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Demonstrated risk preferences and COVID-19 regulations in the United States

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Abstract
Research has pointed towards U.S. state officials setting COVID regulations based on their constituents' political affiliation. But a further explanation is needed as prior to 2020, U.S. voters did not choose their political party in accord with how they thought politicians would act in a pandemic. In contrast, other papers have found that people with higher risk preferences took fewer mitigating actions during COVID. Building on these results and the public choice view that political markets lack a dynamic-feedback process, this paper hypothesizes that upcoming elections incentivized state officials to partially set regulations in congruence with their constituents' demonstrated risk preferences. The hypothesis is tested with a balanced panel of all U.S. states over seven time periods ranging from April until shortly before the 2020 election. A log-linear hybrid model finds a negative relationship between risky actions and the stringency of COVID regulations at the between-state level. The relationship is statistically and regulatorily significant while controlling for relevant time-varying and time-invariant health, political, and economic measures. Multiple robustness tests confirm these results, including instrumenting people's risky actions. At the within-state level, regulations only varied with changes in revealed risk preferences when governors faced impending feedback from a reelection contest. Republican governors running for reelection decreased regulations when revealed risk taking increased whereas their Democratic counterparts responded by increasing regulations. In states without a gubernatorial election, regulations show little responsiveness to changes in risk taking, corroborating the public choice viewpoint.

Keywords COVID-19 · Regulatory federalism · State-level regulations · Risk preference

1 Introduction

'I prefer dangerous freedom over peaceful slavery – Thomas Jefferson'. Written on a placard at a Harrisburg Pennsylvania demonstration against shelter-in-place orders.[1]

[1] Another placard read, 'My rights don't end, where your fear starts!' (Hutchinson, 2020).

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Now forgotten or ignored, Donald Trump spoke strongly about fighting the COVID-19 pandemic in its early days, even calling himself a 'wartime president' in March (Oprysko & Luthi, 2020). By the next month, Trump's stance had softened and his administration provided a plan for how states should go about reopening (CDC Timeline, 2023). This left local officials free to determine their COVID response, leading to noticeable between-state differences in regulations as measured by the Oxford COVID-19 Government Response Tracker (OxCGRT) (Hale et al., 2021).[2] States with Republican leaders or where voters backed Republicans nationally tended to impose a lighter regulatory touch relative to bluer states (Baccini & Brodeur, 2021). But political party membership is not a satisfying explanation of COVID regulations as few if any U.S. voters made choices prior to 2020 based on how they thought politicians would handle a pandemic. Recognizing this, some hypothesized that Trump's cues (McLaughlin et al., 2021) led Republicans to downplay COVID risks. This explanation also underwhelms. In the same month Trump spoke of his COVID leadership in militaristic terms, polls revealed that compared to Democrats, Republicans believed COVID posed fewer economic and health risks (Pew Research Center, 2020), suggesting that differences in people's attitudes to risk had formed prior to changes in Trump's statements.

Research has shown that those with high risk preferences adopted fewer COVID-mitigating behaviors (Byrne et al., 2021) and this paper seeks to determine if these preferences influenced states' regulation setting. Hypothetically, governors and health departments could have increased regulations to limit actions that derived from people's risk preferences, a stance this paper calls the paternalistic approach. Alternatively, a risk-tolerant stance would entail lower regulations where people demonstrated higher risk preferences and higher regulations where people displayed risk aversion. Lastly is the indifferent approach, in which regulations bear no relation to people's risk preferences.

The risk-tolerant approach may appear incongruent with scholarship from the public choice tradition which holds that a limited dynamic-feedback process in politics, as opposed to markets, mutes the urgency with which politicians respond to their constituents' demands (Mises, 1996; Sutter, 2002). But political actors are also self-interested, another staple of public choice theory (Buchanan & Tullock, 1965). With nine incumbent governors standing for reelection in 2020, it is possible that officials partially set regulations in accordance with an observable aspect of regulatory demand, in this case, people's demonstrated risk preferences. This would result in regulations' stringency and populations' risk preferences having a negative between-state association. Outcomes are less certain at the within-state level. The prospect of gaining more votes should incentivize governors facing reelection to lean towards risk tolerance. However, they may go the paternalistic route where their voters frown on others taking risks. Absent reelection, state executives had little impetus to respond to changes in people's demonstrated risk preferences.

These hypotheses are tested with a balanced panel of all U.S. states over seven periods ranging from April to late October 2020. A log-linear hybrid model finds a negative relationship between risky actions and the strength of COVID regulations at the between-state level. The relationship is statistically and regulatorily significant while controlling for relevant time-varying and time-invariant health, political, and economic variables. Robustness tests confirm these results, including two that instrument people's risky actions. The risk-tolerant approach also holds at the within-state level when Republican governors stood for reelection in 2020. In contrast, states with Democratic governors running for reelection

[2] From 1 April to 31 October, the average daily Containment and Health Index ranged from 46.34 (South Dakota) to 74.98 (New Mexico). See Sect. 4.1 for a further explanation of this Index.

exacted more regulations when risk taking increased. Governors without a reelection contest took an indifferent approach to regulation setting.

The rest of the paper is as follows. Section 2 reviews the literature on individuals' and state regulators' differing stances on COVID while also summarizing the findings on the relationship between risk preference, actions during COVID, and U.S. political party affiliation. The paper then considers state officials' potential responses to their constituents' risk preferences along with two testable hypotheses concerning between- and within-state differences in regulations. The fourth section explains the data and model used to test these hypotheses while the fifth section discusses the results. Section 6 provides concluding remarks.

2 Literature review

2.1 Differences in COVID regulations

Researchers have sought an underlying explanation of the correlation between people's party affiliation and opinions on COVID regulations. In addition to Trump's messaging, Democratic congressional members tweeted more about COVID than did their Republican colleagues (Green et al., 2020) while the news also influenced people's views (Bruin et al., 2020). Kerr et al. (2021) posit that pandemic measures increased the size and invasiveness of the state which did not sit well ideologically with U.S. conservatives. Bazzi et al. (2021) argue that people living in areas with a lengthier experience along something that closed 130 years before the COVID outbreak, the U.S. frontier, resisted regulations due to a shared historical inheritance that bred 'rugged individualism' and distrust of the state. Barbalat and Frank (2022) say 'antisocial traits' help explain why Republicans followed COVID regulations less closely.

Explaining regulatory differences between states, Mayer et al. (2022) say that Trump pressured Republican governors to ease restrictions. Gonzalez-Eiras and Niepelt's (2022) surmise that Republican voters thought COVID posed minimal health risks while Republican governors personally disliked regulations. Miozzi and Powell (2023) imply that states where less regulations were democratically popular before the pandemic set less stringent regulations during the pandemic. Murray and Murray (2022) contend that Democratic governors had a higher probability of giving a stay-at-home order because their supporters preferred more COVID-health regulations. This is also why Democratic governors issued these orders faster than Republican governors who cared more about regulations' economic impact (Baccini & Brodeur, 2021). Adolph et al. (2021) write that this lag occurred because Republican leaders sell an anti-state and anti-science political message. Strong quarantine measures would have resulted in a loss of their political credibility amongst supporters. Stated differently, not quite in the spirit of the authors, U.S. state officials tried to democratically set regulations in an otherwise undemocratic time.

2.2 Risk preferences and COVID

This paper hypothesizes that the level of regulations set by state governments partially depended on their constituents' preference for taking risks. Psychology defines risk preference as an individual's willingness to make choices that can provide benefits but may entail adverse consequences (Mata et al., 2018). Economics categorizes a person as risk-averse if

they lose more utility from a potential loss than their utility increases from an equally probable gain of the same amount. No matter how assessed, risk-averse or risk-loving individuals behave in predictable ways. For example, the risk averse and those with greater perceptions of flood risk purchase more flood insurance (Petrolia et al., 2013). People with lower risk aversion tend to choose activities with potentially long-term negative health effects like smoking or not wearing a seatbelt (Anderson & Mellor, 2008) while those with higher risk preferences are less likely to purchase health insurance or spend as much on healthcare (Condliffe & Fiorentino, 2014).

The same is true of the relationship between risk preference, risk perception, and actions during COVID. Risk averse individuals adopted more mitigating practices such as mask wearing (Xu & Cheng, 2021). Higher levels of general risk aversion and intolerance of uncertainty predicted greater fear of COVID in the group surveyed by Millroth and Frey (2021), directly and indirectly predicting their fear via heightened anxiety. Californians with a higher risk tolerance were more likely to leave their home or interact with others for purposes allowed under the state's stay-at-home order (Keth & Wright, 2020). In a cross-country comparison, people living in regions with higher risk preferences had a greater probability of visiting places classified 'retail and recreation' during the pandemic (Chan et al., 2020). Those with higher risk preferences in France took more trips outside their quarantine home and showed lower support for quarantines and their extension (Guillon & Kergall, 2020).

Studies also found that risk preferences influenced pandemic-related behavior independently of political affiliation. Byrne et al. (2021) report that making riskier gambling choices better predicted less mask wearing and less social distancing than the statistically insignificant political affiliation variables, with Republican respondents taking riskier gambles than Democrats or Independents (Byrne et al., 2021). Controlling for political affiliation, risk averse people and people with higher risk perceptions had a greater likelihood of adopting mitigating actions (Kassas et al., 2021), conclusions corroborated by Thomas et al. (2022). In Fan et al. (2020), Republicans assessed themselves as generally more willing to take risks than Democrats who adopted more COVID-mitigating actions. It is these differences in risk preferences amongst reasonable people that Bauchner and Fontanarosa (2020) say made regulators' decisions challenging.

3 Testable hypotheses

State officials could respond to their constituents' revealed risk preferences in one of three ways. The paternalistic approach would involve increasing COVID regulations to tamp down growing risk taking. Alternatively, states could take a risk-tolerant approach and set lower regulations where people had higher propensities for risk taking and higher regulations where people demonstrated lower risk preferences. Panels (a) and (b) of Fig. 1 illustrate these competing approaches. Officials may also take an indifferent approach. Here there will be no discernible relationship between the stringency of COVID regulations and risk preferences.

Officials justified the paternalistic approach in the spring of 2020 by arguing that people would act carelessly and spread COVID to others if left unregulated. In April, Gov. Phil Murphy of New Jersey said that the goal of COVID regulations was not to 'take away people's rights' but to 'save people's lives' (Vella, 2020). Jay Inslee said that he too supported free speech 'but crowd counts or speeches won't determine our (regulatory) course'

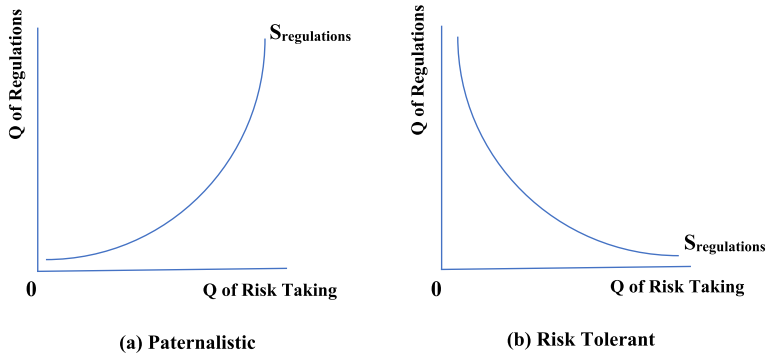

Fig. 1 Regulatory approaches

(O'Sullivan & Gutman, 2020) and Andrew Cuomo called spring breakers 'so unintelligent and reckless I can't even begin to express it' (CBS, 2020). Recommendations for further regulation and 'tailored lockdowns' (Dhillon & Karan, 2020) did not stop here. One group of scientists pushing for heightened winter restrictions lauded the 'robust public health responses' of Vietnam (Alwan et al., 2020) where local cadres spied and reported on those not following social distancing and quarantine rules (Ling et al., 2021). In the United States, California's shelter-in-place order remained in effect until the end of August, New Mexico's ended in November 2020.[3]

Yet this is not the full story of COVID regulations in the U.S. Seven states did not impose shelter-in-place orders and eleven did not issue a masking order.[4] These differences suggest a risk-tolerant approach which may seem at odds with public choice theory skeptical of government responsiveness to constituents' demands (Rowley, 1997, 2008). For instance, the political sphere does not have the dynamic-feedback process between buyers and sellers inherent in markets (Boettke et al., 2007; Rothbard, 1970). Voters will not necessarily know who to hold accountable for a policy or what the policy's long-term consequences are (Gwartney & Wagner, 1988). Even if they did, the ability to act occurs no sooner than the next election (Boudreaux, 1996). However, a risk-tolerant approach to regulations and the public choice critique of 'political markets' can both be true in this instance. With impending fall elections, state officials would have found it politically expedient to partially base COVID regulations on an observable aspect of people's preferences, that is their preference for taking risks. A negative relationship will then emerge between states' revealed risk preferences and the severity of COVID regulations. However, the latter may respond little to changes in demonstrated risk preferences within a state due to the lack of a dynamic-feedback process. The first hypothesis is:

[3] New Mexico fared poorly during the pandemic despite all the restrictions their officials imposed. It had the eighth highest age-adjusted COVID mortality rate amongst U.S. states in 2020 (CDC, 2023) and the second highest standardized total COVID death rate from 2020 to 22 (Bollyky et al., 2023).

[4] Nebraska and South Dakota were the only states that never issued either.

H1: A negative relationship exists between the strictness of states' COVID regulations and their populations' willingness to take risky actions.[5]

Two outcomes would falsify this hypothesis. Results showing a positive relationship between these variables would indicate that a paternalistic approach held sway between states whereas a weak relationship implies an indifferent approach.

The second hypothesis considers the influence of gubernatorial reelections on the response of regulations to within-state changes in demonstrated risk preferences. Empirical work on the political business cycle has shown that upcoming elections can galvanize politicians into choosing policies that increase their votes come reelection time (Bracco et al., 2023; Drometer & Méango, 2020). With an election in November 2020, the nine U.S. governors running for reelection would have had regulation-setting incentives more urgent than where the election schedule insulated them from anything like imminent feedback. Previously cited research showed that Democrats were more risk averse and favored stricter COVID regulations than Republicans (Blendon & Benson, 2020). The three Democratic governors running for reelection should then opt for paternalistic regulation setting to maximize their chance of winning. In contrast, a risk-tolerant approach would benefit the six Republican governors at the polls. Governors without a reelection incentive would more likely adopt an indifferent approach. The second hypothesis is:

H2: Democratic governors seeking reelection in 2020 will choose a paternalistic approach to regulation setting. Republican governors seeking reelection will choose a risk-tolerant approach.

This hypothesis does not necessarily contravene the public choice framework. It merely says that reelection can create an incentive strong enough for governors to consider voters' preferences. Absent this incentive, constituents' preferences are less likely to influence regulatory decisions. Falsification would come in the form of governors up for reelection choosing similar regulatory stances.

4 Data and model

4.1 Variables

The data are a balanced panel of all U.S. states spanning seven periods from spring to autumn 2020. The beginning dates depend on the first availability of data while the final date occurs just before the 2020 elections. By ending the period of inquiry here, the paper covers a timespan in which political leadership remained constant, eliminating the need to differentiate between people's views of a sitting president versus a sitting-duck president. Table A1 in the Appendix provides the dates of all time-varying variables.

[5] Both approaches could lead to government failure. The paternalistic approach by causing excessive internal costs, the risk-tolerant approach by causing excessive external costs (Hebert and Curry, 2022). Applied as a one-size-fits-all policy would have exacerbated these costs nationally, especially the paternalistic approach. One can only imagine the consequences of regulators requiring all U.S. care homes to admit COVID-positive patients like was done in New York. Not to mention evidence of COVID regulations lack of efficacy (Bollyky et al., 2023; Herby et al., 2023) or that officials might mismeasure negative externalities (Leeson and Rouanet, 2021).

The dependent variable is the natural log of the weekly average of the OxCGRT's Containment and Health Index (Hale et al., 2021), a daily index number between 0 and 100 that is comprised of two parts. The first is the Stringency Index which takes the measure of state-level restrictions like bans on gatherings. The second accounts for other state-government COVID interventions like masking requirements (Hale et al., 2023). The Containment and Health Index's average is taken for the week immediately following the end of waves measuring people's risky actions and their view of Trump's handling of COVID. Those variables come from the COVID States Project, an effort begun in the spring of 2020 by a group of academics with wide-ranging fields of expertise. Between April and October 2020, they reported eight waves surveying an average of over 21,000 people across all states. Once collected, the project's authors reweighted the data to match various demographic aspects of the United States (COVID States Project, 2023). This paper excludes the second wave (May 1–21) as it overlaps with the third.

Lacking a metric of a state's average risk preference, the variable Risky Actions measures how people demonstrated their preference for risk. Derived from the COVID States Project's surveys, it is an unweighted average of the proportion that did not answer Yes to 'very closely' following the recommendation to wear a facemask outside their home, wash hands frequently, avoid contact with people, and avoid public or crowded places. Combining these four answers gives a single measure of how people's risk preferences revealed themselves to state officials.[6] Risky Actions precedes the dependent variable in time, but shelter-in-place laws measured by the dependent variable may have stymied social interaction just as masking mandates might have induced people to use facial coverings. In an attempt to avoid this simultaneity bias, regressions include the variables Shelter and Masks. The first is the proportion of days in which a state's shelter-in-place order was in effect during that survey wave (Ballotpedia, 2021b). The second makes the same measurement for masking requirements (Ballotpedia, 2022).

A potential objection to Risky Actions is that it measures risk perceptions, not risk preferences. Both are related, however. People with higher risk preferences have a greater propensity for risk taking and for perceiving less risk. The opposite is true of those with low risk preferences (Sitkin & Pablo, 1992). A second objection is that Risky Actions measures people's uncertainty. To test this, two later regressions use only the final five periods. By June, people had greater certainty about who was at risk from COVID, just as their risk preferences would have had time to adjust to the pandemic's initial shock. In addition, a measure of each state's violent crime rate is included as a proxy for empathy as these variables are negatively correlated across U.S. states (Bach et al., 2017).

Another concern is omitted-variable bias which this paper does its best to minimize by including relevant controls. The variable Trump Approval comes from the same surveys and respondents as Risky Actions. It calculates the proportion of a state's population that somewhat or strongly approved of Trump's COVID response.[7] To some extent it captures people's political beliefs and possibly the news they watched as there is a robust correlation of 0.926 between each state's average Trump Approval and the percentage of the vote he won in 2016. COVID States provides the same measure for governors, but to avoid

[6] Public protests of regulations are another way.

[7] The panel excludes Washington D.C. because COVID States did not report their response for Trump Approval.

endogeneity, the proportion of the vote the governor won in the previous election is used.[8] A quadratic term is included because a binned scatterplot shows non-linearities between it and the dependent variable. Both are interacted with a dummy variable equal to 1 for states with a Republican governor.

Prison Release aims to control for regulatory enforcement.[9] It measures the proportion of the prison population (Carson et al., 2022) freed by a state order (Mitchell et al., 2022). Governments enacted these policies to minimize the spread of COVID in penitentiaries and we might expect that states concerned enough to release prisoners were more likely to enforce COVID orders. Most releases came in the pandemic's early stages which is when news outlets reported arrests of people not following regulations like the man cited for reading a book at a closed New Jersey beach (Attrino, 2023). This occurred in the same month New Jersey's governor signed an executive order that led to the expedited release of more than 1,200 prisoners (Mitchell et al., 2022). Fewer releases took place as time passed, just as the enforcement of restrictions diminished (Kaste, 2020).

Regressions also include two time-varying controls for health outcomes. The first is the state's COVID deaths (USAFacts, 2023) per 1,000 people (USAFacts, 2022) for the week preceding the dependent variable's measurement. Beds Open measures the proportion of unutilized inpatient beds in a state (U.S. HHS., 2023) on the day before the start of the dependent variable. The final time-varying controls are a state's average monthly temperature (NCEI, 2023) and its weekly insured unemployment rate (U.S. Employment and Training Administration, 2023).[10] Officials might have loosened regulations during warmer weather when the spread of COVID lessened (Chen et al., 2021) or as the economy worsened, although Murray and Murray (2022)'s findings do not support the latter.

Time-invariant regressors include Reelection which takes a value of 1 for the nine states where the incumbent governor sought reelection in November (Ballotpedia, 2021a). Old Pop, Black (USAFacts, 2022), and Obesity (CDC, 2022) respectively measure the proportion of a state's population greater than or equal to 65 years of age, African American, or obese in 2020, all three groups at heightened risk from COVID. Education is the proportion of a state's population that completed college as of 2016–20 (USDA, 2023), less schooling associated with worse health outcomes (Zajacova & Lawrence, 2018). Urban is the proportion of a state's population living in urban centers in 2020 (U.S. Census Bureau [Census], 2023) as COVID spread more easily in densely populated areas (Wong & Li, 2020). The natural log of a state's 2019 real median household income (FRED, 2021) looks at whether state governments with more to lose in tax revenue were less willing to stifle their economies with higher regulations. People's regulatory expectations may influence their actions so every estimate includes the Cato Institute's 2019 assessment of a state's fiscal, regulatory, and personal obligations. Higher index numbers indicate lower regulations (Institute and [Cato], 2021) and this regressor may also account for path dependency in regulation setting. All regressions contain a full set of time dummies.

[8] Missouri's governor Mike Parson's share of the vote he won in the 2016 lieutenant governor race is used. Parson came to power when his predecessor, Eric Greitens, resigned in 2018. Both won similar shares of the vote in 2016.

[9] OxCGRT regulatory indexes do not measure enforcement (Hale et al., 2023).

[10] Honolulu's average temperature is used for Hawaii (World Weather Online, 2023). The unemployment rate is for the week ending closest to the start of the dependent variable without overlapping in time.

4.2 Model

A log-linear hybrid estimator tests this paper's hypotheses. Like the STATA program developed by Schunck and Perales (2017), the hybrid model includes time-demeaned variables, the time-varying regressors' averages, and time-constant variables. By using random effects to estimate the regression, it reports both within- and between-state effects without assuming they have the same effect on the dependent variable. The model's time-demeaned variables give results nearly identical to a fixed-effects estimation just like the coefficients on their averages and the time-constant variables show differences between states like a between-effects estimator. Economists tend to prefer fixed-effects models because they reduce omitted-variable bias, but applied here, fixed-effects would only estimate variation in regulations within states whereas this paper's first hypothesis pertains to variation in regulations between states. The model used is:

$$lnY_{it} = \ddot{X}_{it-1}\beta_1 + \overline{X}_i\beta_2 + C_i\beta_3 + \mu_i + \varepsilon_{it}$$

The dependent variable is the natural log of the Containment and Health Index's average for state i in week t. $\ddot{X}$ is a vector of lagged, time-demeaned variables such as Risky Actions. $\overline{X}$ is a vector of the time-varying regressors' averages. C is a vector of the time-constant variables. μ is the random intercept for every state i and the error term of the time-constant variables. It is assumed to be uncorrelated with these variables. ε is the error term for the time-varying variables, also assumed to be uncorrelated with them. Table 1 provides the variables' summary statistics. The top panel of Fig. 2 shows a binned scatterplot of the dependent variable and Risky Actions with a linear predicted line. The bottom panel uses the state averages of Risky Actions. Both demonstrate a negative relationship.

To my knowledge, only Gonzalez-Eiras and Niepelt (2022) tested a similar hypothesis. Their variable *early_activity* measures how much voluntary movement in the U.S. changed just prior to the imposition of COVID restrictions. It has a negative relationship with their two regulatory dependent variables, a relationship they call 'complementarity'.[11] That is, as people reduced voluntary movement, state officials found it easier to impose regulations. Both regressions cover a shorter period than this paper and exclude the seven states that never issued stay-at-home orders. If the authors' complementarity interpretation is correct, then regulators from these seven states presumably threw up their hands at the thought of ever controlling their unruly populations. This paper's data tell another story. The correlation between the average of the dependent variable and the 2019 Regulatory Index is a moderate to strong one of −0.537. Like Miozzi and Powell (2023), this shows that the stringency of a state's regulations during COVID mirrored the stringency of their regulations before COVID.

5 Results

5.1 Initial tests

Table 2 reports nine variables of interest and the constant, their standard errors clustered at the state level. The first two columns use Random Effects. More than just baseline

[11] The authors define 'substitutability' as the hypothetical situation where state governments imposed fewer restrictions on people that voluntarily reduced their movement.

Table 1 Summary statistics

Variables	Mean	Std. Dev	Min	Max	*N*
Containment & health index (ln)	4.084	0.132	3.722	4.356	350
Risky actions	0.374	0.074	0.195	0.628	350
Death rate	0.02	0.027	0	0.266	350
Beds open	0.36	0.105	−0.93	0.727	350
Trump approval	0.366	0.08	0.184	0.617	350
Unemployment	0.089	0.487	0.01	0.277	350
Prison release	0.003	0.022	0	0.339	350
Shelter	0.194	0.386	0	1	350
Masks	0.464	0.49	0	1	350
Temp (ln)	4.163	0.192	3.363	4.442	350
Reelection	0.18	0.384	0	1	50
R. gov	0.52	0.5	0	1	50
Gov. win	0.551	0.057	0.48	0.765	50
Gov. win (sq)	0.307	0.068	0.23	0.585	50
Old pop	0.169	0.018	0.114	0.212	50
Obesity	0.322	0.039	0.242	0.397	50
Black	0.105	0.093	0.005	0.376	50
Education	0.314	0.065	0.036	0.445	50
Urbanization	0.724	0.146	0.351	0.942	50
Median y (ln)	11.19	0.163	10.767	11.525	50
Regulatory index	0.082	0.278	−0.813	0.591	50
Crime rate	3.654	1.501	1.152	8.671	50

Overall standard deviations are reported. $N = 50$ for time-constant variables. The minimum of Beds Open is negative due to Rhode Island reporting more than 100% of their hospital beds utilized in one period

estimates, they tell the importance of omitted variables. Trump Approval is neither regulatorily nor statistically significant in column (1), but it does have the expected negative sign. After the addition of Risky Actions in column (2), its coefficient shrinks considerably. The variable fares no better when these results are broken down into within- and between-state variation.[12] Failure to control for relevant factors like people's demonstrated risk preference or analyzing shorter timeframes may explain why earlier papers found stronger, negative relationships between the degree of a state's regulations and its support for Trump.

The Risky Actions coefficient in column (2) is statistically robust at conventional levels and has a negative sign which corroborates the first hypothesis. However, the change in the dependent variable associated with a change in Risky Actions is not as large as it may first appear. Like the other variables in these models, Risky Actions is calculated as a proportion, not a percent. A one standard deviation increase in Risky Actions is then associated

[12] Using Trump's share of the 2016 vote instead of Trump Approval produces imprecisely estimated coefficients that are either regulatorily negligible or have positive signs.

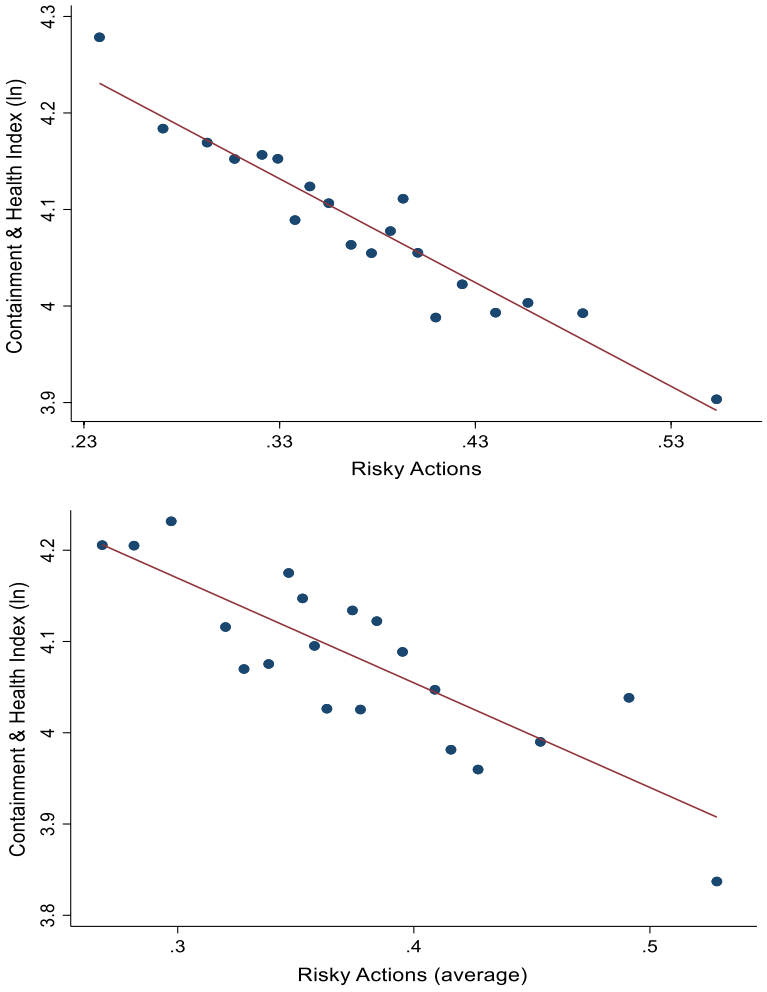

Fig. 2 Binned scatterplot of containment and health index with risky actions. *Notes* The top panel uses time-varying Risky Actions, the bottom panel uses its state-specific average

with a 1.95% decrease in the Containment and Health Index.[13] The next two columns separate the variables' within- and between-state variation. At the within-state level, the Risky Actions coefficient is not statistically significant nor is it particularly large. This may be due to limited variation in this variable at the within-state level or state regulators paying minimal heed to changes in their constituents' risk taking. The between-state estimation in column (4) tests Hypothesis 1 and accounts for more than 81% of the variation in the dependent variable between states. The Risky Actions coefficient corroborates the risk-tolerant explanation of regulation setting. A state with average Risky Actions one standard

[13] The calculation is $1.95 = \left[\left(e^{-0.267\times0.074}\right) - 1\right] \times 100$. Subsequent calculations are made the same way with the relevant standard deviation.

Table 2 Results

Variables	(1) RE	(2) RE	(3) Within	(4) Between	(5) Within	(6) Between
Risky actions		−0.267* (0.147)	−0.154 (0.167)	−1.288*** (0.307)	−0.039 (0.152)	−1.024*** (0.319)
Trump approval	−0.044 (0.071)	−0.008 (0.073)	−0.034 (0.079)	0.313 (0.204)	−0.038 (0.096)	−0.003 (0.226)
Beds open	−0.141* (0.082)	−0.131 (0.085)	−0.109 (0.084)	−0.149 (0.141)	−0.141 (0.189)	−0.24 (0.166)
Reelection	−0.007 (0.023)	−0.012 (0.022)		−0.029* (0.017)		−0.018 (0.024)
R. gov	−4.852** (2.306)	−4.507** (2.209)		−5.323** (2.257)		−6.172** (2.548)
R.gov × Gov. win	17.4** (8.433)	16.091** (8.091)		19.145** (8.402)		21.984** (9.437)
R.gov × Gov. win (sq)	−15.656** (7.72)	−14.428* (7.416)		−17.195** (7.819)		−19.505** (8.695)
Obesity	−0.446 (0.3)	−0.415 (0.295)		−0.539* (0.313)		−0.456 (0.399)
Old pop	1.338*** (0.484)	1.21** (0.471)		0.574 (0.634)		0.925 (0.579)
Constant	9.822*** (2.764)	9.946*** (2.628)		13.732*** (3.039)		15.613*** (3.178)
R^2	0.623	0.645	0.461	0.811	0.3	0.798
N	350	350	350		250	

***p < 0.01; **p < 0.05; *p < 0.1. Clustered standard errors are in parentheses, clustering done at the state level. Containment & Health Index (ln) is the dependent variable. R^2 overall is reported for columns (1) and (2). Columns (3)-(6) report hybrid model results, the last two using only the final five periods. Within columns report R^2 within. Between columns report R^2 between. All regressions include a full set of time dummies

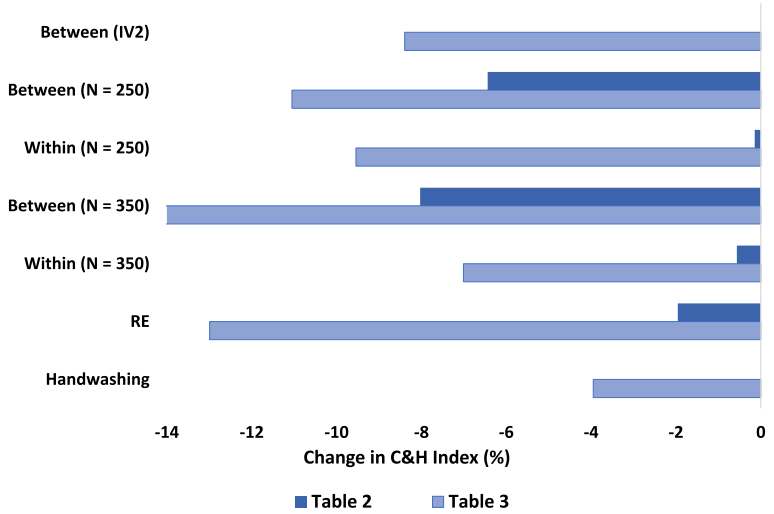

Fig. 3 Responsiveness of regulation to changes in risky actions. *Notes* The % change in the dependent variable is in response to a one standard deviation increase in Risky Actions. The same standard deviations are used for the non-IV and IV regressions. Handwashing: SD between = 0.0383; RE: SD overall = 0.074; Within: SD within = 0.0367; Between: SD between = 0.065

deviation higher than another state (6.5% higher in percentage terms) is associated with an 8.03% lower Containment and Health Index.

Columns (5) and (6) exclude the first two periods to assess whether Risky Actions measures uncertainty. Again, the results tell a consistent story. Risky Actions at the within-state level indicates an indifferent approach to regulation setting. At the between-state level, a state with one standard deviation higher Risky Actions would have 6.43% lower regulations. The result is smaller than column (4) though both point towards constituents' desire to take risks influencing differences in COVID mandates. Figure 3's dark blue columns display these associations.[14]

Of some surprise is that health factors played an indeterminate role or have intuitively contradictory correlations with the degree of COVID regulations. The most noticeable is the negative sign on Obesity's coefficient. It is statistically and regulatorily robust, suggesting that COVID mandates failed to account for some of the most at-risk people. Political results show lower regulations in states where incumbent governors faced reelection, a topic that Sect. 5.3 considers in more nuance. Column (4) also indicates that for an average proportion of the vote won (55.1% in percentage terms) in their last election, states with a Republican governor show scant regulatory differences with states run by a Democratic governor. When the vote share nears 60% and above, then states with Republican governors had lower regulations relative to those with a Democratic governor.

5.2 Robustness tests

The first robustness test reduces Risky Actions to the proportion of people that did not answer Yes to very closely following the recommendation of frequent handwashing. States

[14] Figure 3's notes explain the appropriate standard deviations used.

Table 3 Robustness tests

Variables			IV1					IV2
	(1) Within	(2) Between	(3) RE	(4) Within	(5) Between	(6) Within	(7) Between	(8) Between
Risky actions			−1.881** (0.948)	−1.98 (1.885)	−2.334*** (0.817)	−2.733 (5.518)	−1.802** (0.763)	−1.349** (0.624)
Handwashing	−0.042 (0.139)	−1.052** (0.443)						
Trump approval	−0.05 (0.076)	0.002 (0.249)	0.2 (0.152)	0.186 (0.242)	0.377 (0.237)	0.369 (0.83)	0.115 (0.252)	0.325 (0.216)
Beds open	−0.111 (0.085)	−0.165 (0.161)	−0.033 (0.122)	−0.067 (0.119)	−0.088 (0.164)	0.057 (0.445)	−0.183 (0.191)	−0.145 (0.147)
Reelection		−0.024 (0.017)	−0.043 (0.028)		−0.045** (0.022)		−0.03 (0.024)	−0.03* (0.017)
R. gov		−4.569* (2.417)	−2.582 (2.306)		−5.485** (2.586)		−6.624** (2.654)	−5.208** (2.315)
R.gov × Gov. win		16.508* (8.972)	8.781 (8.497)		19.663** (9.59)		23.593** (9.784)	18.71** (8.639)
R.gov × Gov. win (sq)		−14.858* (8.318)	−7.588 (7.795)		−17.704** (8.878)		−20.983** (8.975)	16.79** (8.043)
Obesity		−0.513 (0.346)	−0.262 (0.341)		−0.5 (0.371)		−0.461 (0.425)	−0.558* (0.308)
Old pop		0.961 (0.634)	0.508 (0.7)		0.153 (0.807)		0.658 (0.729)	0.477 (0.724)
Constant		12.248*** (3.186)	10.862*** (2.643)		16.128*** (3.963)		17.557*** (3.629)	13.717*** (3.181)
	0.459	0.785	0.584	0.269	0.783	0.054	0.778	0.805
N	350	350	350	350		250		343

***$p<0.01$; **$p<0.05$; *$p<0.1$. Clustered standard errors are in parentheses, clustering done at the state level. Containment & Health Index (ln) is the dependent variable. For columns (3)–(7), IV1 instruments Risky Actions. Smoking rates, seatbelt non-usage, and new entrepreneurs instrument the Risky Actions average in column (8) which excludes Utah. See the text for more details. Columns (4)–(7) report hybrid model results, the last two using only the final five periods. RE reports R^2 overall. Within columns report R^2 within. Between columns report R^2 between. All estimates include a full complement of time dummies

never mandated handwashing which should reduce some of the potential for simultaneity bias. Table 3's hybrid estimation with handwashing gives results like those in Table 2. A state that is one standard deviation higher in the proportion of people that did not frequently wash their hands (3.83%) had a 3.94% lower Containment and Health Index. However, there is little support for Handwashing playing a role at the within-state level.

It is possible, if unlikely, that Handwashing measures people's lack of cleanliness, not their willingness to take risks. In addition, simultaneity bias may still plague the regressions that used Risky Actions. To get around these problems, Table 3's other estimates use the instrumental variable IV1 which applies the Risky Actions of one state to the state deemed most similar by www.objectivelists.com. For example, the Risky Actions of North Dakota are applied to South Dakota and vice versa. The idea is that similar populations would demonstrate similar levels of risk taking. Regressing Risky Actions on IV1 results in a statistically significant coefficient at the less than 1% level where a 1 unit increase in IV1 is associated with a 0.78% increase in Risky Actions. The instrumental variable must also have no correlation with the error term. While not testable, there are sound reasons for believing this assumption holds. Previous measures of the Containment and Health Index contained in one state's idiosyncratic error should not affect the contemporaneous risk taking of people in another state.

Columns (3)–(7) in Table 3 run the same regressions as columns (2)–(6) of Table 2, but with IV1 instrumenting Risky Actions. The risk-taking coefficients all have negative signs and are larger than in Table 2 as shown by Fig. 3's light blue columns. The relationship is again smaller when using the June to October subset. Nonetheless, the figures in column (7) are statistically and regulatorily robust in their corroboration of the first hypothesis. The within-state results are particularly large as are their 95% confidence intervals, showing that IV1 is a weak instrument at the within-state level.

Column (8) gives the results of instrumenting the mean of Risky Actions with three time-constant, pre-pandemic measures of demonstrated risk preferences.[15] They are the state-level adult smoking rate (CDC, 2018), non-seatbelt usage rate (U.S. DOT., 2021), and the percentage of a state's population that started a new business (Kauffman Foundation, 2021), a proxy for entrepreneurship. Utah is not included in the estimate as the Mormon religion's proscription of tobacco makes the smoking rate a poor measure of Utahans risk preference.[16] The results again support the story that people's risk preferences influenced differences between states' COVID regulations. Denoted as IV2 in Fig. 3, the regulatory significance is similar to the other between-state outcomes.

5.3 Political influence

The second hypothesis holds that governors' party and reelection status modified how their states responded to changes in residents' demonstrated risk preferences. Six dummy variables were created to make this test. Two account for Democratic or Republican governors running for reelection and two more for those that were not. The final categories control for Montana and Utah which had gubernatorial elections where the incumbent did not run.[17] Each dummy variable was then interacted with Risky Actions, Utah serving as

[15] Time-constant variables cannot instrument time-varying Risky Actions.

[16] Including Utah produces a larger coefficient on the average of Risky Actions, − 1.431, that is not quite statistically significant at conventional levels.

[17] Utah's governor did not seek reelection while term limits ended the time in office of Montana's governor.

Table 4 Political interaction results

Variables	(1) FE	(2) FE
Handwashing		0.888*** (0.274)
Handwashing × D. reelect		−0.329 (0.355)
Handwashing × R. reelect		−1.668*** (0.372)
Handwashing × D.no elect		−0.824*** (0.266)
Handwashing × R. no elect		−0.947*** (0.249)
Handwashing × Montana		−0.057 (0.234)
Risky actions	0.621*** (0.195)	
Risky Actions × D. reelect	−0.522 (0.322)	
Risky Actions × R. reelect	−1.367*** (0.397)	
Risky Actions × D.no elect	−0.527** (0.213)	
Risky Actions × R. no elect	−0.879*** (0.245)	
Risky Actions × Montana	−0.101 (0.144)	
Constant	4.302*** (0.499)	4.322*** (0.492)
R^2	0.488	0.493
N	350	350

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$. Clustered standard errors are in parentheses, clustering done at the state level. Containment and Health Index (ln) is the dependent variable. R^2 within is reported. Each regression includes a full set of time dummies

the reference category. Because Risky Actions may have endogeneity issues, a second regression is run using the Handwashing variable. Fixed-effects regressions are used as any meaningful differences will occur at the within-state level where governors largely determined regulatory outcomes. This specification has the added benefit of reducing endogeneity bias by eliminating time-constant variables. That includes the gubernatorial dummies which never varied during the span of this study and thus do not appear in Table 4.

What is striking is that both results in Table 4 show some statistically and regulatorily robust relationships, something that never occurred in the previous hybrid models' within-state estimates. This supports the hypothesis that a state's regulatory response to risk taking in part hinged on a governor's political party and reelection status. Correctly interpreting the size of the results requires adding one category's interaction coefficient to the reference category's coefficient. Figure 4, which doesn't report Montana and Utah, does just this, visualizing the interactions' regulatory significance in the same way as Fig. 3.[18] The results agree with the second hypothesis. States with a Republican governor facing reelection are associated with a risk-tolerant approach. The smaller interaction coefficient for Republican governors not facing reelection suggests an indifferent approach, a not unexpected result in light of the public choice critique of political markets.

States where Democratic governors stood for reelection took a paternalistic approach which also corroborates Hypothesis 2. Calculations for Fig. 3 include this category's

[18] Percentage changes are calculated as the response to one within-state standard deviation increase in Risky Actions which is 3.67% in percentage terms. Using column (2)'s results, the regulatory response in a state with a Republican governor running for reelection is calculated as, $-2.82 = \left[\left(e^{[(0.888-1.668)\times 0.0367]}\right) - 1\right] \times 100$.

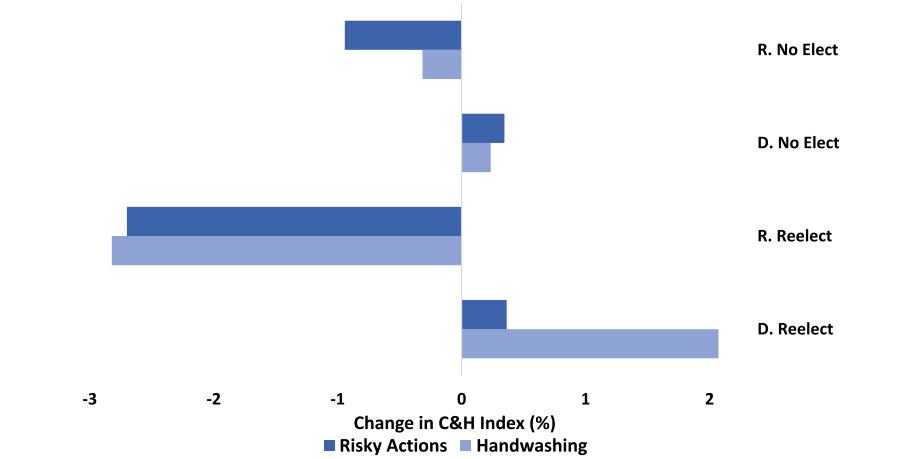

Fig. 4 Political effect on regulatory responsiveness to changes in risk taking. *Notes* The % change in the dependent variable is in response to one within standard deviation increase in Risky Actions which is 0.0367

interaction coefficients even though they are not precisely estimated. Excluding them, however, only strengthens the paternalistic conclusion. Democrats preferred more severe regulations and it appears that Democratic governors running for reelection complied. Intuitively this makes sense as it would increase the probability of the governor retaining their supporters' votes.[19] Like their Republican counterparts, Democratic governors not facing reelection took an indifferent approach. It seems then, that absent political exigencies, governors took little note of changes in their constituents' demonstrated risk preference.

6 Conclusions

This paper has contributed to the understanding of how U.S. states determined the severity of COVID regulations from spring to late October 2020. Its empirical results consistently show a negative relationship between people's revealed risk preferences and the stringency of COVID mandates at the between-state level. The correlations are both statistically and regulatorily robust and are supported by multiple robustness tests. Robust results only emerged at the within-state level once measures for demonstrated risk preferences were interacted with a governor's party and reelection status. Republican and Democratic governors facing reelection respectively took a risk-tolerant and paternalistic approach to regulation setting. An indifferent approach held where governors did not face reelection.

Insights from the public choice view of the political process makes sense of these results. Lack of dynamic feedback in the political sphere will limit government responsiveness to voters. However, the November 2020 elections seem to have spurred

[19] All incumbents won reelection and only the North Carolina and North Dakota governors won by a smaller margin of victory than in 2016 (Ballotpedia, 2021a).

state regulators to set regulations based on people's demonstrated risk preferences, an observable aspect of regulatory demand. This in part explains the negative COVID regulation-risk preference relationship between states. At the within-state level, regulations only varied with changes in revealed risk preferences where governors faced impending feedback from a reelection contest. It is also worth noting that within- or between-state variation in regulations bore little relationship to support for Trump's handling of COVID. This is likely due to this paper covering a longer period and including regressors, like revealed risk preferences, neglected by previous studies.

Further work in this field may prove fruitful, especially closer analysis of how governors' reelection status modified states' regulatory response to risk taking. Those results hinted at a political business cycle, or, what might be called here, a political regulatory cycle. Democratic and Republican state leaders wanted their respective party to succeed in the election and these different political preferences might be visible in the ways state-level COVID regulations changed in the days, weeks, or months leading up to 3 November 2020. While outside the scope of this paper, it could add an important dimension to research on the political business cycle.

Appendix

Table A1 Coverage of time-varying variables

Time period	Containment & health index (ln)	Risky actions Trump approval Shelter; Masks	Death rate	Hospital beds open	Unemployment rate	Prison release	Temp (ln)
1	1–7 May	16–30 Apr	24–30 Apr	30 Apr	19–25 Apr	April	May
2	2–8 June	16 May –1 Jun	26 May –1 Jun	1 Jun	24–30 May		June
3	29 Jun.–5 Jul	12–28 Jun	22–28 Jun	28 Jun	21–27 Jun	June	June/July
4	27 Jul.–2 Aug	10–26 Jul	20–26 Jul	26 Jul	19–25 Jul	July	July/Aug
5	27 Aug.–2 Sep	7–26 Aug	20–26 Aug	26 Aug	16–22 Aug	August	Aug./Sept
6	1–7 Oct	4–30 Sept	24–30 Sept	30 Sept	20–26 Sept	September	September
7	24–30 Oct	2–23 Oct	17–23 Oct	23 Oct	11–17 Oct		October

Risky actions, Trump approval, Shelter, and Masks come from the same period. Temp (ln) measures the state's average temperature for the month in which the dependent variable falls. A weighted average was taken for the periods where the index fell in two months, weighted by the number of days in the month covered by the Index. Honolulu's temperature was used for Hawaii. State orders did not release prisoners in the second or final periods

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Declarations

Conflict of interest I, Peter Anderson, am the sole author of the original research paper entitled, Demonstrated risk preferences and COVID-19 regulations in the United States. In the course of researching and writing this paper, I have received no financial or personal assistance that would influence my results. Nor do I maintain any memberships or professional relationships that would bias my data and conclusions. The work is mine and mine alone.

Human or animal rights The research and writing of this paper did not involve any human or animal testing.

Informed consent In keeping with the second point, there was no need to obtain any conformed consent as no humans or animals were involved in the paper's research or writing.

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