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Distribution of the Burden of Proof in Autonomous Driving Tort Cases: Implications of the German Legislation for China

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Abstract: In the realm of autonomous driving tort, a significant disparity exists in the parties' access to autonomous driving data and essential technical information, resulting in challenges in unilateral proof. The traditional burden of proof framework in driving litigation is inadequate for direct application in the autonomous driving sphere. As we approach the era of widespread autonomous driving operations, there is an urgent need to clarify and redefine the allocation of the burden of proof in specific litigations. Utilizing comparative legal analysis and case studies, this paper delves into the disparities in the legislative provisions concerning the burden of proof for autonomous driving in Germany and China. China can learn from Germany's legislative precedence in shifting the burden of proof for "product defect" and "fault" onto the manufacturer, thereby requiring the infringed party to merely furnish preliminary evidence indicating a "causal relationship between the defect and the damage". This approach mitigates the evidentiary burden on the aggrieved party, clarifies the litigation procedures, incentivizes manufacturers to enhance the technology, reinforces risk management, and ultimately facilitates the progression of autonomous driving technology.

Keywords: autonomous driving; artificial intelligence; burden of proof; liability for tort; product liability

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1. Introduction

With the rapid development of modern science and technology, the combination of artificial intelligence and automobile driving has made qualitative leaps in both depth and breadth. Autonomous driving technology has gradually developed from the closed road test stage to a new commercial operation stage in demonstration zones. The impact of implementing autonomous driving technology on the legal system primarily arises from the distinction between the mode of operation of artificial intelligence, which falls under "machine decision-making", as opposed to "human decision-making". Hence, the longstanding legal framework centered around "man" and "individual decision-making" has encountered significant challenges [1]. Automated driving fundamentally alters the relationship between individuals and vehicles, complicating the assignment of the responsibility for resulting traffic accidents to the human operator. For instance, notable incidents such as the world's first fatal accident involving an autonomous vehicle, known as the "Uber Autonomous Vehicle Fatality", China's inaugural "Autonomous Vehicle Fatality Case", and the multi-vehicle collision involving an electric vehicle in Chengdu, have once again brought autonomous driving to the forefront. The focal point of the aforementioned incidents revolves around determining the party accountable for the accidents, and the burden of proof will significantly influence the assumption of liability. The crux of the aforementioned incidents lies in ascertaining the party responsible for the accidents, with the burden of proof exerting a substantial impact on the attribution of liability. The challenge stems from the extensive volume of sensor data, algorithms, and decision-making processes inherent in autonomous driving technology, where any deviation in one of these components could potentially result in traffic accidents. Given the irrational nature of artificial

intelligence and the issues surrounding "algorithmic black boxes" and "human-machine hybrid driving", the parties involved face significant challenges in providing evidence for such complex facts. Especially for consumers or third parties who are victims of infringement, there exists a significant challenge of information asymmetry and limited evidential capacity. According to the "dual-meaning theory" of burden of proof, the distribution of the burden of proof not only pertains to determining who is responsible for presenting evidence for these complex facts but also decides the attribution of adverse consequences in situations where the truth of the facts is unclear. If the burden of proof in traditional tort litigation involving driving remains applicable, it could lead to an imbalance between the distribution of risk and liability, thereby resulting in the excessive infringement of the rights and interests of one party involved. Therefore, the rules on distributing the burden of proof in tort damages for autonomous vehicles should be appropriately adjusted.

2. Legislative Background

In May 2017, Germany promulgated the Road Traffic Law (Eighth Amendment), the first legislation to regulate smart cars. The legal document clarifies the duty of care and liability for compensating the users and producers of autonomous vehicles. It establishes a legal foundation for the practical application of intelligent vehicles in Germany [2]. In order to further promote the development and operation of autonomous driving technology, Germany promulgated the Autonomous Driving Law in May 2021, which standardizes the access threshold and regulatory framework for autonomous driving operations by means of special legislation [3]. In September 2022, the European Commission adopted the AI Responsibility Directive (Proposal) [4]. The proposal stipulates that the system supplier shall fulfill the obligation of information disclosure to facilitate the proof of the infringed party. On this basis, the "presumption of causation" rule is attempted to alleviate further the burden of proof of the infringed party under the tort of artificial intelligence. In September 2022, the European Commission enacted the Amendment to the Product Liability Directive to regulate the incidents of damage or the loss of data caused by defects in intelligent products or systems from the perspective of product liability [5]. By constructing the dual presumption mode of "causal relationship presumption" and "product defect presumption", the burden of proof for the infringed person to seek relief is further reduced to safeguard his right to claim compensation from the product manufacturer or system supplier. On 21 May 2024, the Council of the EU approved the Artificial Intelligence Act [6]. The burden of proof framework jointly constructed by the aforementioned norms and theories provides a valuable reference for China in establishing a clear and systematic set of rules for distributing and mitigating the burden of proof in the realm of autonomous driving tort.

According to the internationally recognized classification standard for driving automation systems (SAE J3016_202104) [7], Level 3 represents a crucial distinction between assisted and autonomous driving. It is only at Level 3 or higher that cars truly qualify as autonomous vehicles. Thus, this article will limit the research scope to Level 3 and higher levels. The subsequent discussions will center on German law as the focal point of this research. According to the German classification standards for autonomous driving, highly automated, fully automated, and fully autonomous driving align with the L3, L4, and L5 levels of SAE standards, respectively. To ensure the integrity and coherence of the research, we uniformly adopt the classification standards of German traffic law and supplement them with SAE standards.

3. Methods

This research is a legal study that employs both case analysis and comparative analysis methods. The focus is on the cases and legal documents of autonomous driving infringement incidents in Germany and China.

3.1. Case Analysis Method

The life of law lies in its operation. The analysis of the difficulties and challenges in regard to the burden of proof in autonomous driving infringement incidents is performed through case studies. Emphasis should be placed on the level of autonomous driving technology, the difficulty of obtaining key evidence by the infringer, and whether the traditional burden of proof allocation framework applies to the field of autonomous driving. Targeted improvement plans for the problems in case handling are proposed.

3.2. Comparative Legal Analysis Methods

Through comparative legal analysis, we review the legal texts on autonomous driving infringement in Germany, the European Union, and China, and compare the similarities, differences, and development trends of legal systems in different countries. We focus on analyzing the allocation of the burden of proof for autonomous drivers, vehicle holders, producers, or manufacturers in different countries. By drawing on strengths and complementing weaknesses, comprehensive suggestions are put forward to improve the allocation of the burden of proof in China's autonomous driving infringement incidents, improve the fairness and efficiency of resolving the disputes related to autonomous driving accidents, and promote the development of autonomous driving technology.

4. Distribution and Mitigation of the Burden of Proof Concerning the Driver's Liability in Relation to Autonomous Vehicles

4.1. Distribution of the Burden of Proof Concerning the Driver's Liability in Relation to Autonomous Vehicles

The burden of proof is closely related to the liability for damages. Article 823 of the German Civil Code establishes a general liability clause based on fault. Under this article, automobile drivers may be liable for damages in autonomous driving traffic accidents, provided that the driver is at fault. Also, in the German Road Traffic Law (Straßenverkehrsgesetz), paragraph 1 of Article 18 stipulates that a motor vehicle driver who causes death, injury to others, or damage to property while operating a motor vehicle shall be presumed to be at fault.

To meet the liability conditions of Article 18, paragraph 1 of the Road Traffic Law, two essential criteria must be satisfied. Firstly, the driver must be the "actual driver" of the motor vehicle. For the first requirement, the driver's scope is outlined in paragraph 4 of Article 1a of the Road Traffic Law. Even if the driver has activated the functions of high driving automation (L3) or full driving automation (L4) and relinquished control of the vehicle to the driving system, they are still considered the driver of the vehicle. In the legal context, drivers also encompass individuals who relinquish independent driving control and allow the vehicle to operate automatically. Therefore, the driver cannot evade liability by claiming to be a "non-real driver". Secondly, the driver must exhibit intentional or negligent driving behavior while operating the vehicle, for determining whether they have fulfilled their duty of care. The injured party is tasked with the burden of proof for the first and second elements, and providing evidence to establish that the driver is indeed the "actual driver" and that the driver either failed to meet the required duty of care or engaged in intentional or negligent driving during the operation of the vehicle.

While differing in the specifics, the fault tort liability outlined in Article 823 of the Civil Code and the driver's presumed fault liability delineated in Article 18 of the Road Traffic Law share a common underlying duty of care. In full driving autonomous (L5) instances, the shift or exclusion of the driver's responsibility is attributable to the vehicle being entirely system-controlled. Consequently, the driver assumes the role of a passenger and is exempted from bearing any traffic-related duty of care during the vehicle's operation [8]. Nonetheless, the obligation for continuous monitoring remains.

That is, in both traditional and autonomous driving contexts, it is the driver's obligation to ensure the vehicle's safety and roadworthiness prior to operation. Should the driver recognize potential safety hazards with the vehicle and not take remedial measures,

they might be considered to have neglected their oversight obligations. Nonetheless, with Conditional (L3) or High (L4) driving automation, the driver must fulfill not only the supervisory obligations but also the duty of care concerning the operation and management of the vehicle.

For instance, if the driver exceeds the speed limit or overtakes improperly, resulting in an accident, it constitutes a breach of their duty of care. In Article 1b of the Road Traffic Law, the rights and obligations of drivers in the context of automated driving are clarified. Paragraph 1 of this article stipulates that when a vehicle driver activates the aforementioned automated driving functions, they may no longer need to maintain constant attention to the road traffic environment and vehicle handling. However, the driver must maintain a "ready" state to fulfill the obligations in paragraph 2 of Article 1b.

Specifically, the driver is obligated to promptly resume control of the vehicle if either of the following conditions are met: first, if the system prompts the driver to regain control (Article 1B, Paragraph 2, Item 1); second, even if the system does not so prompt, but the driver either recognizes or should recognize, based on clear circumstances, that the conditions necessary for the continued use of highly or fully automated driving systems are no longer present (Article 1B, Paragraph 2, Item 2). In the first cases where a driver fails to promptly respond to a takeover request from an automated driving system, their actions may be deemed responsible for accidents resulting from the violations of traffic regulations.

However, this situation leads to the "operator dilemma": drivers are expected to monitor the vehicle and traffic environment to mitigate risks, yet introducing automatic driving systems aims to relieve drivers of these tasks, resulting in inherent contradictions. Therefore, it is essential to delineate further the specific duty of care that drivers must maintain while utilizing the autonomous driving function and to establish a reasonable takeover time based on the actual circumstances. The research findings in traffic psychology indicate that the driver may require several seconds to complete the takeover of the vehicle. However, legislation has not definitively outlined what constitutes a reasonable and timely takeover duration. Nevertheless, the driver's response under psychological influence must be deemed reasonable. If their behavior deviates significantly from general life experience and appears highly unusual and unexpected, it can be inferred that they have failed to fulfill the relevant duty of care [9].

In the second scenario, the driver is obligated to take control of the vehicle even without a takeover prompt, particularly in situations that are deemed obvious. These "obvious circumstances" typically entail conditions where a rational driver would recognize the necessity to assume control, such as sudden rainstorms, earthquakes, or other emergencies, where continued operation of the automatic driving function could pose a threat. Naturally, it is improbable for legislation to adopt a fully enumerative model; for instance, opting for a more general description, as observed in the German legislation, would be an acceptable approach.

It is imperative to clarify that in most cases, drivers are not held liable during conditionally (L3) or highly (L4) automated driving scenarios. The autonomous vehicle operates autonomously, so the driver is not liable for traffic violations in such circumstances. Even if the driver must continue to supervise the vehicle, they are still required to pay necessary attention, but this does not directly attribute responsibility to the driver. The duty of supervision does not mandate drivers to be constantly prepared to detect driving risks, and it is limited to specific circumstances. Sudden, unavoidable accidents caused by autonomous systems may absolve the driver of liability. Suppose that the driver fails to promptly assume control of the vehicle or take other necessary measures, resulting in the accident occurring within the interval from when the driver becomes aware or should become aware of a potential hazard until the accident transpires. In that case, they can be held accountable for negligence. Different from the legal provisions in Germany mentioned above, the user roles after activating the driving automation system in China are presented in Table 1.

Table 1. Role of the user after the activation of the driving automation system.

User	User Roles (Driving Automation System Activation)					
	L0	L1	L2	L3	L4	L5
Users in the driver's seat	Traditional Driver			Driving Mission Support Users	passenger	
Users not in the driver's seat	Remote Driver				passenger	
Users outside the vehicle	Remote Driver				dispatcher	

Source: Taxonomy of driving automation for vehicles in China (GB/T 40429-2021 [10]).

4.2. Mitigation of the Burden of Proof Concerning the Driver's Liability in Relation to Autonomous Vehicles

Based on Article 823 of the German Civil Code, the infringed party may request the driver of an autonomous vehicle to assume the liability for damages for compensation arising from tort liability. The article adopts the fault-based liability fixation mode within tort law. Therefore, the injured party must demonstrate the driver's fault or negligence in fulfilling their duty of care and establish the causal relationship between the tort and resulting damages. The injured party may submit a claim and prove whether the driver activated the vehicle's automatic driving function at the time of the accident, in accordance with the information specified in Article 63a, paragraph 3 of the Road Traffic Law. In conditionally or highly automated driving, the driver is generally absolved of tort liability, with liability only arising in very few exceptional circumstances.

However, the driver still bears the burden of fault presumption as stipulated in the Road Traffic Law. Based on the shift in the legal burden of proof regarding fault, the driver must furnish evidence demonstrating their lack of fault or establish that the accident resulted from a defect or technical issue with the autonomous vehicle. According to Article 63a of the Road Traffic Law, an autonomous vehicle shall be equipped with an electronic driving recorder to fix the evidence to avoid difficulties in adducing evidence. The recorder must precisely document the exact time and location of the transfer of control from the driver to the automated system. If the system is autonomously operating the vehicle at the time of the accident, it can, in principle, demonstrate that the driver is not liable. Furthermore, it is imperative to precisely document the timestamp and location when the system issues a takeover reminder or experiences a technical failure and to compare this information with the data recorded during the accident. If the takeover request and the occurrence of the technical breakdown are closely aligned with the time of the accident, it can be inferred that the driver did not have adequate time to respond to the traffic incident.

5. Distribution and Mitigation of the Burden of Proof Concerning the Holder's Liability in Relation to Autonomous Vehicles

Considering the separation between drivers and owners in practice, national legislation has responded to this possibility. For instance, Article 3 of the Japanese Road Traffic Act introduces the "operator for use" notion to amalgamate vehicle owners and drivers, identifying the said "operator for use" based on the criteria concerning operational control and benefits [11]. Section 7 of the German Road Traffic Law establishes the legal liability of the motor vehicle holder for the concept of "operational risk" [12]. The prevailing opinion within the German academic community is that the responsibility of the vehicle holder is termed as "liability not related to a fault", originating from the commencement of operation of the hazardous vehicle. Following the liability principle for hazards, individuals who create a hazardous situation are responsible for compensating for any resulting damage, irrespective of whether they have exercised a duty of care. Per Article 1209 of the Chinese Civil Code, in cases of driver–owner separation, the liability for exceeding the compulsory traffic insurance limit in China falls upon the vehicle owner and operator only if they are found to be at fault. Suppose that the driver is not at fault or no driver is present when the vehicle operates autonomously. In that case, the existing liability framework for road traffic accidents in China is insufficient. China may consider adopting the theory of strict liability for innocent holders and restructuring the burden of proof system to compensate for tort

damage caused by autonomous vehicles accordingly. China may consider adopting the theory of the strict liability of innocent holders and restructuring of the burden of proof system for compensating for damage caused by autonomous vehicles accordingly [13].

5.1. Distribution of the Burden of Proof Concerning the Holder's Liability in Relation to Autonomous Vehicles

The holder of a motor vehicle utilizes it for personal advantage and possesses the authority to regulate its operation. As stipulated in Article 7, paragraph 1 of the German Road Traffic Law, in the event of an accident while operating a vehicle resulting in injury to individuals or property damage, the vehicle owner bears responsibility for compensation.

In order to pursue compensation for damage resulting from traffic accidents, the aggrieved party must establish the necessary criteria, namely by presenting evidence demonstrating the occurrence of the infringement, the resulting damage, and the causal links between them. To exercise the right to claim compensation for damage resulting from traffic accident infringement, the aggrieved party must prove the constituent elements of the right norms by providing evidence demonstrating the occurrence of the infringement, the resulting damage, and the causal relationships. As stipulated in Article 7 (2) and (3) of the Road Traffic Law, if the car holder can demonstrate that the damage resulted from force majeure or that others lacked the right to drive, they may be exempted from compensation liability. The concept of force majeure must satisfy three conditions: firstly, the presence of an external force that influences the event's unfolding; secondly, the event's occurrence cannot be reasonably anticipated based on human experience; thirdly, even with the parties fulfilling their duty of care, they cannot avert the accident.

For instance, the pre-programming of the car or its automated driving system, as well as the artificial intelligence based on machine learning, may lead to erroneous judgments. Traffic accidents may also result from the driver's failure to promptly resume control of the vehicle, operational errors during the transition, and external intrusions into the vehicle's system (e.g., cyberattacks by hackers) [14]. In cases where the auto-drive system exhibits a design flaw or malfunctions due to issues with machine learning, it constitutes an endogenous event. There are cases where the accident is unavoidable, and then, the vehicle's software will make the decision based on the principle of "minimum damage" [15]. If the computer system itself has defects that cause greater damage, the vehicle holder needs to bear the liability for damages. In such instances, while the car owner remains liable for damages, the driver bears no responsibility since the failure lies with the driving system. If the decision-making error is caused by design defects in the computer software, the software provider needs to bear the liability for damages. If the driving system loses control of the vehicle due to hacker attacks, resulting in accidents, it is more likely to be interpreted as an exogenous event. While car owners are obligated to maintain the safety and airworthiness of their vehicles, entirely preventing cyberattacks is challenging due to the inherent limitations. Thus, it suffices for car owners to periodically update and maintain their intelligent driving systems to the latest standards.

5.2. Distribution of the Burden of Proof Concerning the Holder's Liability in Relation to Autonomous Vehicles

Since the vehicle holder bears no-fault liability for the traffic accident, there is no need to prove the elements of fault. No legislative provision presumes a causal relationship between autonomous driving and damage. Therefore, there is no room for shifting the burden of proof responsibility. According to Article 7 (2) and (3) of the German Road Traffic Law, if force majeure occurs during driving or results from the unauthorized driving of others, the car owner's liability for damages is exempted. The burden of proof for these two grounds for excluding liability rests with the car holder.

6. Distribution and Mitigation of the Burden of Proof in Regard to the "Producer's Tort Liability" and "Manufacturer's Product Liability"

In the realm of motor vehicle traffic accidents, Germany relies on the hazard liability of car holders for hazards and manufacturers for products, supplemented by the liability of producers and drivers for fault infringements, to ensure comprehensive protection for the injured parties. In German law, "Produzentenhaftung" (producer liability) and "Herstellerprodukthaftung" (manufacturer product liability) represent distinct concepts, differing in terms of the subjects of liability, liability composition, litigation basis, compensation amount, and burden of proof. Producer liability is established by Article 823 (1) of the Civil Code and constitutes a form of tort liability wherein the producers assume the fault liability. Manufacturers' product liability arises from Article 1 of the Product Liability Law, which establishes that manufacturers assume no-fault liability.

6.1. Liability Composition and Liability Concurrence

6.1.1. The Liability Composition of the "Producer's Tort Liability" for Autonomous Vehicles

The composition of tort liability for the producers involved in German autonomous driving must satisfy specific conditions. Firstly, defects must be present in the autonomous vehicle. Secondly, the producers must be at fault for these defects. Finally, there is a causal relationship between product defects and damage. In accordance with Article 823 (1) of the Civil Code, Germany has instituted producer liability in legal practice stemming from the breach of the producer's specific security obligations. If the producer of a defective commodity cannot prove that it is difficult to prevent the defect and its consequences, he shall be liable for the damage caused by the defect [16]. The primary focus of tort liability concerning autonomous vehicle producers centers on those responsible for manufacturing the final product. Autonomous vehicles comprise multiple components, each supplied by different parts manufacturers, all falling within the scope of the term "producer". The producer of the complete product holds the authority to delegate their responsibility to the component manufacturer, thereby absolving themselves of liability. However, they must substantiate the supplier's reliability, incorporate the supplier within the contractual framework, and fulfill the requisite supervisory obligations [17]. In cases where both the supplier and the manufacturer of the complete product bear responsibility for the damage, they can be jointly and severally liable for the harm incurred by the injured party, as outlined in Articles 830 and 840 of the German Civil Code. The essence of producer responsibility lies in defects, which signify inadequate product performance, failure to meet the expected objectives, or usage that may pose risks to purchasers or others. Producer liability for infringement encompasses design, production, and descriptive defects and the obligations related to product monitoring and recall [18]. Producer tort liability arises from the breach of obligations, and producers are held accountable if they fail to identify or prevent defects.

6.1.2. The Liability Composition of the "Manufacturer's Product Responsibility" for Autonomous Vehicles

In 1985, the Council of the European Economic Community issued the EU Product Liability Directive (85/374/EEC) to harmonize the product liability across the member states and facilitate the trade within the region [19]. Before this directive, each member state implemented distinct product liability systems with varying attribution principles, resulting in divergent outcomes in litigation for identical product infringement cases across the different states, contradicting the intended purpose of establishing the European Community. Following this directive, Germany enacted the Product Liability Act in 1990 to comply with the requirement of transposing the European Community directive into national legislation.

If personal injury or property damage arises from product defects, the injured party may seek compensation from the manufacturer (Article 1 of the Product Liability Law). The obligation to compensate for damage resulting from product defects is not contingent

upon the manufacturer's fault. The liable subject scope of the product liability of manufacturers is broader than that of producer tort liability. An individual manufacturing an end product, raw material, or semi-finished product, along with a prospective manufacturer who labels the product for sale under their name and an importer, may assume liability for the manufacturer's product. When there are multiple manufacturers, they shall assume responsibility as joint debtors (Article 5 of the Product Liability Law). The standards for identifying product defects are consistent between the two types of responsibilities, based on whether the product can provide reasonably expected safety (Article 3 of the Product Liability Law).

Under both liability systems, manufacturers or producers may be exempted from liability based on the grounds specified in Article 1, paragraph 2 of the Product Liability Law:

Article 1, Paragraph 2, Item 1	The product has yet to be placed on the market.
Article 1, Paragraph 2, Item 2	The defect leading to the damage is non-existent at the time of placement on the market.
Article 1, Paragraph 2, Item 3	Products are not manufactured or sold for commercial purposes.
Article 1, Paragraph 2, Item 5	When the product is placed on the market, its defects are not discoverable based on the scientific and technological knowledge available.

6.1.3. Management of Liability Concurrence

Paragraph 2 of Article 15 of the German Product Liability Law stipulates: "The liability under other laws shall not be affected by the application of this Law". This provision is derived from Article 13 of the European Community Product Liability Directive (85/374/EC). This directive does not exclusively stipulate the rights of the injured party but makes it clear that it does not affect the rights of the injured party under other legal frameworks. Therefore, civil law and other specific statutes can also be invoked when the Product Liability Law is not directly applicable. Tort law permits liability to persist even when the Product Liability Law mitigates the manufacturer's liability to some extent. In cases where the quota or product scope is exceeded, it becomes necessary to additionally invoke the first paragraph of Article 823 and Article 276 of the Civil Code to establish the liability for producer negligence [20].

6.2. Distribution and Mitigation of the Burden of Proof in "Producer's Tort Liability"

The fact of a product defect essentially belongs to the fact of a tort, and together with the fact of damage result, the fact of a causal relationship, and the fact of fault element, it constitutes the vital fact of a producer's tort liability [21]. According to the classification of legal elements, the infringed party must bear the burden of proof for the abovementioned elements of the creation of rights. The injured party must provide ample evidence to prove both the defectiveness of the autonomous vehicle and the producer's fault for the defect, bearing a hefty burden of proof [22].

Regarding the instructiondefects, the injured party must prove that the producer has failed to fulfill the objective obligation of providing adequate explanations. In design (production) defects, the infringed party shall claim and prove that the damage incurred stems from the inherent flaw of the autonomous vehicle or its failure to meet security obligations. If an autonomous vehicle fails to comply with traffic regulations or exhibits erroneous driving behavior, it can be inferred that it has a flaw in its design or production. Defects may arise from limitations in data collection, code vulnerabilities, and the opaque nature of algorithms. Due to the machine learning capabilities mastered by autonomous vehicles and their potential to evolve based on driving habits post-market circulation, it becomes exceedingly challenging for an aggrieved party to substantiate these aspects.

To address this challenge, German trial practice simplifies the process by shifting the burden of proof for a breach of duty. If a product is defective, the producer must seek to exonerate themselves and demonstrate that they could not have anticipated or prevented the defect (BGHZ 51,91). Furthermore, the injured party lacks insight into the producer's

internal processes during the design and manufacturing phases of the product. Therefore, the burden of proving fault should be shifted to the producer.

6.3. Distribution and Mitigation of the Burden of Proof in "Manufacturer's Product Liability"

It is foreseeable that with the widespread adoption of autonomous driving technology, nearly all accidents involving autonomous vehicles may lead the injured party to file a product liability lawsuit against the manufacturer [23]. The German Product Liability Law imposes strict liability for damages without requiring proof of the element of "fault". Article 1, paragraph 4 of the German Product Liability Law specifies the rules for distributing the burden of proof. However, courts will not apply the product liability doctrine to the manufacturer unless clear evidence is provided [24]. Initially, the infringed party must claim and prove the result of the damage, the product defect, and the causal relationship between the defect and the damage. The manufacturer can prove the exemption reasons specified in Article 1, paragraph 2 and paragraph 3 of the Product Liability Law. In comparing the producer's tort liability with the manufacturer's product liability, it is evident that they possess distinct advantages and disadvantages about the burden of proof. In product liability, the injured party is relieved from the obligation to prove the manufacturer's fault, representing a significant advantage.

However, the burden of proof regarding the causal relationship remains with the injured party, posing substantial challenges. Furthermore, the Product Liability Law does not explicitly specify the manufacturer's obligation to disclose information, representing a relative disadvantage for the injured party in providing evidence. Therefore, the European Commission specifies in the Artificial Intelligence Liability Directive (Proposal) that the providers of intelligent systems must fulfill the obligation of disclosure, enabling the injured party to meet the burden of proof based on the disclosed information.

7. Implications and Recommendations for China

7.1. Transformation and Mitigation of the Burden of Proof for a "Product Defect"

The emergence and advancement of autonomous driving technology have resulted in an increased diversification of vehicle defect sources, defect identification complexities, and a more comprehensive range of judgment standards [25]. The evidence for assessing product defects and essential product information is often concentrated in the hands of the manufacturers. The affected party is typically an ordinary consumer or a third party not well versed in autonomous driving technology, thus creating a genuine dilemma in presenting evidence. Under such circumstances, strictly adhering to the general rule of "who claims, who gives evidence" contradicts substantive justice. To avoid the infringed party falling into the dilemma of being unable to provide evidence, it is appropriate to consider reducing the burden of proof for the affected party through the burden of proof shifting. Under circumstances where the affected party faces particular challenges in presenting evidence, it may be appropriate to alleviate the burden of proof for the affected party by lowering the standard of proof. However, concerning the proof of defects in autonomous driving products, if merely reducing the burden of proof by lowering the standard to the balance of probabilities is relied upon, the infringer may present facts and counter-evidence that undermine the court's confidence in the probability, thus complicating the process of presenting evidence once more [26].

Therefore, it is appropriate to adopt the genuine burden of the proof shifting method, transferring the burden of proof for the presence of defects in autonomous driving products from the plaintiff to the producer, burdening them with proving the absence of defects in autonomous driving vehicles. An example of a similar burden of proof shift can be found in Article 66, paragraph 1 of the Patent Law of China. Here, the burden of proof regarding the defendant's unauthorized use of the patented manufacturing method for its products, initially incumbent upon the plaintiff, is shifted to the defendant. The defendant is then tasked with proving the distinction between their manufacturing method and the plaintiff's patented method. In accordance with Article 23, paragraph 3 of the Consumer Rights and

Interests Protection Law of China, the burden of proof regarding defects in durable goods like motor vehicles and household appliances is shifted to the operator. To summarize, in cases involving damage caused by artificial intelligence technology, given the need for balanced evidence distribution and the complexity of the technology, shifting the burden of proof to producers is a solution to this problem [27].

7.2. Transformation and Mitigation of the Burden of Proof for "Fault"

According to Leo Rosenberg's normative theory, the plaintiff must prove the legal requirements for establishing the norms under which they claim rights. At the same time, the defendant must demonstrate the legal requirements for the norms that they rely on to dismiss the plaintiff's claim [28]. Therefore, the burden of proof for the "fault" element lies with the infringed party claiming the right. The "fault" in cases of producer infringement is often closely linked to the producer's breach of a specific duty of care.

For instance, in cases involving a production defect, the producer may omit or skip essential steps in the production process, such as neglecting quality testing. In instances of a descriptive defect, the producer neglects to specify the usage limitations of the automatic driving function and the circumstances under which the automatic driving function must be deactivated. If the producer fails to fulfill the obligation of product monitoring and recall as stipulated, and if the conditions mentioned above are met, the producer may be deemed liable for the product defect. However, the infringed party has no way of knowing the producer's process of fulfilling its obligations nor the internal processes of the producer's design and manufacturing, making it challenging to meet the burden of proof.

To address this issue, the EU Amendment to the Product Liability Directive suggests that product defects may be presumed when producers fail to disclose the relevant system information, violate safety legislative requirements, or when products exhibit apparent faults [29]. However, the presumption has yet to significantly alleviate the burden on the affected party, who still faces considerable challenges in presenting evidence regarding the aforementioned circumstances. Therefore, within Chinese tort law, it is fitting to shift the burden of proof regarding the fault element onto the producer, who must demonstrate compliance with the relevant obligations and the absence of fault. In the realm of product liability law, Articles 1202 to 1207 of the Civil Code of China establish a framework that imposes strict liability for product defects without the need to prove fault. This benefits the injured party more.

7.3. Transformation and Mitigation of the Burden of Proof in Relation to the "Causal Relationship"

Whether addressing tort liability based on fault in civil law or product liability without fault as a specialized legal principle, establishing causation is fundamental given the information disparity between both parties concerning autonomous vehicle products and the complexity involved in proving causal relationships. If the burden of proof of the causal relationship falls on consumers, it can lead to high proof costs and hinder their ability to provide evidence for effective redress [30]. Moreover, during the proof process, inferring the causal relationship between the defect and damage to an autonomous vehicle based on the facts and everyday rules of experience presents significant challenges.

To mitigate the challenges faced by the infringed party in presenting evidence, they may offer preliminary evidence or preliminary proof of the causal relationship. If the proof standard indicates a preponderance of probability, the burden of proof could shift to the producer. The producer may counter this by presenting evidence that disproves the established causal relationship, demonstrating a standard of high probability. Alternatively, the defendant may assert that the likelihood of damage resulting from other causes surpasses that of product defects.

The current laws and judicial interpretations in China contain numerous explicit provisions regarding preliminary evidence or preliminary proof. For instance, under Article 1195 of the Civil Code of China, if a network user engages in infringement through a network service, the rights holder must furnish the network service provider with preliminary

evidence of the infringement. Upon receipt of such evidence, the network service provider may take necessary measures, such as deletion, blocking, or the disconnection of links. Reference can also be made to Article 5, paragraph 2 of the Provisions of the Supreme People's Court on Several Issues Concerning the Application of Law in the Trial of Cases Involving Food and Drug Disputes (Interpretation [2021] No.17), wherein consumers are only required to provide preliminary evidence of the causal relationship between the damage and the consumption of food or drugs. The standard of proof for preliminary evidence can be reduced to the preponderance of probability [31]. However, the producers and sellers of food and drugs may be exempt from liability by demonstrating that the damage was not caused by the product's failure to meet quality standards [32]. This can be used for reference in the field of automatic driving infringement, and the burden of proof can be transferred after the infringed party has preliminarily proved that the product defect and damage are causally linked.

The provisions of Article 63a of the German Road Traffic Law can be used for reference, and similar technical means to the "black box" can be used to preserve the evidence, which can provide evidentiary facts for the judgment of the appropriateness of takeover control and the distribution of responsibilities between human and machine [33]. Similar provisions in California and Nevada require that data from 30 s before an autonomous vehicle accident must be recorded and preserved for at least three years [34]. The time and location of the technical system failure must be accurately recorded using the traffic recording instrument, and the data should be compared with the data at the time of the accident. If the technical failure occurs infinitesimally close to the accident, it can be inferred that there is a causal relationship between the product defect and the resulting damage. According to the EU Amendment to the Product Liability Directive, the infringed party must demonstrate that the artificial intelligence (AI) product contributed to the damage and that the product may have defects or could have led to the damage. Once these requirements are met, a presumption of a causal relationship between the product defect and the resulting damage can be made. Such a presumption has a similar legal effect as preliminary proof.

8. Conclusions

As the era of large-scale autonomous driving approaches, Germany and the European Union have spearheaded the efforts to adjust the burden of proof concerning infringements by autonomous vehicles through regulatory and legislative measures. These initiatives aim to mitigate the challenges that injured parties face in seeking recourse through pre-established legal frameworks. China has made significant strides in industrial scalability, vital technological advancements, and demonstration applications in recent years, establishing itself as a frontrunner in global automotive intelligence. China should learn from the legislative experience of Germany and the European Union to accelerate the process of autonomous driving legislation. Efforts to clarify and reconstruct the distribution of the burden of proof in cases of autonomous vehicle tort aim to alleviate the burden on consumer rights protection, thereby fostering consumer confidence and establishing a virtuous cycle. At the same time, transforming and alleviating the burden of proof for the factual elements of liability can also urge technology companies to be more transparent and standardized regarding their production safety, prompting them to achieve "traceability everywhere" throughout. Demonstrating that the producer has fulfilled the duty of care without negligence can serve as evidence to defend against liability reduction or exemption, thereby incentivizing the producer to continue investing in the safety of autonomous driving. Furthermore, it is imperative to persist in exploring the nuanced equilibrium between the alleviation of rights and interests and the advancement of the emerging science and technology to effectively mitigate the inherent risks associated with the scientific and technological advancements.

While Germany and the EU's legislative approach to autonomous driving tort cases offers valuable insights for China, there are potential drawbacks and future challenges. Imposing the burden of proof on manufacturers could increase the litigation costs and stifle

innovation, as companies might spend heavily on data analysis and expert testimony to defend against claims. This could also lead to an increase in frivolous lawsuits, straining the court system and harming manufacturers' reputations and finances.

Additionally, the rapid evolution of autonomous technology and the increasing complexity of AI algorithms may outpace the current legislation, introducing uncertainty in liability determinations. Therefore, it is crucial to continuously update the legal frameworks and develop a comprehensive strategy that balances the needs of all stakeholders to support the safe and sustainable advancement of autonomous driving technology.

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