AUTONOMOUS VEHICLE POLICY ADOPTION

AN ANALYSIS OF POLITICAL IDEOLOGY, UNIFIED PARTY CONTROL & LOBBYING OF FIRST ADOPTER STATES

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Executive Summary

This study explores policy diffusion among autonomous vehicle laws. Using event history analysis and statewide analysis of policy enactment patterns, it examines the diffusion of policy adoption for this sector from 2011 to 2019. The study makes four primary findings:

1. Significant emphasis has been placed on policies pertaining to testing and studies of autonomous vehicles. A particularly large number of policies have also emerged allowing for the deployment of autonomous vehicles *without* an operator.

2. Clear patterns of *horizontal diffusion* (i.e., jurisdictions learning or copying policies from other jurisdictions) exist in states with either unified Republican and Democratic party control within state government. The number of autonomous vehicle policies passed in states with unified Republican control is disproportionately greater than it is in states *without* unified party control. Among states with unified Democratic control, the number of policies emerging is also disproportionately large compared to those without unified control, but slightly less so than in states with unified Republican control.

3. There has been extensive *vertical diffusion* (i.e., states influencing municipal policy) among states that have enacted policies. States that enacted a policy in one area are inclined to expand policy into new areas, creating a clear pattern of "leaders" and "laggards" with respect to policy. There is also evidence of "Go-Betweens" (i.e., professional associations, think tanks, advocacy groups, conferences, lobbyists) exerting pressure via lobbying.

Broadly interpreted, results suggest that policy diffusion increases sharply among states and that unity in the party affiliation within state governments can reduce the friction associated with creating policy on autonomous vehicles. Political polarization has spread in the past decade in the U.S. this past decade due to polarizing leaders that aggravate tensions by demonizing opponents and technology-fueled disruption via social media (Carothers and O'Donohue, 2019). As polarization continues, there will continue to be a clear split between states that learn and copy from their politically like-minded neighbors, while divided government states will have a harder time agreeing on and passing legislation.

For photo captions (cover) please refer to page 13

Introduction

This study explores the process of policy adoption for autonomous vehicles among state governments. The analysis draws upon event history analysis and statewide analysis of policy enactment patterns to explore the ways states have developed policies for autonomous vehicles from 2011 to 2019.

Particular emphasis is placed throughout the study on how the political landscape of a state government influences that's state's decisions to enact autonomous vehicle policies. It draws upon the extensive literature on policy diffusion used to evaluate state adaptations to new technology as well as update policies in response to social and commercial needs.

The report (a working paper) begins with a review of the research question before turning to methods and data, analysis, and finally, conclusions. An extensive list of the existing literature on the topic is provided in the reference section. The authors welcome feedback on the study's findings as they explore this important dimension of U.S. transportation policy.

Theoretical Framework

Policy diffusion has generated a rich academic literature, with many classic works evaluating marijuana legalization and same-sex marriage (F. S. Berry and Berry 1990; Boushey 2010; Gilardi 2016; Gray 1973; Karch 2007a; Savage 1985; Walker 1969). These studies have spurred questions about how policy diffusion mechanisms are identified in other contexts, such as disruptive technology and, more specifically, autonomous vehicle laws in states across the United States.

Policy diffusion, broadly defined, is "any pattern of consecutive adoptions of a policy innovation". Such diffusion occurs when the policy choices of one jurisdiction (e.g., countries, states, cities, etc.) are influenced by the policy choices of other jurisdictions (Dobbin, Simmons, and Garrett, 2007; Gilardi, 2012). Much of the literature's focus is the various diffusion *mechanisms*, which can be characterized as "a systematic set of statements that provide a plausible account of why the behavior of A influences that of B" (Braun and Gilardi 2006).

The different actors that influence policy diffusion are internal actors such as elected officials and bureaucrats (Graham, Shipan, and Volden; 2013); External Actors that consist of jurisdictions that have already adopted the policy (Graham, Shipan, and Volden; 2013); and Go-Betweens which are actors across jurisdictions (e.g. Top-Down Go-Betweens that exert pressure on lower-tier jurisdictions, think tanks, advocacy groups, professional associations conferences, lobbyists) (Douglas, Raudla, and Hartley 2015; Karch, 2006; Stone, 2000).

POLICY DIFFUSION MECHANISMS

Previous studies provide a solid foundation for understanding the framework of policy diffusion mechanisms; these include Horizontal and Vertical Mechanisms.

Horizontal mechanisms include three different categories: learning, imitation, and competition. Learning, the most popular diffusion mechanism, takes place when actors change their beliefs once they have learned from other policy diffusion mechanisms (Meseguer 2006; Braun and Gilardi 2006; Shipan and Volden 2008). Imitation takes place when actors incorporate a policy innovation because it is useful to enhance their reputation and validity (Martin 2001; Douglas, Raudla, and Hartley 2015). Lastly, competition occurs when a policy adopted by one jurisdiction creates negative externalities for another jurisdiction (Braun and Gilardi 2006; Simmons and Elkins 2004; Füglister 2012).

Vertical mechanisms include coercion, bottom-up and top-down federalism. Coercion occurs when jurisdiction is pushed into adopting a policy because of potential benefits (e.g., monetary), or because of a potential threat (Douglas, Raudla, and Hartley 2015). Both bottom-up and top-down federalism occurs when there is a vertical relationship between states and the federal government, or cities and states (Karch 2007b, 67–68; Karch 2006, 2012; Shipan and Volden 2006, 2008; McCann, Shipan and Volden 2015).

Both policy diffusion methods listed above can often be difficult to differentiate (Graham, Shipan, and Volden 2013). Jurisdictions do not only learn from the policy but also *political* outcomes, this is why imitation and learning are difficult to differentiate (Gilardi 2010; Graham, Shipan, and Volden 2013).

POLICY CYCLE STAGES AND PRACTICAL IMPLICATIONS

There are several policy-cycle stages: problem definition, agenda-setting (bill introduction), decision making, and post-bill passing stages such as implementation or enforcement. Most studies focus on the decision-making stage of the policy cycle while others focus on diffusion during the agenda-setting stage, or when bills are newly introduced (Shipan and Volden 2012, 793; Karch 2007a; Pacheco and Boushey, 2014). Very few diffusion studies have considered other stages such as the implementation or enforcement of policies (Shipan and Volden).

Policy diffusion is largely an academic interest and considered to be niche by leaders in the public policy space. In order to make analysis of policy diffusion more common and accessible for public policy leaders, this report: (1) creates methods and insights that apply to public policy leaders in a policy field that is growing (e.g., policy pertaining to disruptive technology - specifically autonomous vehicle companies): (2) creates policy categories and subcategories in legislation to simplify the analysis, while other diffusion studies have focused on the actors involved, this study focuses on the ideas within the legislation; (3) presents findings that form a framework that can serve as a resource that allows for policy teams to gather information on policy diffusion related to their issues of interest.

Methods & Data

This study looks at policy diffusion concepts, specifically horizontal mechanisms (e.g., learning, imitation, and competition) and vertical mechanisms (e.g., Top-Down Go-Betweens like advocacy groups and lobbyists) while looking at bills that have been enacted via legislation and executive orders.

Data utilized for the study has been taken from a variety of sources: (1) the NCSL's list of autonomous vehicle policies; (2) NCSL's breakdown of the legislative ideology of a state and

the unified party control of state legislature and governorships; (3) and lobbying spending totals from the OpenSecrets website.

1. *Autonomous Vehicle Policies*
   The authors utilized NCSL's list of autonomous vehicle policies from 2011 to 2019 to understand the history of autonomous vehicle policies. The authors hand-coded the list of legislation and executive orders into seven Policy Categories:

   Definition: Any legislation or executive order pertaining to the definitions of autonomous vehicle technologies.

   Deployment No Operator: Policies that create standards for autonomous vehicles that do not require a driver in the vehicle.

   Deployment with Operator: Creation of policies to regulate how autonomous vehicles are deployed, requiring a human operator be in the vehicle.

   Permits Platooning: Regulates platooning (the connected technology by which two or more trucks circulate on the road in a joint and coordinated manner).

   Regulation: Creation of policies relating to liability and protection of private companies from lawsuits or the creation of specific requirements for autonomous vehicle companies to adhere to (e.g., data collection, weight, and speed requirements, etc.).

   Study: Creation of a working group or committee to analyze potential issues among autonomous vehicles; proactively creating policies to protect from potential danger in unknown circumstances.

   Testing: Allows the statewide government to test certain aspects of autonomous vehicles before approval for driving.

2. *Legislative Ideology and Unified State Party Control*
   NCSL data set titled "Partisan Composition" was used to understand which party had control of the legislature, governorship, and overall state government control from the years 2011 to 2019.

3. *Lobbying Spend*
   Information was collected from the OpenSecrets website (2011 to 2019) to measure the amount of special interest lobbying spending. The research focused on the following: Cruise (owned by General Motors); Ford Autonomous Vehicles LLC (a subsidiary of Ford); Volvo; Waymo (owned by Alphabet); Tesla; Uber; Lyft; Aurora; and the Self-Driving Coalition for Safer Streets organization.

Analysis

Lists were compiled to understand the adoption of autonomous vehicle policies across states including: (1) Autonomous Vehicle Policies by year (to understand the total policies over time and the frequency of policy categories over time); (2) the identification of legislative ideology and unified party control by year; and (3) the amount of annual lobbying spending by the nine biggest Autonomous Vehicle lobbies in the United States.

Autonomous Vehicle Policies

Autonomous Vehicle Legislation Introduced by States (Fig. 1) shows that beginning in 2011, 42 states (plus D.C.) have introduced autonomous vehicle policies via legislation or executive order. Locations that were first adopters include Nevada, California, D.C., Florida, Michigan, North Carolina, North Dakota, Tennessee, and Utah.

Nevada, the first state to pass autonomous vehicle legislation, initially passed four bills: Deployment with Operator; Definitions; and two bills pertaining to Regulation (i.e., prohibits the use of cell phones and requires an autonomous vehicle to meet certain conditions relating to a human operator).

During the next three years (2012 to 2014) states were less ambitious. In 2012, the locations that introduced legislation were California (Testing), D.C. (Deployment with Operator), and Florida (two bills pertaining to Deployment with Operator). In 2013, Michigan passed two laws, one allowing Testing, and one Regulation pertaining to the liability of vehicle manufacturers. In 2014, there were zero laws passed. The following year, 2015, there were laws passed in the following states: North Carolina (Permits Platooning); North Dakota (Study); Tennessee (Regulation); and Utah (Testing). In 2016 legislation adoption increased dramatically. The years 2017 and 2019 had the highest volume of legislation with a total of 21 bills passed. 2018 was just shy of that number with 19 total bills.

Autonomous Vehicle Executive Orders Introduced by Governors (Fig. 2) shows the first governor to sign an executive order was Arizona in 2015 (Testing), followed by Massachusetts in 2016 (Testing). This was followed by Delaware (Study), Hawaii (Test), and Washington (Deployment No Operator) in 2017. 2018 had the greatest number of executive orders introduced (8 total). States that have yet to introduce any legislation or executive orders pertaining to autonomous vehicles include Alaska, Kansas, Missouri, Montana, New Mexico, Rhode Island, West Virginia, and Wyoming.

Autonomous Vehicle Policy Categories (Fig. 3) shows the policy most introduced was Testing, with 24 total policies. The second most popular policy introduced was Study, with 19 policies. Tied for the third most popular policy with 16 total each, are Regulation (which is understandable since this technology is still in its infancy (and Deployment No Operator. Next was Permits Platooning with 11 policies, Definition with 9 policies, and Deployment with Operator with 7 policies.

The two most popular policy categories, Testing and Study, fit the narrative that states were looking to move forward *carefully* with autonomous vehicles due to safety reasons. The third most introduced category, Regulation, fits that narrative too. Surprisingly, Deployment No Operator is the other third most introduced policy since autonomous vehicles are still being tested. However, it should be noted that most of the laws allowing for Deployment No Operator allow it only for testing.

Figure 1: Autonomous Vehicle Legislation Introduced by States

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Year Total	**4**	**4**	**2**		**4**	**14**	**21**	**19**	**21**
Alabama						1		1	1
Arkansas							1		2
California		1				1	4	2	
Colorado							1		1
Connecticut							1		1
D.C.		1						1	
Florida		2				2			3
Georgia							2		
Hawaii									1
Illinois							1		
Indiana								1	
Iowa									1
Kentucky								1	
Louisiana						1		1	1
Maine								1	
Maryland							1		
Michigan			2			4		1	
Minnesota								1	
Mississippi								1	
Nebraska								1	
Nevada	4								
New Hampshire									1
New Jersey									1
New York							1	1	
North Carolina					1		1		
North Dakota					1		1		2
Oklahoma									2
Oregon								2	
Pennsylvania						1		1	
South Carolina							1		
South Dakota									1
Tennessee					1	2	2		
Texas							2		
Utah					1	1		1	2
Vermont							1		1
Virginia						1			
Washington								1	
Wisconsin							1	1	

Figure 2: Autonomous Vehicle Executive Orders Introduced by Governors

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Year Total					**1**	**1**	**3**	**8**	
Arizona					1			2	
Delaware							1		
Hawaii							1		
Idaho								1	
Illinois								1	
Maine								1	
Massachusetts						1			
Minnesota								1	
Ohio								2	
Washington							1		

Figure 3: Autonomous Vehicle Policy Categories

Policy Category	2011	2012	2013	2014	2015	2016	2017	2018	2019	Category Total
Year Total	**4**	**4**	**2**		**5**	**15**	**24**	**27**	**21**	**102**
Definition						2		5	2	**9**
Deployment No Operator	1					2	6	1	6	**16**
Deployment with Operator		3				2	1	1		**7**
Permits Platooning	1				1		4	5		**11**
Regulation	2		1		1	2	2	4	4	**16**
Study					1	3	5	7	3	**19**
Testing		1	1		2	4	6	4	6	**24**

Unified Party Control and Ideology

Many policy diffusion studies have found a correlation between legislative ideology and unified party control on state policy adoption (Carter & LaPlant, 1997; Ka & Teske, 2002; Skocpol, 1993; Starr, 1982). The chart below, *Autonomous Vehicle Legislation Introduced by States* (Fig. 4), overlays red and blue highlights on the Fig. 1 chart signifying whether the state had unified party control (red for Republican control and blue for Democratic control). The data show that while Nevada *did not* have unified party control of the legislature and governorship in 2011, all the other early adopter locations did. Eight out of nine early adopter locations had unified party control from 2012 to 2015. Six out of nine locations had unified Republican control (Florida, Michigan, North Carolina, North Dakota, Tennessee, and Utah), while two had unified Democratic control (California and D.C.), and one with divided control (Nevada).

The data show that the influence of ideology on autonomous vehicle policy adoption *may* exist due to political party differences of first adopters. Specifically, the differences between conservative and liberal perspectives regarding economic regulation and legislation that is seen as “pro-business” may play a role in autonomous vehicle policy adoption. In general, conservatives have a less favorable opinion of economic regulation than liberals and tend to embrace more free-market ideologies (Balla, 2001; Goldstein, 1997; Johnson and Broder, 1996).

Figure 4: Legislation and Unified Party Control

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Year Total	4	4	2		4	14	21	19	21
Alabama						1		1	1
Arkansas							1		2
California		1				1	4	2	
Colorado							1		1
Connecticut							1		1
D.C.		1						1	
Florida		2				2			3
Georgia							2		
Hawaii									1
Illinois							1		
Indiana								1	
Iowa									1
Kentucky								1	
Louisiana						1		1	1
Maine								1	
Maryland							1		
Michigan			2			4		1	
Minnesota								1	
Mississippi								1	
Nebraska								1	
Nevada	4								
New Hampshire									1
New Jersey									1
New York							1	1	
North Carolina					1		1		
North Dakota					1		1		2
Oklahoma									2
Oregon								2	
Pennsylvania						1		1	
South Carolina							1		
South Dakota									1
Tennessee					1	2	2		
Texas							2		
Utah					1	1		1	2
Vermont							1		1
Virginia						1			
Washington								1	
Wisconsin							1	1	

Unified Democratic Party Control
Unified Republican Party Control

Executive Orders and Unified Party Control (Fig. 5) shows the first governor to sign an executive order was Arizona in 2015 (Republican control), followed by Massachusetts (divided control) in 2016 signed by Republican Governor Charlie Baker with a Democratic legislature. The governors that introduced executive orders in 2017 included: Delaware (D), Hawaii (D), and Washington (D). All had unified Democratic party control. Four out of the five executive orders passed were in locations that had unified party control. One location had Republican unified party control, three had Democratic unified party control, and one (Massachusetts) had divided control. 2018 had the greatest number of executive orders introduced, with 8 total. There were five from states with unified Republican party control (AZ, ID, OH) and three from divided party control (IL, ME, and MN).

Figure 5: Executive Orders and Unified Party Control

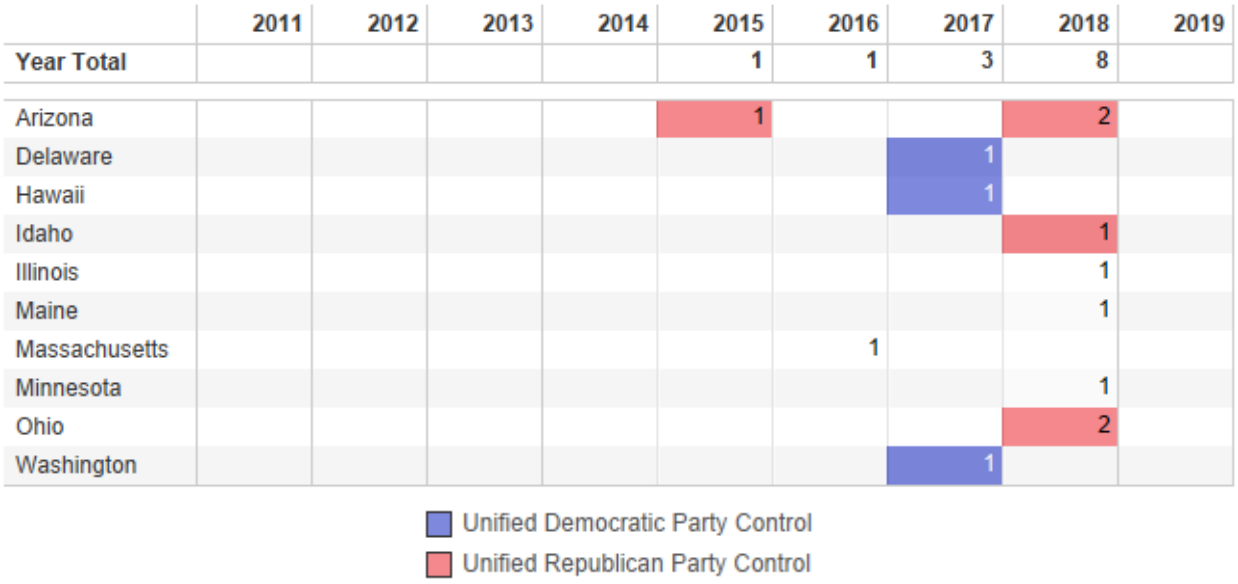

Figure 6 shows the categorization of party control for all 101 policies passed from 2011 to 2019. The chart shows that 55% of the autonomous vehicle policies passed came from states with unified Republican control (56 policies total), while 24 of the policies passed (24%) came from divided control states. Only 20% of policies (21 policies total) came from states with unified Democratic control. Figure 7 shows the percentages of unified party control. From 2011 to 2019 Republicans had control of 44% of state governments, Democrats had unified control of 22%, and 34% of state governments were under divided control. This illustrates that while there was a *higher* percentage of divided party control states, those states did not pass the same percentage of autonomous vehicle bills. Our analysis reveals that states with unified Republican control passed a slighter higher percentage of autonomous vehicle bills than Democratic-controlled states.

Special Interest Lobbying Spending

Lobbying works to increase the speed of policy diffusion, as lawmakers find themselves pressured to pass laws when there is a lobbyist presence. Due to more pressure on the legislative system, lawmakers are more likely to adopt previously successful policies from other states (Wavre 2018). This concept falls under the “Top-Down Go-Betweens” that exert pressure on lawmakers (e.g., advocacy groups, lobbyists) (Douglas, Raudla, and Hartley 2015; Karch,

2006; Stone, 2000). There is a pattern between lobbying spending and an increase in autonomous vehicle policies being introduced (Fig. 8). This points to evidence of lobbyists exerting increased pressure on lawmakers beginning in 2016, the same year the Self-Driving Coalition for Safer Streets was created (Douglas, Raudla, and Hartley 2015; Karch, 2006; Stone, 2000).

The first three years (2011 to 2013) the average lobbying spend was $16 million. In 2014, the total spends decreased to $14 million and zero laws were passed. In 2015, the total spends increased to $31 million, and five laws were passed. In 2016, the year the Self-Driving Coalition for Safer Streets was created, a total of 15 laws and executive orders were passed. By 2017, there were a total of 24 policies passed.

Figure 6: Unified Party Control and Policy Enactment Percentage

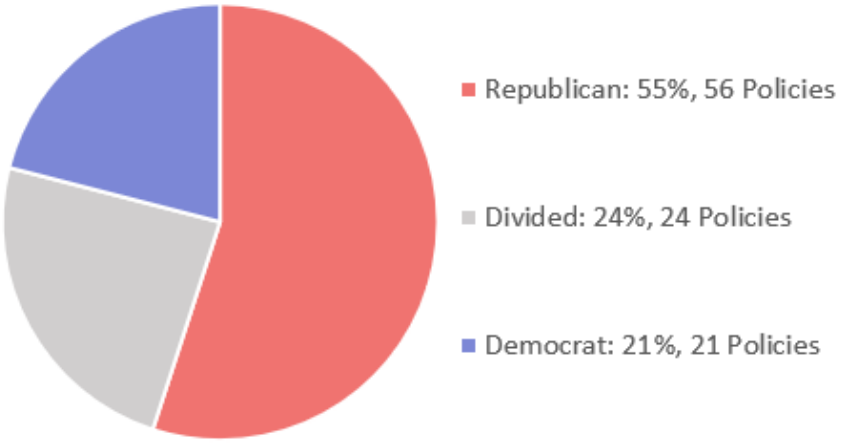

Figure 7: Percentage of Unified Party Control of States from 2011 to 2019

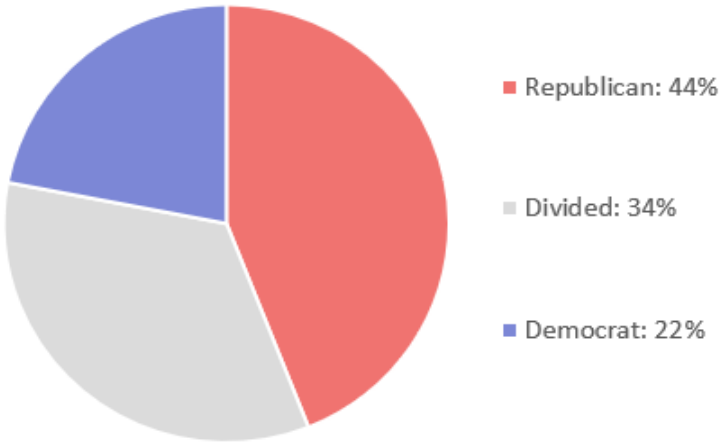

Figure 8: Special Interest Lobbying Spending

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Aurora								$50,000	$140,000
Cruise	$11,055,000	$7,260,000	$8,840,000	$8,510,000	$9,120,000	$8,500,000	$8,640,000	$7,770,000	$8,380,000
Ford AV LLC	$6,657,000	$6,830,000	$6,120,000	$4,506,708	$4,218,086	$4,681,960	$4,295,718	$4,284,422	$4,271,953
Lyft				$100,000	$130,000	$250,000	$600,000	$870,000	$930,000
Self-Driving Coalition						$30,000	$320,000	$320,000	$140,000
Tesla	$120,000				$580,000	$820,000	$760,000	$890,000	$600,000
Uber			$50,000	$200,000	$470,000	$1,360,000	$1,830,000	$2,310,000	$2,360,000
Volvo		$680,000	$680,000	$670,000	$720,000	$610,000	$670,000	$740,000	$710,000
Waymo					$16,660,000	$15,430,000	$18,390,000	$21,850,000	$12,780,000
TOTAL SPENT	**$17,832,000**	**$14,770,000**	**$15,690,000**	**$13,986,708**	**$31,898,086**	**$31,681,960**	**$35,505,718**	**$39,084,422**	**$30,311,953**
TOTAL POLICIES PASSED	**4**	**4**	**2**	**0**	**5**	**15**	**24**	**27**	**21**

Autonomous vehicle companies understand the regulatory challenges their respective companies face and have followed the lead set by other tech companies like Airbnb and Uber (Tusk, 2018; Isaac, 2015; Weinberg, 2020). In 2016, a collection of companies with driverless car technologies that include Google, Uber, Lyft, Ford, and Volvo, formed a lobbying group called the Self-Driving Coalition for Safer Streets. The group was led by David Strickland, a former administrator of the National Highway Traffic Administration. The creation of the coalition aimed to: (1) boost federal lobbying efforts to convince Washington policymakers that their vehicles are safe, with a particular focus on issues involving self-driving cars, including road safety to cybersecurity; and (2) focus on statewide lobbying pertaining to officials that control traffic policing and licensing of drivers (Gangitano, 2019; Bowles. 2016). The group sought to preempt the patchwork of contradictory state laws that had already passed that were seen as inconsistent and deleterious to the commercial viability of self-driving cars (Shaban, 2016).

Conclusions

Policy diffusion scholars have yet to focus on innovation and disruptive technology. The findings from our research will help lay the groundwork for future academic studies pertaining to policy adoption pertaining to innovative technology like autonomous vehicles.

The findings of this study reveal an emphasis on policies pertaining to testing and studies, with a surprising number of policies allowing for the deployment of autonomous vehicles *without* an operator. Other interesting insights include potential patterns pertaining to horizontal diffusion (via learning and imitation) by states with both Republican and Democratic party control and potential vertical diffusion (via Top-Down Go-Betweens such as advocacy groups and lobbyists) by way of the amount of money spent lobbying related to the number of policies adopted.

Clear patterns of horizontal diffusion exist in states with either unified Republican and Democratic party control within state government. The number of autonomous vehicle policies passed in states with unified Republican control is disproportionately greater than it is in states *without* unified party control. Republican-controlled governments accounted for 44% of all states but generated 55% of the policies, whereas divided states accounted for 34% of the state and generated just 24% of the policies (Figure 4).

Among states with unified Democratic control, the number of policies emerging is also disproportionately large compared to those without unified control, but slightly less so than in

states with unified Republican control. Democratic-controlled states account for 22% of all states and generated 21% of all policies. These states generated nearly the same number of policies as divided governments despite being much fewer in number.

Considerations Moving Forward

The landmark book *Innovation and Its Enemies: Why People Resist New Technologies* (Juma, 2016) makes clear that most controversies over innovation and disruptive technology are associated with the perceptions of risks and benefits. Notable examples include perceptions about immediate risks and long-term benefits, benefits to only small sections of society, and the threat of altering cultural identities. Debates about innovative technologies are more about the perception of risk as opposed to the impact of the risks (Ropeik, 2010).

Technological innovation has historically been a gradual (and sometimes slow) process. Due to an acceleration in innovation in recent years, however, product releases have sped up, resulting in anticipatory regulatory approaches (Laurie, et al, 2012). There is a risk that governments could heavily regulate certain technologies because of societal opposition as people evaluate risk cognitively while reacting emotionally (Gupta, et al, 2012). On the other hand, regulatory interventions can help reduce public concern and tension that may take the form of prohibitions, trade restrictions, demonization, and delayed market approvals (Juma, 2016). Understanding how public policy diffusion for innovative technology spreads will be useful for generations to come.

Many technology companies struggle with regulatory and legislative issues. Disruptive technology companies specifically have an exceptionally difficult time dealing with these issues. The authors hope their research has the potential to give disruptive technology companies, like autonomous vehicle companies, some insight into how policies are adopted and the potential benefits of venue shopping. Venue shopping occurs when “Political actors seek policy venues where the balance of forces is tipped in their favor,” according to Guiraudon (2000). It may be beneficial for autonomous vehicle companies, and other disruptive technology companies, to introduce their preferred policy ideas in cities with a legislative environment that will give their policy the greatest chance of diffusion.

Finally, policy diffusion has only been used sparsely to study disruptive technologies. The lone study on policy diffusion identified focusing on the sharing economy, for example, was Shields’ 2016 publication “Analysis of Policy Diffusion and Its Role in the Development and Implementation of Ridesharing Regulations in Four Canadian Municipalities”. Although the present working paper focuses on autonomous vehicles, the findings apply to many other types of disruptive technology companies, such as ride-hailing, delivery apps, shared-mobility, contract employment service apps, home-sharing, and cryptocurrency.

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