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RESEARCH ARTICLE

Liability as a complement to environmental regulation: an empirical study of the French legal system

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Abstract Reasons for the joint use of *ex ante* regulation and *ex post* liability to cope with environmental accidents have been a longstanding issue in law and economics literature. This article, which includes the first empirical study of the French environmental legal system, analyzes courts' decisions when injurers complied with regulatory standards. The results provide some evidence that liability may be a complement to regulation by encouraging aspects of care that cannot be regulated at reasonable costs, especially human behaviour and organization within dangerous entities. An unexpected effect of liability is observed: judges are more severe with the most regulated firms and public agents compared to smaller, private actors. This might be interpreted as complementing regulation when enforcement of regulatory standards is thought to be weak.

Keywords Regulation · Liability · Environmental risk · Institutional design

JEL Classification K13 · K32 · K41 · L51

1 Introduction

Although the question whether regulation and tort liability are complements or substitutes in the domain of environmental accidents has been strongly debated in law and economics literature, only few empirical studies (Viscusi 1988;

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Dewees et al. 1996) assess how regulation and liability interact in legal systems.[1] Our objective is to fill in this gap, which is an important one in our knowledge because joint use of *ex ante* regulation and *ex post* liability exists in almost every developed country.[2] This paper examines the decisions of France's highest court to assess the roles played by regulators and judges in ensuring that firms exercise due care. The study relies on data covering judgements of the *Cour de Cassation* for the period 1956–2010.

We attempt to assess whether liability ensures compliance with regulation, or encourages more stringent care than required by regulation, and if so, whether liability encourages aspects of care that cannot be monitored by regulators at reasonable costs. Indeed, as Bhole and Wagner (2008) notes, regulators can monitor the installation of certain filters, the compliance with certain procedures and the use of certain products but cannot observe the care taken by individuals in their daily operations. Thus, the existence of two dimensions of care—one observable *ex ante* by regulators and one unobservable before an accident occurs—might explain the joint use of *ex ante* regulation and *ex post* liability, as complements to induce care to potential injurers.

Our primary results are descriptive and our conclusions rely on an econometric logistic analysis. We focus on trial outcomes when environmental accidents occurred despite injurers having complied with regulatory standards. Studying this restricted sample allows exploring whether civil liability is only used to provide polluters with incentives to comply with regulations or whether liability generates incentives to take care in dimensions not covered by regulation. Although courts' decisions where defendant did not comply with regulations might shed light on the role of courts, restricting our analysis to compliant defendants will make the observation of the role played by courts easier. Indeed, in such situations, compliant injurers will be held liable, if so, under legal motives that are not directly related to regulatory standards of care, so that interpreting these legal motives will allow us to assess whether liability is used as a complement to regulation in preventing and punishing environmental accidents.[3]

Our main result is that judges complement regulators' action by focusing primarily on resources management (mismanagement and careless behaviour) that cannot be regulated *ex ante*. Hence, it seems that liability is used to mitigate the limits of the French environmental regulation.[4]

[1] Most empirical and experimental studies focus on the relative efficiency of negligence and strict liability rules and reach very different conclusions. See Sect. 2.

[2] For an overview of environmental law in developed countries, see OCDE (2009). And for a comparative law approach, see Hinteregger (2008).

[3] In other words, we try first to assess whether the "compliance defense" (i.e. compliance with regulatory standards relieves the injurer of liability) applies in the French legal system, and if not, we try to understand the role of liability when injurer complied with regulatory standards. Doing so, we could bring some empirical evidence to the theoretical debate over the efficiency of the "compliance defense". For a theoretical analysis of the "compliance defense", see Shavell (1984), Viscusi (1988) and Burrows (1999).

[4] The theoretical limits of regulation are described in Sect. 2, and their impacts on the French regulatory efficiency are described in Sect. 4.

The paper proceeds as follows: section 2 discusses the relevant literature and Sect. 3 provides background information about French environmental institutional structure, which combines regulation and liability. Section 4 describes our empirical approach and dataset. Section 5 presents statistical observations and our main hypotheses and Sect. 6 provides the results of the logistic regression. Section 7 concludes and presents further research issues.

2 Related literature

Most authors have focused on modelling potential injurers' behaviour when confronted with either regulation alone, liability alone, or both. The aim of these studies is to determine whether regulation and liability, which share a common objective, i.e. reaching the optimal level of prevention, are complements or substitutes. They are considered as complements if they can mitigate each other's failures. Civil liability failures arise when the threat of liability is weakened by the victim's rational apathy (Shavell 1982; Menell 1983; Kaplow 1986; Rose-Ackerman and Geitfeld 1987), the judgement-proof problem[5] (Shavell 1986) or the causal uncertainty,[6] which is often considered as the major defect of environmental liability. Indeed, as far as environmental hazards and pollution are concerned, causal links can seldom be established with absolute certainty when damages are either latent or widespread and/or the origin of harm cannot be established because potential polluters use the same pollutants (Faure 2007). For these reasons, regulation combined with a public insurance system is often considered as superior to liability since regulatory standards are set up *ex ante*, solving the problem of causal uncertainty (Rose-Ackerman 1991; De Geest and Dari-Mattiacci 2003). Though, regulation is also subject to two major problems: assessing the costs and benefits of care and implementing optimal standards. The first issue is an informational problem that arises when potential polluters are reluctant to reveal their costs of abatement or when they face different costs of abatement because of the size, the productivity or the age of their facilities (Viscusi et al. 1995). Victims' heterogeneity may also lead to information problems when they have different preferences according to the level of risk and its counterpart in terms of costs of the goods produced by the regulated industry (Baumol and Oates 1988). To cope with the asymmetric information problem, regulators have to cooperate[7] with polluters and victims to adopt a differentiated regulation according to polluters' and victims' costs and preferences (Ogus 2004), which may lead to "regulatory capture".[8] The second issue is a financial problem. Regulators have a

[5] Compulsory insurance with a financial asset requirement might be a solution to judgement-proof problems, so that it is not considered as the most important failure of liability. See Monti (2001).

[6] On the problems related to causal uncertainty, see Shavell (1980, 1985). For an overview of the issues raised by causation see Ben-Shahar (2000).

[7] The term "cooperation" was first used by Richardson et al. (1982).

[8] The risk of regulatory capture has been emphasized as a strong case for judicial intervention. See Boyer and Porrini (2001) and Hylton (2002).

limited budget to control and audit regulated facilities and this may lead to a weak enforcement of standards (Ogus 2004).

In this context, the joint use of environmental regulation and liability may be desirable if liability can mitigate one or more regulatory failures. In his seminal paper, Shavell (1984) concludes that joint use is socially efficient if polluters' costs of abatement are heterogeneous with a sufficient dispersion and some of them are judgement proof. Kolstad et al. (1990) show that regulation can be used to inform polluters on minimum due care when uncertainty exists about the level of care accepted by courts, if regulation is always enforced. Studies have also focused on the judgement proof problem (Schmitz 2000; Shavell 2005; Hiriart et al. 2004) and on asymmetric information about polluters' assets (Hiriart et al. 2008) to explain joint use efficiency. More recent studies address a more specific division of tasks: joint use is socially efficient when both level of care and level of activity must be regulated (Innes 2004), when care is multidimensional—some dimensions of care are unobservable by the regulator such as organization and human behaviour within the regulated facility—as stated by Bhole and Wagner (2008), and when there is a risk that the regulator can be captured by polluters private interests (Hiriart et al. 2010).

The vast majority of economic scholarship questioning the role of tort liability and regulation in environmental law is purely theoretical, making it difficult to understand the emergence of joint use within actual legal systems, and in common law countries as well as in civil law countries. Dewees et al. (1996) in their an empirical study of tort law efficiency in USA relating to environmental accidents concluded that it has a weak impact on environmental quality compared to regulation, especially when pollution due to accidents is diffuse, cumulative and where causation is uncertain. In the same vein, Almer and Goeschl (2010) empirically studied the enforcement of environmental law in Germany and reached the conclusion that administrative agencies possess a better knowledge of environmental cases than courts. However, they did not assess the role that tort liability may have in the enforcement of regulation and on day-to-day care of polluters, whereas liability regimes may have an important impact as observed in experimental studies. Angelova et al. (2013) ran an experiment to compare the performance of liability rules and concluded that negligence and strict liability rules are equally effective although they are less effective than predicted by the law and economics theory. Though, in a similar experiment, Kornhauser and Schotter (1990) observed that a negligence rule may outperform a strict liability rule even when policymakers face incomplete information about the optimal level of care, and in some specific context, strict liability may even reduce rather than increase care relative to a negligence rule (Alberini and Austin 1999a). Nevertheless, there is no consensus over the relative efficiency of negligence and strict liability rules; their relative efficiency depending on the context (Alberini and Austin 1999b, 2002). Besides, another experiment concludes that liability is costlier than expected when legal suits involve two or more defendants (Dopuch et al. 1997).

From this literature, general conclusions can be drawn. First, it is commonly accepted that care enforced through regulation should be set at a lower level when combined with tort liability than when used alone to avoid over-deterrence effects.

Second, judges should focus essentially on compensatory aspects of litigations. No consensus has been reached, however, concerning both regulatory compliance as a defence against liability (Shavell 1984; Viscusi 1988; Burrows 1999) and the deterrent effect of liability in courts. A logical next step in analysing joint use is to empirically study legal systems to determine whether regulatory compliance is actually accepted as a defence and if not, whether judges are willing to encourage unobservable care by holding compliant defendants liable for human or organizational misconduct. This study, therefore, observes French courts' decisions when environmental accidents occurred even though injurers complied with regulatory standards.

3 French legal background in environmental law

French environmental law is a mix of international, mostly European, and national regulation and liability regimes. Although some European conventions were initiated as early as 1993,[9] the first European action ratified and enforced by Member States was the 2004 Directive on Environmental Liability with Regard to the Prevention and Remedying of Environmental Damage.[10] It is based on the "polluter pays" principle and the "Precautionary Principle". The main objective is to prevent loss of biodiversity and restore contaminated sites, imitating the US CERCLA in many respects.[11] Although civil liability is left to the discretion of the member states, the Directive imposes strict liability on several activities considered the most dangerous. These include installations subject to authorisation by the competent authority—prefect, i.e. State's representative in charge of the respect of Law in a department or a region or mayor—relating to waste management, use, storage and transport of dangerous products. Within this legal frame, French environmental regulation seems to aim at deterrence (Sect. 3.1), whereas environmental civil liability is seen as a compensation mechanism (Sect. 3.2).

3.1 French environmental regulation: setting optimal technical care

From 1992 to 2000, the French regulatory system became more sector-specific and more complex. For instance, since 1992, activities considered dangerous to water quality must limit their emissions of toxic products such as cadmium, arsenic, or lead,[12] and firms producing wastes must store, treat and recycle them.[13] Regulation is also more stringent against most environmentally unfriendly firms called

[9] The Lugano Convention was passed in 1993. It is considered as one of the most stringent environmental convention, providing for strict liability for damage caused by dangerous activities including public ones. Though it has not been ratified yet.

[10] EC Directive 2004/35/EC.

[11] Comprehensive Environmental Response, Compensation and Liability Act, 1980, 1985, 1996, applying a strict, joint and several liability for environmentally-unfriendly facilities' owners and operators. For a comparison of the US CERCLA and the EU Directive, see Boyer and Porrini (2002).

[12] Water Act of January 3, 1992.

[13] Waste Act of July 15, 1975 amended by the July 13, 1992 Law on elimination and treatment of waste.

Classified Installation for the Protection of the Environment[14] (hereafter called ICPE facilities). First, ICPE facility owners are liable to domestic environmental authorities. Second, for critical ICPE facilities,[15] a prior consent procedure has been implemented whereby local government authorities' consent is required before any business activity is started. Furthermore, administrative sanctions have increased. For example, fines for water pollution or illegal waste deposit may reach 76,000 € and 2 years in jail and up to 150,000 € and 2 years in jail for unauthorized exploitation of an ICPE facility.

Since 2005 the core of environmental regulation lies in the Environment Code; government enforcement authorities are in charge of controlling polluting facilities.[16] The Bachelot Act[17] of July 30th 2003 strengthens obligation set on companies according to risks and compliance costs. In this perspective, facilities located in populated areas are subject to more stringent standards than those located in industrial areas. Moreover, cost-effective facilities are subject to more stringent abatement and technical requirements than older or less effective facilities.[18] In other words, the French legislator requires cooperation between relevant authorities and polluting firms, allowing for heterogeneous abatement costs and adjustment to specific geographical situation.

According to administrative procedures, environmental NGOs may be part of the regulation designing process, inform people and reveal specific riparian preferences. Thus, safety levels will be adjusted to local specific conditions—i.e. technology, population density and preferences conditions—lowering the risks of setting sub-optimal standards (Ogus 2004).[19] Besides, local regulators have to inform people about the environmental and technological risks within their territory and the regulatory standards implemented to cope with those risks (Act of 22 July 1983 and Bachelot Act). Hence, potential victims should be aware of the level of risks legally accepted and the actual level of risks they have to bear. This differentiated regulation, in line with economic advice, seems to be an efficient solution to the regulator's informational constraint. However, the cooperative process may lead to regulatory capture (Hawkins 1983). With local standards based on private information, regulated firms are incentivized to behave strategically; they can claim either for lower standards in order to minimize compliance costs

[14] Law on Classified Installations of July 19, 1976 (Loi relative aux Installations Classées pour la Protection de l'Environnement).

[15] Among ICPE facilities subject to authorization we find the riskiest facilities—quarries, nuclear plants—also classified as Seveso (high risk) facilities and IPPC (most polluting) facilities. See The Inspectorate of Classified Installations. http://www.installationsclassees.developpement-durable.gouv.fr/.

[16] The Ministry of Environment, prefects and mayors are in charge of different environmental polices and another police department is in charge of the control of ICPE on the national territory. See Prieur (1993) for a detailed description of French environmental polices.

[17] Law No. 2003-699 of 30 July 2003 on Environmental and Technical Risk Prevention.

[18] See Arrêté du 29 juin 2004, which compels hazardous facilities to adopt "best available techniques" to reduce environmental risks.

[19] Sub-optimal standards result either from minimum care levels (Hutchinson and van't Veld 2005) or from average care level given heterogeneous costs of regulated facilities (Shavell 1984; Faure 2007).

(Kagan 1978) or claim for stringent ones as a compliance strategy to ward off competing operators (Pashigian 1984; Neumann and Nelson 1982).

Nevertheless, since cooperation implies that polluters reveal their costs and some information about their organization to benefit from suited norms this information might be used by judges to detect organizational and human care within the regulated firm. Thus, even though regulators cannot directly monitor this dimension of care, they may provide judges with relevant knowledge about it.

3.2 French environmental liability: allowing for victims compensation

In France, liability can take two forms: either no fault liability or negligence liability. Concerning an ICPE subject to authorisation, strict liability applies. For other polluters and injurers, the liability regime is contained in the rules of the 1804 Civil Code and its accompanying jurisprudence. Articles 1382 and 1383 of the *Code Civil* provide for negligence-based liability when breach of a general duty of care or violation of a statutory provision occurs and allow victims to seek relief before civil or criminal courts if they have suffered losses. Article 1384 §1 of the *Code Civil* applies strict liability and allows victim to seek relief in civil court if damage is certain, direct and personal. This article is rarely used,[20] however, which might be due to the difficulty for a victim to prove that damage is certain and direct in an environmental accident (Shavell 1984; Dewees et al. 1996).

Although civil liability might provide incentives to polluters to take care, this role is not commonly accepted as a major one. According to legal scholars, the only role of civil liability within the French environmental system is to allow for compensation when an accident occurs (Trébulle 2008; Martin 1994). Thus the choice between negligence and strict liability is only a matter of redistributive justice and negligence, if preferred to strict liability, should be aligned with regulatory standards to conserve optimal incentives to take care. However, compulsory liability insurance is required for the most environmentally unfriendly activities (Deprimoz 1978) and since the explosion of the AZF facilities in Toulouse in 2001, a public insurance system for technological/environmental accidents has been set up. Moreover, the Fonds de Garantie Automobile is used to compensate damage not covered by private insurers (Law n° 85–677, 5 July 1985.). Hence, victims of environmental damages can be compensated to a large extent for damage they suffer without having to use the civil liability system.

4 Empirical approach and hypotheses

4.1 Role of civil liability and potential failures of French regulation

The key question in this paper is to determine whether civil liability is used as a complement to regulation. This would be the case if civil liability mitigates

[20] This article is used in less than 5 % of the cases of environmental accidents judged by the *Court of Cassation*, see *infra* Fig. 1.

regulatory failures. Indeed, French regulation suffers from the typical regulatory problems mentioned in Sect. 2. First, the cooperative process of designing regulation may lead to regulatory capture. This is particularly true in France because public officers in charge of environmental regulation often follow opposing objectives simultaneously. For instance, mayors are in charge of the treatment of waste and polluted water within their administrative territory. This means that they should impose stringent standards over the facilities' owners who actually store, treat and recycle waste and polluted water. However, to be re-elected they also have to encourage economic growth, and this may lead to lower standards of best practice, especially in cities where unemployment is high. Same risks hold for prefects who may impose low standards to encourage new start-up businesses within their territory.[21] Thus, from an economic perspective, it seems that the cooperation mechanisms between regulatory authorities and regulated firms increase the risks of regulatory capture and are likely to favour heavily regulated large firms that simultaneously operate several plants because they have more interactions with the legislator than smaller firms (Pashigian 1984; Neumann and Nelson 1982).

The second source of regulatory failure relates to the traditional budget constraint of regulatory agencies. There are only 1171 ICPE inspectors in France who are in charge of controlling 50,000 ICPE facilities subject to prior consent and 450,000 other ICPE facilities (MEEDDM 2009). Thus the probability of being audited is very low (by our calculation, we conclude that only 42 % of ICPE facilities subject to prior consent and only 2 % of the other facilities are monitored for at least 1 h, on an annual basis).

The third cause of regulatory failure lies in the fact that certain safety aspects are difficult—if not impossible—to observe before an accident occurs. We call this aspect "organizational care". This can seldom be discerned by regulators, because it depends on the practice standards undertaken by individual firms in their day-to-day operations and regulators cannot oversee at this level because it would require detailed knowledge of every firm's organization and its employees. This issue is of particular importance in France because, according to a governmental database (ARIA), 63 % of environmental accidents in 2009 were caused by human/organizational misconduct (MEEDDM 2010).

Following the French regulatory failures, it appears that civil liability might be a complement to regulation if it (1) helps regulators reducing the risks of capture, (2) provides additional incentives to most regulated firms and (3) encourages best practice in the unobservable aspects of the facilities' management.

To assess the role of civil liability, we focus our attention on litigation before civil courts when polluters have complied with regulatory standards. We study civil judges' decisions and victims' rate of success on the period 1956–2010.[22] Our database is unique; it comprises all litigations concerning environmental accidents

[21] According to the Cour des Comptes, this category of capture is one of the most important causes of the proliferation of toxic seaweed in the Côtes d'Armor, where prefects have been reluctant to impose stringent environmental impact assessment and controls because they feared a massive exit of agricultural firms. See Cour des Comptes (February 2002).

[22] 1956 represents the first year where data courts decisions are recorded and available.

that went to the *Cour de Cassation*, the highest civil court in France.[23] To construct our database, we used two French official legal search engines,[24] which list all cases before the Court of Cassation and the most important jurisprudence in lower courts. We used the following keywords to gather the whole set of cases related to environmental accidents: pollution, ecological damage, environmental damage, ecological loss, environmental loss, environmental risk, ecological risk, ICPE, natural catastrophe, risk prevention, prevention principle and *troubles de voisinage* (nuisance to neighbours). We obtained 3206 different cases and after selecting only litigations concerning environmental accidents, we were left with 615 relevant decisions.[25] In 331 cases out of those 615 cases, polluters did comply with regulatory standards.

All the variables presented in the following sub-sections are originally dummy variables noted "*1*" when present in cases and "*0*" otherwise.

4.2 Dependent variable

To analyse the role of civil judges when polluters have complied with regulatory standards, we focus on the results of the litigation. Our primary interest is the victims' rate of success[26] and its evolution over time. This outcome is easily observable, though of course not all formal successes are equal in their degree of success from the victim's perspective. A win by the victim with a very low award might not be regarded as successful. Nevertheless, a win by the victim is a reasonable proxy for success that is often used in the legal literature. In our dataset, victims won 164 cases over the 331 relevant cases.

4.3 Explanatory variables

We focus on three types of variables that might have affected the victims' rate of success: legal motivation given by the judge to support her decision, polluter's identity and date of the judgement (since there was a period of regulatory transition during which regulation rapidly changed, which might have led to regulatory uncertainty).

[23] We observe trials before the *Court of Cassation* only, because they are published every year contrary to litigations before lower courts such as *Tribunal d'Instance*, *Tribunal de Grande Instance* and *Cour d'Appel*. Our sample would have been greater taking litigations before every court but would have necessitated visiting physically each court in France to gather relevant information.

[24] Lamyline and Dalloz, http://www.lamyline.fr; http://www.dalloz.fr.

[25] Most of the 3206 cases were not directly related to environmental accidents although they contained one or more keywords. For instance, more than 300 cases were concerned with environmental taxation, more than thousand cases were concerned with *"nuisance to neighbours"* where pollution was not an issue, and about thousand cases concerned litigations before lower courts.

[26] Using the rate of success of victims as a proxy for the "effectiveness" of a liability regime may be questionable because of the possible existence of frivolous cases, where there are no actual losses but just plaintiffs that go on trial to obtain some benefits. However, it is usually so difficult for victims to win a case in the environmental field that this argument does not apply in the present study.

4.3.1 Legal grounds

The first set of explanatory variables describes judges' legal basis for resolving the case. Five legal grounds are available: duty to compensate, nuisance to neighbours, duty to inform people about risks of accidents, uncertainty about the consequences of the accident and organizational care.

1. *Duty to compensate* is often considered by legal scholars as the most fundamental function of civil liability. It represents judges' willingness to force responsible parties to pay for the whole damages suffered by the victims. Judges invoke this principle when parties are conflicting about the amount of awards fixed by judges of lower courts during the first trial (Première Instance, Grande Instance). Because this function is regarded as the most important and is commonly accepted by legal scholars, we use it as the *reference variable*[27] to observe the relative impact of other legal grounds: if some legal grounds increase victims' rate of success relatively to the duty to compensate principle, we would be able to interpret additional functions judges are willing to fulfil.
2. *Nuisance to neighbours* Judges invoke this legal ground when parties disagree on the definition of what is a "reasonable" nuisance or damage. In other words, this principle is used whenever parties are conflicting about the intensity of the nuisance one may reasonably expect given his geographic and industrial situation. Due to regulatory evolution, especially differentiated norms to take local conditions into account, the number of these conflicts should have decreased over the observed period. Besides, a polluter who complied with locally designed standards should not be held liable on this legal ground unless judges consider regulation as incomplete or insufficiently adapted to this specific situation. Should this be the case, judges would have an informational function vis-à-vis the regulator: by ruling in favour of the victim, judges would inform the regulator that norms are not well-suited to local conditions.
3. *Duty to inform* regards the obligation for the polluter to explain to local residents the consequences of his pollution and the risks of his activity on their health and property. This principle is usually invoked when victims recently located next to a polluting firm or on the opposite when a firm recently located next to a residential area, and an accident occurred. Parties are then asking judges to answer the question whether the resulting damages might have been expected by the polluter and/or by the victims. One of the functions of French regulators is to provide people with relevant information about environmental damages and risks of polluting activities. Mayors and prefects assume this function by publishing orders and reports about firms' emission levels and specific risks in city halls and town halls. For this reason, the number of these conflicts should also have decreased if regulation is efficiently designed and

[27] Because we study dummy variables, a logistic regression is relevant; and with logistic regression, for each category of variables, it is necessary to define a "reference variable" which will be used as the baseline to interpret the results. In other words, the coefficient and probability of one variable represents the impact of this variable as compared to the "reference variable". See Gujarati and Porter (2009), p. 558–565.

enforced and this principle should have a lower impact on victims' rate of success than the duty to compensate one. Thus whenever judges use this legal ground to rule against a compliant polluter, they would inform regulators that they did not fulfil their informational tasks.

It appears that both *nuisance to neighbours* and *duty to inform* principles follow the same reasoning—they can be interpreted as a way to mitigate the regulator's informational problems—and should have been influenced by regulatory changes in the same way, since regulators apply a more differentiated regulation and have to publish reports on risks (especially during the last decade). That is the reason why these two variables will be gathered into one global variable in our econometric regression (a dummy variable noted "1" if nuisance to neighbours or duty to inform was invoked in the case, and "0" otherwise).[28]

4. *Uncertainty about the consequences* This legal ground indicates whether judges apply a strict or more flexible view of the "Precautionary Principle".[29] Since the Law "Barnier" of 1995[30] and according to this principle, hazardous installations have to carry out environmental impact assessments and report them to the people via publications on city halls. Environmental impact assessments are primarily focused on the application of "Best Available Technologies" and the following of specific technical procedures such as filters, air ventilation and safety room installations. Thus, the application of the "Precautionary Principle" relies heavily on observable care that regulators can monitor.

This legal ground is used when victims claim that an accident may be imminent and therefore ask for either more investment in care from the firms or for an injunction to stop the activity. When a polluter invokes this ground, he claims that he already took all the precautions he could in complying with regulation. Contrary to the *nuisance to neighbours* and the *duty to inform*, the question here is not about knowing the intensity of the damages but rather about the effort the firm has to do to contain and reduce risks. Given regulatory changes, and especially the role of experts, working for prefects, mayors and environmental polices, who carry out impact assessments and monitor dangerous firms, this legal ground should lower victims' rate of success because regulators already control observable care. If this ground has a positive impact on victims' success, this would mean that judges are willing to encourage more stringent observable care or interpret "Precautionary Principle" in a broader sense that regulators do. Then, judges and regulators would have a complementary role to promote care mostly in the observable dimension.

5. *Organizational care* represents judges' interests in detecting personnel's care in their daily operation, i.e. unobservable care. This principle is invoked when

[28] See "Appendix" for an econometric analysis of their partial regression coefficients.

[29] Article L 110-1 Code de L'Environnement defines the precautionary principle as "the principle according to which the absence of certainty, taking account of current scientific and technical knowledge, ought not to delay the adoption of effective and proportionate measures aimed at preventing a risk of serious and irreversible damage to the environment, at economically acceptable cost."

[30] See "Law Barnier. No 95–101, 2 February 1995.

parties disagree on the "accidental" nature of the damages: victims claim that damages are due to careless organization (understaffing, mandatory overtime, inadequate delegation of power) or individual misconduct (inadequate qualifications, reckless behaviour) whereas injurers claim that damages are purely accidental since each individual within the firm was qualified to perform his task and did it with careful attention.

4.3.2 Polluter's identity

Polluters might be individuals, small private firms, large private firms or dangerous firms (ICPE), or state-owned firms. Defendants in the studied cases might also be officials with specific authority over hazardous activities—such as mayors who are in charge of water treatment within their administrative area. The polluter's identity may have an influence over judges' decisions and thus over the victims' success rate because the bargaining power of the polluter with the regulator varies with its identity.

As explained earlier (Sect. 4.1.), the cooperation mechanisms between regulation authorities and regulated firms increase regulatory capture risks and are likely to favour the most heavily regulated and large firms that operate several regulated plants at the same time. Empirical studies suggest that environmental, health and safety regulation may benefit large firms erect barriers to entry against smaller competitors (Neumann and Nelson 1982). Thus courts' severity against ICPE facilities and big companies could be interpreted as a willingness to mitigate the consequences of regulatory capture. That attitude may be even more desirable when suspected polluters are state-owned firms or officials because of high capture risk and conflicts of interests. In this perspective regulators and state-owned companies would have common political interests in case they can influence each other's career and/or common economic interests in case they share a willingness to develop the regional industry under the scope of regulators power. To test our hypotheses regarding polluters' identity, we use *individuals and small firms* as the reference variable, since they are less likely to capture or influence the regulator than the other two categories.

4.3.3 Transition of regulatory policy

As explained in Sect. 3.1, from 1992 to 2000, France greatly increased regulation in the domain of environmental protection.[31] The role of environmental policies was defined regarding unexpected control and environmental quality monitoring.[32] A governmental agency was created to collect environmental taxes from wastes' use, storage and treatment and to inform polluters about the risks of their installations.[33]

[31] The vast majority of laws and orders concerning environmental protection has been enacted and enforced at that time. We referenced eight laws and orders on air protection, five on noise pollution (out of five), six on waste use and treatment and eleven on water protection.

[32] Water Act 1992: environmental police classifies as an ICPE facilities any facilities using or polluting rivers or groundwater.

[33] ADEME: Agency for the Environment and the Control of Energies, collects and uses environmental taxes according to Waste Act 1992.

The role of NGOs in the process of regulatory cooperation was codified[34] and emission limit values were extended to almost every dangerous product and significantly lowered.[35] Thus, we consider these years as a *"period of transition"* because regulation became more technical, focusing mainly on materials and devices rather than controlling human care. This transition might have increased freedom for judges to rule based on the organizational care legal ground; but this may also have led to regulatory uncertainty since regulatory standards changed rapidly.

In the same vein, after the transition period, the development of cooperation-based regulation may have better judges' ability to detect unobservable care, if regulators and judges share their knowledge. If it were the case, this *post* transition period (2001–2010) would have had a positive impact on victims' success when suing a compliant polluter, since judges would definitively not accept regulatory compliance as a straightforward defence against liability.

5 Model and general observations

Resulting time series statistics allow for two general observations. First, as stated above, breach of general duty of care has been used in a broader sense during more recent decades. Figure 1 shows this general trend by showing the percent of cases in which judges cite Article 1382 and Article 1384 §1 of the Code Civil to hold injurers liable for having been negligent when they complied with regulatory provisions. Whereas breach of a general duty of care was cited in less than 20 % of cases before 1990—and even less than 10 % for a few years—it represents almost 30 % of the cases between 1992 and 2000 with a general trend higher than 25 % since 1992.[36] Strict liability, in contrast, is not used very often and remains stable over the observed period. So it seems that negligence has become a means for judges to observe organizational care and human misconduct and this severity is not due to changes in the liability regime; indeed, since 1976+, only authorized ICPE facilities are subject to strict liability, and they are less than 50,000 installations out of 500,000 ICPE facilities. The use of negligence is associated with victim success, as also shown in Fig. 1, by the dashed line representing negligence cases.

Figure 2 shows the increasing percentage of cases reaching the *Cour de Cassation* in which injurers complied with regulatory provisions and also shows the increasing rate of victims' success. Victims won two-thirds of the cases in 2006 compared to only two-fifths of the cases in 1974. Cases reviewed by the *Cour de Cassation* show an increased rate of compliance, which more or less doubled over the period, going from approximately 30 to 60 %.

[34] See "Law Barnier" No 95-101, 2 February 1995.

[35] "Arrêté" Seveso II, 10 May 2000.

[36] We cannot determine with certainty why the trend of negligence decreases from 1976 to 1988. This could be due to the fact that from 1976 (beginning of the ICPE regulation) courts heavily relied on regulation to determine liability but they changed their approach to negligence in 1986, when, for the first time, the Conseil d'Etat held liable the compliant owner of a quarry for imposing risks of water pollution. CE, ssr 6/2, 30 mai 1986, n.62277, Inédit au Recueil Lebon.

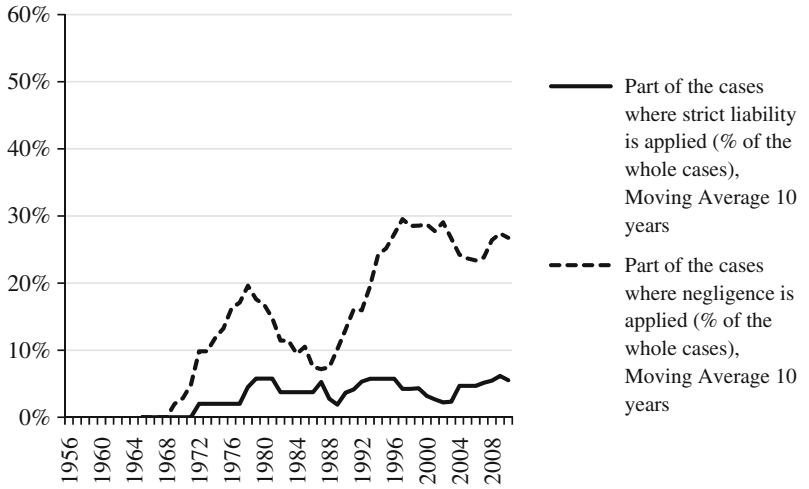

Fig. 1 Injurers held negligent or strictly liable when compliant with regulatory standards. We use a moving average of 10 years to smooth out short-term variations and focus on the long-term trend. Consequently, the specific influence of each period is ignored but will be deeply analysed in the econometric regressions

This increasing compliance with stringent standards is initially surprising given the low monitoring rate of hazardous plants. In 2010 only 42 % of the 50,000 authorized ICPE facilities and less than 2 % of the 450,000 other ICPE facilities were monitored by the 1470 ICPE inspectors. The increasing compliance rate though, might be explained by the increasing role of judges in holding compliant injurers liable for negligence. Table 1 shows the changes in environmental legal frame since 1956. During the transition period, the majority of cases concern compliant injurers. During the pre-transition period state-owned firms and officials were compliant in 33 % of the cases and large firms in 42 %. These figures increased to more than 85 % for state-owned firms and officials and 62 % for large firms. Thus, judges from the highest court do not regard compliance as conclusive evidence of optimal care, especially when dealing with state-owned firms and officials, and carefully scrutinize compliant injurers as part of a cooperative process between the court and regulators.

The only theoretical justification for such judicial activity in compliant cases is that litigation observes a dimension or degree of care not directly controlled by regulation. Otherwise, liability in litigation would over-deter polluters' behaviour since regulatory standards are presumptively already optimized. French jurisprudence during and after the transition period illustrates judges' broader conception of fault for the past two decades. For example, the owner of a site where a fire broke out was held liable for the resulting smoke damaging nearby crops based on breach of a general duty of care under Code Civil article 1382, even though he complied

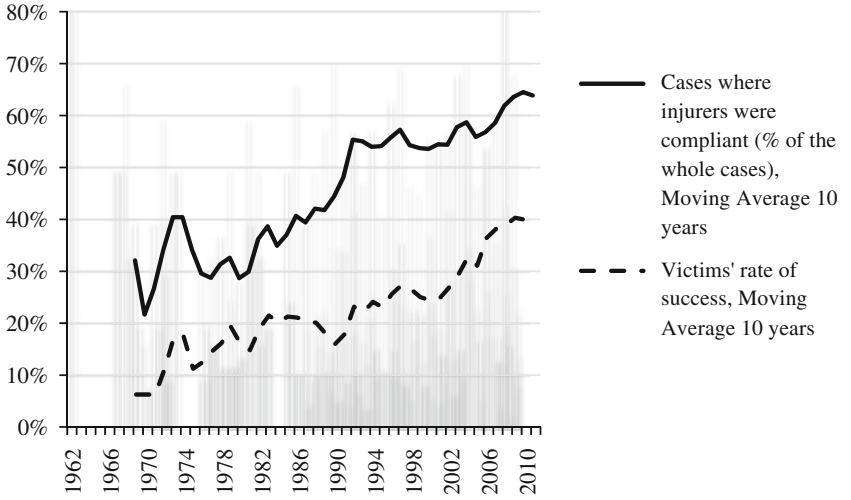

Fig. 2 Evolution of litigations and victims' success when injurers were compliant with regulatory standards

with every regulatory and statutory provisions.[37] And the owner of a site on which an environmental accident occurred, due to unknown individuals who broke into the site, was held negligent for insufficient security on the site and thus required to repair the site and compensate victims in the neighbourhood.[38] If regulators were able to perfectly control care, such decisions would be socially inefficient. So we expect judges to control another dimension of care.

The evolution of legal grounds invoked by judges over the period seems to confirm this hypothesis (Table 2). Whereas *organizational care* was invoked in only 11 % of the cases before 1992, it is invoked in one-third of the trials occurring during the *post* transition period. As expected, trials concerning the uncertainty about the consequences have been lower since regulatory changes: before 1992 this legal ground was present in 24 % of the cases and this figure decreases to 11 % after 2000.

Nevertheless, some observations do not confirm our expectations: trials regarding *nuisance to neighbours* and *duty to inform* increased during the transition period, going, respectively, from 14 to 19 % and from 13 to 22 % of the cases. This evolution might be interpreted as an evidence of the opacity of regulatory information provided to victims and injurers when old and new norms are coexisting. In other words, the increasing use of these two legal grounds might be interpreted as follows: (1) either mayors and prefects do not perfectly know the scope of their functions when regulatory policy changes, or (2) their informational task is more complex when regulatory policy changes and consequently the relevant information does not reach all the parties that are potentially targeted. Although we cannot verify this interpretation with our dataset, the decrease in the use of these

[37] Cass. Civ. II, 24 February 2000. Recueil jurisprudence Dalloz, http://www.dalloz.fr.

[38] Cass. Civ. II, 22 May 2005. Recueil jurisprudence Dalloz, http://www.dalloz.fr.

Table 1 Cases before the Cour de Cassation given regulatory compliance

Polluter's identity	Pre-transition period 1956–1991		Transition period 1992–2000		*Post* transition period 2001–2010	
	Compliant	Not compliant	Compliant	Not compliant	Compliant	Not compliant
Individuals and small firms	20	23	28	18	26	20
Large firms or ICPE	57	78	65	60	95	51
State-owned firms or officials	14	28	14	4	12	2

legal grounds during the *post* transition period (diminishing respectively to 12 and 18 %) seems to be relevant with our hypothesis. Indeed, this might be understood as follows: as regulation becomes clearer, there are less conflicts (1) over the information polluters have to provide to potential victims and (2) over the definition of what is a "reasonable" nuisance or damage.

We can summarize our four hypotheses to be tested as follows:

H1 Judges may not consider regulatory compliance as a defence against liability because they control another dimension of care: organizational and human care. Thus, this legal ground should increase victims' rate of success.

H2 If judges consider regulatory norms are well suited, they will tend to rule against victims when conflicts rely on observable care.

H3 ICPE facilities or large firms and state-owned firms or officials should be held liable more often than small firms since they may capture regulators more easily.

This is due to the French regulatory cooperation, which implies *de facto* a risk of regulatory capture. In such cases, a socially desirable judicial role would be to control regulatory capture to promote regulator's incentives to enforce efficient standards of care on dangerous activities.

H4 The period of transition and the *post* transition period may be associated with more judicial discretion since regulators backed off of trying to control non-observable care—since, after all, only observable care can be regulated—and strengthened requirements regarding technical, observable care. Thus judges may have more room to rule against polluters and may benefit from regulatory information since 1992 and especially during the *post* transition period.

To test our hypotheses, we propose to observe the following relationship (*Regression 1*), within which the reference situation[39] represents a conflict about the amount of awards (*duty to compensate*) opposing a victim to an *individual or small firm* during the *pre-transition period*:

[39] Under a logistic regression, the predicted impact of each explanatory variable measures the marginal effect of the explanatory variable as compared to the reference situation. See Gujarati and Porter (2009), p. 529–533.

Table 2 Apportionment of legal grounds when injurers complied with regulation and victims' success

Legal grounds	Overall period 1956–2010		Pre-transition period 1956–1992		Transition period 1992–2000		Post transition period 2000–2010	
	Number of trials	Proportion of trials (%)	Number of trials	Proportion of trials (%)	Number of trials	Proportion of trials (%)	Number of trials	Proportion of trials (%)
Duty to compensate	91	27	29	32	27	25	35	26
Troubles de voisinage	50	15	13	14	21	19	16	12
Duty to inform	59	18	12	13	24	22	23	18
Uncertainty about the consequences	52	16	22	24	15	14	15	11
Organizational care	79	24	15	16	20	19	44	33
Total	331		91		107		133	
Victim wins	164	49	38	42	51	48	75	56

$$L_{\text{VICT}} = \ln\left(\frac{P_{\text{VICT}}}{1 - P_{\text{VICT}}}\right) = \beta_0 + \beta_1 \text{NUISANCE \& INFO} + \beta_2 \text{UNCERTAINTY} + \beta_3 \text{ORGANIZATION} + \beta_4 \text{ICPE} + \beta_5 \text{PUBLIC} + \beta_6 \text{TRANS} + \beta_7 \text{POST\_TRANS} + \varepsilon$$

L_{VICT} represents the change in probability of the victims' rate of success. Variables NUISANCE & INFO, UNCERTAINTY and ORGANIZATION represent the legal grounds invoked by judges, where *nuisance to neighbours* and *duty to inform* are combined into one unique variable. Variables ICPE and PUBLIC represent the injurer's identity, respectively, large firms and ICPE facilities and state-owned firms or officials. Variables TRANS and POST_TRANS represent the *period of transition* (1992–2000) and the *post transition period* (2001–2010), respectively.

Based on this first regression, we also observe how the different periods might affect the other variables. From Tables 1 and 2, we have observed that during the period of transition, the uncertainty about regulation is higher and this may lead to more conflicts based on the nuisance to neighbours and the duty to inform legal grounds (see hypotheses H2 + H4). In the same vein, as regulation became clearer, the uncertainty about the consequences has been less invoked (H2 + H4), whereas the organizational care has been invoked more often (H1 + H4). Moreover, during the transition period, the risk of capture might have been higher, since cooperation between regulators and regulated firms was necessary to define new standards (H3 + H4). Consequently, the complementary roles of civil liability may have changed over the periods. To test this hypothesis (*Regression 2*), we add the following interaction terms[40] to the first regression: NUISANCE&INFO*TRANS, NUISANCE&INFO*POST_TRANS, UNCERTAINTY*POST_TRANS, ORGANIZATION*POST_TRANS, ICPE*TRANS.

6 Results

The results of the regressions and the predicted probabilities are presented in Table 3. Results partially confirm our hypotheses: judges do not accept regulatory compliance as a defence against liability and judges seem to have an effective role in complementing regulators' action. Two interpretations are available. First, judges and regulators may not control the same dimension of care, making their actions complementary to encourage care. Second, judges are severer with the most regulated firms and public companies and that may be because these entities are more likely to capture the regulator given French regulatory design. Moreover, as expected, the role of civil liability seems to be more effective since regulatory changes occurred. Though, judges tend to rule against compliant injurers when they invoke the *nuisance to neighbours* or the *duty to inform* principles as legal grounds (except during the *post transition period*), which was unexpected.

[40] Interaction terms are dummy variables notes 1 if both interacting terms are 1 and 0 otherwise.

6.1 No defence of regulatory compliance and multidimensional care

As observed above, judges do not accept a regulatory compliance defence to escape liability, even in a negligence regime. The common argument supporting such a defence—civil liability has only a compensatory function (Trébulle 2008) and must be used only to compensate harm—given by French legal scholars does not explain the observed pattern of case outcomes. As explained earlier (Sect. 3.2), a public insurance system for environmental accidents exists in France[41] so victims can be compensated for environmental damages without seeking relief in civil courts when an accident occurred and an injurer complied with regulatory standards. Given the available compensation, those favouring a defence argue, a combination of regulation and public insurance would be more efficient than a joint use of regulation and civil liability, as stated by De Geest and Dari-Mattiacci (2007). This argument is not supported from the results in Table 3: *nuisance to neighbours* and *duty to inform* on the one hand and *organizational care* on the other hand increase victims' chances of success compared to the *duty to compensate*, meaning that judges do not only focus on their compensatory function.

A possible explanation is that judges do not observe the same aspect of care that regulators do. Regulators impose a technical level of care *ex ante*, to limit the entrance of most dangerous polluters into risky activities. In comparison, judges control day-to-day care *ex post* to limit moral hazard arising from polluters escaping liability based on regulatory compliance. So, civil liability is socially desirable if accidents occur not only because of obsolete capital or dangerous products—*elements of risk that regulators can control*—but also because of insufficient human care and dangerous organization within the polluting firm too—*some elements regulators cannot control at reasonable cost*. Thus, civil liability complements regulation by focusing on unobservable—day-to-day—care, as illustrated by the empirical results. Indeed, as expected concerning the influence of legal grounds, *organizational care* has a positive coefficient: when this legal ground is invoked victims have 36 % more chances to win the trial than when duty to compensate is invoked.[42]

The econometric analysis of French legal system allows us to demonstrate institutional "complementarity" between judges and regulators in the domain of environmental accidents: non-compliance with regulatory standards is considered *de facto* as a fault and leads to (mostly) criminal liability, but compliance is not considered a complete defence against civil liability. Thus the regulatory standard of care separates criminal and civil liability and gives room for civil judges to control the other dimensions of care. Figure 3 illustrates the role of civil liability as a complement to regulation.

Besides, as expected, *uncertainty about the consequences* reduces victims' rate of success by 37 % compared to the reference situation. This result seems to confirm

[41] The "Fonds de Garantie Automobile" is used to compensate victims of environmental and technological accidents, see Law n° 85–677, 5 July 1985.

[42] The *log odds ratio* for "organizational care" is 1.860, which means that using this legal ground instead of the "duty to compensate" increases victims' success by a probability p such that: $\ln(p/1-p) \approx 1.860$. We find 86 %, which means an increase of 36 % when "organizational care" is invoked (statistically, when the value of the dummy variable "organizational care" goes from *0* to *1*). Same calculus is done for each predicted probability. See Gujarati and Porter (2009), p. 558–561.

Table 3 Results of the logistic regressions: effects of various legal grounds, injurer's identity and regulatory period over victims' success

	Regression 1		Regression 2	
	Coefficients (log odds)	Predicted probabilities[a] (%)	Coefficients (log odds)	Predicted probabilities[a] (%)
Legal grounds				
Duty to compensate (reference variable)				
Nuisance to neighbours and duty to inform	0.600* (0.347)	14	0.923* (0.512)	22
Uncertainty about the consequences	−2.213† (0.559)	−37	−2.100** (0.845)	−35
Organizational care	1.860† (0.433)	36	1.642† (0.509)	33
Injurer's identity				
Individual or Small firm (reference variable)				
Large firm or ICPE	1.414† (0.302)	31	1.398** (0.593)	30
State-owned firm or officials	1.998† (0.502)	37	2.019** (0.841)	38
Transition period (1992–2000)	0.825** (0.346)	16	0.818** (0.353)	19
Transition*nuisance to neighbours and duty to inform			1.106* (0.672)	25
Transition*large firm and ICPE			1.596*** (0.581)	33
Post transition period (2001–2010)	0.881*** (0.326)	16	0.849*** (0.325)	20
Post transition*nuisance to neighbours and duty to inform			−1.439* (0.811)	−31
Post transition*uncertainty about the consequences			−2.572*** (0.799)	−44
Post transition*organizational care			2.177† (0.582)	42
Constant	−2.011† (0.426)		−2.337† (0.572)	
Number of trials	331			
Victim wins (victim = 1)	164			

Table 3 continued

	χ^2	*df*	*p*	χ^2	*df*	*p*
Tests[b]						
Overall model evaluation						
Likelihood ratio test	127.55	7	0.0000	133.12	12	0.0023
Score test	108.40	7	0.0000	31.94	5	0.0000
Wald test	75.98	7	0.0000	77.06	12	0.0068
Goodness of fit[c]						
Hosmer and Lemeshow	8.03	8	0.4302	4.19	12	0.9798
c-statistic[d]		75.83 %			74.92 %	

Significant at: † $p < 0.001$, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are in parentheses

[a] Change in victim's success, compared to the reference situation, when the explanatory variable changes from *0* to *1*

[b] We provide tests considered as fundamental and sufficient by Peng et al. (2002)

[c] For each regression, two additional descriptive measures of goodness-of-fit might be added. Regression 1: Cox and Snell $R^2 = 0.320$; Nagelkerke $R^2 = 0.426$, Regression 2: Cox and Snell $R^2 = 0.331$; Nagelkerke $R^2 = 0.442$

[d] *C* statistic means that the models assigned the correct actual outcome in 75.83 and 74.92 % of all trials, respectively

the fact that judges rely on regulatory knowledge as far as observational care is concerned. In other words, whenever regulators consider the polluter took the relevant technical level of care, judges do not interfere with their decision and adopt the same interpretation of the "Precautionary Principle".

Though the positive impact of *nuisance to neighbours* and *duty to inform* diverges from our interpretation since it overall increases victims' rate of success by 14 % instead of reducing it, what should be the case if judges strictly followed regulators' decisions concerning technical care and their diffusion to potential victims. Thus judges tend to be severer than regulators as far as informational issues are concerned. This result might be due to regulators' budgetary constraints: since regulators have a limited budget, they focus on most dangerous activities and give up conflicts concerning few people, local damages and clearly identified parties, that is to say they do not focus on *nuisance to neighbours*. The role of judges in these specific conflicts may then be a desirable complement to regulators' activity, based on the awareness of both judges and regulators that regulatory costs might be reduced by civil liability. This interpretation is consistent with Innes (2004) analysis of joint use.

6.2 Impact of injurer's identity

As expected, coefficients of *large firms or ICPE facilities* and *state-owned firms or officials* are significant and positive. The presence of a *state-owned firm or officials* increases victims' rate of success by 37 % compared to the reference situation, and the presence of a *large firm or ICPE facilities* leads to an increase of 31 %. This suggests that judges are more severe when dealing with state-owned firms or officials because of their duty of sanitary security. Recent jurisprudence illustrates this severity, stating that local authorities may be held liable for accidents occurring within their administrative area, even if they actually monitored injurers because they have relevant information and legal means to prevent them.[43] From an economic point of view, this severity will incentivize regulators to efficiently set and monitor technical levels of care, reducing the risks of capture when dealing with influential firms; this is consistent with recent work of Hiriart et al. (2010).

6.3 Regulatory period of transition and post transition period

The coefficients of both periods are significant and positive (16 % for each). This confirms our hypothesis that the role of civil liability in an already regulated field has been adjusted through a dynamic process. This process has seen a kind of specialization of regulators and judges in two different dimensions of care and allows for one more observation: during *the period of transition*, the number of cases concerning compliant injurers increased sharply and this can be explained by the uncertainty resulting from regulatory changes. Because the number of regulatory provisions increased, it could have been unclear to injurers whether they were

[43] See Chabanne-Pouzynin (2001) for a detailed explanation of the jurisprudence concerning public agents' duty to sanitary security and the increasing number of cases where mayors, prefects and even the State are held liable for failure to take necessary measures.

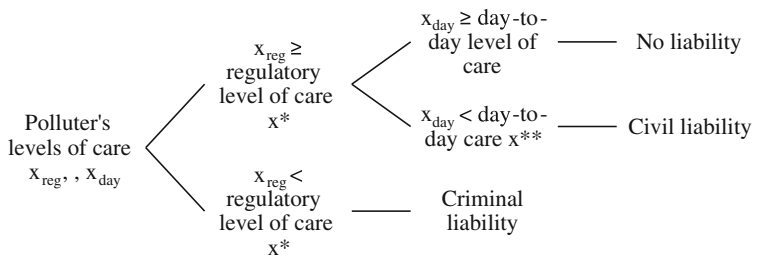

Fig. 3 French multi-dimensional control of care*. *Where x_{reg} and x_{day} represent, respectively, the polluter's level of observable "technical" care and unobservable "organizational day-to-day" care and x and x** represent, respectively, the due level of technical care and the level of organizational care to avoid negligence

compliant and if so, whether they could escape liability. That may be the reason why more injurers sought review of lower court outcomes by the *Cour de Cassation*. Some French legal scholars define this situation as "legal regulatory conflict".[44] Given increased regulation, civil judges may have an unexpected positive effect—positive externality—on environmental accident prevention by specifying the level of due care when multiple regulatory provisions conflict (Kolstad et al. 1990). This may happen when new European or national regulations replace obsolete ones but the latter are not yet reformed. This might have been the case in France because until the 2005 *Code de l'Environnement*, environmental regulations were spread in different Codes and enforced by different regulators so that polluters may be authorized to run a polluting activity by the mayor but found not compliant by the prefect, leading to great legal uncertainty (Prieur 1993). Our results seem to confirm this hypothesis: victims who invoked *a nuisance to neighbours or a duty to inform* had more chance to success during the period of transition (25 % instead of 14 %) and the same legal ground decreases their rate of success by 31 % during the *post transition period*. In other words, it seems that judges accept that regulatory information might be an issue when regulation is changing but rely on regulators' expertise and ability to provide information otherwise. Another result shows that judges heavily rely on regulation: victims' chance of success decreases by 44 % when they invoke *an uncertainty about the consequences* of an activity during the *post transition period,* whereas the same legal ground decreases their chance by 35 % the rest of the time. Hence, as regulation becomes more precise, judges tend to rely on regulators' ability to assess the risks of an activity. Once regulatory standards are clear, differentiated and potentially well understood by victims and injurers (i.e. post transition period), judges seem to almost only accept an organizational or human negligence as a successful legal ground against compliant injurer. Thus one might say that civil liability remains a complement to well-designed regulation by focusing on an aspect of care that cannot be observed *ex ante*.

The results also show that judges were more severe against ICPE facilities during the period of transition (victims' rate of success was 33 % instead of 30 %).

[44] Fonbaustier (2010) defines it as a "Télescopage" in French.

Although we cannot explain this situation with absolute certainty, it might be interpreted as a way to overcome regulatory capture when regulation is changing and consequently when regulators are the most likely to be influenced by the regulated industry.

6.4 Limitations of the study

Our study focuses on cases adjudicated by the *Cour de Cassation*, raising a selection bias for two reasons. First, out of courts settlements are neglected in our analysis; therefore, private bargaining was not observed (Priest 1984). Therefore, our analysis focuses on high expected damages. Second, we only focused on the *Cour de Cassation* case law, and did not observe litigations judged by lower courts. Hence, our sample might be considered as biased since only complex or financially significant cases are finally within the scope of our analysis (Clermont and Eisenberg 1998).

In addition to this, 30 % of cases are declared as "non admissible" ones by the *Cour de Cassation*. For the 70 % remaining cases, the *Cour de Cassation* is more prone to reject than confirm lower-level courts decisions. Since 78 % of cases decided over by the *Cour de Cassation* are brought by victims, victims' chances of success might be over-represented in highest-level courts compared to lower-level jurisdictions (Eisenberg et al. 2011).

Notwithstanding selection bias, the study shows the role of civil judges of the highest jurisdiction in preventing environmental accidents and shows that this pattern has significant features beyond chance outcomes. The outcomes of cases in the *Cour de Cassation* are especially important because they are both final and can be expected to have the most influence on lower courts and on other actors in the system of environmental regulation.

7 Concluding remarks

Our paper represents the first empirical study of the oucomes of French environmental cases. Our econometric study focuses on joint use of *ex ante* regulation and *ex post* liability to cope with environmental accidents within the French legal system. More precisely, we observe the role of civil liability when the potential injurer complied with regulation.

We conclude that civil liability has become a complement to regulation as regulation itself became more precise. Once regulators adopted a differentiated regulation based on "observable care", judges had more room to detect "organizational and human negligence" of a compliant injurer. Furthermore, judges appear to be more severe with the most regulated firms and with state-owned companies and state officials. This might be interpreted as a willingness to overcome regulatory capture, although this remains only an interpretation of our results in light of the related literature since our data do not directly test the role of capture before courts. Far from weakening previous formal theoretical studies in that field, our analysis confirms their validity, especially the Bhole and Wagner (2008) and

Hiriart et al. (2010) hypotheses that civil liability might be desirable when care is multidimensional and regulators might be captured or unable to fully monitor most dangerous activities.

Because we only focused on how civil liability might positively affect regulatory outcomes in this article, further research should examine how regulation may positively affect civil outcomes. This may occur when causation is uncertain because of multiple potential injurers or too costly to prove for victims; regulators might then use the knowledge acquired during the cooperation process to identify potential injurers most likely to be liable, lowering victims' burden of proof. Another worthwhile extension would be to empirically study the role of injurers' insurers in the prevention of accidents since insurers are allowed to contractually set up higher standards of care than those legally fixed (Boyer and Porrini 2011) and can act before courts to recover their expenditures when insured injurers did not comply with these standards.

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Appendix

We run the following regression:

$$L_{\text{VICT}} = \ln\left(\frac{P_{\text{VICT}}}{1 - P_{\text{VICT}}}\right) = \beta_0 + \beta_1 \text{NUISANCE} + \beta_2 \text{INFO} + \beta_3 \text{UNCERTAINTY} + \beta_4 \text{ORGANIZATION} + \beta_5 \text{ICPE} + \beta_6 \text{PUBLIC} + \beta_7 \text{TRANS} + \beta_8 \text{POST\_TRANS} + \varepsilon$$

We obtain the following results:

	Coefficients (log odds)
Legal grounds	
Duty to compensate (reference variable)	
Nuisance to neighbours	0.917* (0.527)
Duty to inform	0.373* (0.205)
Uncertainty about the consequences	−2.229† (0.561)
Organizational care	1.861† (0.436)
Injurer's identity	
Individual or Small firm (reference variable)	
Large firm or ICPE	1.465† (0.311)
State-owned firm or officials	2.147† (0.511)
Transition period (1992–2000)	0.818** (0.353)
Post transition period (2001–2010)	0.911*** (0.332)
Constant	−2.068† (0.434)

We know that the partial regression coefficients of nuisance to neighbours and duty to inform are different but we have to test whether this difference is statistically significant, because (from a theoretical point of view) these two variables could have the same influence over victims' rate of success since they are both linked to the regulator's ability to provide information to victims and injurers.

Thus, we test the null hypothesis that the partial regression coefficients of these two variables are equal:

$$H_0 : \quad \beta_1 = \beta_2$$

We obtain: $\chi^2(1) = 1.12$ with $p > \chi^2 = 0.2901$.

So we cannot reject the null hypothesis that coefficients are equal to one another. Then these dummy variables can be combined into one single dummy variable (Allen 1997, p. 136–137) as follows:

$$\beta_1 \text{NUISANCE} + \beta_2 \text{INFO} = \beta_{(1+2)}(\text{NUISANCE} + \text{INFO}).$$

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