans, Berardi, Ducla-Soares, and Portney, 1992; Ando, 1999; Weingast and Moran, 1983; Magat, Krupnick, and Harrington, 1986; Thomas, 1988, etc.). For example, and very closely related, Cropper, Evans, Berardi, Ducla-Soares, and Portney (1992) study determinants of the U.S. Environmental Protection Agency's decisions to either cancel or renew permissions for the usage of carcinogenic pesticides, based on factors such as interest group commentaries and estimated costs and benefits. However, they do not focus on the impacts of economic fluctuations on these cancellation decisions. To the best of my knowledge, among these studies, economic determinants of Federal Aviation Administration rulemakings„ and in particular with regards to responses to NTSB recommendations, has moreover not been previously considered.

Third, in focusing on aviation safety, this study thus also relates to the broader literature on the air transport industry and airline safety. For example, Borenstein and Zimmerman (1988) study market incentives for safety and find that airline crashes lead to small but significant decreases in equity values, and no discernible impact on passenger demand. Rose (1990) finds that reduced airline profitability (operating margins) is associated with significantly increased probabilities of incidents and accidents. For a review of these topics, see also Rose (1992). These studies have generally focused on determinants of safety at the airline level. In contrast, this paper considers endogenous incentives for and resulting fluctuations in government intervention in aviation safety.

2 Background: Aviation Safety and Key Federal Agencies

The United States government has regulated aviation safety since the early days of commercial air transport.[6] Over the course of the past half century, the industry has experienced tremendous growth both in terms of safety (Barnett, 2008) and passenger numbers: In 2012, U.S. airlines transported more than 800 million passengers - over 2 million souls each day.[7] While fatality rates have declined remarkably over this period, aviation safety remains an evolving target due to changes in the industry and technology (see, e.g., Barnett, 2001). The National Transportation Safety Board (NTSB) thus investigates every civil aviation accident in the United States, and conducts special studies in order to improve and maintain aviation safety. Although it was initially and briefly part of the Department of Transportation, in 1974 the NTSB was made a

[6] The Air Commerce Act of 1926 is often cited as beginning of U.S. aviation safety regulations (Carlisle, 2000; FAA, 2013).

[7] Data source: Bureau of Transportation Statistics, Summary Table: "Passengers - All U.S. Carriers - All Airports."

completely independent Federal agency in order to safeguard its objectivity.[8] The NTSB's most important role is to issue safety recommendations based on the findings of its investigations and studies. However, the NTSB is not a regulatory agency; it can only recommend actions to agencies with the relevant regulatory authority. For aviation, this is most commonly the Federal Aviation Administration (FAA).

While the FAA is legally bound to *respond* to NTSB recommendations, it does not have to *adopt* them. Indeed, regulatory agencies such as the FAA are generally mandated to weigh both costs and benefits of proposed regulations, unless mandated otherwise.[9] In contrast, there is no such requirement in place for the NTSB, and indeed the agency notes that its staff "investigate significant accidents and develop factual records and safety recommendations with one aim—to ensure that such accidents never happen again."[10] As explained by industry observer Ray Holanda, "the NTSB can make recommendations that represent the ideal safety system without regard to cost, while the FAA must respond to the recommendations based on a legislatively mandated cost/benefit analysis" (Holanda, 2009). This paper thus uses the flow of NTSB recommendations as an exogenous (to economic conditions) measure of potential new regulations, and studies the *fraction of NTSB recommendations adopted* as key regulatory decision outcome variable. The main question of interest is whether and how the fraction of NTSB recommendations adopted varies with economic conditions.

Importantly, I take advantage of the fact that the NTSB grades the FAA's responses to all of its recommendations. After issuance of a recommendation the NTSB and FAA enter into a dialogue, and the NTSB assigns and updates the recommendation's status until the case is considered "Closed." At this point, a final status is assigned that is typically "Acceptable," "Unacceptable," or "Exceeds Recommended Action."[11] The main part of the empirical analysis focuses specifically on the probability that NTSB recommendations receive an "unacceptable" response.

Before proceeding to the main analysis, I briefly want to discuss some of the controversy that surrounds FAA responses to NTSB recommendations. Historically, an important critique of the FAA was that its "dual mandate" of both promoting and regulating aviation would prevent it from being sufficiently strict on safety issues. While the language of the FAA's mandate was changed in 1996 to emphasize safety, some observers remain skeptical (see, e.g., Carlise, 2000). Perhaps in line with these concerns, since 2011 Congress has required the FAA to report

[8] http://www.ntsb.gov/about/history.html

[9] The precise requirements about whether and what kind of cost-benefit analysis needs to be done vary by the type of regulation or action, and have also evolved over time. See, e.g., FAA (1998).

[10] "History of The National Transportation Safety Board," NTSB Website: [http://www.ntsb.gov/about/history.html].

[11] Alternatively, recommendations can also be "Reconsidered," "No Longer Applicable," or "Superseded."

annually on all NTSB safety recommendations pertaining to main commercial aviation which are in "open" status or were closed in an "unacceptable" status in the previous year. The NTSB also maintains and publicly advertises a list of "Most Wanted" safety problems that remain unaddressed, suggesting that it considers some unresolved issues as particularly important for transportation safety.

However, on the other hand, it should be noted that the majority of safety recommendations receive an "acceptable" response (80.5% on average 1974-present) . More importantly, the FAA is legally bound to consider both costs and benefits of proposed rules, which should be expected to lead to an implementation rate of NTSB recommendations below 100% (Holanda, 2009). Finally, in order to provide further intuition, I briefly review three examples of NTSB recommendations that the FAA did not implement and that received an "unacceptable" status:

- In response to several incidents of taxiing aircrafts' wingtips colliding with other planes, the NTSB recommended that the FAA "require the installation of anti-collision aid, such as a camera system" on all newly manufactured aircraft where this might be a concern. However, the FAA did not implement this recommendation, arguing that "the limited safety benefit of a taxi anti-collision system, such as wingtip cameras, does not justify the cost burden of an FAA mandate for their installation on the transport airplane fleet."[12]

- In response to several crash landings where overhead compartments and service units fell on passengers, the NTSB recommended that the attachments of these compartments be required to be resistant to higher G-forces. The FAA disagreed, reasoning that the load factors experienced in these accidents exceeded aircraft certification standards, that the standards did not apply in case of fuselage fracture, and that the evidence linking passenger injuries to this particular problem was not sufficiently strong.

- One of the NTSB recommendations based on the US Airways 1549 landing in the Hudson River in 2009 was that the FAA "develop and validate comprehensive guidelines for emergency and abnormal checklist design and development" that would "minimize the risk of flight crewmembers becoming stuck in an inappropriate checklist or portion of a checklist," among other factors.[13] The FAA disagreed, arguing that existing FAA guidelines were sufficient. In turn, the NTSB disagreed, noting that existing guidelines were over 15 years old and did not take into account new research on checklist design.

These examples thus revolve around safety in the unlikely case of an emergency, rather than on imminent threats to the flying public. However, it should be noted that considerable dis-

[12] Safety recommendation A-12-048. Quoted text is from FAA-NTSB correspondence narrative provided on the ASIAS website. [http://www.asias.faa.gov/pls/apex/f?p=100:38:0::NO:::]

[13] Safety recommendation A-10-068.

agreement and controversy exists over the lack and delay of implementation of certain safety recommendations. This study does not make any statements about the welfare implications of the FAA's responses to NTSB recommendations; it merely considers whether and to which extent these responses vary with economic conditions and other explanatory variables.

3 Data

3.1 Main Data: NTSB Recommendations and FAA Responses

For NTSB recommendations and FAA responses, I obtain data from two sources.

First, I scrape NTSB-FAA correspondence text data from all available recommendations from the FAA Aviation Safety Information Analysis and Sharing (ASIAS) database. For each of the 4,810 recommendations issued between 1968 - 2013, ASIS provides a narrative text summarizing the letter correspondence between NTSB and FAA about the recommendation and its implementation. From this text, I extract the (1) dates of correspondence, and (2) NTSB recommendation status designations, including the final or current status.[14]

Second, I also collect information from the NTSB's Safety Recommendations Database, which provides information on 5,379 records. These data include the "source event" giving rise to a recommendation, including an accident date, location, and ID number, if applicable. These data also include the recommendation issue date.

3.2 Main Covariates

First, data on air transport industry output are obtained from the Bureau of Economic Analysis (BEA). I specifically consider real (chained 2005 US$) value added for the air transport industry (2002 NAICS 481) to compute both the real level and growth rates in industry output. I also obtain aggregate real GDP data (chained 2009 US$) from the BEA.

Second, I obtain data on fatal air crashes by U.S. carriers and/or on U.S. soil from the NTSB[15]. Third, the real crude oil prices series comes from the Energy Information Administration.[16]

[14] The narratives separate each listed letter by the text "NTSB LTR DTD 01/01/1970" or "FAA LTR DTD 01/01/1970," making it easy to separate text by letter through simple string function manipulations. In order to extract NTSB status designations, I further search each letter text for keywords "open" and "closed," extracting subsequent characters, and subsequently cleaning out false status designations that appear, for example, in letters talking about an "...*open*ing of the cabon door..."

[15] Secifically, I search the NTSB "Aviation Accident Database & Synopses" [URL: http://www.ntsb.gov/aviationquery/index.aspx] data base for all fatal accidents affiliated with the United States and operating under Part 121 ("Air Carrier," major), Part 135 (Air Taxi & Commuter), or Part 129 ("Foreign" air carrier) of the regulatory code.

[16] Imported real crude oil price in 2013 US$ per barrel.

Fourth, U.S. airline traffic information is obtained by aggregating carrier-level data from the Bureau of Transportation Statistics.[17] Finally, information on FAA administrators was taken from the FAA website.

3.3 Additional Regulation Measures

I consider several sources of additional information to proxy regulations. First, I collect data on "Airworthiness Directives" (ADs) issued by the FAA. These directives alert aircraft operators about (potentially) unsafe conditions and generally outline remedial actions which must be taken within a specified timeframe. I obtain data on new ADs by scraping relevant Federal Register entries from the website www.federalregister.gov as well as from ProQuest archives.[18]

Next, I obtain data on proxies for the amount of regulation contained in different sections of the Code of Federal Regulations (CFR) from the RegData, collected and provided by Al-Ubaydli and McLaughlin (2012).

Finally, I collect data on reviews of proposed regulations performed by the Office of Information and Regulatory Affairs (OIRA) from the OIRA website. This federal U.S. government agency is mandated with providing oversight of regulations proposed by all independent regulatory agencies, such as the FAA.[19]

4 Empirical Analysis

4.1 Descriptive Statistics

Figure 1 depicts the number of NTSB aviation safety recommendations issued by year since 1975, the year the NTSB became an independent agency in its current form as per the 1974 Independent Safety Board Act.

Safety recommendations are predominantly based on investigations of specific accidents. At times the NTSB engages in safety studies - motivated by one or more accidents or incidents - and may issue safety recommendations based on the results. Accident investigations can take varying amounts of time. The average time lapse between source accident and safety recommendation issuance is 360 days, with a standard deviation of 405 days. Consequently, there is

[17] Specifically, the data are from the "Air Carriers - T100 Market (US Carriers Only)" data series.

[18] I also attempt to collect estimates on cost of compliance and the number of planes affected that are presented in many of the ADs, however due to the highly heterogeneous nature of individual ADs, this information ends up being very spotty, and their analysis remains work in progress.

[19] Specifically, I collect OIRA review counts and average review times from 1981-2013, scraped at quarerly intervals from URL: [http://www.reginfo.gov/public/do/eoCountsSearchInit?action=init]

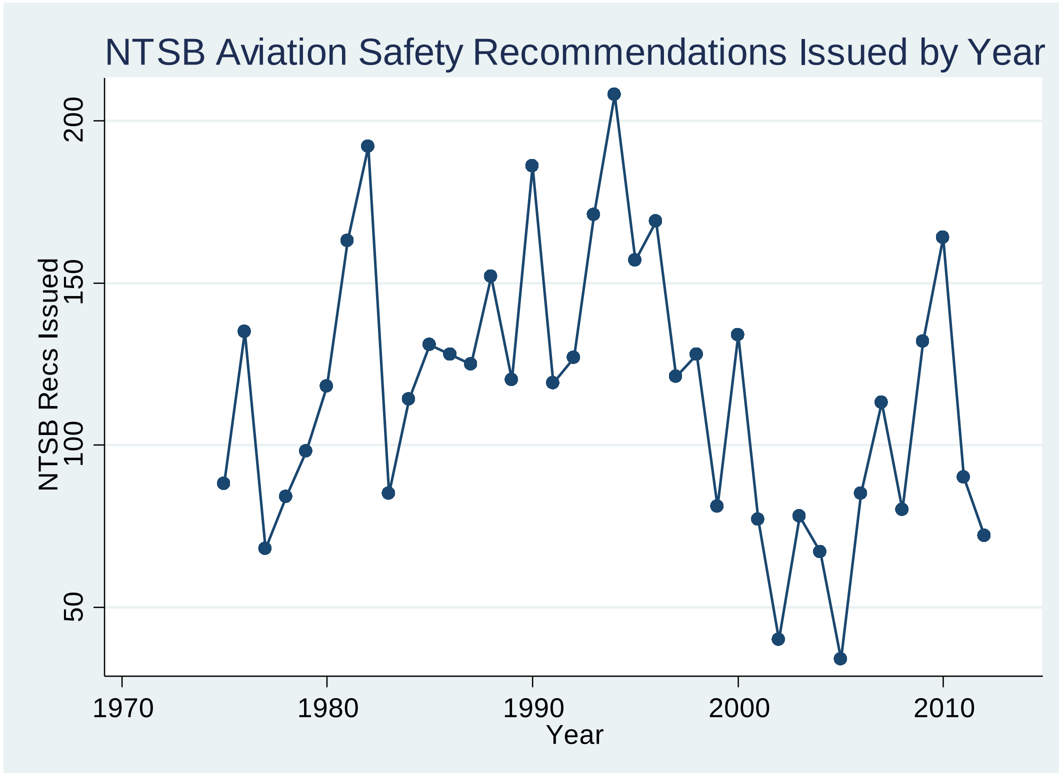


Figure 1:

no readily apparent relationship between contemporaneous aggregate U.S. accidents and safety recommendation issuance, as shown in Figure 2.

Every NTSB safety recommendation receives a response from the FAA. Figure 3 depicts the fraction of recommendations issued in a given year to which the eventual FAA response was rated as "unacceptable" by the NTSB:

The key question of interest is whether and how the regulatory implementation of new NTSB safety recommendations depends on economic conditions. Figure 4 adds the lagged real U.S. air transport industry growth rate to the plot of Figure 3:

Based on a basic visual inspection, it thus appears that the fraction of NTSB safety recommendations obtaining an "unacceptable" regulatory response by the FAA is strikingly responsive to the lagged real air transport industry growth rate. In the next section, the robustness of this pattern is explored more formally.

One point to briefly be noted is that Figures 3 and 4 and the subsequent analysis focus on FAA responses for recommendations based on the year in which they are *issued* rather than when they are designated as "closed" by the NTSB. The median (mean) time between the issuance and closure of a recommendation is 2 years (3 years). The reason for this analytic choice is that the duration for which the NTSB will consider correspondence with the FAA on a given

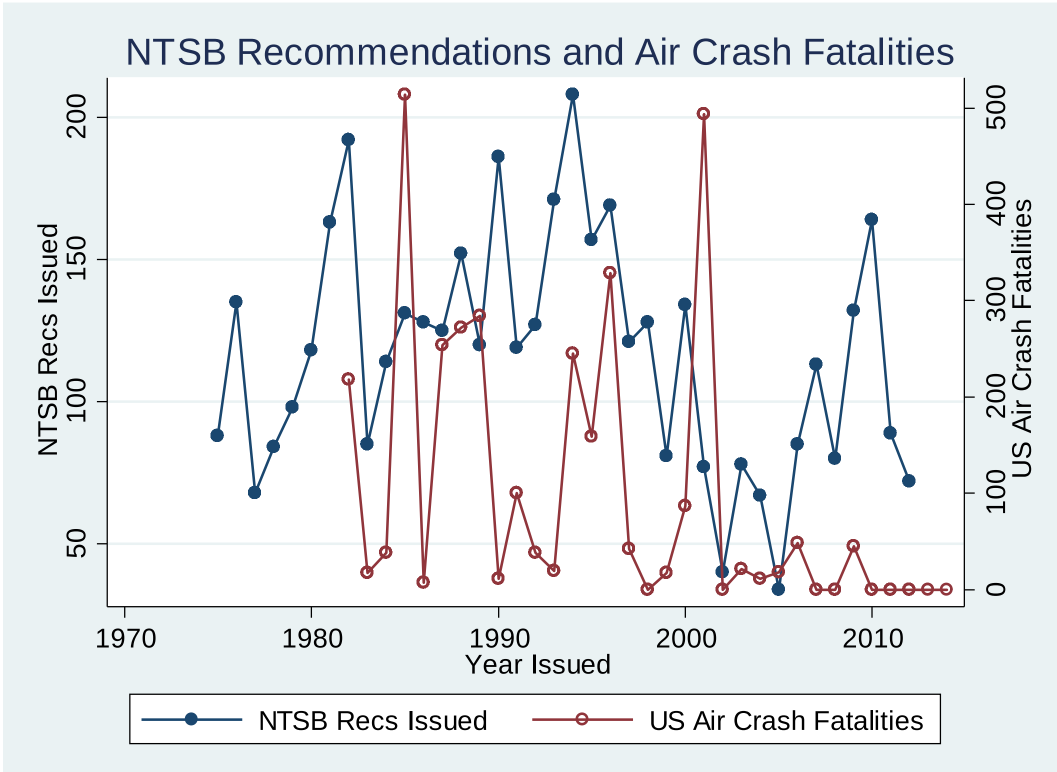


Figure 2:

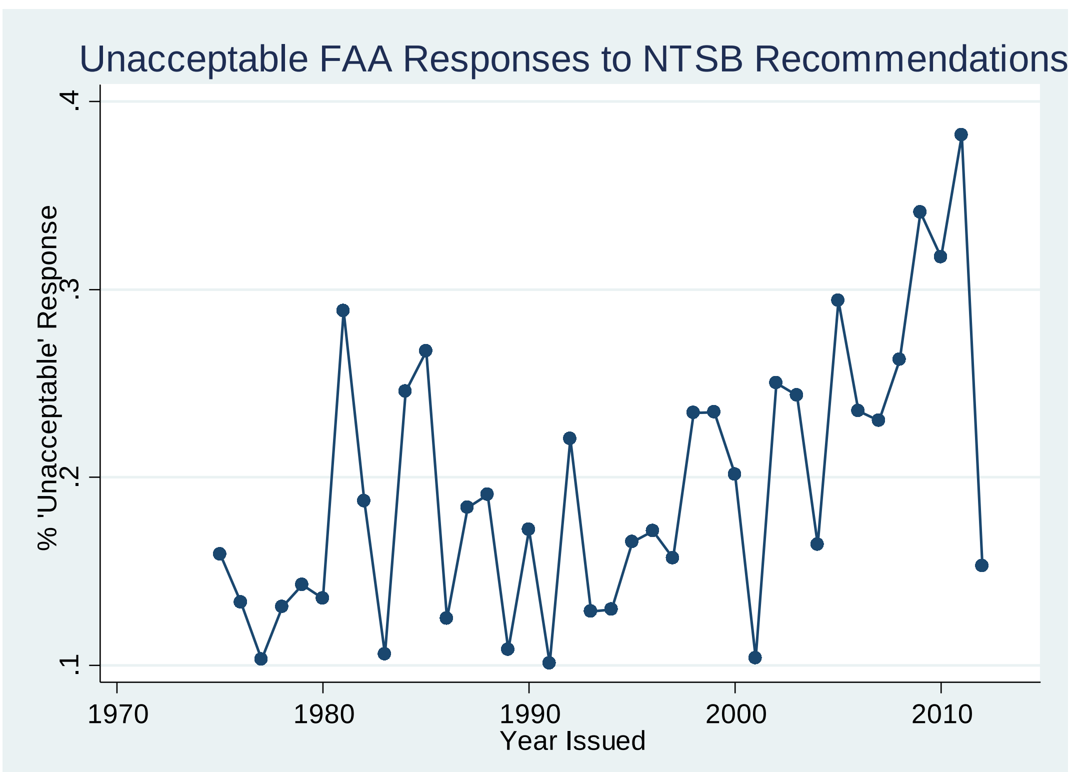


Figure 3:

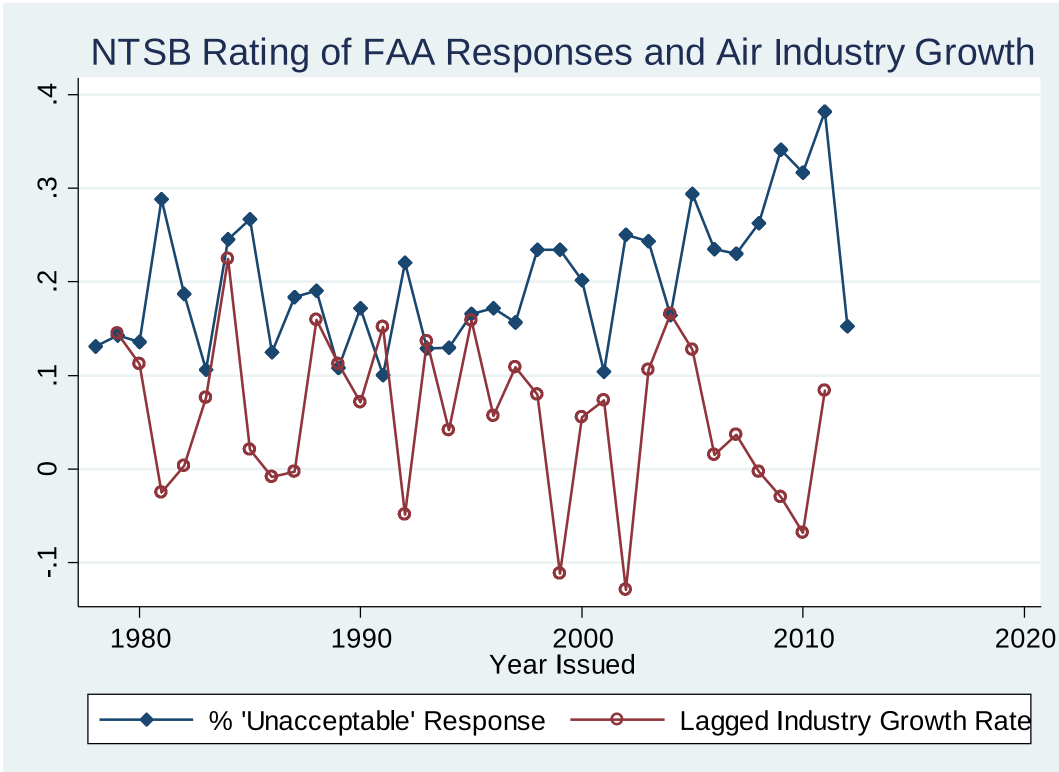


Figure 4:

recommendation "open" is endogenous. Particularly with regards to recommendations for which the FAA response is held in "unacceptable" status, the NTSB only closes those cases when there "is no further evidence to offer, and the Safety Board concludes that further correspondence on, or discussion of, the matter would not change the recipient's position."[20] The timing of when a case is "closed" may thus not reflect a contemporaneous FAA decision, particularly when the response is rated "unacceptable." However, for robustness, the Appendix provides analogs to Figures 3 and 4 based on the recommendation closure year. The pattern appears roughly similar.

4.2 Model and Econometric Analysis

4.2.1 Benchmark Model: Recommendation Level

The benchmark model focuses on outcomes at the NTSB recommendation level. The FAA is assumed to evaluate each NTSB recommendation j issued at time t based on its expected benefits and costs. The expected net benefits, $y^{\star}_{jt}$, are a latent variable assumed to be a function

[20] Source: NTSB Safety Recommendation Status Assignment Definitions
URL: [http://www.ntsb.gov/safetyrecs/Help.html#recstatus]

of covariates X_{jt} and a stochastic term ε_{jt} :

$$y^{\star}_{jt} = X'_{jt}\boldsymbol{\beta} + \varepsilon_{jt} \tag{1}$$

The FAA implements recommendation j (to an extent considered "acceptable" or better by the NTSB) if the expected net benefits are positive:

$$y_{jt} = \begin{Bmatrix} 1 \text{ if } y^{\star}_{jt} \geqslant 0 \\ 0 \text{ if } y^{\star}_{jt} < 0 \end{Bmatrix}$$

If the error term in (1) is distributed according to the standard logit distribution, the probability that the FAA implements NTSB recommendation jt is thus given by:

$$\Pr(y_{jt} = 1) = \Pr(Acceptable_{jt} = 1) = \frac{e^{X'_{jt}\boldsymbol{\beta}}}{1 + e^{X'_{jt}\boldsymbol{\beta}}} \tag{2}$$

The benchmark specification focuses on $X_{jt}\boldsymbol{\beta}$ of the form:

$$X'_{jt}\boldsymbol{\beta} = \beta_0 + \beta_1 t + \alpha_0[g^{air}_t] + \alpha_1[g^{air}_{t-1}] + X_{it} + X_{it-1}$$

where t is a linear time trend, g^{air}_t is the real growth rate (chained 2005 US dollars) of the air transport industry in year t, and X_{it} are additional contemporaneous and lagged controls for factors such as U.S. airline fatalities and GDP growth. The standard errors are clustered at the annual level, since the error term may be correlated across recommendations issued within a given year.

4.2.2 Aggregate Level

The analysis of individual level outcomes as a function of macro-level aggregates brings with it the econometric challenge of potentially correlated error terms within "groups" (Moulton, 1990), which in this setting consist of air industry growth rate episodes. Clustering of standard errors at the annual level may moreover not address this issue sufficiently well when the number of groups is small (Donald and Lang, 2007). As an alternative specification to the benchmark (2), I thus collapse all recommendation and response data to the annual aggregate level. That is, I consider as a dependent variable the *share* of NTSB recommendations issued in year t that receive an "acceptable" or better FAA response, θ_t :

$$\theta_t = X_t\boldsymbol{\alpha} + \epsilon_t \tag{3}$$

The level of variation between the dependent and independent variables in specification (3) is thus equal at the annual aggregate level. As the dependent variable in (3) is a proportion rather than a binary outcome, a fractional logit model is estimated (GLM). A final point to note is that one may be concerned about stationarity in this time-series specification. Results from Dickey-Fuller tests indicate that the null hypothesis of a unit root in both θ_t and g_{t-1}^{air} can be confidently rejected (with p-values of 0.0002 and 0.0000, respectively).

4.3 Results

The results for the benchmark model are provided in Table 1. The probability that the FAA implements a given NTSB recommendation appears to be positively and significantly associated with lagged air transport industry growth: a 1% increase in the lagged real industry growth rate increases the odds of an "acceptable" FAA response by a factor of between 1.018 to 1.024. A one-standard deviation in the lagged annual real industry growth rate (8%) is similarly estimated to increase the odds of FAA implementation by a factor of between 1.16 and 1.218. The results further suggest that both lagged and contemporaneous U.S. air crash fatalities are significantly and positively associated with likelihood of a positive FAA response to NTSB recommendations. Finally, I fail to find evidence that overall GDP growth has an effect on the FAA's responses to NTSB recommendations when controlling for the air transport industry growth rate.

Table 1 : Benchmark Specification Results

	(1)	(2)	(3)
	odds ratio	odds ratio	odds ratio
Year	0.984**	0.986*	1.002
	(0.00805)	(0.00789)	(0.00899)
g_t^{air}	1.010	1.016*	1.009
	(0.00842)	(0.00946)	(0.00709)
g_{t-1}^{air}	1.020**	1.018*	1.024***
	(0.00957)	(0.00980)	(0.00915)
g_t^{GDP}		0.967	0.988
		(0.0318)	(0.0259)
g_{t-1}^{GDP}		1.039	0.991
		(0.0378)	(0.0346)
# Recs. Issued$_t$			1.001
			(0.00168)
Air Crash Fatalities$_t$			1.001***
			(0.000520)
Air Crash Fatalities$_{t-1}$			1.001**
			(0.000554)
Republican			1.096
			(0.170)
Constant	3.209e+14**	5.657e+12*	0.0701
	(5.253e+15)	(9.056e+13)	(1.277)
Observations	3,953	3,953	3,953

Logit regression where dependent variable equals 1 if FAA response to NTSB recommendation is rated "acceptable" or better.
Standard errors clustered at issue-year level.
Significance level: * 10%, ** 5%, *** 1%.

Table 1: Benchmark Specification Results

Next, I repeat the core analysis on the aggregated time-series specification (3) through a fractional logit estimation (via GLM). Table 2 provides the results in terms of marginal effects (evaluated at the mean). The results indicate that a 1% increase in the lagged air transport industry growth rate increases the predicted share of NTSB recommendations implemented by the FAA by between 0.22 and 0.35 percentage points (against a mean acceptable implementation rate of 80.5%, standard deviation 7.2%). A larger shock, such as a one-standard deviation decrease in the lagged air transport industry growth rate (-8%), is estimated to decrease the share of NTSB recommendations implemented to an acceptable degree by between 1.8 and 2.9 percentage points (regression output not shown). This change corresponds to between 25% and 40% .of one standard deviation in the in the acceptable implementation rate.

Table 2 : Aggregate Time Series Results

	(1)	(2)	(3)
	Share Accpt.	Share Accpt.	Share Accpt.
	mfx (at mean)	mfx (at mean)	mfx (at mean)
Year	-0.00328**	-0.00315**	0.000139
	(0.00131)	(0.00133)	(0.00137)
g_t^{air}	0.00105	0.00191	0.00118
	(0.00149)	(0.00172)	(0.00109)
g_{t-1}^{air}	0.00232*	0.00220*	0.00345***
	(0.00126)	(0.00124)	(0.00126)
g_t^{GDP}		-0.00577	-0.000948
		(0.00595)	(0.00437)
g_{t-1}^{GDP}		0.00486	-0.00309
		(0.00632)	(0.00564)
# Recs. Issued$_t$			0.000233
			(0.000254)
Air Crash Fatalities$_t$			0.000261***
			(6.74e-05)
Air Crash Fatalities$_{t-1}$			0.000177***
			(6.81e-05)
Republican			0.0237
			(0.0234)
Observations	33	33	33

Fractional logit regression where dependent variable equals fraction of NTSB recommendations issued in year t receiving "acceptable" or better FAA response. Robust standard errors in parentheses.
Significance level: * 10%, ** 5%, *** 1%.

Table 2: Aggregate Time Series

As in the benchmark analysis, the results further show a positive and significant association between U.S. air crash fatalities and the fraction of safety recommendations implemented to an "acceptable" or better degree. In contrast, the results fail to detect a significant correlation between GDP growth and FAA responses once air industry growth rates are controlled for.

4.4 Extension 1: Airworthiness Directives

As an extension, I consider changes in the rate at which the FAA issues airworthiness directives (ADs) over time. ADs alert aircraft operators or other relevant parties about (potentially) unsafe conditions and outline remedial actions which must be taken within a specified timeframe.[21] Figure 5 plots the evolution of proposed and final rules pertaining to airworthiness directives published in the Federal Register over time. The two series differ because airworthiness directives can be published directly as final rules (without prior notice of proposed rulemaking) when the FAA determines that the risk to the flying public is sufficiently large:

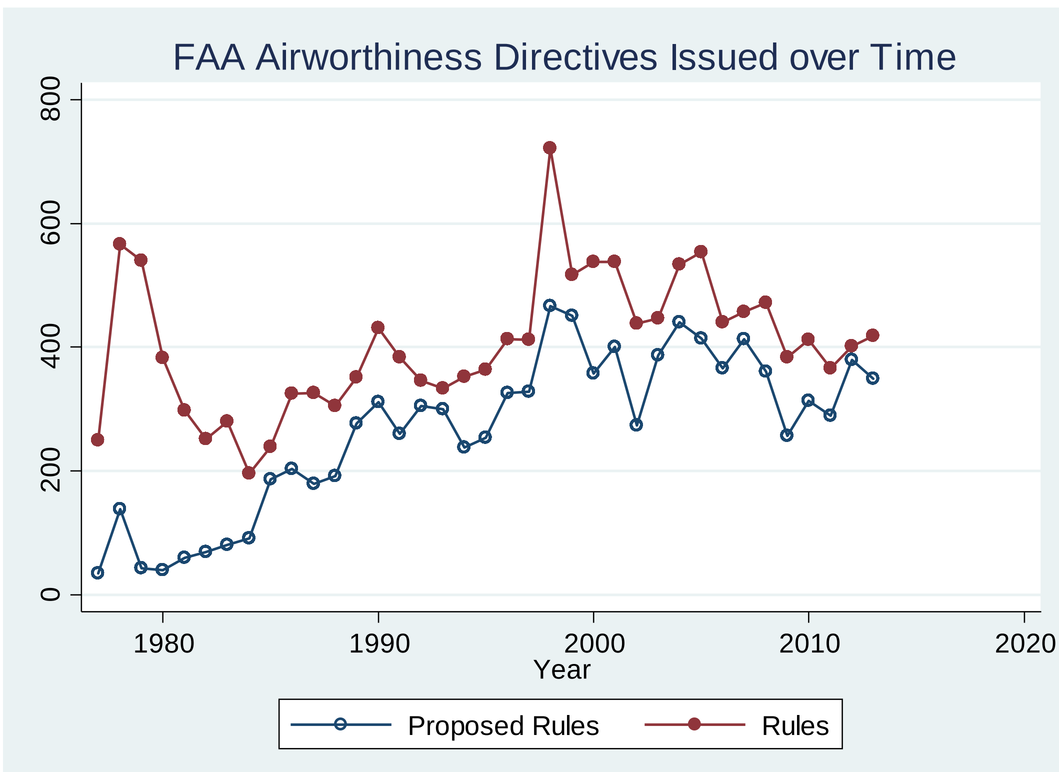


Figure 5:

Visual inspection suggests that the number of ADs issued per year has increased over time.[22]

[21] ADs are highly heterogeneous in terms of content, and using a simple count measure thus only serves as a proxy for regulatory burdens. I have also collected data on the number of products affected by each AD, and the estimated compliance costs provided by the FAA. However, these data are highly heterogeneous and difficult to standardize. I nonetheless hope to provide a more detailed AD content analysis in future work.

[22] Indeed, Dickey-Fuller test results suggest that non-stationarity in the series cannot be rejected at conventional

This is not surprising, as aviation has grown considerably in scope over the time period considered. Deflating the series by an industry size measure does not, however, necessarily address this concern. For example, deflating ADs by available seat miles of U.S. airlines in a given year (as is done, e.g., by Borenstein (2010) for metrics such as net income and operating cost in his analysis of airline profitability) is problematic here for two reasons. First, the resulting series still appears nonstationary (see Figure 7 in Appendix).[23] Second, one may be concerned about introducing a spurious relationship between lagged growth and deflated AD issuance if the deflator is misspecified in terms of capturing the relevant growth factors in the AD issuance process. I thus simply detrend the data by HP-filtering the (logged) series, where a penalty value of $\lambda = 6.25$ is chosen for analysis of the annualized data (Ravn and Uhlig, 2002). Figures 6, 7, and 8 illustrate the trend and cyclical components of the series, respectively:

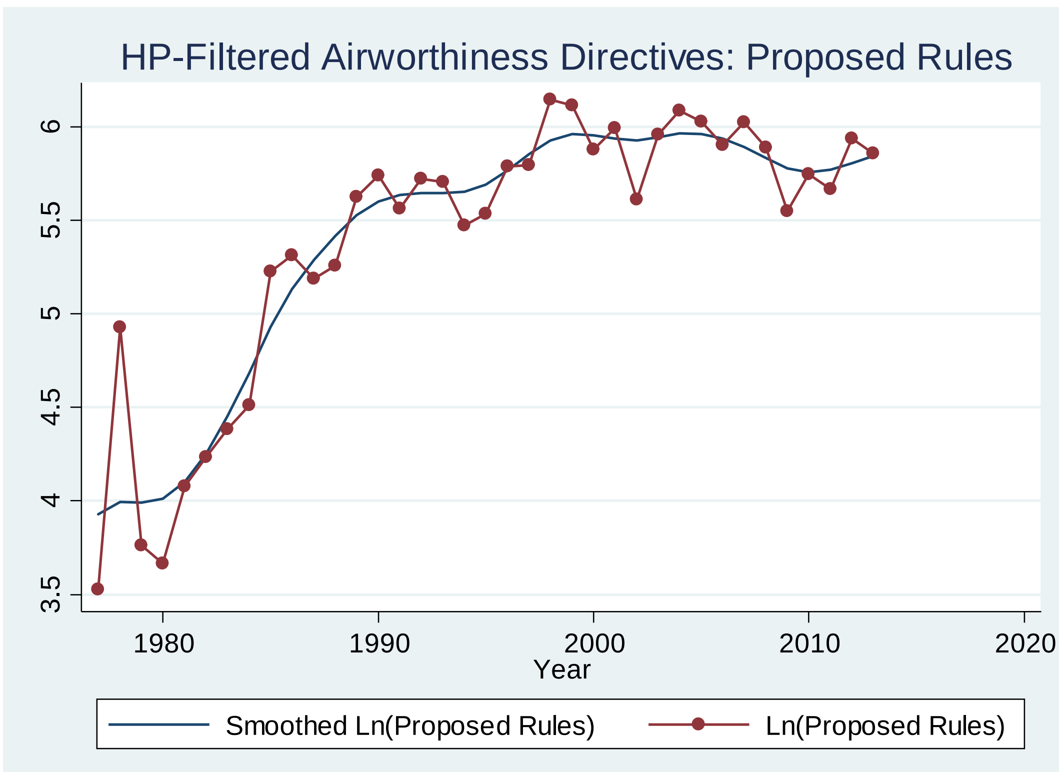


Figure 6:

Next, Figure 9 compares the cyclical components of the proposed AD rules series and 2-year lagged (logged) real air transport industry value added series. An analogous figure for the 1-year lagged series is presented the Appendix. The 1-year lagged series visually seems to provide a better fit for the 2000s, whereas the 2-year lagged series seems more correlated with shocks to

levels of significance.

[23] Dickey-Fuller test results imply that a unit root cannot be rejected for proposed rules per ASM, and can only barely be rejected at conventional levels of significance for final rules per ASM (p-value 0.0448).

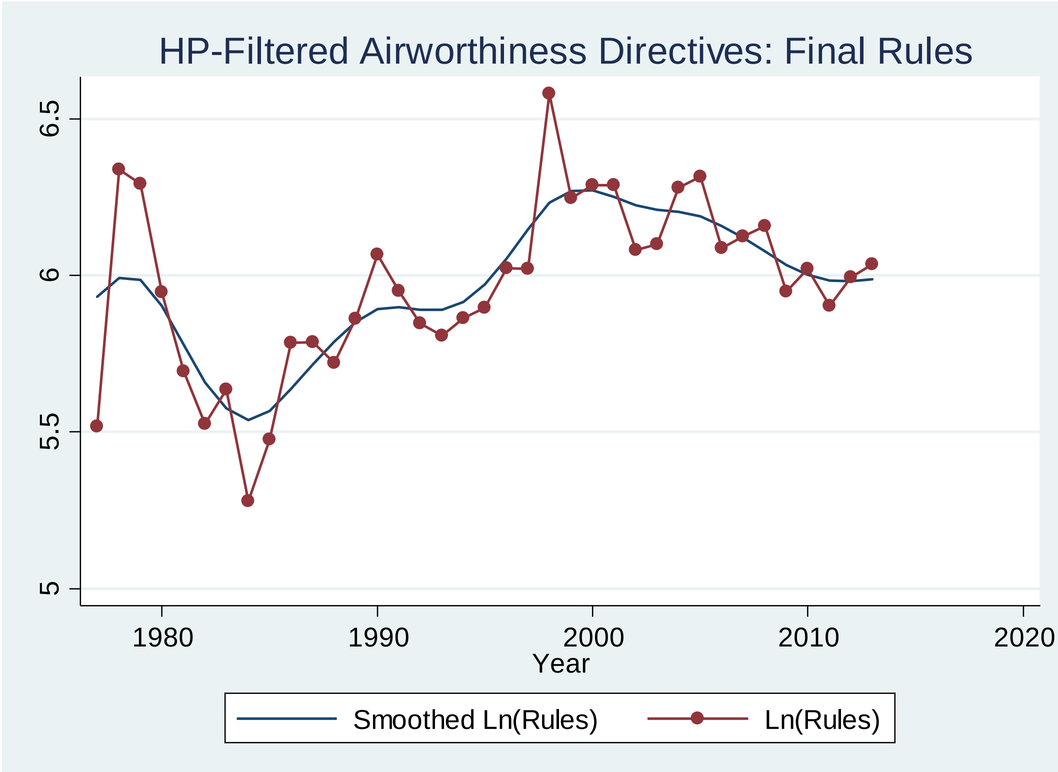


Figure 7:

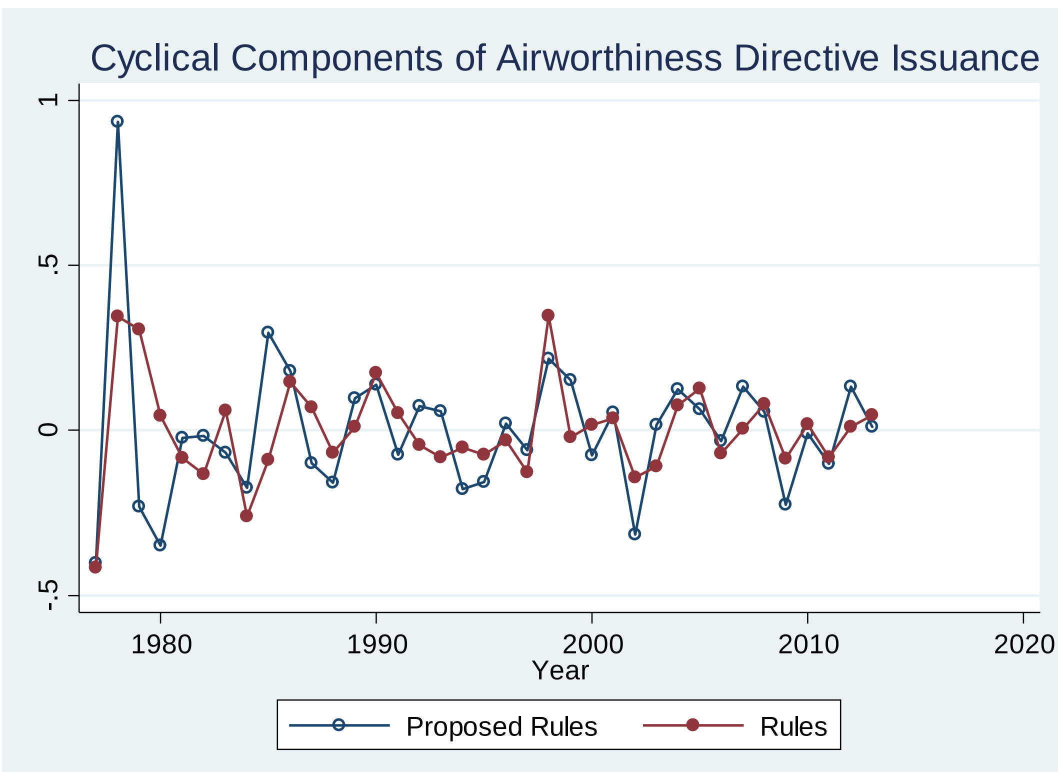


Figure 8:

proposed AD rules in the 1980s. While the data are generally quite noisy, visually there does seem to be at least a weakly positive relationship between fluctuations in air industry growth and shocks to proposed AD rules.

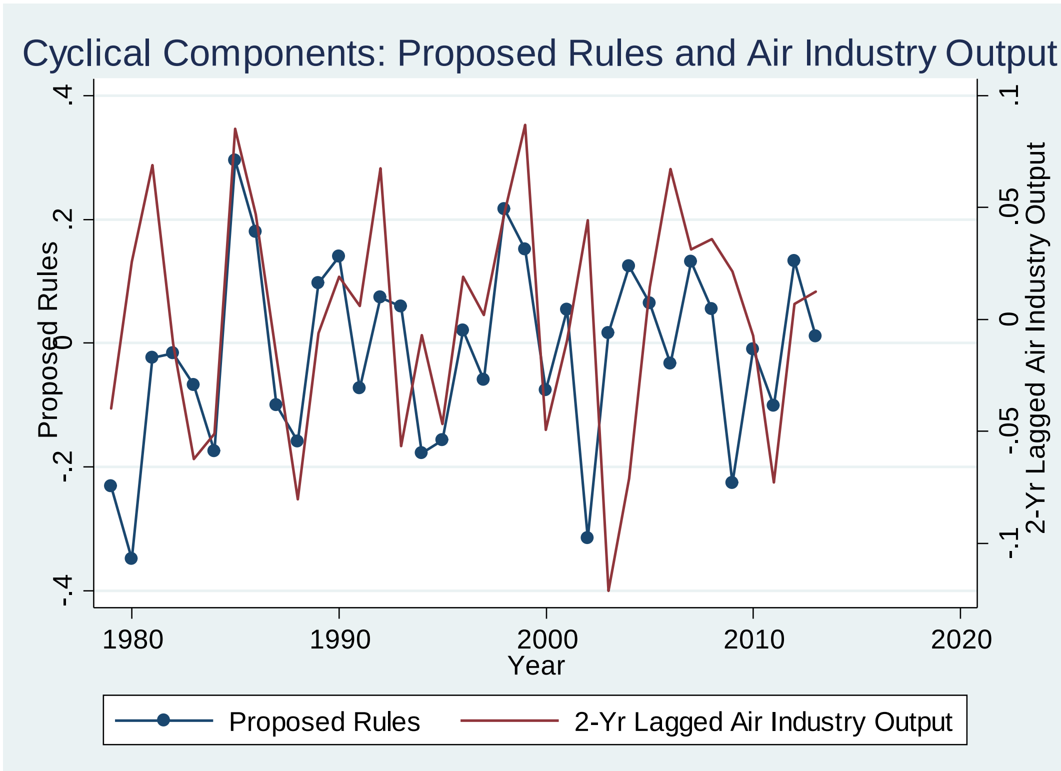


Figure 9:

Figure 10 compares the cyclical component of final rules and the lagged air industry growth rate. Interestingly, the correlation between these series appears considerably weaker, if at all existent. This finding is to be expected since the "Rules" series differs from the "Proposed Rules" series mainly through the addition of the most urgent safety issues, which we would expect to be unresponsive to economic conditions.

Finally, I regress the cyclical components of both the proposed and final rules series on (lagged) cyclical components of air industry output, as well as on other covariates as in the previous section. Table 3 provides the results. The correlation between shocks to air industry output and to AD issuance is positive in all specifications; however only the 2-year lagged output change attains marginal significance, and only for the issuance of proposed rules.[24] It should also be noted that this significance is not robust to repeating the analysis with the unfiltered air industry growth rate series, rather than with the HP-filtered cyclical component of air industry

[24]The negative and significant coefficient on the lagged number of air crash fatalities is due to the September 11, 2011 outlier. The coefficient ceases to be statistically significant when the year 2002 is excluded from the analysis.

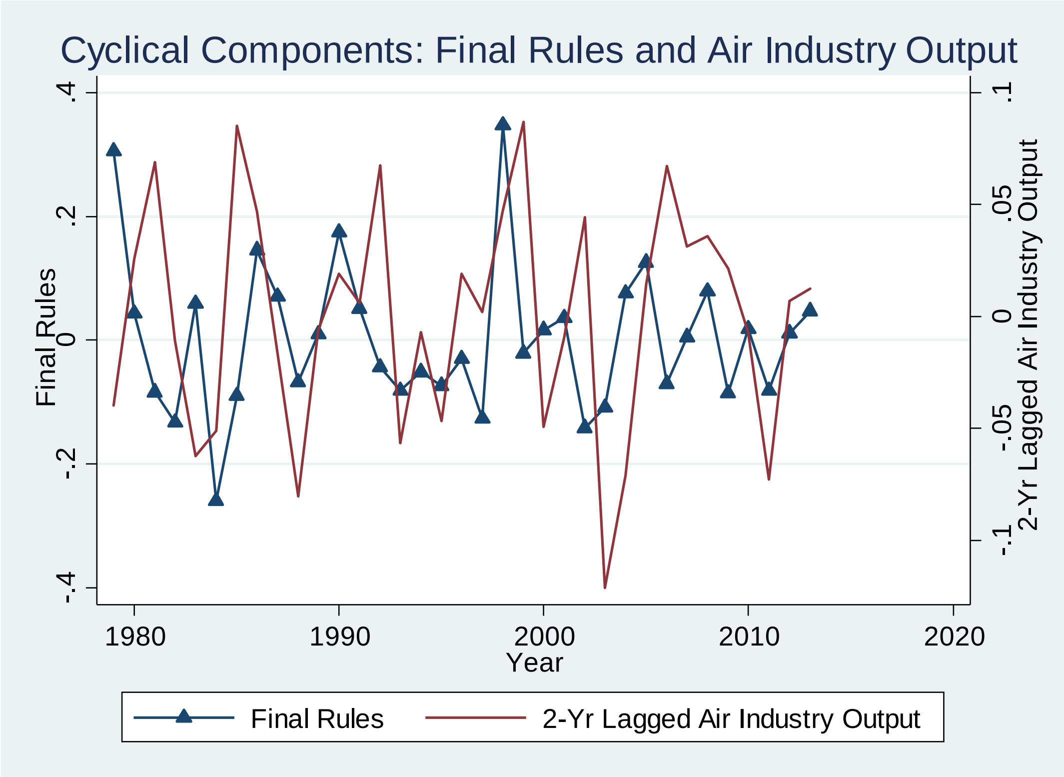


Figure 10:

output, although the results are qualitatively similar. A general lack of precision should also not be surprising given that there are only 32 observations in the analysis.

	(1) Proposed Rules	(2) Proposed Rules	(3) Final Rules	(4) Final Rules
$c_t^{air\ transport}$	0.117	0.109	0.194	0.275
	(0.552)	(0.502)	(0.466)	(0.469)
$c_{t-1}^{air\ transport}$	0.370	0.370	0.548	0.530
	(0.518)	(0.467)	(0.437)	(0.437)
$c_{t-2}^{air\ transport}$	0.936*	0.894*	0.302	0.396
	(0.545)	(0.496)	(0.460)	(0.464)
Air crash fatalities$_{t-1}$		-0.000411**		0.000137
		(0.000160)		(0.000150)
Air crash fatalities$_{t-w}$		-4.73e-05		0.000173
		(0.000133)		(0.000125)
Republican President		0.0680		-0.0103
		(0.0487)		(0.0455)
Constant	-0.0203	0.0233	-1.72e-05	-0.0545
	(0.0260)	(0.0561)	(0.0220)	(0.0525)
Observations	33	33	33	33
R-squared	0.121	0.364	0.076	0.178
Adj. R2	0.0303	0.217	-0.0194	-0.0116

OLS regression of cyclical components from HP-filtered ($\lambda = 6.25$) series of airworthiness directives (proposed or final) on real air transport industry output c_t^{air}, as well as the (lagged) number of U.S. air crash fatalities and a dummy for Republican president. Significance levels: * = 10%.

Table 3: Airworthiness Directives

In summary, the analysis of airworthiness directives thus provides some tentative evidence that fluctuations in the issuance of less urgent ADs is mildly positively associated with lagged air transport industry fluctuations. However, on the whole it does not appear that airworthiness directives are an important margin for cyclical adjustments of the regulatory burden in aviation.

4.5 Extension 2: Code of Federal Regulations and RegData

The airworthiness directives considered in the previous section are only one of many elements in the Code of Federal Regulations (CFR) under the authority of the Federal Aviation Administration. In this section, I thus consider changes in the overall "stock" of FAA regulations in the U.S. CFR. The literature has proxied levels of regulation in different ways, most notably by the number of pages or bytes contained in statutes, as reviewed by Al-Ubaydli and McLaughlin (2012). These authors further propose and provide an additional novel proxy for total regulatory burden by counting the number of times constraining words such as "required" or "prohibited" occur in different Titles of the CFR. The analysis below combines the data set they assemble on the CFR between 1997 and 2010 - RegData - with industry growth rates and other covariates in order to study the degree to which the stock of regulations appears to respond to air transport industry fluctuations. Figure 11 plots two proxies for the level of regulation contained in Title 14 of the CFR ("Aeronautics and Space")[25] over time:

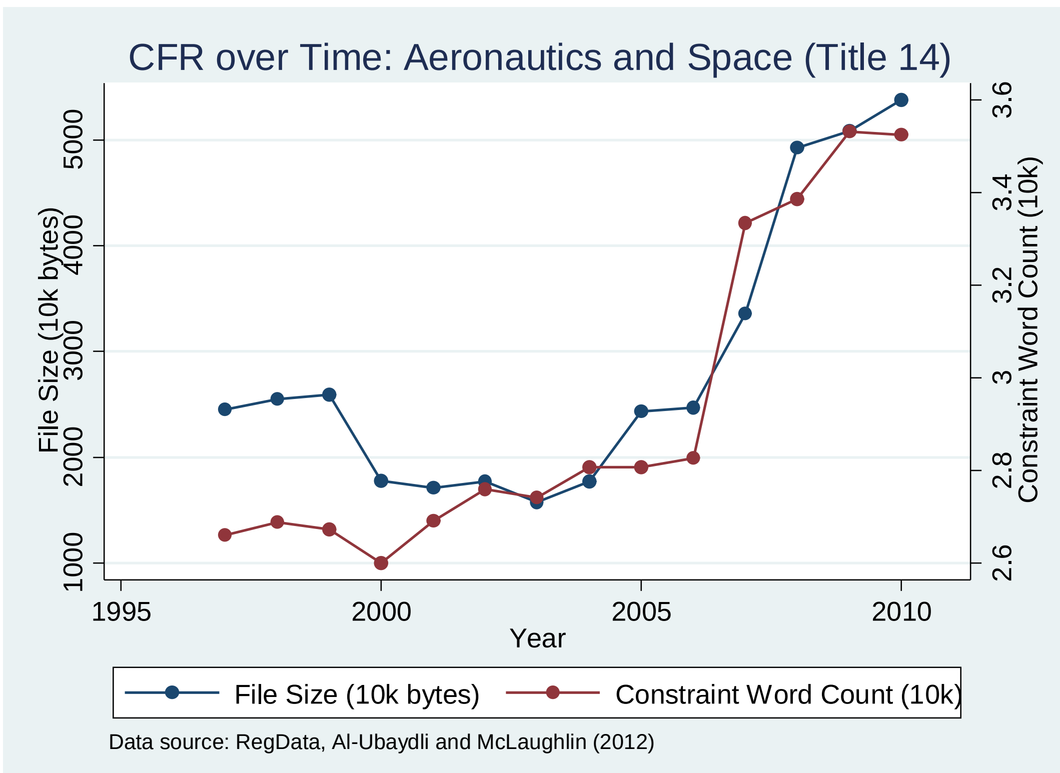


Figure 11:

The series is clearly non-stationary. Figures 12 and 13 below thus focuses on the cyclical component of the series extracted after HP-filtering (with penalty $\lambda = 6.25$ as above for annual data), and compare these fluctuations in CFR growth against air industry fluctuations, measured

[25] Title 14 contains the FAA regulations pertaining to contemporary aircraft and their operations. Source: FAA, "Overview - Title 14 of the Code of Federal Regulations (14 CFR)" [URL: https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_handbook/media/FAA-8083-30_Ch12.pdf]

by cyclical components of air industry output extracted through HP filtering, and through the simple air industry growth rate, respectively. For robustness, the Appendix also provides an analogous figure using the simple growth rates of both the CFR and air industry series; the figure looks very similar.

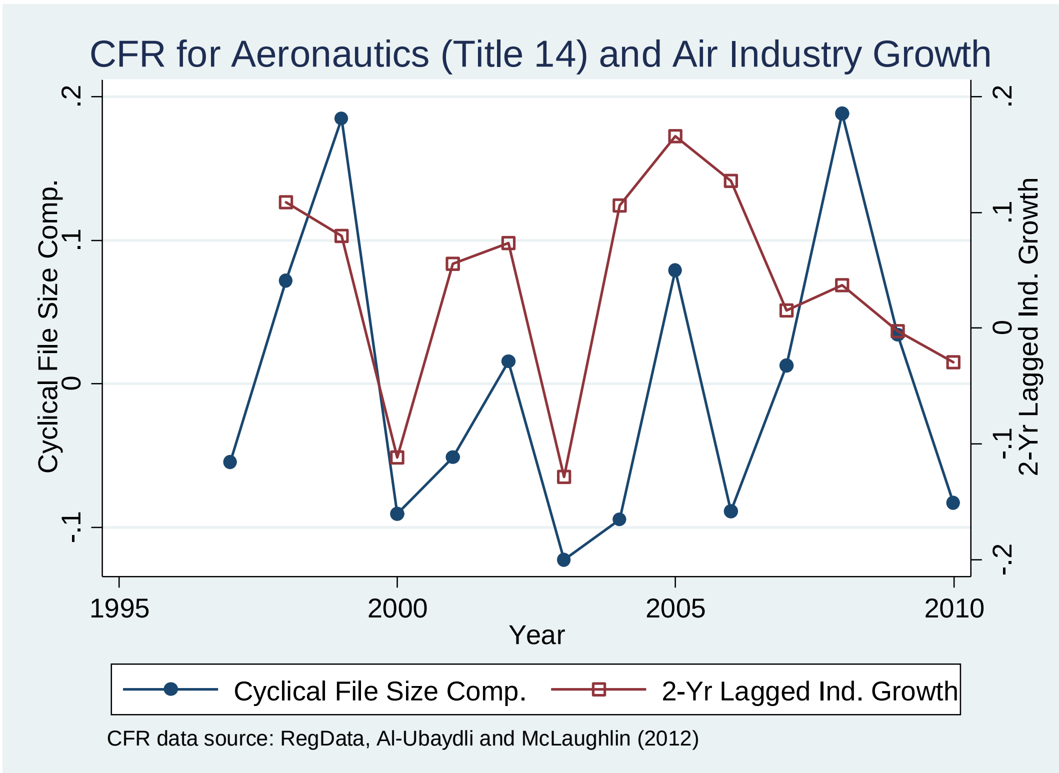


Figure 12:

Both figures suggest a positive association between fluctuations in growth of aviation regulation and lagged air industry output. The size of the correlation is difficult to estimate with precision as the HP-filtering reduces the available observations to 12. A simple regression of CFR size fluctuations on a constant and lagged air industry output fluctuations produces a positive and significant ($p = 0.031$) coefficient, and moreover yields an (adjusted) R-squared value of 0.38 (0.32), which would suggest that the lagged air industry output fluctuations can account for up to a third of the variation in CFR size fluctuations. However, the precision of the estimate diminishes as additional control variables are included in the regression, although the size of the coefficient remains similar. It should further be noted that the error induced by HP filtering the original series is not accounted for in computation of the standard errors. A final caveat is that using constraint word counts instead of CFR file size as measure for regulation introduces additional noise in the relationship between regulation and industry growth (see Figure 7 in the Appendix). Overall, however, although not precisely estimated, the analysis does

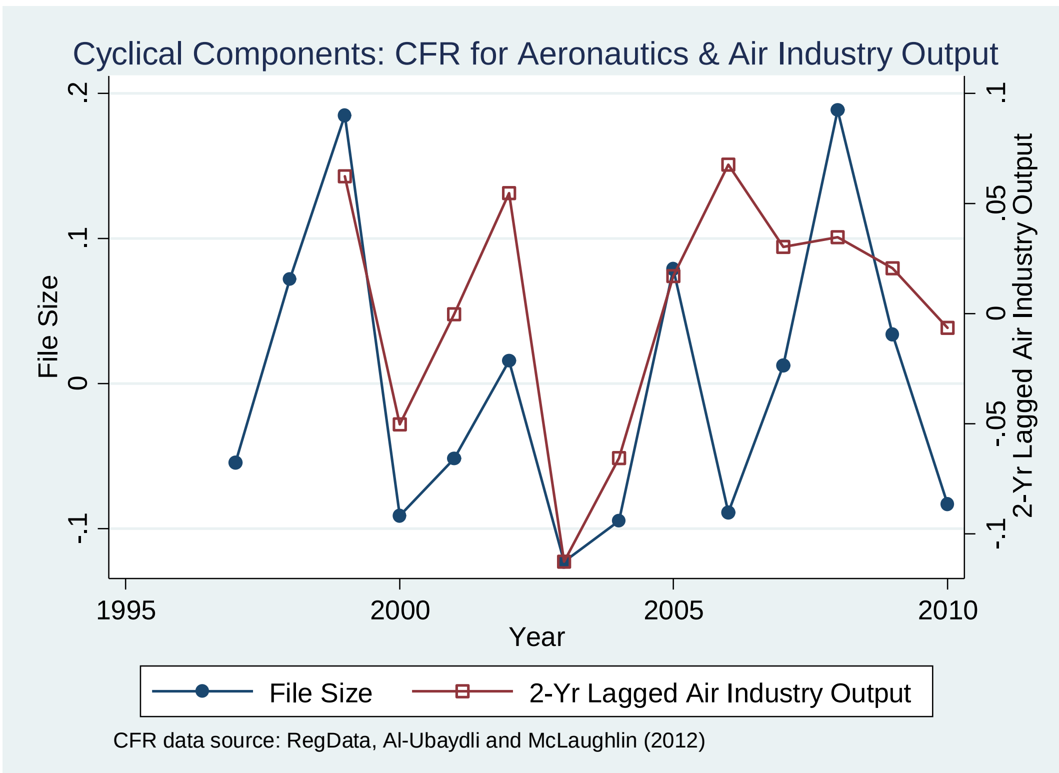

Cyclical Components: CFR for Aeronautics & Air Industry Output
File Size
2-Yr Lagged Air Industry Output
Year
-.1
0
.1
.2
-.1
-.05
0
.05
.1
1995
2000
2005
2010
File Size
2-Yr Lagged Air Industry Output
CFR data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 13:

provide additional tentative evidence consistent with state-contingent fluctuations in regulatory rulemaking.

5 Additional Evidence

5.1 RegData for Other Areas of Regulation

In order to broaden the analysis beyond U.S. aviation, this section considers evidence from other areas and measures of regulation. While NTSB safety recommendations are not usually known before being announced, this broader analysis arguably has a higher risk of simultaneity bias due to anticipation of future regulation causing changes in industry growth in preceding periods. I thus consider the evidence presented below to be strictly descriptive at this stage.[26]

First, I consider RegData measures of federal regulation (Al-Ubaydli and McLaughlin, 2012) for titles in the CFR besides Aeronautics. Figure 14 plots two measures of the stock of regulation for the combination of CFR Titles 7 and 9: "Agriculture" and "Animals and Animal Products," respectively. I focus on these titles as their correspondence with a specific industry is clearer than for other industries.[27] Figures 15 and 16 proceed to compare the levels of regulation with lagged growth rates of value added in the "Farms" sector (NAICS 111 and 112, "Crop Production" and "Animal Production," respectively). The results once again suggest a positive association between lagged farming industry growth and the stock of relevant regulations, although this association appears to break down in the years of and after the 2008 recession.

Next, I consider changes in regulations of CFR Title 40: *Protection of the Environment,* which reflects the Environmental Protection Agency's regulatory authority. Although arguably a regulatory measure of great interest, due to its broadness it appears that simultaneity bias is a potentially important concern. Figure 17 plots changes over time in the two main measures of the stock of EPA regulations in the CFR. Contrary to the other titles considered, here there is considerable disagreement between the file size and constraint word count measures.

Figure 18 compares the file size measure of environmental regulations under Title 40 of the CFR against the contemporaneous real U.S. GDP growth rate. However, no readily apparent pattern exists between the two series.

[26] In the future, based on current work in progress, I hope to add state-level measures of regulation to the analysis for which a panel data analysis can be performed, and where instruments for cross-state variation in sectoral growth may be available (e.g., weather shocks to agriculture, shale gas endowments, etc.).

[27] For a discussion on the challenges of mapping CFR titles and industries, see Al-Ubaydli and McLaughlin (2012).

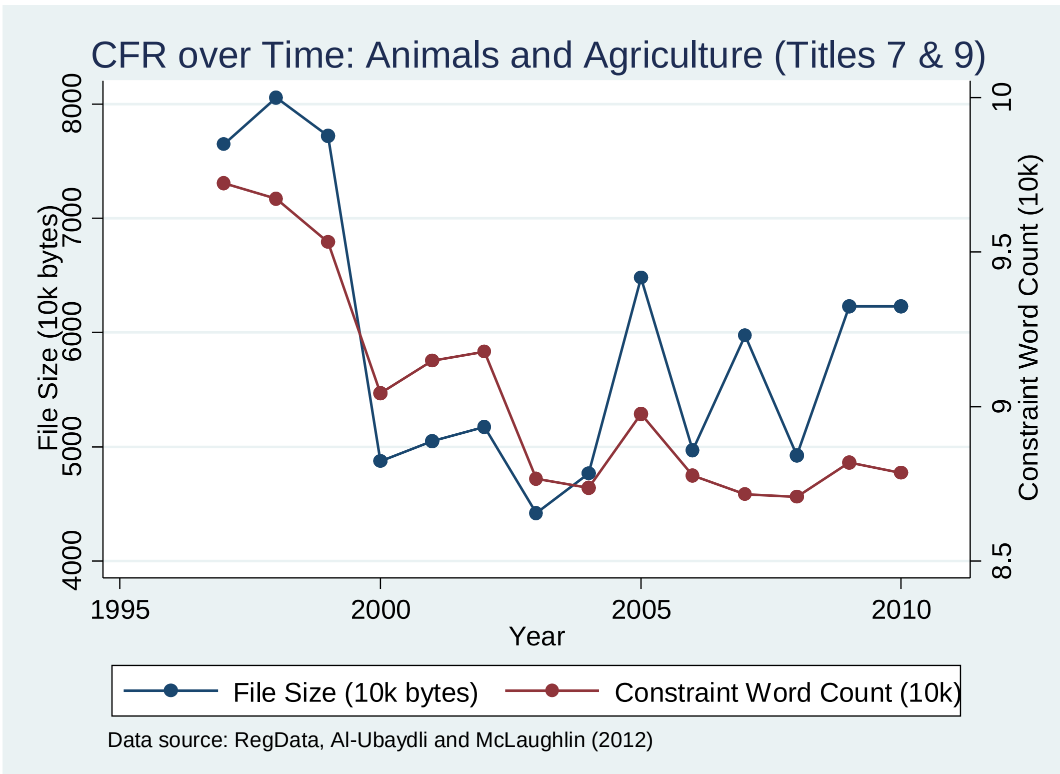

CFR over Time: Animals and Agriculture (Titles 7 & 9)
File Size (10k bytes)
4000
5000
6000
7000
8000
Constraint Word Count (10k)
8.5
9
9.5
10
1995
2000
2005
2010
Year
File Size (10k bytes)
Constraint Word Count (10k)
Data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 14:

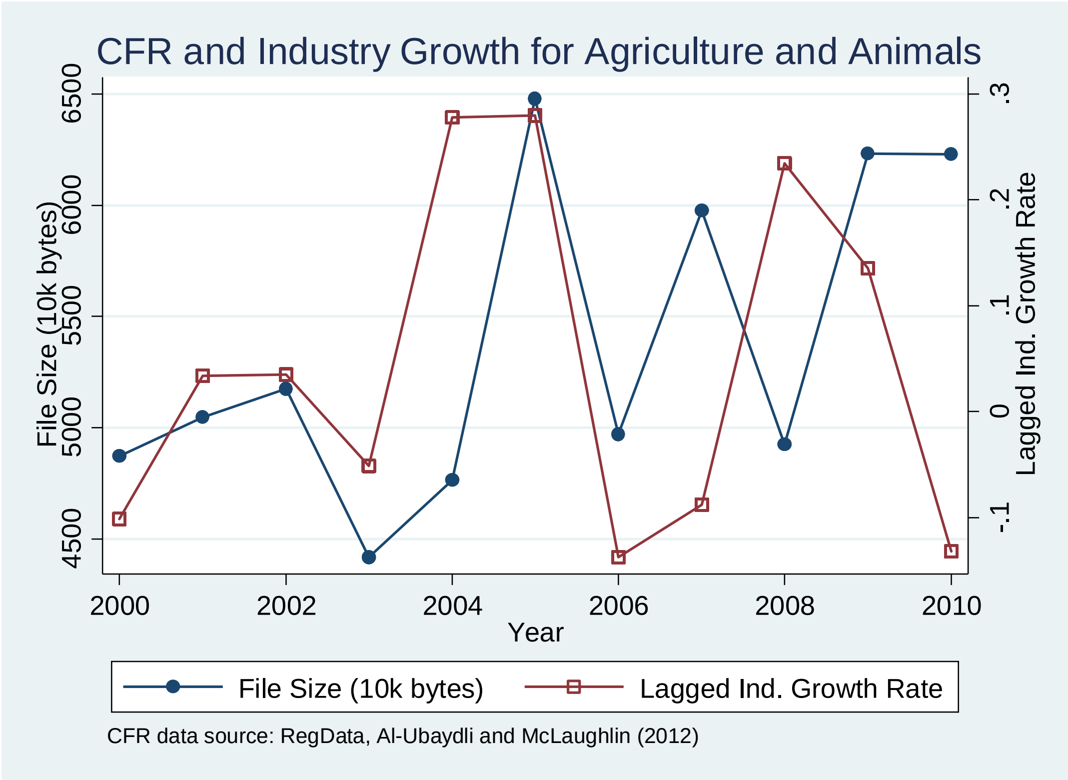

CFR and Industry Growth for Agriculture and Animals
File Size (10k bytes)
4500
5000
5500
6000
6500
Lagged Ind. Growth Rate
-.1
0
.1
.2
.3
2000
2002
2004
2006
2008
2010
Year
File Size (10k bytes)
Lagged Ind. Growth Rate
CFR data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 15:

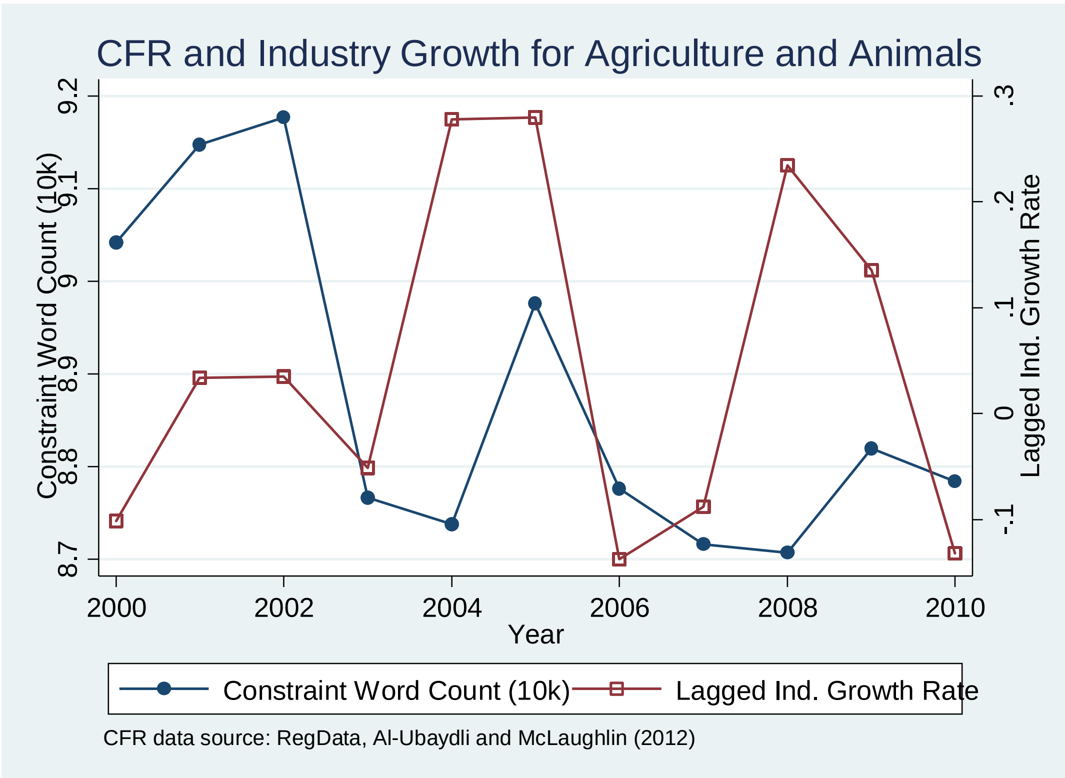

CFR and Industry Growth for Agriculture and Animals
Constraint Word Count (10k)
8.7
8.8
8.9
9
9.1
9.2
Lagged Ind. Growth Rate
-.1
0
.1
.2
.3
2000
2002
2004
2006
2008
2010
Year
Constraint Word Count (10k)
Lagged Ind. Growth Rate
CFR data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 16:

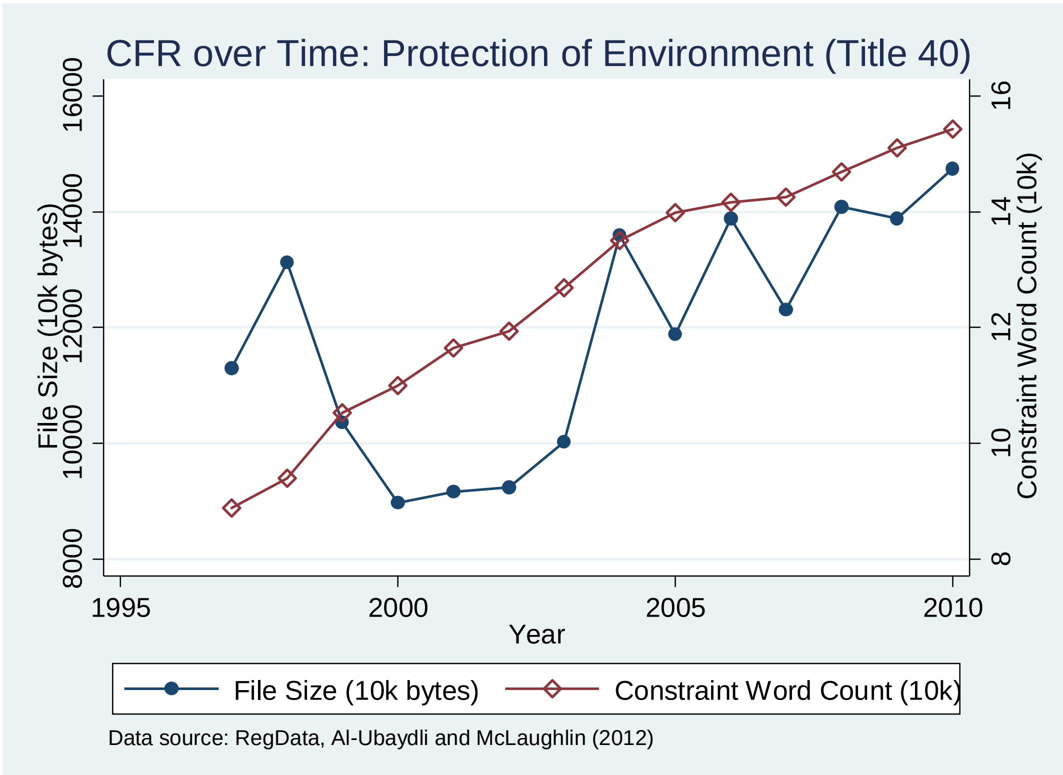
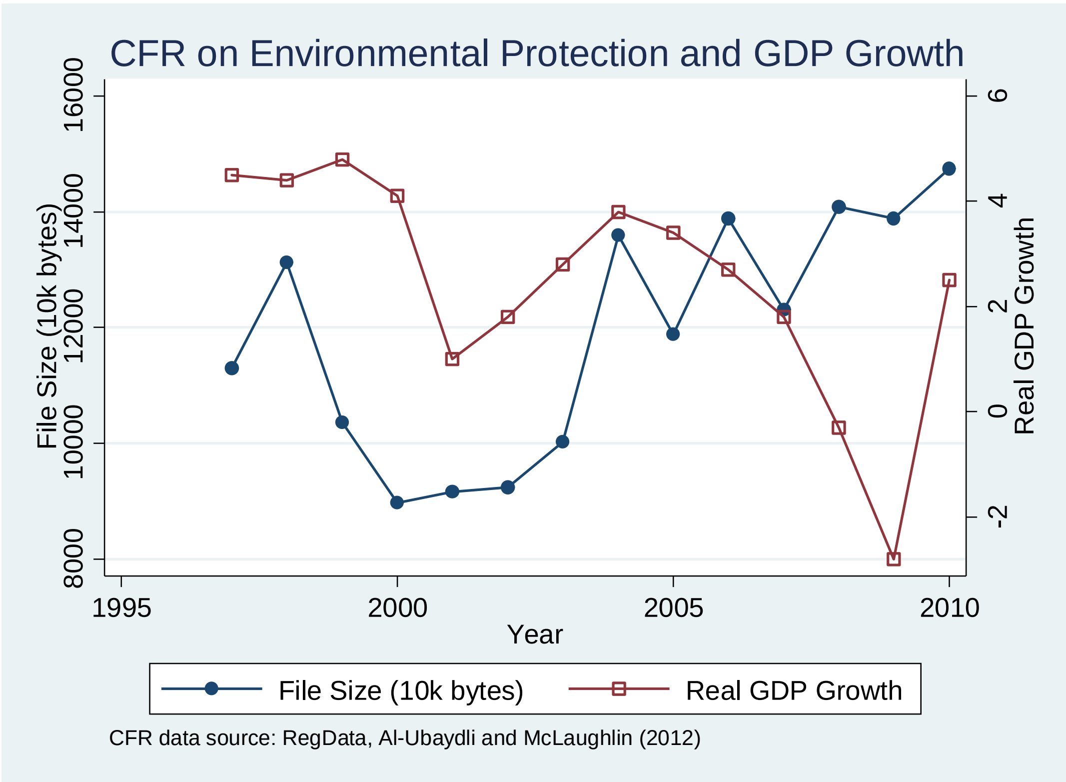

CFR over Time: Protection of Environment (Title 40)
File Size (10k bytes)
8000
10000
12000
14000
16000
Constraint Word Count (10k)
8
10
12
14
16
1995
2000
2005
2010
Year
File Size (10k bytes)
Constraint Word Count (10k)
Data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 17:



CFR on Environmental Protection and GDP Growth
File Size (10k bytes)
8000
10000
12000
14000
16000
Real GDP Growth
-2
0
2
4
6
1995
2000
2005
2010
Year
File Size (10k bytes)
Real GDP Growth
CFR data source: RegData, Al-Ubaydli and McLaughlin (2012)

Figure 18:

In sum it thus appears to be challenging to measure or draw inferences on changes in broad aggregate regulatory areas such as "Protection of the Environment" (Title 40). Focusing on more specific areas and industries beyond aviation, however, it does for example appear that there exists a positive association between lagged farming industry output growth and the amount of related regulations in the early-mid 2000s.

5.2 OIRA Regulatory Reviews

Finally, this section considers yet another proxy for regulatory rulemaking: the rate at which proposed new regulations become subject to additional scrutiny under review by the Office of Information and Regulatory Affairs (OIRA). One of OIRA's tasks is to review "significant" new regulations proposed by regulatory agencies. While a regulation can be deemed "significant" for several reasons, if it is designated as "*economically* significant" it will be subject to even more detailed review, including formal cost-benefit analysis. According to OIRA, a regulation is "'economically significant' if OIRA determines that it is likely to have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities" (OIRA, 2013). Whether and how economic fluctuations should be taken into account in this designation is thus arguably ambiguous based on this definition.

Figure 19 displays the share of rules reviewed by OIRA that are designated as "economically significant" over time. Not surprisingly, a sharp break occurs after the criteria for OIRA review of regulations was changed by Executive Order 12866 in 1993.

Thus focusing on the period after enactment of EO 12866, Figure 20 displays both the share of reviewed proposed regulations deemed "economically significant" and the lagged aggregate annual real GDP growth rate:

Figure 20 suggests that an inverse correlation may indeed exist between the share of proposed regulations deemed "economically significant" by OIRA and the lagged real GDP growth rate. Regression analytic results, shown in the Appendix, confirm a significant negative relationship between contemporaneous GDP growth rates and the share of rules designated as "economically significant."[28] Unfortunately, however, one cannot establish without further information to which extent these changes are driven by differences in the nature of proposed regulations, or by OIRA taking into account economic conditions when making its designations. Moreover, reverse causality is again a concern, as expectations of significant future regulations could affect even lagged growth rates and regulatory designations. While further research is thus clearly needed, Figure

[28]The regression controls for a time trend, contemporaneous and lagged real GDP growth rates, and whether the President is a member of the Democratic Party.

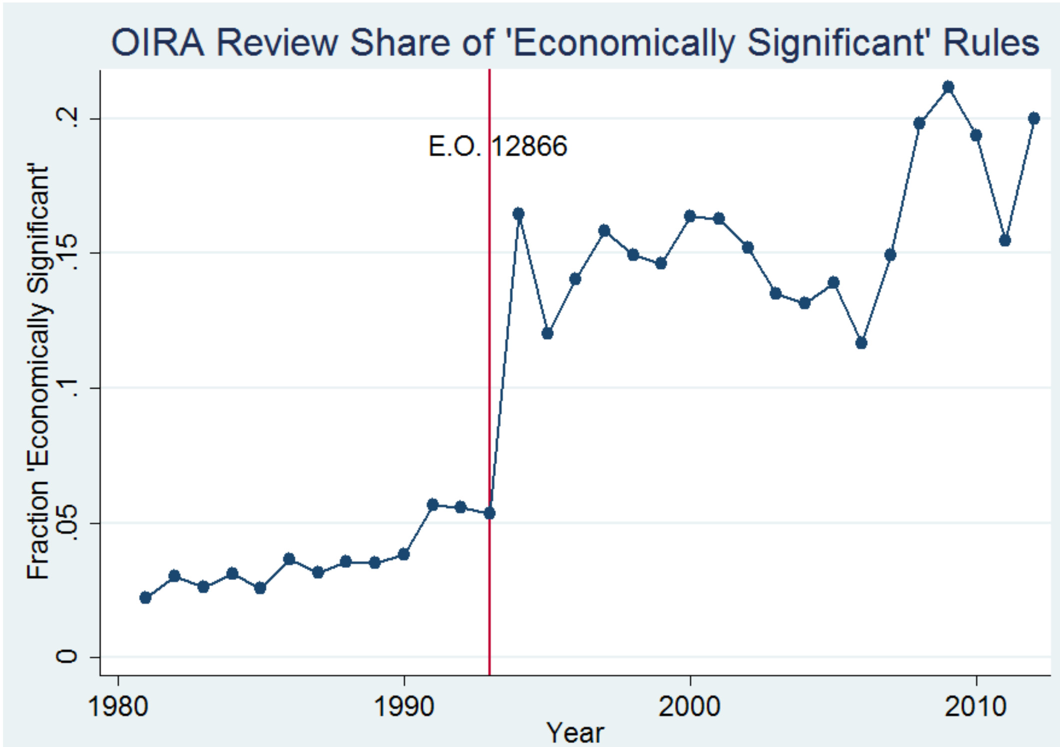


Figure 19:

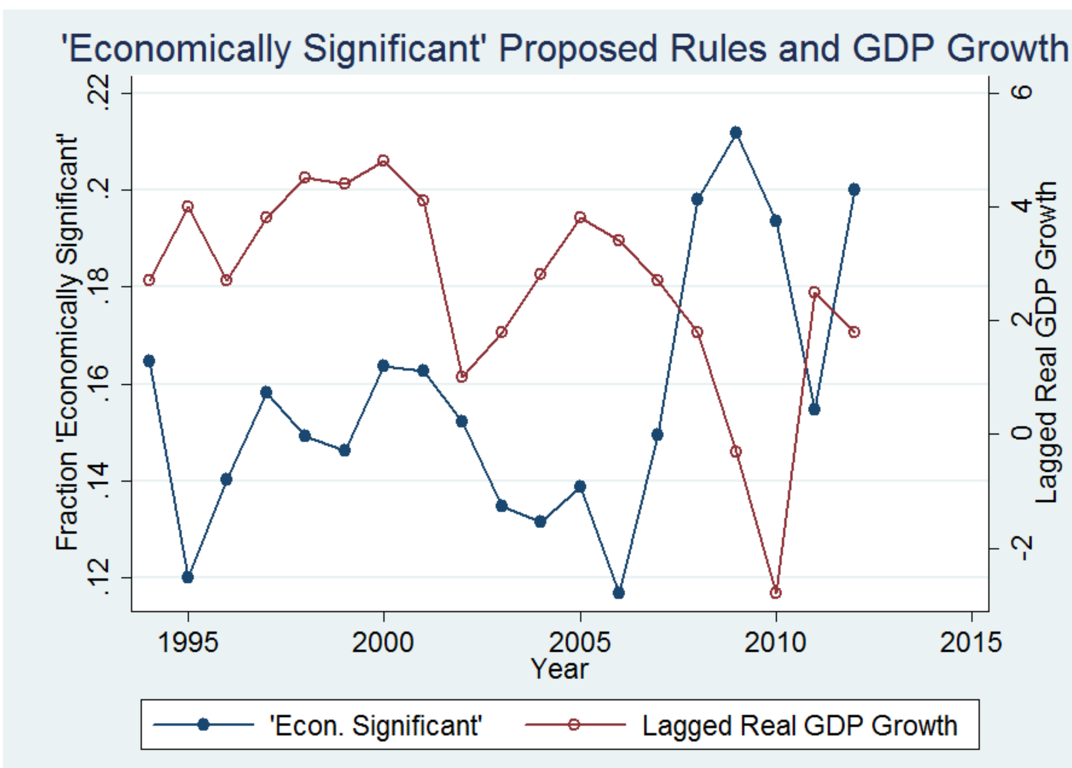


Figure 20:

20 is again consistent with the possibility that OIRA considers the state of the economy in its decision to submit proposed rules to additional scrutiny for being "economically significant."

6 Conclusion

A growing theoretical literature has explored the potential benefits of state-contingent policies in areas beyond monetary and fiscal policy, such as environmental regulations. However, the extent to which such state-contingencies are feasible is an open question. This paper thus investigates the state-contingency of regulatory rule-making from a positive and empirical perspective, seeking to add to a number of recent studies on shocks and policymaking.

The fundamental identification challenge in such analyses is to estimate the counterfactual regulatory burden without a given shock. The core analysis of this paper takes advantage of a unique feature of the U.S. aviation safety regulatory system to overcome this challenge, namely that the National Transportation Safety Board issues aviation safety recommendations without the need for cost-benefit analysis, whereas the main relevant regulatory agency - the Federal Aviation Administration - must weigh whether to implement these recommendation. The core analysis thus studies how the FAA's responses to NTSB recommendations fluctuate based on economic conditions. The main result is that aviation safety regulation appears partially state-contingent on the extensive margin: A one-standard deviation decrease in the real air transport industry growth rate (-8%) is estimated to decrease the fraction of NTSB recommendations that will be fully implemented by the FAA by $2-3$ percentage points. I further find tentative evidence that fluctuations in the amount of regulations contained in the Code of Federal Regulations are positively associated with lagged industry growth rates for both FAA regulations (CFR Title 14) and the air travel industry, and for agriculture and animal regulations (CFR Titles 7 and 9) and farming output growth. Here, the amount of regulations in the CFR is proxied by RegData variables (Al-Ubaydli and McLaughlin, 2012). Finally, additional suggestive evidence based on federal government reviews of proposed regulations across U.S. government agencies similarly suggests that such regulations are significantly more likely to be subject to stricter oversight when issued during economic downturns.

In sum, the findings of this paper are consistent with the possibility that there are multiple margins along which regulators can and do - in some cases - adjust rulemakings based on the state of the economy. Whether these adjustments are socially optimal, and to which extent they can approximate the benefits of *explicitly* state-contingent regulations, remains an interesting question for future research.

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7 Appendix

Figure 21 depicts the share of "unacceptable" FAA responses to NTSB safety recommendations by year of case closure:

Figure 22 shows how the share of "unacceptable" FAA responses to NTSB safety recommendations varies with the lagged air transport industry growth rate by year of case closure:

Table 4 provides the OLS regression results for OIRA regulatory review designations:

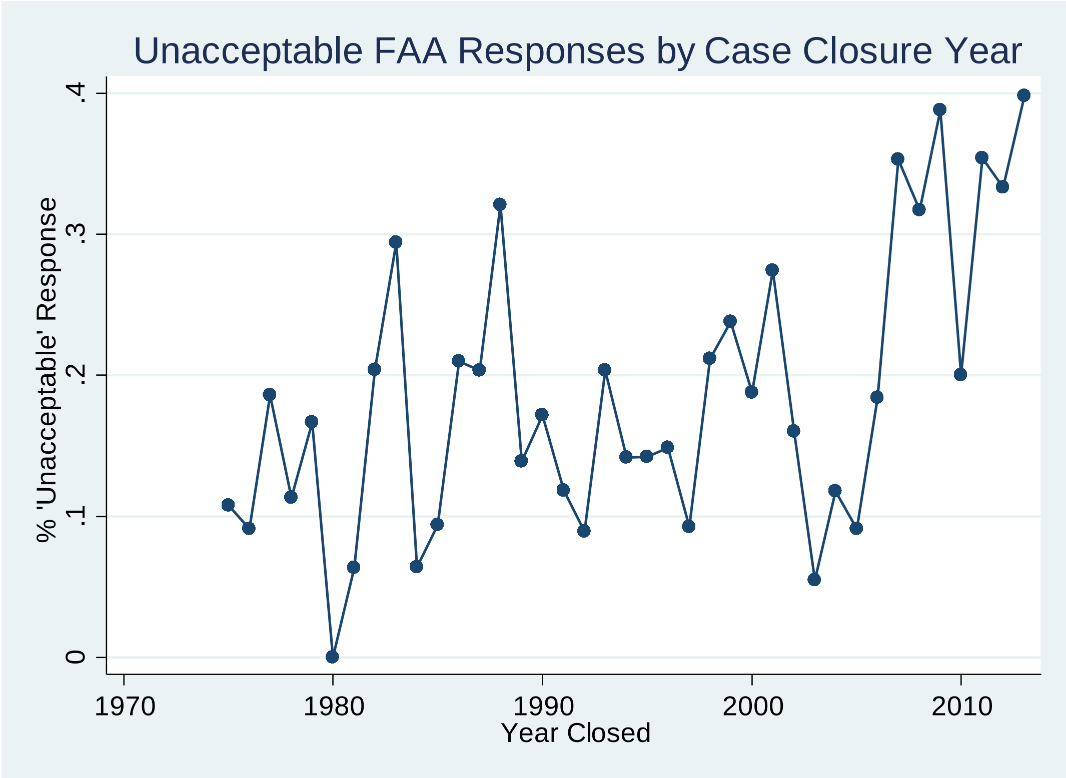


Figure 21: Figure 21

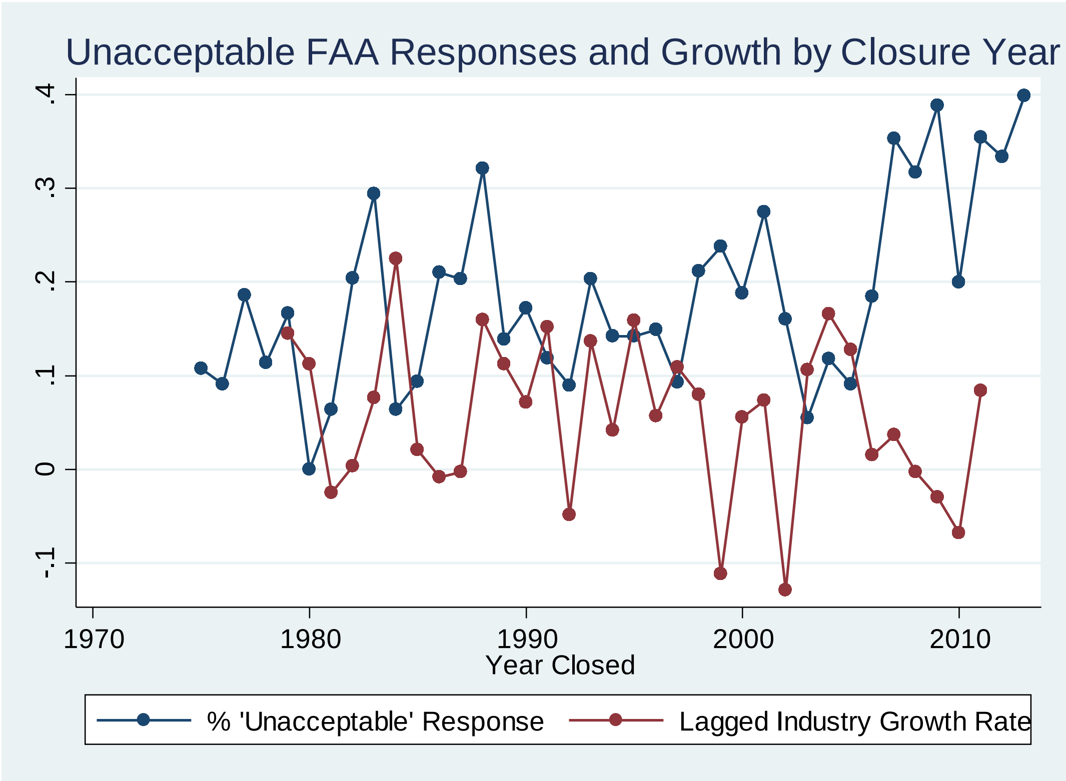
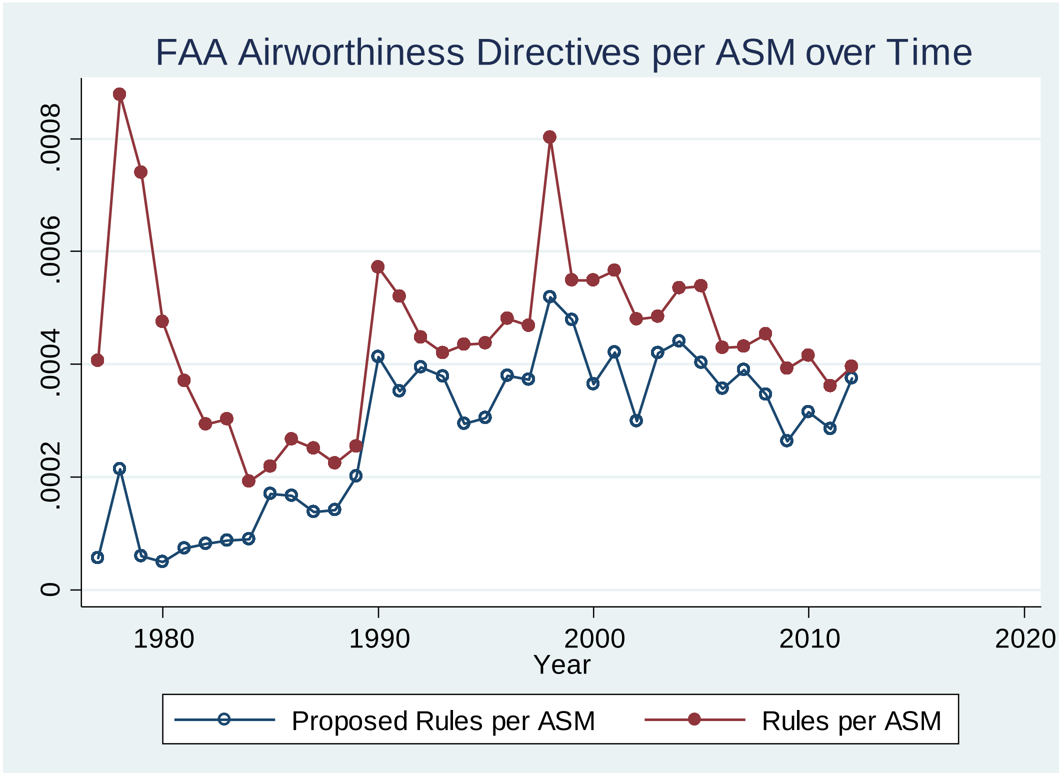
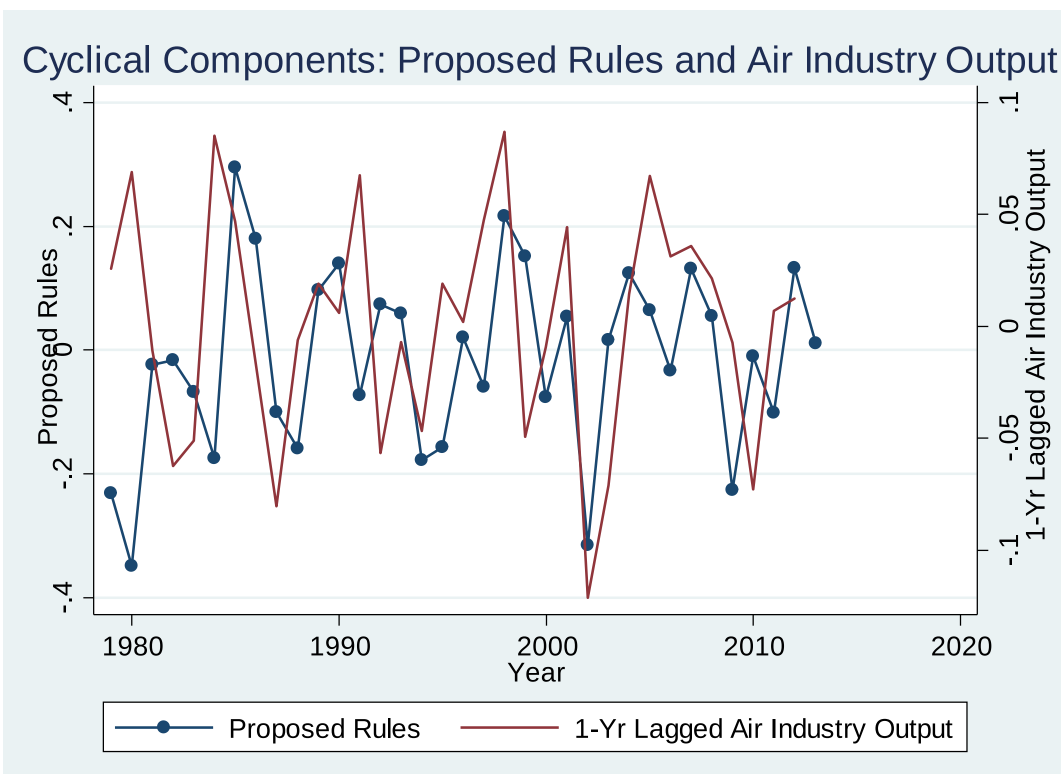
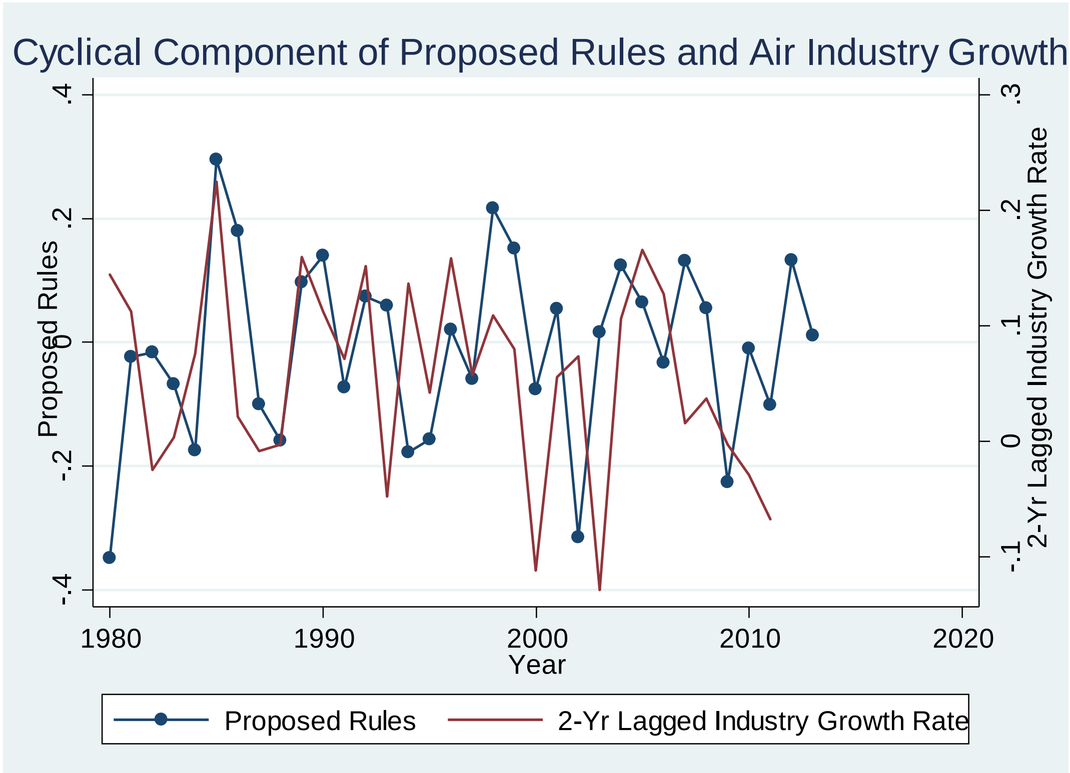
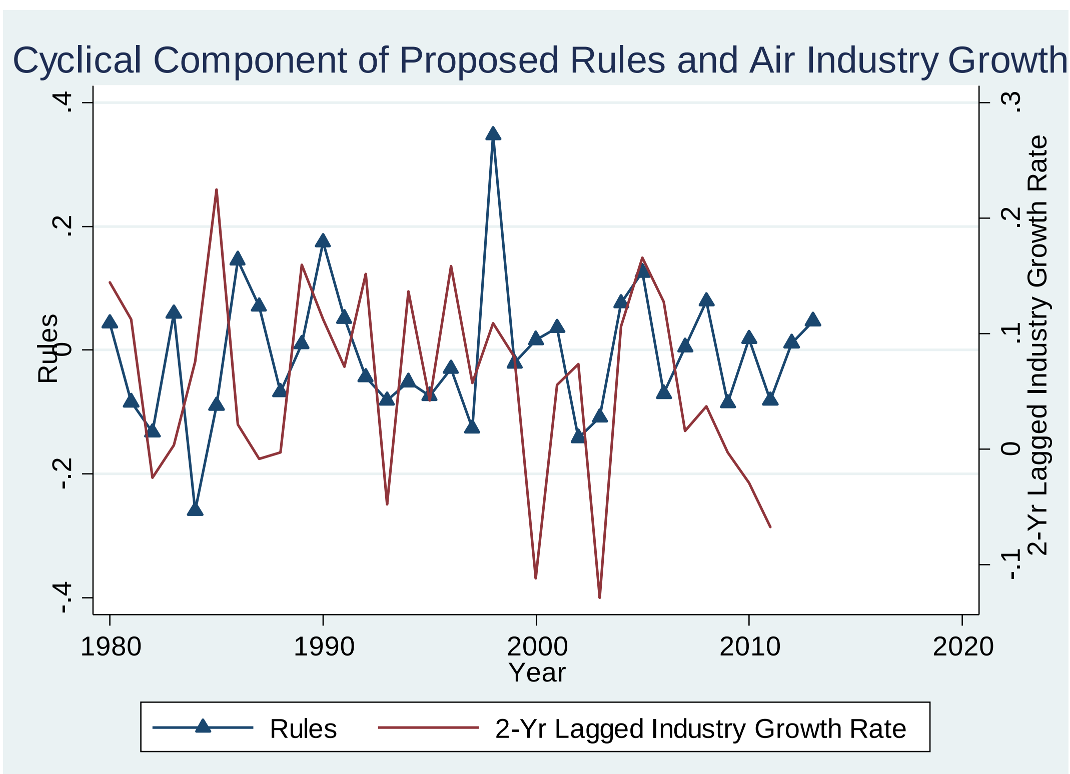


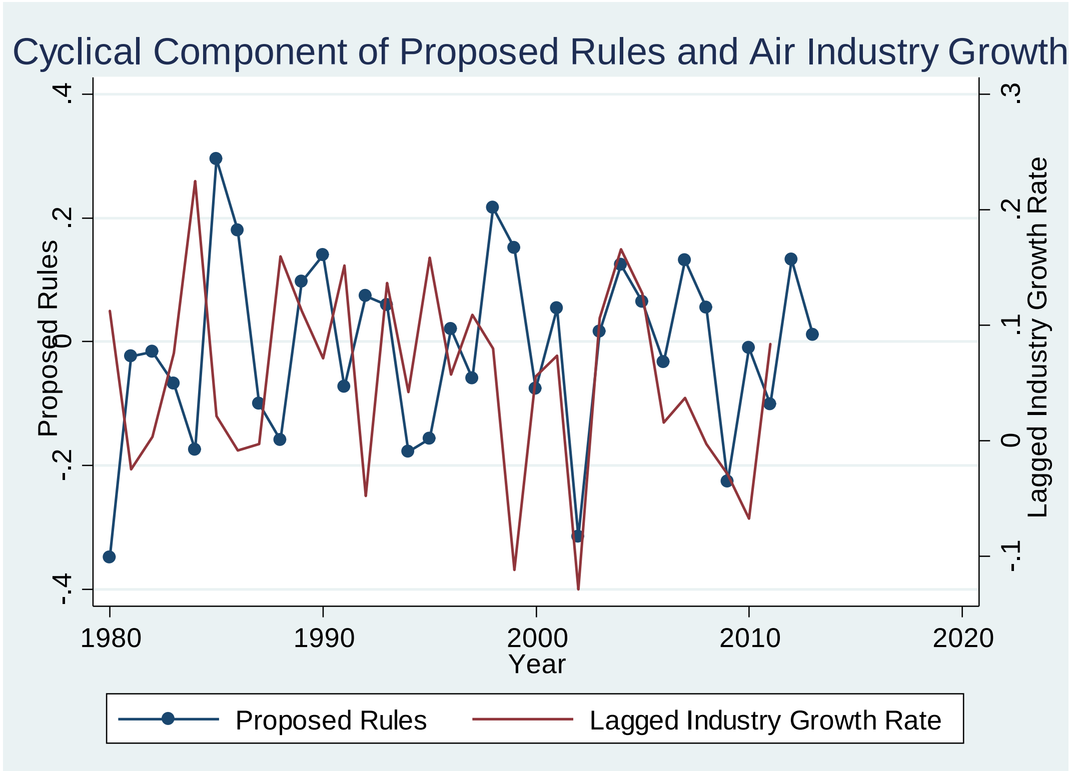
Figure 22: Figure 22

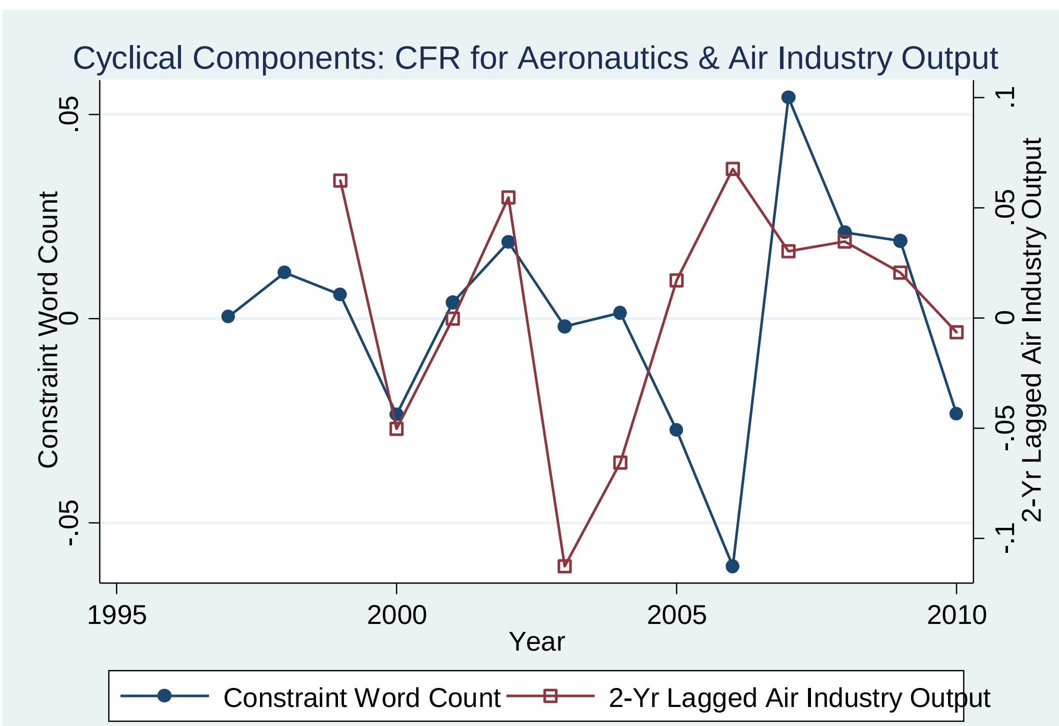

FAA Airworthiness Directives per ASM over Time
0
.0002
.0004
.0006
.0008
1980
1990
2000
2010
2020
Year
Proposed Rules per ASM
Rules per ASM


Cyclical Components: Proposed Rules and Air Industry Output
Proposed Rules
-.4
-.2
0
.2
.4
1-Yr Lagged Air Industry Output
-.1
-.05
0
.05
.1
1980
1990
2000
2010
2020
Year
Proposed Rules
1-Yr Lagged Air Industry Output


Cyclical Component of Proposed Rules and Air Industry Growth
Proposed Rules
-.4
-.2
0
.2
.4
2-Yr Lagged Industry Growth Rate
-.1
0
.1
.2
.3
1980
1990
2000
2010
2020
Year
Proposed Rules
2-Yr Lagged Industry Growth Rate


Cyclical Component of Proposed Rules and Air Industry Growth
Rules
-.4
-.2
0
.2
.4
2-Yr Lagged Industry Growth Rate
-.1
0
.1
.2
.3
1980
1990
2000
2010
2020
Year
Rules
2-Yr Lagged Industry Growth Rate





CFR data source: RegData, Al-Ubaydli and McLaughlin (2012)

Table 4: Regression Results for OIRA Review Designations

	%"Economically Significant"
Real GDP Growth Rate	-0.493***
	(0.174)
Lagged Real GDP Growth Rate	-0.235
	(0.172)
Quarter	0.0572***
	(0.0203)
Democrat	3.464***
	(0.832)
Constant	5.723
	(3.865)
Observations	76
R-squared	0.376

OLS regression of the fraction of OIRA regulation reviews between 1994-2012 deemed "economically significant" on quarterly (seasonally adjusted) real (chained 2009) GDP growth rates, a linear time trend, and a dummy for Democratic President.

Table 4: OIRA Review Designations