AUTOMATED VEHICLES AND MANUFACTURER RESPONSIBILITY FOR ACCIDENTS: A NEW LEGAL REGIME FOR A NEW ERA

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Over a century ago, industrialization and its accompanying increase in workplace injuries were placing substantial pressures on the tort system and its ability to compensate the victims of these injuries. Eventually, the interests of labor and management came together, giving rise to a new administrative compensation system. Unlike tort remedies, this new scheme imposed strict financial responsibility on employers for work-related injuries to their employees.[1] This system of workers' compensation is still the most far-reaching tort reform ever adopted—promoting safety and compensating for injuries more effectively than tort did both at the time and today. Workers' compensation has its flaws, but there is no significant desire on anyone's part to go back to tort.

We are on the verge of another new era, requiring yet another revision to the legal regime. This time, it is our system of transportation that will be revolutionized. Over time, manually driven cars are going to be replaced by automated vehicles. The new era of automated vehicles will eventually require a legal regime that properly fits the radically new world of auto accidents. The new regime should promote safety and

[1] See generally Kenneth S. Abraham, The Liability Century: Insurance and Tort Law from the Progressive Era to 9/11 39–68 (2008).

provide compensation both more sensibly and more effectively than what could be done under existing tort doctrines governing driver liability for negligence and manufacturer liability for product defects. Like labor and management a century ago, auto manufacturers, consumers, and the public at large—often currently at odds about the tort system—will need to have their interests come together if the new era of automated transportation is to be governed by an adequate legal regime.

Any new approach will have to deal with the long and uneven transition to automated technology, impose substantial but appropriate financial responsibility for accidents on the manufacturers of highly automated vehicles, and provide satisfactory compensation to the victims of auto accidents in the new era. This Article develops and details our proposal for an approach that would accomplish these goals.

I. THE SETTING AND THE CHALLENGE

Auto accidents injure approximately 2.44 million people and kill nearly 40,000 each year.[2] Driver error causes the vast majority of these injuries and deaths.[3] It is no surprise, then, that auto manufacturers, high-tech companies, news purveyors, and scholarly commentators all are abuzz with the coming prospect of driverless vehicles humming down the road. No longer will high-risk, momentarily incautious, or distracted drivers jeopardize highway safety. No longer will the disabled remain bound to dependence on others for motorized transport. Accident rates will decline precipitously, by some estimates as much as eighty to ninety percent.[4] Liability law, regulatory regimes, and insurance ar-

[2] These are data for 2015 compiled by the National Highway Traffic Safety Administration ("NHTSA"). U.S. Dep't of Transp., NHTSA, DOT HS 812 318, Traffic Safety Facts: Research Note, 2015 Motor Vehicle Crashes: Overview 1 (Aug. 2016), https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812318 [https://perma.cc/LB9W-TDVP].

[3] NHTSA estimates that ninety-four percent of auto crashes can be related to "human choice or error." U.S. Dep't of Transp., NHTSA, Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety 5 (Sept. 2016), https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf [https://perma.cc/JN2Q-2LB2].

[4] Jeff McMahon, Driverless Cars Could Drive Car Insurance Companies Out Of Business, Forbes (Feb. 19, 2016, 12:01 AM) https://www.forbes.com/sites/jeffmcmahon/2016/02/19/autonomous-vehicles-could-drive-car-insurance-companies-out-of-business/#5e14e0d12231 [https://perma.cc/VQ3J-FELA]; see U.S. Dep't of Transp., NHTSA, DOT HS 812 115, Traffic Safety Facts: Crash Stats, Critical Reasons for Crashes Investigated in the National Motor Vehicle Causation Survey 1 (Feb. 2015), http://www-nrd.nhtsa.dot.gove/pubs/812115.pdf [https://pe rma.cc/SE7H-7K9M] (indicating that more than ninety percent of all auto acci-

rangements will be recast. Indeed, private vehicle ownership may go the way of the horse-and-buggy.[5] We are urged to envision this bright new future. And the promise is clearly there.

But from an accident law perspective—with a focus on liability and compensation—we are getting way ahead of ourselves. The immediate future will not be dominated by a roadway filled with totally automated vehicles—and "the immediate future" may span another thirty years or so; it is difficult to say.[6] In its September 2016 policy statement, providing policy guidelines for the coming transition to a roadway dominated by highly automated vehicles ("HAVs"), the National Highway Traffic Safety Administration ("NHTSA") adopted the five-tiered levels of automation developed by the Society of Automotive Engineers ("SAE") International:

- At SAE Level 0, the human driver does everything;
- At SAE Level 1, an automated system on the vehicle can *sometimes assist* the human driver to conduct *some parts* of the driving task;
- At SAE Level 2, an automated system on the vehicle can *actually conduct* some parts of the driving task, while the human

dents are due to driver error, and only two percent are the result of auto defect) [hereinafter Critical Reasons].

[5] Tim Higgins, The End of Car Ownership, Wall St. J. (June 20, 2017, 10:10 PM), https://www.wsj.com/articles/the-end-of-car-ownership-1498011001 [https://perma.cc/SXG6-NKJ2]; Faiz Siddiqui, Lyft's Vision: An Autonomous Fleet, 'Bar Car,' and the End of Private Ownership, Wash. Post (Sept. 19, 2016), https://www.washingtonpost.com/news/dr-gridlock/wp/2016/09/19/lyfts-vision-an-autonomous-fleet-bar-car-and-the-end-of-private-cars/?utm_term=.c1c2b3413da5 [https://perma.cc/TFD6-6S5X].

[6] See Todd Litman, Victoria Transp. Pol'y. Inst., Autonomous Vehicle Implementation Predictions: Implications for Transport Planning, 19 (2018), vtpi.org/avip.pdf [https://perma.cc/Q3B2-TYBB] (estimating SAE level 4 or 5 vehicles to constitute 80–100% of sales and 40–60% of fleet by 2050s); Ravi Shanker et al Morgan Stanley Res. Glob., Morgan Stanley, Autonomous Cars: Self-Driving the New Auto Industry Paradigm 8 (2013), https://orfe.princeton.edu/~alaink/SmartDrivingCars/PDFs/Nov2013MORGAN-STANLEY-BLUE-PAPER-AUTONOMOUS-CARS%EF%BC%9A-SELF-DRIVING-THE-NEW-AUTO-INDUSTRY-PARADIGM.pdf [https://perma.cc/F678-359U] (estimating two decades for one hundred percent penetration of high-level automation); Prateek Bansal & Kara M. Kockelman, Forecasting Americans' Long-Term Adoption of Connected and Autonomous Vehicle Technologies, 95 Transp. Res. pt. A 49, 60–61 (2017) (estimating, conservatively, 24.8% adoption and optimistically estimating 87.2% adoption of high-level automation by 2045).

continues to monitor the driving environment and performs the rest of the driving task;

- At SAE Level 3, an automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests;

- At SAE Level 4, an automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions; and

- At SAE Level 5, the automated system can perform all driving tasks, under all conditions that a human driver could perform them.[7]

Currently, there are not even Level 3 vehicles available for sale. But predictions are that the roadways will carry an array of vehicles falling into SAE Levels 4–5 by the mid-2020s.[8] At that point, significant issues regarding the appropriate approach to liability and compensation will be ripe. Even in the longer term, however, the rollout of HAVs—those with Level 4 and Level 5 capabilities—will not suddenly remove all traditional motor vehicles from the road. Indeed, it will not, in one fell swoop, obliterate the sale of "conventional" vehicles ("CVs"). No matter how great their popularity, the incremental introduction of HAVs means that for many years they will co-exist with CVs on the roadways—not only because of the existing stock of pre-HAVs on the road, but also because of continuing sales of new models of partially automated CVs.[9] Add to this mix bicyclists, motorcyclists, and pedestrians for a

[7] See SAE Int'l, J3016-JUN2018, Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles 19 (2018), https://www.sae.org/standards/content/j3016_201806/ [https://perma.cc/G8CA-MJCA] (emphasis added).

[8] U.S. Chamber Inst. for Leg. Reform, Torts of the Future 2 (2017).

[9] See estimates cited supra note 6 (providing various timelines in which HAVs may increasingly dominate sales but may continue to share the road with less-autonomous vehicles). Moreover, the incremental change will not come uniformly across states: the car-

more comprehensive picture of those who may cause, contribute to, or be victims of, motor vehicle-related injuries as HAVs are introduced.

Thus, we are going to experience incremental, staged movement in the direction of SAE Levels 4–5. The traffic mix will evolve, as will the accident mix accompanying it during that transitional period. Presumably, there will be a gradual decrease in the number of motor vehicle-related accidents. But as discussed in greater detail below, substantial numbers of accidents and injuries will nonetheless continue to occur. Promotion of safety and provision of compensation for the losses that result when accidents do occur still will serve, as traditionally has been the case, as touchstones for assessing whether the liability regime addressing auto accidents is functioning in optimal fashion.

In those immediately ensuing years, then, what will be the likely impact on the tort system? As the roadway scenario begins to shade from predominantly Levels 2 and 3 to Levels 4 and 5—so that a non-trivial proportion of the motor vehicle fleet is highly automated—the current tort system will be increasingly challenged to adequately address the kinds of auto accidents that occur. Part II of this Article addresses this challenge. And once a significant portion of roadway traffic consists of HAVs, a reshaping of the system's approach to deterrence and compensation will be required. In Part III we address that issue and propose a new approach to responsibility for accidental harm associated with HAVs. The "trigger point" we propose for setting aside the current liability and insurance regime would be reached when twenty-five percent of all registered vehicles are HAVs operating at SAE Level 4 or 5.[10] Our proposal will entail auto manufacturer responsibility for all injuries arising out of the operation of HAVs. We call this system "Manufacturer Enterprise Responsibility" ("MER").

II. THE NEAR FUTURE: A SUNDRY MIX ON THE ROADWAYS

It will be a long time—probably several decades—before HAVs are the only type of motor vehicle on the road.[11] During this long period of

owning population will vary from state to state in its replacement rate of more conventional vehicles with automated vehicles.

[10] See also discussion infra notes 29, 47 (stating twenty-five percent is not intended as hard cut-off).

[11] In fact, HAVs may never be the only vehicles on the road. For example, as long as high-performance sport cars like Ferraris and Lamborghinis are attractive to at least a few purchasers, and are not outlawed, that will be the case. And there may well be a continuing

transition, there still will be accidents involving CVs only—or CVs and motorcycles, bicycles, pedestrians, and/or other third parties. In addition, these accidents will sometimes involve alleged defects in CVs with some automated features, such as the automated lane-drift and blind-spot alerts that are already features of some vehicles. For the reasons spelled out below, as long as HAVs remain an insignificant proportion of the motor vehicle accident mix, current rules governing driver liability and manufacturer product liability should apply to claims involving CVs and HAVs. As HAVs become more common, however, drivers will be progressively less responsible for accidents and—as we explain—products liability law as it now stands will be an increasingly less suitable means of allocating the costs of auto-related injuries.

We begin our discussion of the transitional period by noting contextual considerations: the incidence of safety technology and the prospect of regulatory enhancements while CVs remain the dominant mode of transportation. Against this backdrop, we then assess the role of tort in these transitional years.

A. Driver-Focused Liability and Technology Regulation During the Long Transition

Whether by default or by choice, the current tort liability regime will continue in force for a considerable period of time, while CVs remain the predominant type of vehicle on the road. Liability for most accidents will continue to be driver-focused, because most accidents will involve driver error, although new safety technology for CVs could help to reduce the accident rate.

1. Driver-Focused Liability: Insurance and Technology in the CV Context

The current auto liability and insurance regime is primarily driver focused, because drivers' mistakes cause the vast majority of auto accidents.[12] In most states, traditional negligence liability currently applies to auto accidents involving CVs. Drivers in this regime are protected by

market for those who get satisfaction out of the spontaneity of driver control rather than spectator status, for example, on an extended road trip.

[12] Products liability on the part of auto manufacturers is a very secondary source of liability and compensation for auto-related injuries. See NHTSA, Critical Reasons, supra note 4, at 1.

third-party liability insurance, and underwriting is owner-and-driver focused.[13] When setting premiums, insurance companies focus on the characteristics of the owner and those in his or her family who can be expected to drive the insured vehicle.[14] These characteristics include, but are not limited to, the accident experience and driving record of these insured parties. In the current world of driver liability for negligence coupled with liability insurance, however, the threat of liability on the part of a driver creates only very attenuated safety incentives, because the principal economic impact of liability is only an eventual increase in the cost of auto liability insurance.[15]

The importance of this owner-and-driver-focused underwriting in auto liability insurance in a world of CVs is worth emphasizing. In contrast, in a world of HAVs, there will be less and less driving by individuals, and therefore correspondingly less reason to underwrite insurance or impose liability on this basis.[16]

Before we reach that point, however, a wide variety of technological innovations are presently available or on the drawing board to make conventional driving a safer enterprise. There is existing technology, for example, involving interlock systems that shut off vehicle use by inebri-

[13] Auto no-fault applies in the twelve states that have adopted that approach, limiting victims to their own first-party insurance recoveries, unless their losses surpass a monetary or serious-injury "threshold." When the threshold is met, victims still may bring a negligence action for losses not compensated by their first-party insurance. In many other states, what is sometimes called "add-on" no-fault provides very limited first-party medical benefits to the driver and passengers, as well as pedestrians suffering injuries arising out of the operation of the vehicle but leaves all tort rights intact. See Nora Freeman Engstrom, An Alternative Explanation for No-Fault's "Demise," 61 DePaul L. Rev. 303, 320–22 (2012).

[14] But see id. at 331 & n. 134 ("[T]he extent to which insurers reliably experience-rate premiums to account for drivers' accident costs (as opposed to merely adjusting rates based on crude calculations such as a drivers' 'territory' or credit worthiness) remains surprisingly unclear.").

[15] Plaintiffs could theoretically bring a claim against the driver personally but almost never pursue this possibility. See Tom Baker, Blood Money, New Money, and the Moral Economy of Tort Law in Action, 35 L. & Soc'y Rev. 275, 275 (2001).

[16] In addition to auto liability insurance, in most states uninsured motorists insurance is also required, or must be offered to the insured. This covers losses that would be recoverable in a negligence suit against a driver who is not covered by the requisite liability insurance. Most vehicle owners also have first-party property damage insurance, covering them against losses resulting from collision and other hazards (fire, wind, animals, etc.) that cause damage to the insured vehicle.

ated drivers. Over half the states now mandate breath control devices for drivers after first DUI convictions.[17]

Inattentive driving that can be chalked up to non-auto technology innovations—such as texting while driving—has become similarly prominent among sources of motor vehicle-related personal injury.[18] Again, entirely apart from HAVs, the technology exists on the part of *cellphone* manufacturers to block usage by drivers.[19] More generally, automakers have developed drowsiness detection systems capable of monitoring and warning when a vehicle's movements indicate a prospective concern.[20] Widespread introduction of such systems also could improve net safety.

Finally, of course, there is the long-time nemesis of auto-related safety: speeding. In addition to more effective policing, there are more sophisticated technological methods of roadway tracking and responding to driving in excess of the speed limits. Familiar forms of technology-assisted law enforcement, such as speed guns and speed cameras, could have already given way to automated vehicle-to-infrastructure speed re-

[17] Jim Motavalli, New York Requires Alcohol Interlocks for First-Time Drunken Drivers, N.Y. Times: Wheels (July 20, 2010), https://wheels.blogs.nytimes.com/2010/07/20/new-york-requires-alcohol-interlocks-for-first-time-drunken-drivers [https://perma.cc/2GBA-CJNU]; Status of State Ignition Interlock Laws, Mothers Against Drunk Driving (March 2018), https://www.madd.org/tennessee/wp-content/uploads/sites/56/2018/04/Status-of-Ignition-Interlock-Laws-map-March-2018.jpg [https://perma.cc/ZP6K-F5XK]. Applying such devices in all CVs might raise issues that are not considered sufficiently important when compared to those who have previous DUI convictions. For example, there are situations in which an emergency might justify driving under the influence of a minimal amount of alcohol, but the interlock system prevented doing so. These considerations, however, involve tradeoffs that certainly could be handled in a way that improved net safety without unduly hampering drivers' ability to deal with emergencies.

[18] See U.S. Dep't of Transp., NHTSA, Distracted Driving 1, https://www.nhtsa.gov/risky-driving/distracted-driving [https://perma.cc/S2Q7-A23E]. And conversely, on attention-aided driving, see Neal E. Boudette, Deer Caught in the Headlights? Your Car May Soon See Them, N.Y. Times (July 20, 2017), https://www.nytimes.com/2017/07/20/automobiles/wheels/deer-caught-in-the-headlights-your-car-may-soon-see-them.html [https://perma.cc/5KXQ-YWP5].

[19] Matt Richtel, Phone Makers Could Cut Off Drivers. So Why Don't They?, N.Y. Times (Sept. 24, 2016), https://www.nytimes.com/2016/09/25/technology/phone-makers-could-cut-off-drivers-so-why-dont-they.html [https://perma.cc/276T-ZBNM]; see Neal E. Boudette, Auto Safety Regulators Seek a Driver Mode to Block Apps, N.Y. Times (Nov. 22, 2016), https://www.nytimes.com/2016/11/22/business/auto-safety-regulators-seek-a-driver-mode-to-block-apps.html [https://perma.cc/XZ4B-2VSB].

[20] Eric A. Taub, Sleepy Behind the Wheel? Some Cars Can Tell, N.Y. Times (Mar. 16, 2017), https://www.nytimes.com/2017/03/16/automobiles/wheels/drowsy-driving-technology.html [https://perma.cc/5ESQ-HEE7].

porting absent considerable privacy pushback.[21] Such concerns, however, have not completely deterred commercial attempts at tracking, via advanced in-car telemetry, by rental-car and insurance companies.[22]

While these technological innovations do not in any way cancel out the presumed additional safety benefits that will accrue from removing drivers from an active role behind the steering wheel, they are complementary design strategies for diminishing the accident costs of driving CV vehicles.[23] During the long transition, we do not simply have to wait for the brave new world of HAVs to take greater advantage of technology that could considerably improve driving safety. The increased use of such technology could itself start to diminish the consequences of the current liability and insurance regime's focus on the driver.

2. The Prospects for Regulatory Guidance of Technological Innovation

While the market may generate more widespread use of these new CV safety technologies in the emerging era, sensible regulatory mandates probably would be required to take full advantage of their availability. And an entirely new level of technological complexity, as HAVs

[21] See Elizabeth E. Joh, Discretionless Policing: Technology and the Fourth Amendment, 95 Calif. L. Rev. 199, 217–21 (2007) (highlighting a Department of Transportation advisory committee's envisioned use of "Dedicated short-range communications (DSRC)" to enforce speeding laws). Despite this hypothesized use, Professor Joh noted that such automated enforcement at the time was "not being actively pursued," because of "privacy concerns." Id. at 202 n.17; see also Michael L. Rich, Should We Make Crime Impossible?, 36 Harv. J.L. & Pub. Pol'y 795, 816–18 (2013) (evaluating the privacy concerns of monitoring and governing speed within car computers).

[22] See, e.g., Am. Car Rental, Inc. v. Comm'r of Consumer Prot., 869 A.2d 1198, 1201, 1207 (Conn. 2005) (invalidating rental-car contract speeding penalty enforced through in-car telemetry); Ron Lieber, Lower Your Car Insurance Bill, at the Price of Some Privacy, N.Y. Times (Aug. 15, 2014), https://www.nytimes.com/2014/08/16/your-money/auto-insurance/tracking-gadgets-could-lower-your-car-insurance-at-the-price-of-some-privacy.html [https://perma.cc/L372-62F8] (reporting on trend in "usage-based insurance" where in-car telemetry, for example speed and acceleration, influences insurance premiums).

[23] Indeed, one can press a step further. In the current driving environment, why is it that auto manufacturers can design cars to run 120 MPH without facing design defect liability when, predictably, some high-risk drivers will drive nearly that fast and get into accidents? Relatedly, in the interim era of newly-minted Level 2 and 3 autos, why shouldn't there be manufacturer liability for failing to implement speed controls linked to the road on which the vehicle is being driven—with some margin for necessity of exceeding the speed limit within reasonable bounds in exceptional circumstances (e.g., driving a sick infant to the hospital)? And when autos are fully automated, is there an argument for allowing them to proceed above the speed limit (again, with some margin for necessity)?

become prominent, will introduce still greater challenges. Unfortunately, we are not sanguine about the efficacy of such regulatory involvement.

NHTSA is the principal federal agency charged with regulating auto safety, and there is comparatively little state-based regulation.[24] There is substantial reason for pessimism, however, about NHTSA's capacity for proactive performance on the rulemaking front.[25] Testifying at congressional hearings in recent years, long-time observers of the Agency have sharply criticized NHTSA for its continuous failure to adopt—or, in some cases, avoid delay in generating—safety standards. This testimony attributed the Agency's inactivity to congressional underfunding, industry opposition, and a penchant for taking the less controversial route of recalls. There seems a near consensus that, at best, recent notable standard-setting efforts have either been compelled by Congress in response to perceived safety crises or, as in the case of electronic stability controls (not phased in for all vehicles until 2009–12), have been adopted after delay has resulted in substantial numbers of needlessly lost lives. In addition, the recall process—NHTSA's bread-and-butter—appears to be as flawed, in its own way, as rulemaking performance.

A dismal picture has emerged in congressional hearings and agency reports on the most recent recalls.[26] The findings of a detailed audit report in 2015 of NHTSA's performance by the Office of Inspector General, Department of Transportation—a systematic review of the 2014 GM ignition switch recall process—led to the following conclusions: 1) the Agency fails to provide detailed guidance on information that consumers and manufacturers can be expected to report to the Agency's Office of Defects Investigation; 2) the Agency fails to provide follow-up in

[24] State-based regulation is also constrained to some extent by preemption considerations. Compare Williamson v. Mazda Motor of Am., Inc., 562 U.S. 323, 336 (2011) (holding that, although restricting the manufacturer's choice, state tort suit not preempted because it was not an obstacle to achieving federal law's purpose), with Geier v. Am. Honda Motor Co., 529 U.S. 861, 886 (2000) (holding a state tort suit preempted because it obstructed federal law's purposes).

[25] See Jerry. L. Mashaw & David. L Harfst, The Struggle for Auto Safety 173–201 (1990), (concluding that, beginning in the early 1970s, NHTSA shifted focus from its mandate to adopt performance-based safety standards through its rulemaking authority, to pursuing recalls (a far less controverted strategy), largely as a response to lack of support—and in many instances, direct challenge—from the courts, Congress, and the industry to its rulemaking efforts).

[26] For more extensive discussion of the issues briefly alluded to in the text, see Robert L. Rabin, Pathways to Auto Safety: Assessing the Role of the National Highway Transportation Safety Administration, in Administrative Law from the Inside Out: Essays on Themes in the Work of Jerry L. Mashaw 297, 309–11 (Nicholas R. Parrillo ed., 2017).

verifying and clarifying the data that it does receive; 3) the staff is inadequately trained in statistical analysis and consequently lacks any clear set of priorities; 4) the Agency has shown minimal regard for transparency in its operations.[27]

These subpar regulatory processes have predominantly involved *mechanical* design defects. The passivity on the rulemaking front and deficiencies in the recall process are especially unsettling at a time when technological developments are ushering in a new era of computer-related design features, which hold out both the promise of enhanced driver safety and the peril of falling outside the Agency's institutional capacity to effectively implement directives in this complex environment of safety concerns.

If NHTSA is to play a meaningful role in promoting auto safety as technology evolves, the Agency will have to provide both front-end and back-end oversight. It will have to set up some ex ante performance standards to guide and channel industry innovation, and it will also be crucial for NHTSA to set up effective ex post oversight (perhaps through recalls) when unanticipated risks arise from design miscalculations. In either case, based on its track record, NHTSA faces severe challenges. As the ignition switch debacle[28] makes clear, the Agency needs a major overhaul, including more refined techniques for gathering and systematizing accident injury data, better trained personnel in automotive design and statistical analysis, greater infusion of funding from Congress, and leadership with a can-do, proactive mindset. In the current political climate, none of this seems likely. Clearly, it will be necessary to continue to rely on the threat of tort liability to contribute to incentives for driver and vehicle safety—along with marketplace and reputational motivations.

[27] Id. at 311–13; see also U.S. Dep't. of Transp., Office of the Inspector General, ST2018062, NHTSA's Management of Light Passenger Vehicle Recalls Lacks Adequate Processes and Oversight 27 (2018), https://www.oig.dot.gov/sites/default/files/NHTSA%20Auto%20Recalls%20Final%20Report%5E07-18-18.pdf [https://perma.cc/RWU4-M35C] ("NHTSA's lack of internal accountability and risk-based oversight inhibits the Agency's ability to meet its safety mission, as evidenced by the series of ineffective Takata recalls between 2008 and 2015.").

[28] See, e.g., Katy Stech & Mike Spector, GM Loses Legal Bid to Limit Fallout From Ignition Switch Cases, Wall St. J. (Apr. 24, 2017, 4:13 PM), https://www.wsj.com/articles/supreme-court-declines-to-review-gm-ignition-switch-case-1493044197 [https://perma.cc/4VS9-D2GB]; Jeff Bennett, GM Ignition Switch Death Toll Rises to 56 People, Wall St. J. (Feb. 16, 2015, 10:39 AM), https://www.wsj.com/articles/gm-ignition-switch-death-toll-rises-to-56-people-1424101164 [https://perma.cc/J52K-HCTH].

B. Products Liability in a World of Increasingly Automated Vehicles: The Interim Period

The proposal for a Manufacturer Enterprise Responsibility ("MER") system that we set out in Part III departs significantly from the current products-related tort approach. As a consequence, we do not envision the MER regime coming into play until twenty-five percent of the motor vehicle fleet consists of HAVs operating at Levels 4 and 5. Otherwise, HAVs, in their infancy, would be subjected to a notably different liability regime than the prevailing tort system applicable to the CVs predominantly involved in injury-related accidents.[29] This would be undesirable from both political and fairness perspectives: while HAVs are a relatively minor contributor to the roadway accident toll, accidents involving HAVs reveal issues that cannot be completely anticipated or addressed in advance.

In the near future, therefore, tort will remain the prevailing system for allocating responsibility for *all* motor vehicle accidents. With this in mind, we will focus first on accidents involving what we envision will be classified as Level 2 and Level 3 vehicles, which still will fall into the category that we have been calling "CV accidents."[30] As CVs at these Levels become increasingly automated, the new technology will introduce products liability considerations that foreshadow and are instructive for issues eventually arising in accident liability claims involving Level 4 and Level 5 HAVs.

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[29] From a liability perspective, these are not entirely discrete categories, of course. Some proportion of the accidents in this transitional period—as well as later, when HAVs are dominant—will involve intersecting causal conduct between HAVs and CVs, underscoring the complexity (and potential incoherence) of a dual-system approach to liability and compensation.

As discussed in Part III, the MER system establishes responsibility based on an "arising out of the operation of a motor vehicle" nexus, in contrast to design defect liability in tort, which is primarily grounded in risk/utility analysis. As a systemic change in legal responsibility, MER is best introduced when HAVs can be regarded as a substantial feature of roadway activity. The twenty-five percent figure is meant as a placeholder for present purposes. Whether it is the optimal target figure should turn on circumstances that are difficult to predict at present, such as whether HAVs attract dominant market share mostly in Level 4 or Level 5 vehicles.

[30] On this score, it should be noted at the outset that the SAE Levels 2–4, referenced above are designated without much elaboration in the NHTSA policy statement and the SAE's own description, and consequently they fail to offer helpful illustrations of coverage parameters. See NHTSA, Federal Automated Vehicles Policy, supra note 3, at 9.

1. Products Liability for Automation Defects in CV Vehicles

The dividing line between SAE Levels 2 and 3 (the latter involving "conditional automation") appears to be whether the automated system operates exclusively subject to driver monitoring (Level 2), or by monitoring the roadway circumstances to determine whether its own limits will be exceeded (Level 3).[31] In the latter situation, driver "takeover" will often be central to safe operation, and driver-takeover issues may be central in products liability litigation. To illustrate, compare normal highway driving under adaptive cruise control, now standard in Level 2 vehicles, with negotiating a roadway section involving narrow mountainous terrain or driving under exceptionally hazardous weather conditions in a Level 3 vehicle that monitors the roadway "under some circumstances." Assessing the manufacturer's liability in a Level 3 vehicle accident in which driver takeover was necessary could raise new driver negligence issues (whether the driver exercised reasonable care to take over) and new products liability issues under existing defect doctrine.

Two distinct product-defect scenarios might be present in these Level 3 situations: (1) the takeover alert might fail to function properly, in accordance with its design, or (2) the algorithm might fail to anticipate the need for takeover in the particular circumstances. The first scenario, in which the takeover function failed to work properly, would generate a standard claim of manufacturing defect. Tracking section 2(a) of the Products Liability Restatement ("PLR"), this would be a straightforward claim of strict liability.[32] The sole issue that could arise would be one of proof: plaintiff's burden to persuade that the warning signal in fact failed to be activated.

The second scenario, however, in which the scope of the algorithm failed to anticipate the need for takeover, would be somewhat more complicated. Here, the claim might be one of failure to provide "reasonable instructions or warnings," tracking PLR section 2(c) on warning defects; alternatively, the claim might be that the accident was attributable to a risk-utility design defect as defined in PLR section 2(b).[33] In es-

[31] SAE Int'l, supra note 7, at 21–22.

[32] See Restatement (Third) of Torts: Prods. Liab. § 2(a) (Am. Law Inst. 1998).

[33] See id. § 2(b)–(c). Design defect based on failure to meet consumer expectations—a test rejected by the PLR but adopted in many states as an alternative head of design defect liability—is less likely to succeed, because of the technical nature of the claim. See Soule v. Gen. Motors Corp., 882 P.2d 298, 308 (Cal. 1994) ("[T]he consumer expectations test is reserved

sence, this claim—whatever the doctrinal pigeonhole—would raise technical issues regarding the scope and quality of the algorithm for engaging driver takeover: Should the specific roadway risk that came to fruition have been anticipated or detected by the automated system? While this could raise hotly contested issues regarding the reasonable limits of engineering expertise, such issues do not seem different in kind from those arising in Level 2 CV cases, when the performance parameters of computerized safety devices (e.g., lane-drift or blind-spot alerts) have been embedded in the vehicle.

In other situations, however, decisions about whether an automated system in a Level 3 vehicle contained a design defect would be less tractable. Consider liability for accidents in which driver takeover was not feasible: a child impulsively dashing into the road, or a cyclist unexpectedly (and without margin for safe response) swerving into the path of the Level 3 vehicle. At some point, split-second automated reactions to unanticipated interceding hazards simply defy reasonable expectations of engineering design.[34] But what is that point, and according to what criteria would this decision be made? At a sufficient level of generality, there is nothing conceptually distinctive about applying design-defect doctrine to this problem, but the issues posed often will be technically complex and new to products liability litigation.

Accidents that are even more distinctively associated with automated technology, however, may start to press the limits of meaningful design-defect characterization. Suppose that, because of the background setting of sky and sun, a Level 3 vehicle fails to detect and collides with another CV, or with a cyclist or pedestrian.[35] Again, at a sufficient level of generality, products liability law provides the means of resolving a suit for any resulting injury. Design-defect doctrine would require a plaintiff in this situation to prove that there was a reasonable alternative design that could have avoided the accident, presumably by detecting and reacting to the cyclist or pedestrian. Because automated technology will surely

for cases in which the everyday experience of the product's users permits a conclusion that the product's design violated minimum safety assumptions . . . .") (emphasis omitted).

[34] This is why the *Restatement (Third) of Torts: Prods. Liab.*, supra note 32, § 3—addressing the "malfunction" theory of defects—would not be generally applicable to these cases.

[35] See, e.g., Bill Vlasic & Neal E. Boudette, As U.S. Investigates Fatal Tesla Crash, Company Defends Autopilot System, N.Y. Times (July 12, 2016), https://www.nytimes.com/2016/07/13/business/tesla-autopilot-fatal-crash-investigation.html [https://perma.cc/5FM7-PFN5].

be in a state of continual improvement, state-of-the-art issues that products liability law has put to rest in other contexts may be re-introduced in such situations. Litigation over the availability of reasonable alternative designs could easily involve challenging and technical comparisons of design risk, utility, and feasibility.

Add to these situations the variant of intersecting conduct by a victim, and the issues would become even more challenging. For example, suppose that a CV driver or a cyclist failed to exercise due care and, consequently, was partially responsible for an accident when a Level 3 vehicle failed to detect the presence of the driver or cyclist, or failed to call for driver takeover. In the modern era of product-defect liability, the joint-responsibility allocation issues that arise out of such situations have been addressed and resolved—albeit not in a single voice.[36] As in the earlier scenarios, in the short term the introduction of these circumstances to the accident mix may not press flexible application of products liability doctrine beyond its limits, but it will be yet another distinctive development with which this body of law will eventually have to cope.

2. Products Liability in the Longer Term: Will the Concept of "Defect" Be Worth Retaining?

At some point, Level 4 and Level 5 vehicles will become the dominant though still not exclusive mode of roadway transport, and accidents attributable to driver negligence—and to a lesser extent, contributory negligence by other parties, such as wayward bicyclists or darting pedestrians—will become a minor safety (and accident) concern. Should liability for driver negligence and manufacturer liability for product defects be retained in this new era? We argued above that the tripartite products liability framework of manufacturing, design and warning de-

[36] Still another variant would arise when the HAV signaled the need for driver take-over but the operator failed to respond in a reasonable fashion and a third-party was injured. Here, questions of foreseeability (of the HAV manufacturer) and proximate cause (assigned to the inattentive operator) would be triggered under the traditional tort framework.

Proximate cause issues could conceivably arise in yet another daunting context: external hacking and corresponding disablement of safety controls in the vehicle. See Deirdre K. Mulligan & Kenneth A. Bamberger, Public Values, Private Infrastructure and the Internet of Things: The Case of Automobiles, 9 J.L. & Econ. Reg. 7, 8 (2016); Aaron M. Kessler, Fiat Chrysler Issues Recall Over Hacking, N.Y. Times (July 24, 2015), http://www.nytimes.com/2015/07/25/business/fiat-chrysler-recalls-1-4-million-vehicles-to-fix-hacking-issue.html [https://perma.cc/VQV4-PBF3].

fects, along with applicable defenses, can in principle accommodate the emerging presence of Level 3 accidents, although sometimes with conceptual and technical difficulty. Whether it would make sense to continue to apply this framework to Level 4 and Level 5 vehicles is another matter. In our view, substantial considerations militate against continued reliance on negligence and products liability once a vehicle mix threshold has been crossed and the roadways contain a substantial proportion of HAVs that retain very limited driver control over the vehicle's operation or eliminate driver control altogether.

First, by definition, failure to warn defects will no longer be an applicable category. Of course, vehicle owners still will need to be clearly alerted to responsibility for routine maintenance. But driver takeover issues in Level 3 vehicles, which will raise highly contestable questions of reasonable expectations—and correlatively, reasonable attentiveness—will be a vestige of the past. Apart from conventional warnings, manufacturers would presumably be responsible for providing consumers aggregate information regarding the accident risks associated with different vehicle models. But this information is most satisfactorily provided through the pricing system, with identification of the risk premium included in the cost of the vehicle. For example, along with the pre-sale information disclosed about fuel economy, operational characteristics, and other marketing information, the vehicle's safety record and past per-vehicle MER assessments could be disclosed. Importantly, this is not reliant on a tort remedy.[37]

Second, by hypothesis, given the greatly heightened complexity and sophistication of the computerized control systems in highly automated vehicles, judicial and jury assessment of the acceptable limits of engineering capability for alleged design defects, through reliance on expert assessments of risk-utility analysis, will come to be needlessly contentious and costly.[38] From a systemic perspective, once the contribution of third parties to HAV-related accident scenarios becomes virtually de minimis, contests over blameworthiness will be replaced by examination of esoteric alleged engineering failures that can best be regarded—both from the vantage points of administrative cost and administrative feasibility—as simply having arisen out of the operation of a motor vehicle.

[37] False disclosures might still be actionable in tort.

[38] It should be noted that in some instances technological change might be expected to lower the difficulty of identifying the causes of accidents (e.g., by black box-type feedback on what happened).

Hence, retaining tort would ignore the substantial efficiencies that could be achieved by eliminating hotly contested issues of reasonable technological expectations.

Indeed, at this point, the underlying premise of risk-utility analysis in the context of HAVs warrants rethinking. As largely uniform software becomes pervasive, the concept of a reasonable alternative design ("RADs," under PLR terminology) is likely to become increasingly indeterminate. Moreover, the confounding effect of technological innovation is perhaps most evident as HAV software increasingly incorporates machine learning—that is, the compilation of operational data on the roadways through trial-and-error leading to continuous revisions and updating of algorithm-based driving instructions.[39]

These esoteric, algorithm-based design differences—which might, in addition, be subject to trade secret protection—would impose overwhelming stress on the premises of conventional analysis. Relatedly, as software-related failures become not just the prevailing, but the near-exclusive source of HAV-related injuries, a limitation on the consumer expectations test along conventional lines—that is, disavowing the test in cases of complex products—will not be a rational basis for denying victim compensation.

Nonetheless, auto accidents, though at a much-reduced level, will continue to occur. The needless cost and anachronistic quality of design defect litigation will consequently call into question not only how responsibility for these accidents should be allocated, but also how compensation should be measured and awarded. In this regard, a reformulation of responsibility standards for HAV-related accidents would highlight for reconsideration the case-by-case "make whole" approach to tort compensation as well. We now turn to such a reformulation by detailing our proposal for the adoption of MER.

[39] For discussion, see Cade Metz, Competing With the Giants In Race to Build Self-Driving Cars, N.Y. Times (Jan. 4, 2018), https://www.nytimes.com/2018/01/04/technology/self-driving-cars-aurora.html [https://perma.cc/QT84-JNNR]; Evan Ackerman, How Drive.ai Is Mastering Autonomous Driving With Deep Learning, IEEE Spectrum (Mar. 10, 2017, 9:30 PM), https://spectrum.ieee.org/cars-that-think/transportation/self-driving/how-driveai-is-mastering-autonomous-driving-with-deep-learning [https://perma.cc/V68T-7LQC].

III. MANUFACTURER ENTERPRISE RESPONSIBILITY: VEHICLE-FOCUSED LIABILITY AND INSURANCE FOR HAV ACCIDENTS

We argued above that, once Level 4 and Level 5 HAVs become a significant and frequently adopted mode of transportation, retention of the fault-oriented standards of negligent driving and of liability for defective products would become outmoded or inconsequential as these standards pertain to HAVs. The current driver-focused liability system will become a thing of the past by virtue of technological change itself—there will be very few occasions for drivers to be negligent, because there will be very little "driving" by people. Auto manufacturers will still be making vehicles, however, and their vehicles will be the cause of most accidents. But the system of auto manufacturer liability for products liability will become inordinately anachronistic and difficult to apply.

A number of scholars have nevertheless envisioned retaining liability for product defects by adjusting the standard under which defectiveness is assessed. One of the most developed analyses is Professor Mark Geistfeld's proposal to insulate auto manufacturers from design defect liability if aggregate premarket testing data show that the autonomous vehicle performs at least twice as safely as conventional vehicles, and the manufacturer warned consumers about residual risks.[40]

We think that this approach would result in considerably less-than-optimal liability, because the liability standard that Professor Geistfeld develops is insufficiently exacting. As long as current projections are not hopelessly optimistic, it will be an easy matter for HAVs to be more than twice as safe as conventional vehicles. As we indicated at the outset, estimates are that HAVs will essentially reduce auto accidents by as much as eighty to ninety percent. In any event, products liability law has never gauged the reasonableness of a design by comparison to designs that have been rendered obsolete. A chainsaw's trigger guard may be defectively designed even if the design is twice as safe as a saw without any guard at all; and depending on its side effects, an MRI machine may

[40] Mark A. Geistfeld, A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation, 105 Calif. L. Rev. 1611, 1612 (2017). Professor Geistfeld envisions this standard as applicable to a transitional period: "As the market matures and autonomous vehicles become the norm, a different baseline of comparison will be required. For now, however, the baseline for evaluating safety benefits of an autonomous vehicle can be defensibly defined in terms of conventional vehicles." Id. at 1653.

be defectively designed even if it is twice as safe as the X-ray machine that it supersedes.

Other scholars, aware of the difficulties of applying the defect concept to HAVs and interested in ensuring compensation for the residue of injuries that HAVs will not eliminate, have gone further along the path toward more far-reaching liability. Some have simply envisioned liability without regard to defectiveness, without substantial analysis or elaboration.[41]

Among the scholars who favor dispensing with the product-defect standard, Professor David Vladeck has worked through the rationale for such an approach in more detail and proposed what he refers to as "common enterprise liability."[42] In Professor Vladeck's telling, this would consist of strict joint and several liability for all HAV-related injuries, on the part of not only the manufacturer of the vehicle, but also the makers of component parts.[43] Professor Vladeck favors such joint liability because he apparently is more concerned than we think is necessary about the difficulty of determining whether the auto manufacturer or the maker of a component part was the cause of an accident. As we indicate below, these probabilities can be assessed ex ante by manufacturers and handled by indemnity agreements or price adjustments with their component-part suppliers.

[41] See, e.g., F. Patrick Hubbard, "Sophisticated Robots": Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1866–67 (2014) (describing the possibility of automobile distributors forming a fund that compensates victims for injuries caused by robotic automobiles); Jeffrey K. Gurney, Sue My Car Not Me: Products Liability and Accidents Involving Autonomous Vehicles, 2013 U. Ill. J.L. Tech. & Pol'y 247, 271–72 (2013) (arguing that the manufacturer of the specific autonomous technology should be liable for accidents in autonomous mode, not the automobile producer); Kevin Funkhouser, Note, Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach, 2013 Utah L. Rev. 437, 461–62 (2013) (asserting that a no-fault compensation system similar to that created by the National Childhood Vaccination Injury Act should be imposed on autonomous vehicle manufacturers); Omri Ben-Shahar, Should Carmakers Be Liable When a Self-Driving Car Crashes?, Forbes (Sept. 22, 2016, 11:36 AM), https://www.forbes.com/sites/omribenshahar/2016/09/22/should-carmakers-be-liable-when-a-self-driving-car-crashes/2/#309606f74378 [https://perma.cc/P44C-HM9L] (arguing that imposing liability on autonomous carmakers would not chill production, because the additional cost would instead be calculated in the purchase price).

[42] David C. Vladeck, Machines Without Principals: Liability Rules and Artificial Intelligence, 89 Wash. L. Rev. 117, 129 n.39, 146–47 (2014).

[43] Id. at 148.

Professor Vladeck's approach, however, moves in the right direction.[44] Once HAVs no longer retain even limited driver control over the vehicle's operation, it would make sense to shift to a system of manufacturer responsibility for bodily injuries arising out of the operation of an HAV. As we describe it below, our conception of this approach, which we call "Manufacturer Enterprise Responsibility" ("MER"), is that it would be a manufacturer-financed, strict responsibility bodily injury compensation system, administered by a fund created through assessments levied on HAV manufacturers.

The adoption of the MER system will entail a variety of rules governing scope and implementation. In this Part, we address these matters in detail. The amount of detail we provide in our proposals may at first blush seem surprising, given that our subject is a basic issue of public policy that has only recently been the subject of any discussion at all. In our view, however, whether a proposed policy makes sense almost always depends on whether it is workable, and whether it is workable depends on exactly how it will, or at least could, function. For the most part, the first generation of discussions of HAV liability have, understandably, talked at the level of principle and concept. To push the discussion forward, it is necessary to include, but also to go beyond, principle and conceptual matters alone. Actual policy choices and details must be identified and analyzed.

A. The New Taxonomy of Accident Types

Once HAVs are on the road, there will be two new types of accidents, in addition to accidents involving CVs only, for which a liability regime is required: "pure" HAV accidents, whether involving one or multiple HAVs (and sometimes involving HAVs and pedestrians or other third parties); and "mixed" accidents involving a CV and an HAV (and sometimes pedestrians or other third parties, as well).[45] Our proposals for the legal treatment of these two new types of accidents, and for the use of MER in connection with them, are set out below.

[44] Vladeck, however, does reject a move to no-fault but with some ambivalence. See id. at 147 n.91. Moreover, his sole expressed basis for rejection is the failure of auto no-fault schemes in the 1970–80s to drive down insurance costs. Id. But those schemes bore little resemblance to our proposal, and more importantly, were grounded in a contemporary driver-responsible accident context.

[45] See Figure 1.

Figure 1

Accident Type	Car 1	Car 2
Conventional	CV	CV
Mixed	CV	HAV
Pure	HAV	HAV
Pure	HAV	No Car (one-car collision or collision involving pedestrian, bicyclist, etc.)

We first address how MER will be adopted and activated. We then separately discuss the treatment of pure and mixed HAV accidents, in that order. Logically, it may be that mixed accidents should be discussed first, since such accidents are likely at first to be predominant. But as a practical matter, first discussing pure HAV accidents gives us the opportunity to describe MER in detail, and then, with this description on the table, to consider whether and to what extent it makes sense to apply MER, or some other approach, to mixed accidents. Finally, we discuss the administration and resolution of disputes under MER.

B. Adopting and Activating MER

To be effective, MER will have to be a uniform system enacted at the federal level and applicable throughout the country. It should be activated only after a threshold percentage of registered vehicles are HAVs.

1. A Single National Rule

As a practical matter, what we propose would require a single national rule enacted by the U.S. Congress, pre-empting all inconsistent state legislation and common law rules. Any other approach would create a patchwork of potentially inconsistent state regimes. Some states would adopt MER; others would retain common law negligence liability; others would retain their hybrid negligence/auto no-fault approaches; still other states might adopt a revised version of common law tort, along lines now being proposed by commentators.[46] Even among states that adopted MER, eligibility and benefit levels could vary. Realistically,

[46] See generally, e.g., Geistfeld, supra note 40; Vladeck, supra note 42.

state-based legislation is too uncertain, and will be too varied, to be satisfactory. In order to achieve uniformity, federal legislation, not state-to-state variation or the hortatory approach of a proposed uniform state law, will be necessary.

In any event, auto manufacturers are national, indeed international businesses. Their HAVs will carry the same safety features and the same risk in whatever state they are driven, independent of where state boundaries are located. Variation in products liability standards and the unpredictability of their application from state to state, as much as the scope of potential liability, have been the major dissatisfaction of auto manufacturers with the current system. A single national approach would solve this problem.

2. The Threshold for Activation of MER

As mentioned earlier, the MER system should go into effect when twenty-five percent of all vehicles registered in the United States are HAVs. The twenty-five percent threshold that we propose is not arbitrary, but neither is it set in stone. MER should be introduced as soon as the percentage of HAV vehicles is substantial.[47]

An HAV vehicle should be defined as one that satisfies the definition of Level 4 and Level 5 vehicles under the Society of Automotive Engineers ("SAE") classification system. These categories are for vehicles that incorporate "high automation" and "full automation," respectively.[48] In contrast, at Level 3 there is only conditional automation, because the driver is expected to respond to a request to intervene in the operation of the vehicle.[49] Both the conceptual and practical difficulties that would be associated with application of MER to the automated operation of Level 3 vehicles, in our view, argue against applying MER to such vehicles. Some accidents would arise out of the automated operation of a Level 3 vehicle; some would arise from driver error such as arguably negligent takeover; and others might be the result of a combination of the two factors. Attempting to determine which occurred, and applying MER only in some situations, would be a game not worth the candle.

[47] See supra note 10 and accompanying text (proposing triggering MER once HAVs make up 25% of vehicles on the road).

[48] SAE, Automated Driving: Levels of Driving Automation Are Defined in New SAE International Standard J3016 2 (2014).

[49] Id.

A separate problem is how to identify Level 4 and Level 5 vehicles. The differences between the SAE Levels are not fully objective: as the SAE itself states, "A particular vehicle may have multiple driving automation features such that it could operate at different levels depending upon the feature(s) that are engaged."[50] The development of HAVs that could qualify as Level 4 or Level 5 vehicles, however, is too far in the future for any definitive definition to be developed now. It will be at least the early or mid-2020s before the issue can be considered ripe.[51] The most promising approach will probably be to designate certain core features of a vehicle that must be highly or fully autonomous in order to qualify. But it would be premature to try to identify the universe of such features at present.

An alternative that could be kept on the table for the present is manufacturer self-designation/opt-in during an initial phase, such as the first five to ten years. That would solve problems of definition. A manufacturer willing to declare coverage eligibility under the MER regime for all HAV accidents could simply certify its vehicles, or a subset of them, as qualifying. But we are concerned about the risk of what would amount to adverse selection problems—for example, manufacturers of vehicles encountering significant numbers of suits for design defects arising out of particular design features and then opting into MER for later model years in order to save on tort costs, instead of redesigning their vehicles. For this reason, we do not favor this approach at present. If technological developments made the risk of this sort of adverse selection minimal, however, it could then be appropriate to consider manufacturer self-designation.

C. Pure Cases: HAV-Only Accidents and the Scope of MER

HAV occupants and specified third parties involved in HAV-only accidents would be entitled to MER, provided automatically as one of the terms of sale of all HAV vehicles. All bodily injury "arising out of the operation" of the vehicle would be covered, up to the specified benefit limits, except for injuries caused by the HAV owner's own negligence. For example, MER would not cover injuries caused by the negligent failure to upload software updates, negligent tweaking of software, or

[50] Id.

[51] See predictions cited supra note 8 and accompanying text.

negligent maintenance.[52] Nor would MER cover negligent "drivers" for those limited tasks that they could perform. For example, we envision the possibility that an SAE 4 vehicle could be manually driven a few feet in order to set it at a particular angle to a wall or to place it on a hydraulic lift for maintenance.[53]

MER would be a victim's exclusive remedy for the injuries to which it applied; there would be no tort cause of action for injuries caused by allegedly defective features of an HAV. Benefits would be provided for out-of-pocket losses (such as medical bills and lost wages), plus scheduled benefits for substantial pain and suffering. We discuss each of these features of MER below.

1. Covered Individuals and Manufacturer Responsibility

In fashioning the MER system, a number of choices must be made. In this Subsection we address two choices. The first is which individuals should be entitled to MER. The second is whether MER should be a third-party system of manufacturer liability, or a first-party system of vehicle-owner and victim-purchased insurance.

a. Covered Individuals

MER would provide compensation to the HAV's occupants, as well as to pedestrians, bicyclists, motorcyclists, and other third-party bystanders, for bodily injuries "arising out of the operation" of an HAV. This would include injuries suffered in accidents involving two or more HAVs.[54] It is conceivable that on rare occasions an injured pedestrian or

[52] An array of related variations on owner/manufacturer responsibility could arise, but it is too speculative to assess comprehensively at this point. For example, it is conceivable that the HAV manufacturer would offer a setting in which the owner was given some leeway in determining the speed/safety trade-off under specified circumstances. The owner's choice among options might raise questions of negligence or comparative responsibility. Less speculative would be settings that allowed the owner to determine route preferences. But these scenarios seem unrelated to limiting manufacturer responsibility for vehicle-related accidents. Similarly, it is conceivable that owner preferences would be programmed without precluding operation under various hazardous conditions (hurricane alerts, for example). But in these latter scenarios, failure to warn doctrine (and concomitantly, ignoring manufacturer warnings) would likely be determinative of liability.

[53] The MER Fund, however, would have the burden of proving that injuries otherwise arising out of the operation of an HAV were proximately caused by the HAV owner's (or "driver's") negligence.

[54] When a third party, not an occupant, is injured by the convergence of two HAVs, to promote simplicity and low administrative costs, the third party should be able to choose

bicyclist will have been so substantially responsible for an accident that his or her injuries would not be considered to have "arisen out of the operation" of an HAV and therefore be non-compensable. For example, if a pedestrian stepped directly in front of an HAV or a bicyclist rode directly into the rear of an HAV as the HAV was properly coming to a stop, neither the pedestrian's nor the bicyclist's injuries would arise out of operation of the HAV. The notion of an accident "arising out of" HAV operation contemplates a sufficient causal nexus between operation and injury that would be absent in our hypotheticals. But these cases should be the rare exception.[55]

MER will not cover property damage suffered either by an HAV owner or occupant, or by a third-party.[56] In most instances, this will produce no hardship or unfairness. HAV owners still will likely purchase conventional auto insurance (sometimes called "collision" and "comprehensive" coverage) covering damage to their vehicles—for example, protection against fire and theft. HAV occupants, pedestrians, and bicyclists still will be able to purchase property insurance (usually under Homeowners or Renters policies) covering them against loss related to personal property. And owners of real property damaged on rare occasion by an HAV will have similar coverage (if, for example, an HAV damages a garage).[57]

between HAVs, and there should be no contribution. This mirrors the old common law rule that there is no contribution among joint tortfeasors. Statistically, this will end up being random for manufacturers and therefore should not be unfair in the aggregate. In practice, of course, there will be relatively few cases of this sort.

[55] Reverting back to the negligent maintenance and/or failure-to-download-software-updates examples, supra note 52 and accompanying text, if the vehicle is owned by a ride-sharing or rental enterprise—which many commentators believe will become increasingly the case in the new era—then presumably an injured occupant or other third-person would retain a tort action against this entity for the subpar conduct. See, e.g., Collazo v. MTA-New York City Transit, 905 N.Y.S.2d 30, 31 (N.Y. App. Div. 2010) (holding negligent maintenance suits against car and truck rental companies are not barred by the Graves Amendment, 49 U.S.C. § 30106, which generally precludes vicarious liability). But see Mark Harris, Passengers in Uber's Self-Driving Cars Waived Right to Sue for Injury or Death, The Guardian (Sept. 26, 2016), https://www.theguardian.com/technology/2016/sep/26/uber-self-driving-passengers-pittsburgh-injury-death-waiver [https://perma.cc/7HCM-P2QW] (reporting that passengers in Uber's self-driving cars in Pittsburgh had to waive right to sue even for "negligence or human error").

[56] Current auto no-fault legislation similarly precludes coverage for property damage. See, e.g., Mich. Comp. Laws § 500.3123(1)(a) (1978) (excluding coverage damage to non-parked vehicles and contents).

[57] Homeowners and renters policies contain motor vehicle exclusions that are applicable to the liability insurance components of these policies, but these exclusions do not apply to the

Given the widespread availability and actual purchase of property insurance, we favor eliminating HAV manufacturers' tort liability for such property damage, despite the fact that it will not be compensable by MER. But even if tort liability for property damage is preserved, liability is likely to be an issue mostly between subrogated auto or property insurers and HAV manufacturers. Such suits will succeed only if the former are able to prove that the property damage was caused by a defect in the HAV. That will be an expensive proposition for all but the most substantial amounts of property damage. We therefore do not expect that there would be many such suits.

b. Manufacturer Responsibility

The second choice is between third-party and first-party insurance: between manufacturer and auto-owner financial responsibility for the costs of HAV-related compensation. For a number of reasons, manufacturer liability is highly preferable.

Most importantly, the owner and occupants of an HAV will have no operational control over the vehicle. Their only involvement will be the decision to purchase and/or ride in the vehicle. In contrast, the manufacturer will design or purchase from a supplier the autonomous driving system incorporated into the vehicle. A number of factors flowing from these differences support the choice of manufacturer responsibility.

First, the manufacturer will be in the best position to decide what to invest in designing the system by comparing (among other things) the cost of compensating losses for which it is responsible with the cost of including features that will help to avoid additional accidents. Second, bearing financial responsibility for HAV losses will give the manufacturer an incentive to research ways of avoiding accidents that are currently unavoidable. For example, vehicle-to-vehicle ("V2V") communication is likely to become one of the methods that HAVs employ to avoid accidents.[58] Some accidents resulting from the failure of one vehi-

property insurance coverage provided by the policies. See Kenneth S. Abraham & Daniel Schwarcz, Insurance Law and Regulation: Cases and Materials 202 (6th ed. 2015).

[58] U.S. Dep't of Transp., 11078-101414-v2a, NHTSA Issues Advance Notice of Proposed Rulemaking and Research Report on Ground-Breaking Crash Avoidance Technology: "Vehicle-To-Vehicle Communications: Readiness of V2V Technology for Application" (2014), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/v2v_fact_sheet_101414_v2a.pdf [https://perma.cc/ZP3Y-L9Q7]; Cecilia Kang, Cars Talking to One Another? They Could Under Proposed Safety Rules, N.Y. Times (Dec. 13, 2016), https://www.nytimes.com/2016/12/13/technology/cars-talking-to-one-another-they-could-under-proposed-safety-rules.html

cle's V2V communication system may be unavoidable given the state of technology at the time. But relieving a manufacturer of responsibility for accidents that result from the failure of another vehicle's V2V communication system would generate complicated factual disputes about causation. It would also diminish that manufacturer's incentive to discover ways of avoiding this kind of accident. Imposing responsibility on the manufacturer of the vehicle whose V2V system worked properly (for injuries suffered by the occupants of its own vehicle) would give that manufacturer the incentive to develop methods of avoiding accidents resulting from the failure of another vehicle's V2V communication system.

Third, because the manufacturer will bear the above-mentioned costs, the anticipated cost of HAV-related accidents will be reflected in the price of the vehicle. As a result, HAV manufacturers will internalize the cost of HAV accidents, the purchase price of HAVs will reflect that cost, and an "excessive" number of HAV vehicles will not be on the road. This will reflect what tort theorists sometimes call an "activity-level" effect that strict liability produces more effectively than negligence liability.[59]

As to this last point, some observers have argued that the threat of even conventional products liability would impede the development of HAVs.[60] They can be expected to argue that adoption of MER would generate an even greater disincentive to the development of HAVs. In our view, however, this effect is likely to be minimal. HAV technology promises transportation and safety advances of such magnitude, and profits that will inevitably accompany these advances, that the threat of financial responsibility for HAV-related losses is unlikely to deter research and development or the marketing of HAVs in any significant way. This is especially true given that the cost of funding MER is likely

[https://perma.cc/5LGR-3QWM]; John R. Quain, Cars Will Talk to One Another. Exactly How Is Less Certain., N.Y. Times (Mar. 9, 2017), https://www.nytimes.com/2017/03/09/business/cars-v2v-dsrc-communication.html [https://perma.cc/7YT2-XAXQ].

[59] Steven Shavell, Strict Liability Versus Negligence, 9 J. Legal Stud. 1, 2–3 (1980).

[60] See, e.g., Ryan Calo, Robotics and the Lessons of Cyberlaw, 103 Calif. L. Rev. 513, 535–37 (2015) (noting possibility of breakdown in legal liability apportionment with more automation and "intangible" products such as automated car intelligence); Gary E. Marchant & Rachel A. Lindor, The Coming Collision Between Autonomous Vehicles and the Liability System, 52 Santa Clara L. Rev. 1321, 1333–35 (2012); Jessica S. Brodsky, Note, Autonomous Vehicle Regulation: How an Uncertain Legal Landscape May Hit the Brakes on Self-Driving Cars, 31 Berkeley Tech. L.J. 851, 861–65 (2016).

to be more predictable and steady than the threat of conventional products liability.

It is worth contrasting manufacturer liability for MER with the choice between the negligence system and first-party auto no-fault that has long been made in connection with accidents involving conventional vehicles. In CV accidents, some incentive effects can be generated by each approach. The threat of negligence liability probably has a modest influence on safety levels, mainly by way of variation in the cost of liability insurance that is partly dependent on the insured's driving history. But even without any negligence liability, some incentive effects can be generated in traditional auto no-fault by varying first-party insurance premiums so that they too are partly based on driving history.[61]

An owner-responsibility, first-party insurance approach for HAVs, however, would sacrifice these incentive effects, but (in contrast to auto no-fault) generate little or no incentive effects in return. Charging HAV owners and/or occupants for their own insurance would not have any direct effect on safety levels because these individuals will have no control over the operation of their vehicles. Conceivably the prospect of paying more for first-party insurance depending on which HAV a potential purchaser chose could create an indirect effect by influencing demand for different HAVs. But for this effect to occur, potential purchasers would have to consult their insurance agents, or make independent inquiries, about the potential first-party insurance premiums they would pay depending on which vehicle they chose. Prospective purchasers would have to make their purchasing decisions based at least in part on the differential in premium quotations they had received. Manufacturers would then have to find a way to calculate the portion of any variation in demand for their vehicles that could be attributed to the influence of purchasing decisions based on differentials in first-party insurance premiums, and then make design decisions corresponding or in reaction to these calculations. Even if this whole process actually occurred as precisely as we have described it, it would be a far more attenuated and imprecise way to create safety incentives for HAV manufacturers than imposing responsibility for HAV accidents directly on the manufacturers.

[61] In no-fault states, compromises were reached in which cases involving substantial losses remained subject to tort, both to preserve deterrence and to enable seriously injured victims to recover pain and suffering damages, which were never made available under auto no-fault. Abraham & Schwarcz, supra note 57, at 711–12.

2. MER as the Exclusive Remedy, with Limited Exceptions

MER would eliminate manufacturers' and operators' liability in tort for bodily injuries "arising out of the operation" of an HAV. Virtually all studies suggest that the advent of HAVs will radically reduce the incidence of auto-related injuries because such a high percentage of these accidents now result from driver error.[62] For the remaining HAV accidents that still occur, the *quid pro quo* given to claimants in return for the elimination of their potential tort claims is the expansion of the right to compensation to include all injuries arising out of the operation of the vehicle, even if not caused by a defect in the HAV. MER would provide a swift and, in most instances, automatic source of full compensation for bodily injuries arising out of the operation of a vehicle.

It is worth emphasizing that, with the exceptions we note below, HAV occupants would not have a tort cause of action for injuries caused by defects in either the autonomous features or the remaining non-autonomous component parts of the vehicle. For example, even if a vehicle's brakes failed, or it suddenly accelerated because of an ignition malfunction, or its fuel injectors sprayed gasoline over the engine and caused a fire that resulted in a collision, or its occupants were injured because it was not crashworthy—and even if injuries resulting from these or similar malfunctions had been actionable under current products liability doctrine because they resulted from manufacturing or design defects—a products liability action for injury or damage caused by such malfunctions would not be available. Instead, MER would compensate individuals injured as a result of any of these defects.

a. Arguments for an Exclusive Remedy

There are a number of arguments for making MER an exclusive remedy. First, without making this remedy the only option, there could still be difficult conceptual and practical problems arising out of the distinction between accidents "caused" by the autonomous features of a vehicle and those caused by other defective features. The conceptual problem involves joint causation. If a vehicle's brakes failed, for example, and the vehicle failed to bring itself to a safe stop before an accident occurred, there is a sense in which both the defective brake component part and the autonomous features of the brakes were causes of the acci-

[62] See NHTSA, Federal Automated Vehicles Policy, supra note 3, at 5.

dent. Making MER the exclusive remedy will avoid the complicated, expensive litigation and the uncertainty that would otherwise be associated with the slow development of common law rules about knotty issues such as this. Because all the costs of HAV-related injuries would be internalized to the manufacturer, the transaction costs that would otherwise be necessary to resolve such issues would be eliminated.

The practical problem is evidentiary. Sometimes the cause of an accident will not be easy to determine. As a result, if MER were not the exclusive remedy, there would be factual disputes at the borderline between MER and product-defect liability. Some plaintiffs would seek to bring themselves within the coverage of MER, while others would seek to avoid it. Some defendants would seek to avoid MER, while others would seek to bring themselves within it.[63] These kinds of disputes could not arise when MER is the exclusive remedy.

Second, accidents caused by defects in the non-autonomous features of an HAV are likely, at least over time, to arise less frequently than might be supposed. Presumably the incidence of defect-caused accidents would decline because at least some such accidents, and perhaps most, would be avoided by the operation of the HAV. For example, features of the vehicle involving defective crashworthiness would much less frequently cause harm because there would be fewer crashes. Similarly, operational malfunctions resulting from malfunctions of component parts such as tire blowouts or the sudden failure of headlights or signaling capacity would often be handled more effectively and with fewer accidents by HAVs than they would have been handled by an active driver. This would reduce the number of conventional products liability actions that could have been brought after HAVs become dominant, even if such liability had been preserved.

Third, under current law, the threat of liability for injuries caused by product defects is a major financial incentive that auto manufacturers have for optimizing the safety of their vehicles. Although making MER the exclusive remedy would diminish this particular financial incentive, adoption of MER for all operation-related losses would substitute a potentially even greater incentive for manufacturers to optimize safety, because MER would apply to an expanded group of claimants.

[63] Analogous boundary issues have sometimes troubled other administrative compensation systems. See, e.g., Nora Freeman Engstrom, A Dose of Reality for Specialized Courts: Lessons from the VICP, 163 U. Penn. L. Rev. 1631, 1706–09 (2015) (discussing boundary issues within the Vaccine Injury Compensation Program).

Fourth, the exclusive remedy approach would cleanly and effectively render the manufacturer the focal point for the creation of incentives that would otherwise have to be addressed through complex rules regarding component-part maker responsibilities for funding MER or for defects in the parts they supplied to the manufacturer. Thus, we see no reason to involve the makers of component parts in the MER system, but they should also be immune from conventional tort liability. The result will be a significant saving on transaction costs.[64]

Nor will there be any need to address what has come to be called the "trolley problem" in the philosophical and legal literature.[65] This is the split-second choice that HAVs will have to be programmed to make: whether and when to enhace safety to HAV occupants at the cost of endangering occupants of other HAVs or pedestrians. Should the vehicle collide with a utility pole or swerve to avoid it and strike pedestrians instead? HAV manufacturers will internalize the costs of whatever programming choices they make regarding such dilemmas because the manufacturers will bear MER responsibility for the consequences of their choices.[66]

In short, making MER the exclusive remedy in virtually all cases will minimize complications and uncertainty about liability, and it will optimize safety incentives by focusing financial responsibility on the manu-

[64] The transaction costs associated with tort litigation, sometimes—though not always—involving the allocation of responsibility among defendants, are high. See, e.g., Deborah R. Hensler et al., RAND Institute for Civil Justice, Trends in Tort Litigation: The Story Behind the Statistics 29 tbl. 4.1 (1987) (reporting that, in auto cases, defendant and plaintiff legal fees consumed forty-five cents of every dollar expended); James S. Kakalik & Nicholas M. Pace, RAND Institute for Civil Justice, Costs and Compensation Paid in Tort Litigation 70 (1986) (reporting that, in auto cases, plaintiffs' net compensation as a percentage of total expenditure was fifty-two percent); State of N.Y. Ins. Dep't., Automobile Insurance… For Whose Benefit? A Report to Governor Nelson A. Rockefeller 34–35 (1970) (finding that transaction costs consumed fifty-six cents of every premium dollar). In contrast, according to one study, a true no-fault regime would reduce transactions costs as compared to the tort system by 7% (from 33% to 26%). Stephen J. Carroll et al., RAND Institute for Civil Justice, No-Fault Approaches to Compensating People Injured in Automobile Accidents 20 (1991).

[65] The name comes from the hypothetical choice that a trolley driver must make between striking multiple people on the trolley's track and affirmatively shunting onto another track and striking only one person. Seminal work on the problem can be found in Philippa Foot, *Virtues and Vices and Other Essays in Moral Philosophy* 23 (1978), and Judith Jarvis Thomson, *The Trolley Problem*, 94 Yale L.J. 1395 (1985).

[66] If the choices they make are nonetheless deemed unacceptable, regulatory directives can mandate the best approach for all manufacturers.

facturers of HAVs, who will be in the best position to make the decisions that influence safety levels.

b. Exceptions to the Exclusive Remedy: Punitive Damages, Third-Party Responsibility, and Owner Modification

The substitution of MER for manufacturer (and component-part maker) liability for injuries caused by manufacturing, design, and warning defects will be the right tradeoff for the vast majority of HAV-related accidents. There may be occasional situations, however, in which manufacturer or component-part maker wrongdoing has been so egregious that the threat of direct or indirect responsibility for MER compensation clearly has been an insufficient incentive for these parties to take optimal care. In recent years there have been a number of instances in which this has arguably been the case,[67] even though most run-of-the-mill products liability suits have not involved this degree of malfeasance.

Consequently, we believe that the right of MER claimants to bring a suit alleging manufacturer or component-part maker liability for punitive damages should not be abolished under an MER-enabling statute. Rather, whether and to what extent such a cause of action should be available and/or preserved should be a matter of otherwise-applicable state law.

In addition, there are likely to be some cases (though we expect they will be a minority) in which an outside agent is responsible for an HAV-related accident. For example, the possibility of a cyberattack on HAV software or another form of terrorism is often mentioned.[68] Other third

[67] See, e.g., Jack Ewing, Inside VW's Campaign of Trickery, N.Y. Times (May 6, 2017), https://www.nytimes.com/2017/05/06/business/inside-vws-campaign-of-trickery.html?mcubz=1 [https://perma.cc/VVW4-GUGG]; Jack Ewing & Hiroko Tabuchi, Volkswagen Set to Plead Guilty and to Pay U.S. $4.3 Billion in Deal, N.Y. Times (Jan. 10, 2017), https://www.nytimes.com/2017/01/10/business/volkswagen-diesel-settlement.html?mcubz=1 [https://perma.cc/AGT8-W4HM]; Hiroko Tabuchi, Hawaii Sues Takata, Alleging Cover-Up of Airbag Defect, N.Y. Times (May 13, 2016), https://www.nytimes.com/2016/05/14/business/takata-airbag-defect-lawsuit.html [https://perma.cc/7C52-SDZX]; Hiroko Tabuchi & Neal E. Boudette, Automakers Knew of Takata Airbag Hazard for Years, Suit Says, N.Y. Times (Feb. 27, 2017), https://www.nytimes.com/2017/02/27/business/takat a-air bags-automakers-class-action.html [https://perma.cc/5KCS-Z4GD]; Bill Vlasic, G.M. Inquiry Cites Years of Neglect Over Fatal Defect, N.Y. Times (June 5, 2014), https://www.nytimes.com/2014/06/06/business/gm-ignition-switch-internal-recall-investigation-report.html [https://perma.cc/3MBT-9UUG].

[68] Andy Greenberg, Hackers Remotely Kill a Jeep on the Highway—With Me in It, Wired (July 21, 2015, 6:00 AM), https://www.wired.com/2015/07/hackers-remotely-kill-jeep-high

parties also might tortiously cause or contribute to an accident—for example, a vandal could drop a heavy object from a highway overpass onto a vehicle, or highway design or digital infrastructure[69] might cause or contribute to an HAV accident. In each of these instances, an HAV claimant should be entitled to bring a conventional tort action.[70] Finally, in the event that the owner of the vehicle has modified it in a manner that causes an accident, MER should not be available.

3. MER Benefits

The benefits available from MER should serve several purposes: (a) they should be an adequate substitute for the tort remedy that potential claimants would no longer have; bearing responsibility for these benefits should give HAV manufacturers a strong incentive to optimize the safety of their vehicles (including by exercising careful oversight over component part manufacturers); and (b) the benefits should fully compensate the vast majority of HAV victims for their losses, so that they are not worse off under the new system.[71]

way [https://perma.cc/7TS3-UQA6]; Nicole Perlroth, Electronic Setups of Driverless Cars Vulnerable to Hackers, N.Y. Times (June 7, 2017), https://www.nytimes.com/2017/06/ 07/technology/electronic-setups-of-driverless-cars-vulnerable-to-hackers.html?mcubz=1 [https://perma.cc/9QUU-ETD3]; Nicole Perlroth, Why Car Companies Are Hiring Computer Security Experts, N.Y. Times (June 7, 2017), https://www.nytimes.com/2017/06/07/technology/why-car-companies-are-hiring-computer-security-experts.html?mcubz=1 [https://perma.cc/GR3X-49VB].

[69] So-called vehicle-to-infrastructure ("V2I") communication failures would fall into this category. See Alexandria Sage, Audi Vehicles to Talk to U.S. Traffic Signals in First for Industry, Reuters (Aug. 15, 2016, 12:15 PM), http://www.reuters.com/article/us-audi-trafficsignals-idUSKCN10Q1KL [https://perma.cc/6XT5-JBVZ]; U.S. Dep't of Transp., Office of the Assistant Sec'y for Res. & Tech., Intelligent Transp. Sys. Joint Program Office, Vehicle-to-Infrastructure (V2I) Resources, https://www.its.dot.gov/v2i [https://perma.cc/6XT5-JBVZ].

[70] It should be noted that in the case of highway design or digital infrastructure negligence or defect, rules governing state or municipal tort immunity may limit the claimant's or MER's rights of recovery.

[71] The benefit levels proposed and discussed in the following paragraphs are not set in stone. There is no precise science to setting cap levels, as a close observation of existing tort and no-fault caps will confirm. By way of illustration, consider the array of auto no-fault and tort pain and suffering caps. Our cap levels are meant to strike a balance among considerations of victim compensation, manufacturer safety incentives, and political feasibility, while recognizing that these benefits are a trade-off against the elimination of responsibility in tort. If the MER system seems a sensible approach to HAV-related accident law, then benefit levels should be set with sensitivity to the considerations just mentioned.

a. Benefit Levels

For these purposes, our working assumption is that unlimited medical expenses and up to $1 million in compensation for wage losses, indexed for inflation, should be available to each eligible MER claimant. Benefits would be paid periodically.[72] In addition, up to $500,000 should be available, according to a schedule of noneconomic losses, for specified permanent or long-term injuries. The schedule should be modeled on, but substantially more generous than, the lump sums available under state workers' compensation regimes for permanent disabilities. Finally, up to $1 million for wrongful death should be payable to the heir or heirs-at-law of a person killed in an HAV accident. This also should be paid pursuant to a schedule that is a function of the heir, or heirs', age and relationship to the decedent.

On one hand, a disadvantage of the $1 million limit on wage loss benefits is the risk that it will provide insufficient protection against long-term, substantial wage losses suffered by a high-end earner claimant. It is easy to picture a relatively young victim with permanent disabling injuries suffering wage loss in excess of that level. In contrast to medical expenses, there will much less frequently be another source of compensation for wage loss after MER benefits are exhausted. Few people have private disability insurance that would cover them to that extent, and neither workers' compensation nor social security disability provides generous wage loss protection. To be candid, the U.S. population is underinsured for long-term disability, the probability of which is roughly equivalent to the risk of death at any given age. On the other hand, people have very different likelihoods of suffering $1 million in wage losses. Low-income individuals would, in effect, have paid a premium (included in the price of the vehicles they purchase) to cover high-income individuals against the greater risk that they would suffer $1 million in wage losses. Covering even higher levels of wage loss would exacerbate this regressive effect.

A $1 million cap on wage loss benefits is therefore an imperfect but reasonable way to balance these competing considerations. Beyond this limit, there is a mechanism that could be used to help resolve the problem in the HAV accident context. Purchasers of HAVs could be allowed to elect at the time of purchase, for themselves and other claimants suf-

[72] While this creates a risk of malingering, we address this concern in part by proposing relatively modest deductibles and copays. See infra Subsection III.C.3.b.

fering injuries associated with their vehicles (or their heirs in the event of death), to be covered by *excess* MER (e.g., up to $10 million) for an additional price to be set by each manufacturer. This excess coverage could also be made available for additional pain and suffering compensation. In such a way, a major portion of any compensation shortfall that might otherwise have occurred in a small minority of claims could be addressed.[73]

b. Cost-Sharing and Coordination of Benefits

There is also an important choice to be made regarding possible cost-sharing and the coordination of MER with other sources of compensation.

Private health insurers, even after the Affordable Care Act, have incorporated substantial elements of managed care into their coverage. But workers' compensation and auto no-fault have not done so to nearly this extent.[74] Consequently, both workers' compensation and auto no-fault have been criticized for their inadequate management of medical costs.[75]

On one hand, in order to control costs, MER could adopt managed-care principles, including deductibles and copay provisions, that would be applicable to medical expenses. On the other hand, the inclusion of such provisions would deny victims compensation for a portion of their losses and would reduce manufacturer financial responsibility, thereby diminishing manufacturer safety incentives because victims would bear a portion of their own losses. If, as is currently the case, accidents causing comparatively minor injuries continue to constitute the vast majority of accidents once HAVs are dominant, then even a modest amount of

[73] Further, an injured HAV occupant covered by excess MER who is associated with another vehicle (for example, a passenger in an HAV who also owns a different, uninvolved HAV) would be entitled to his or her own excess MER, even if there were no excess MER covering the HAV in which he or she was injured. Claimants who do not own an HAV and have no relation to an HAV that would afford them the possibility of having excess MER could be given the opportunity to purchase excess MER from the Fund itself, which would prorate the cost of this form of coverage along with its other assessments.

[74] See Engstrom, supra note 13, at 341–44.

[75] See id. at 340–41 (noting "one of the main reasons that no-fault cost significantly more than expected was that it was ultimately deemed the primary payer" for medical costs); see generally Jerry L. Mashaw & Theodore R. Marmor, Conceptualizing, Estimating, and Reforming Fraud, Waste, and Abuse in Healthcare Spending, 11 Yale J. on Reg. 455, 463–66 (1994) (analyzing the diverse reasons for health care over-spending in worker's compensation cases).

cost-sharing would significantly reduce manufacturers' costs and thereby decrease safety incentives.

A similar dilemma is posed in connection with the coordination of compensation sources. Again, in order to maximize manufacturers' safety incentives, MER should have primary responsibility for medical expenses and lost wages, and other sources, such as health insurance, sick leave, disability insurance, and workers' compensation, should have only secondary responsibility. But this approach will pose administrative complications. Health insurance and workers' compensation will automatically and/or quickly be paid to health care providers when an injured party seeks treatment from a physician or hospital. Similarly, an employee who is injured and takes sick leave or claims workers' compensation will automatically be paid his wages or benefits. To enforce its secondary-payer status, the health insurer, workers' compensation insurer, or employer will then be required to seek reimbursement, perhaps after a number of months, from the individual's eventual MER recovery. And successful MER claimants will need to reserve part of their MER recoveries for such reimbursement obligations. In contrast, most of this would be unnecessary if MER were a secondary, rather than primary, source of compensation.

Thus, the choices regarding victim cost-sharing and priority among sources of compensation are difficult because each has both advantages and disadvantages. Nonetheless, we think that the balance strongly favors some, but very limited, medical cost-sharing. Given the experience of workers' compensation and auto no-fault, MER should not pay medical expenses on a first-dollar/all-dollars basis. Rather, there should be deductibles and copays equivalent to high-end health insurance policies.[76] An arrangement analogous to the difference between in-network and out-of-network health insurance, where the amount of cost-sharing is greater under the latter than the former, might also be workable. These devices should help manage MER medical costs, while still imposing responsibility for a very high percentage of those costs on HAV manufacturers.

Similarly, MER should be designated as the primary, rather than secondary, source of compensation. The alternative would risk sacrificing far too much of the incentive-creating potential of MER. And it would

[76] For example, $25 per office visit and no more than 10% of a hospital or emergency-room bill, subject to a low ceiling such as $1,000.

put claimants in the position of having to seek compensation from multiple sources, since MER would still be the primary (and probably the only) source of compensation for the lump-sum benefits that would function like pain and suffering recoveries. Consequently, any non-MER source that pays a victim's losses should have a right of subrogation against MER, or a claimant's MER recovery, for these losses to the extent that the claimant has been reimbursed in excess of his or her actual out-of-pocket losses.

Although this approach may appear to be complicated, as a practical matter, the difficulties that health insurers and other collateral sources currently face in seeking reimbursement out of their insureds' tort recoveries would either be minimal or non-existent in the MER context. One of those difficulties is monitoring the progress of the insured's tort claim and presenting a demand for reimbursement while there is still a fund of money out of which reimbursement can be paid. That function can be performed by the insured's own auto insurer, which, as we describe below, will be processing the claim and can be made the agent for disbursement of funds.

Another current difficulty is that most tort recoveries come in the form of compromise settlements that, by definition, do not pay the plaintiff in full for his or her losses. The proportion of a settlement that should be due to collateral sources under these circumstances has been a vexing issue on which there is a split of authority.[77] The MER situation will be different and easier. Except under highly unusual circumstances, MER payments will include full compensation for medical expenses and lost wages, up to the benefit ceiling of $1 million. Consequently, in all but the largest cases involving out-of-pocket losses in excess of $1 million, collateral sources should be entitled to full reimbursement out of an MER recovery, rather than a proportionate reimbursement.

D. Mixed Accidents

During the decades-long period when both CVs and HAVs are on the road, a substantial percentage of all multiple-vehicle accidents are likely to be mixed. Here, two accident types should be distinguished: those in which a CV driver or passenger is injured and an HAV is also in-

[77] See Abraham & Schwarcz, supra note 57, at 419–20 (discussing the split of authority and citing relevant cases).

volved,[78] and those in which an HAV occupant is injured and a CV or third-party is involved.

1. CV Plaintiffs

There are three possible approaches for handling injuries that a CV plaintiff incurs when an HAV is also involved: (a) retention of the current rules governing tort liability; (b) permitting CV plaintiffs access to the HAV owner's MER; and (c) enactment of mandatory first-party no-fault insurance covering such losses by CV plaintiffs. We discuss each in turn.

a. Retention of Tort

One approach would simply continue to provide CV plaintiffs the remedies to which they are entitled under current negligence and products liability law. There would rarely be any negligence on the part of the owner of an HAV involved in an accident with a CV, although conceivably there might be suits for negligent maintenance. Rather, most such suits would have to allege that the CV plaintiff's injuries were caused by a manufacturing or design defect in the HAV. Litigation over alleged defects in any of the many component parts that are not part of the autonomous driving system of the HAV would replicate what now occurs. But litigation over alleged defects in the autonomous driving system of an HAV would introduce complications that, other things being equal, would be desirable to avoid.[79]

b. Provide Access to MER

A second approach would eliminate CV victims' potential causes of action in tort, but it would make the HAV manufacturer responsible for losses suffered by CV drivers and occupants, regardless of fault on either side, by giving CV victims access to the MER accompanying the HAV involved in the accident. The argument for this approach is that, as with manufacturer responsibility for pure HAV accidents, manufacturer responsibility for CV accidents would create safety incentives for manufacturers. Under such circumstances, the price of HAVs would include

[78] Accidents between CV plaintiffs and bicycles, motorcycles, pedestrians, and other CVs would continue to be handled, as they are now, by current state tort law rules on negligence and products liability, and by auto no-fault statutes, if applicable.

[79] See discussion supra subsection II.B.1.

the cost of compensating CV drivers and their passengers. For this reason, HAV manufacturers would have the incentive to compare the costs of developing technology that will avoid currently unavoidable accidents involving CVs with the costs of continuing to incur financial responsibility for these accidents.

There are three possible arguments against this approach. First, CV victims will have paid nothing, directly or indirectly, for their access to the MER via the HAV involved in their injuries. The entire cost would be paid directly by the HAV manufacturer and indirectly by the HAV purchaser by way of the purchase price of the vehicle. It might be considered inappropriate or unfair for CV victims to be entitled to MER compensation without having contributed to the cost of providing it. A partial answer to this concern is that neither HAV passengers or pedestrians injured in HAV accidents have contributed to the cost of the MER that would compensate them when they were involved in an HAV-only accident. Indeed, a similar and apparently not objectionable situation already exists in states with auto no-fault, where a vehicle owner's insurance pays for injuries suffered by passengers and pedestrians injured in an accident in which the vehicle is involved, despite their not having contributed to the cost of this insurance.

If it were thought necessary, in order to make the distributional effects of this approach more palatable, during the early portion of the long transition to HAVs, the purchasers of these vehicles could be afforded a tax credit that would partially compensate them for the additional purchase price of HAVs attributable to the cost of compensating CV occupants. As the percentage of CVs on the road declines and the percentage of HAVs increases, the incidence of mixed accidents would decline, the distributional objections to CV compensation would fade away, and the tax credits could be phased out.

The second argument against this approach is that in some cases the negligence of the CV victim (e.g., if he or she were an intoxicated or distracted driver) will have contributed to the accident involving an HAV. Giving these victims access to the HAV owner's MER would ignore that negligence. This is a powerful concern. Of course, one of the purposes of HAV technology will be to avoid accidents with CVs that are negligently driven. Just as HAV technology could, and perhaps should, be capable of avoiding pedestrians who run into the street, it could, and ideally should, be capable of avoiding CVs operated by drunk or distracted drivers. But not all such accidents will be avoidable

by the HAV, and the argument that it is not appropriate for HAV manufacturers to bear the cost of failing to avoid such accidents has considerable weight. As we noted earlier in connection with pure HAV accidents, a middle ground could be to provide that injury caused by the egregious negligence of a CV driver, coupled with minimal causal involvement by the HAV (e.g., a rear-end collision while the HAV is nearly stopped or reckless, intoxicated driving by the CV driver), does not "arise out of" the operation of the HAV.

A third (and in a way, converse) argument against recourse to the MER is that CV plaintiffs could plausibly object to having their tort rights eliminated and being limited to MER recovery on the ground that they had not purchased or agreed to ride in HAVs and therefore should not be denied traditional tort remedies when injured by an HAV. However, access to broad MER for all injuries, even if not caused by negligence or a defect in the HAV, would seem to be a generous *quid pro quo* for the elimination of CV plaintiffs' tort remedies.[80] Moreover, as HAVs become more and more effective, the practical value of a CV plaintiff's tort rights will decrease, because there will be correspondingly less tortious conduct associated with accidents involving HAVs.

c. Substitute First-Party CV Insurance for Tort

A final approach would eliminate CV plaintiffs' tort rights and require owners of CVs to purchase their own first-party insurance, covering them against the risk that they would be injured in an accident arising out of the operation of an HAV. This form of coverage could be added to existing auto insurance, adopting a benefit structure identical to that available under MER (together with an option to purchase excess MER). This would amount to highly targeted first-party auto no-fault.

[80] More generally, we envision no Seventh Amendment problems with adoption of MER. See, e.g., N.Y. Cent. R.R. Co. v. White, 243 U.S. 188, 201 (1917) (upholding New York's workers' compensation law against constitutional challenge, because, though the "employee is no longer able to recover as much as before . . . he is entitled to moderate compensation in all cases of injury, and has a certain and speedy remedy"); Samsel v. Wheeler Transp. Servs., Inc., 789 P.2d 541, 555 (Kan. 1990) ("Due process requires that the legislature substitute the viable statutory remedy of quid pro quo (this for that) to replace the loss of the right."), overruled in part on other grounds by Bair v. Peck, 811 P.2d 1176, 1189, 1191 (Kan. 1991). The U.S. Supreme Court has not yet clearly incorporated a quid pro quo test into its due process analysis, though it has toyed with the idea. See Amy Widman, Why Health Courts are Unconstitutional, 27 Pace L. Rev. 55, 76 (2006).

The advantages and disadvantages of this approach are roughly the converse of those that characterize the preceding approach of giving CV victims access to HAV owners' MER.

The advantage is that CV victims would pay the cost of ensuring that they were compensated for injuries in accidents in which they were involved. Correspondingly, HAV manufacturers and (indirectly) purchasers would not have to pay these costs. The disadvantages, however, are that the additional safety incentives that would be created for HAV manufacturers by bearing the cost of compensating CV victims would disappear; HAV manufacturers would avoid bearing the cost of some injuries that were at least partly caused by the failure of HAV technology; and some CV owners would fail to purchase the required insurance, whereas MER would be automatically available to all eligible victims.[81]

2. HAV Plaintiffs

Should HAV occupants have a right to recover from CV drivers in tort for injuries caused by the latter's negligence? We prefer the complete abolition of such negligence liability, for the same reasons that we referenced above.[82] As much as possible during the long transition to the time when there will be only HAV vehicles on the road, we should be moving HAV accident victims into an exclusively MER system.[83]

If complete abolition of HAV plaintiffs' tort rights were inadvisable or politically infeasible, however, then we think that CV defendants could still be liable in negligence to HAV occupants for sums not compensated by HAV plaintiffs' MER. For the reasons we have noted, this would preserve HAV manufacturers' safety incentives. And given the high percentage of all cases in which an HAV occupant would be fully compensated by MER, the amount of negligence litigation and liability that would remain is likely to be comparatively small. In effect, exhaustion of MER would serve a function analogous to the one that thresholds in auto no-fault serve. The negligence system would be a source of lia-

[81] Nationwide as of 2015, 13% of drivers do not comply with state laws requiring the purchase of auto liability insurance; in at least one state the rate is as high as 26.7%. See Ins. Info. Inst., Facts + Statistics: Uninsured Motorists, www.iii.org/fact-statistic/uninsured-motorists [https://perma.cc/39NW-FQUQ].

[82] See supra Subsection III.C.2, citing the no-fault arguments against tort.

[83] Recall that the transition period moves in incremental stages: here, we are discussing the period after the twenty-five percent threshold has been reached and the MER system has been activated.

bility and compensation only for the most serious cases in which there has not been full MER compensation paid already.

E. Funding, Administration, and Resolution of Disputes

Three issues remain to be discussed: the implementation of manufacturer funding; the process of administering MER; and the method by which disputes over MER will be resolved. Again, we discuss each in turn.

1. Funding: Assessments on Manufacturers

During the initial phase of MER, manufacturers should be assessed a presumptive charge based on annual market share. Once there is statistically adequate data, however, assessments should be based on the frequency and severity of payouts for each manufacturer's HAVs. This targeted experience-rating of assessments should maximize each manufacturer's incentive to optimize the safety of its HAVs.

2. Administration and Claim-Processing

Although HAV owners will be relieved of most tort liability, for the foreseeable future they still will need to purchase auto liability insurance. Pockets of liability exposure may remain, for example, for injuries resulting from negligent failure to maintain the vehicle, for shoddy repairs, and—to the extent that HAV technology makes limited manual operation possible—for aspects of the vehicle that still can be operated manually. In addition, auto owners still will be purchasing insurance covering property damage to their own vehicles, whether that property damage results from an accident or not.

Consequently, it will be a simple matter for each owner's auto insurance policy to carry a statement or endorsement indicating the scope of MER that automatically accompanies the insured vehicle and to give the policyholder notice that claims are to be submitted to the insurer. The insurer can then be the conduit for MER claims. This is the way that most federal flood insurance is currently purchased and that claims for coverage are made—through a property owner's own homeowners' or commercial property insurer. The U.S. government is the flood insurance risk-bearer, but private insurers are its processing agents, for which

insurers receive a commission.[84] California follows a similar approach for earthquake insurance, where the state government is the actual risk-bearer.[85]

The MER Fund, created by assessments on HAV manufacturers, would operate the same way, although there would be no need for individual HAV owners to purchase MER coverage as it would have been incorporated into the purchase price of the vehicle and would run with the vehicle even after change of ownership. But the MER Fund would disburse claim payments through insurers upon submission by the claimant's auto insurer. Each insurer would receive a commission paid by the Fund for processing a claim, whether or not the claim was paid in full.

The great advantage of this approach is that HAV owners will have a pre-existing relationship with a particular insurer, will know with whom to file a claim, and will not be forced to file a claim and then deal with proof of claim through communications with a far-off government bureaucracy. The vast majority of non-owner passengers will be family members of the HAV owner and therefore will effectively have the same relationship with the owner's insurer. Third-party claimants entitled to access to an HAV owner's MER would communicate with the HAV owner at the initial stage and would be given the owner's insurance information, in the same manner in which drivers of CVs involved in accidents now exchange insurance information. At that point the claimant would deal directly with the HAV owner's insurer.

As we envision it, an HAV's auto insurer would be the agent for receipt of claims and would submit them to the MER Fund, along with accompanying documentation. The process would be roughly analogous to making a workers' compensation claim through an employer to the employer's insurer. The MER Fund would then pay in full, pay in part, or deny the claim. The Fund would be a small agency or division within a cabinet department, with personnel that would manage the process of assessing manufacturers, perform other administrative functions, receive and evaluate claims, and disburse claim payments.

[84] Robert L. Rabin & Suzanne A. Bratis, United States, in Financial Compensation for Victims of Catastrophes: A Comparative Legal Approach 330–32 (Michael Faure & Ton Hartlief eds., 2006).

[85] Id. at 327–30.

3. Resolution of Disputes

If the Fund denied the claim or paid only in part, disputes would be resolved by an individual serving effectively as an administrative law judge ("ALJ") in each state. The proceedings before the ALJ would, when possible, be summary and based on claim documentation alone. The ALJ would make *de novo* findings of fact and, if necessary, conclusions of law. ALJ decisions could be appealed to a federal district court, which could reverse them only if they were arbitrary or capricious, or not in accord with existing law.[86]

CONCLUSION

We have the luxury of knowing that profound technological changes in the world of motor vehicles are coming with adequate time to plan for the liability reforms that should accompany those changes. The current system of driver-focused liability will eventually disappear on its own. But before that disappearance, there will be decades of mixed accidents involving various combinations of CVs, HAVs, and third parties. It makes sense to begin addressing such mixed accidents with the doctrinal tools in tort that we have at hand. Over time, however, the deficiencies of that approach will become apparent.

In any event, over time HAVs will largely supplant CVs, and pure HAV accidents will come to dominate. As that occurs, we will need a legal regime that better fits the new world of accidents than our current negligence and product-defect liability system. We have argued that MER, as we have outlined it, can do this job. Just as our forebears did a century ago when they proposed and then enacted workers' compensation, we believe that a break with the tort system, dramatic and unsettling though it may be to some, will prove to be a desirable approach.

[86] ALJ decision-making in no-fault programs has not gone smoothly in all settings. See, for example, Engstrom, supra note 63, at 1711–15, discussing an array of no-fault systems and noting how "adversarialism" has crept into the administration of claims. The MER should not generate a high volume of discretionary eligibility determinations that would trigger this concern.