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*Flávio Henrique Silva Ferreira*

# Technological Change, Accident Prevention and Civil Liability

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Edited by:
Goethe University Frankfurt am Main
Department of Law
Grüneburgplatz 1
60629 Frankfurt am Main
Tel.: [+49] (0)69 - 798 34341
Fax: [+49] (0)69 - 798 34523

Flávio Henrique Silva Ferreira, Juiz de Fora / Brazil

# Technological Change, Accident Prevention and Civil Liability

*Abstract: The improvement of accident prevention technology in many fields of social life has spurred new challenges to the doctrinal tools of fault and strict based civil liability in the law of torts. Amid these challenges lies the identification of the proper scope of the respective criteria of liability in a changing factual environment, their suitability as doctrinal tools, as well as their actual application to concrete cases given the amount of information which would be needed to render adequate judgments. Precedents and old laws should be assessed with caution, taking into account the tacit cost-benefit analysis embedded in them, for they may or may not serve the interests of welfare maximization in an environment with constantly renewed accident prevention technology.*
*Key-words: technological change, precautionary measures, accident prevention technologies, negligence, strict liability*

## I. Introduction

Accidents occur in many different shapes and forms in various fields of human activity such as traffic related accidents involving drivers, pedestrians and other road users; sports related accidents involving competitors or spectators; defective products related accidents involving consumers; medical care related accidents involving patients; industry related accidents concerning the operation of hazardous activities which either affects the property and safety of employees or of the public at large. Prevention of accidents can usually be accomplished not only by the person or organization responsible for the creation of the risk of a given type of accident but also by its victim. However, we are here concerned mainly with the duties of prevention imposed on injurers rather than on victims. We will try to illustrate how a changing factual environment regarding the development of new and improved accident prevention technology in some selected fields of social life poses a challenge to the doctrinal tools of civil liability as well as to the precedential value of old laws, regulations and case-law. When new accident prevention technology emerges it usually alters the costs which would have to be borne by the injurer/defendant in order to prevent an accident from occurring, either lowering or increasing them. Sometimes the employment of this new technology can be verified by the courts, other times it cannot. These changes affect the adequacy of the legal regime governing civil liability in those areas of social life. We will try to show how this can happen by developing a general theoretical framework for the law of torts which will serve as a yardstick to analyze the impact of said technologies on the

suitability of the aforementioned legal regime. First we will clarify what is the meaning of negligence or fault and compare it with strict liability. Then we will elucidate how and why the law provides incentives for the injurer to behave more carefully. Afterwards we will identify the factors that bear on the choice between negligence and strict liability as well as the question of which precautionary measures should be included in the negligence inquiry. Finally we will analyze how new accident prevention technologies might impact the adequacy of the civil liability regime under the previously developed theoretical framework. However, before we do all of the above, we will try to connect the theme of this paper to moral philosophy.

## II. Connecting the theme of the paper to moral philosophy: welfare, fair allocation of resources and the law

Law is assumed to be intimately related to the realization of justice, which is assumed to involve questions pertaining to the fair division or allocation of resources.[1] There is a considerable debate among moral philosophers whether fair allocation of resources should pursue an egalitarian or other ideal, regardless of the promotion of people's well-being or welfare,[2] or rather should pursue such ideals in order to advance said well-being or welfare.[3] The very notion of well-being is the subject of acute debate. It has been identified with the promotion of people's pleasures, actual preferences, ideal or rational preferences, attainment of a list of objective goods or even the pursuit of lives which are in accordance with human nature.[4] Equality itself, as a criterion of fairness, has multiple meanings. Fortunately, for the purposes of this paper, we need not resolve all of these issues. Civil liability for harm tends to reduce the overall costs of protection taken by the injurer and the victim and, moreover, it tends to conserve their endowments and resources by diminishing the likelihood of an accident. Thus, even if one or both parties are expected to bear some costs in order to avoid some harm, they both are expected to be benefited by the fact that they will remain with a larger share of resources and endowments than they would otherwise have had in the absence of liability. This assumption holds, of course, only if the harm avoidance costs are less than the saved endowments and resources, or the activity of the injurer itself will not create greater

[1] John Rawls, *A Theory of Justice*, 1971; Ronald Dworkin, What is Equality? Part I: Equality of Welfare, *Philosophy and Public Affairs*, 1981, 185-246; id., What is Equality? Part II: Equality of Resources, *Philosophy and Public Affairs*, 1981, 283-345; Amartya Sen, *The Idea of Justice*, 2009.
[2] E.g., Rawls (note 1); Dworkin (note 1); Thomas Scanlon, *What we Owe to Each Other*,1998.
[3] E.g., James Griffin, *Well-being: Its Meaning, Measurement and Moral Importance*, 1986; Richard Arneson, Equality and Equal Opportunity for Welfare, *Philosophical Studies*, 1989, 77-93; Roger Crisp, *Reasons and the Good*, 2006.
[4] For a brief review, see Griffin (note 3).

endowments or resources and said injurer is not able to adequately and fully compensate the victim for the harm done. For, otherwise, it would not be clear whether the reduction of harm caused by civil liability would indeed create a larger share of resources and endowments to be distributed to the parties.

Civil liability for harm, when appropriate, can thus be accommodated within the framework of different conceptions of justice or fair allocation. On the one hand, it may satisfy the requirements of non-welfarist theories of justice, such as the promotion of the ideal of equal respect for each other's liberties and rights; or the deference given to deontological constraints against causing harm. On the other hand, it may also increase people's well-being or welfare under most, if not all, conceptions of well-being or welfare. Having greater amounts of resources and endowments allows people to pursue their chosen life plans with greater easiness, since they can be traded for or used for the accomplishment of things which are valuable to them, or allows them to obtain certain objective goods on their own, or allows them to pursue life plans which would be in accordance with their human nature, and so on. Reduction of harm caused in the context of social interactions can be equated with what economists call a "public good".[5] Difficult questions would still remain about the fair division between the parties, injurer and victim, of the costs related to the creation of said public good.[6] These difficulties, however, do not alter the fact that it would be just and fair to have some sort of rule proscribing the causing of harm by careless conduct under some circumstances.

## III. Basic assumptions about rationality, distributive justice and the relevance of the model presented in this paper

The fact that various kinds of social interaction can result in unconsented harm, and that the reduction of said harm can be socially desirable, means that there may be room for legal intervention in order to achieve such reduction. Those who are familiar with the methodology employed in the economic analysis of law may skip this section. For those who are not so familiar, this section will lay out the basic assumptions guiding the analysis of the regime of civil liability pursued in the next sections of this paper. Let us begin with some basic questions and short answers, and then we will elaborate a bit more on those questions and answers. *When* does the law need to provide rules in order to encourage parties to act in a way

[5] For a general discussion of the notion of a "public good", cf. Richard Cornes and Todd Sandler, *The Theory of Externalities, Public Goods and Club Goods*, 1996.

[6] For a very technical overview of different methods of fair allocation of benefits and burdens, cf. Hervé J. Moulin, *Fair Division and Collective Welfare*, 2003.

that is socially desirable? Short answer: when "social" norms aren't capable to steer their conduct towards such desirable outcome *and* "legal" norms can satisfactorily induce them to act in a socially beneficial manner. *How* can the incentives provided by "legal" norms be adequately analyzed? Short answer: by developing models of human interaction in specific contexts (game theory), which assume people possess a certain kind of rationality which will motivate them to seek certain kinds of rewards. These rewards or payoffs will vary, among other factors, according to the strategies taken by each party to the interaction as well as according to the legal rules and sanctions governing such interaction.

*Where* do "social" norms come from and *what* is the nature of their relationship with "legal" norms? Social norms come from the spontaneous outcome of human interactions within and outside the most varied groups in different fields of social life, while the more formal legal norms are the result of an institutionalization process.[7] When these "social" norms, which come from different normative orders, begin to be supported by more well-structured social sanctions, applied by official authorities, they then receive the qualification of "legal" norms.[8] Such "legal" norms are those "social" norms which have undergone a process of "institutionalization".[9] Of course, the boundary between them is not as clear cut as it may sound. The fact is that the separation between the normative legal tissue and the normative tissue which is not considered to attain the status of legally binding depends, to a great extent, on the purposes of the investigator. Thus, the distinguishing criteria may vary in accordance with the society and historical time under study.[10] The process of creation of legal norms through the adoption, elaboration and or modification of those social norms already found in the relevant society as the spontaneous and not entirely planned outcome of innumerous human interactions, carried out by formally constituted authorities, may be called

[7] There is a growing literature on the nature and emergence of social norms. Cf., e.g., Michael Hechter and Karl-Dieter Opp (eds), *Social norms*, 2001; Cristina Bicchieri, *The grammar of society: the nature and dynamics of social norms*, 2006; Eric Posner, *Law and social norms*, 2002.

[8] Cf. Neil MacCormick, *Institutions of Law: An Essay in Legal Theory*, 2008. The author provides the example of the *social norm* regarding the formation of *queues* for obtaining services as well as for other purposes. Such norm emerges spontaneously from the interaction of people and has the objective of solving problems of social cooperation in a mutually advantageous way. Frequently, a given authority, with the power to supervise and regulate the formation of the line, makes said norm undergo a process of institutionalization by the provision of a detailed regulation regarding the conditions of access to the line, waiting order, privileges, loss or renewal of the right to wait in line and so on.

[9] Cf. Alan Watson, *The Evolution of Western Private Law*, 2001, 195: "[A] legal institution is a social institution that has been given legal effectiveness and is being regarded from the legal point of view. A legal institution, to be at all meaningful, depends on a societal institution". Obviously, we need to consider the possibility that the scope of said legal institution may not coincide entirely with the scope of the social institution, or the law may simply ignore the second one.

[10] Geoffrey MacCormack, Anthropology and Legal Theory, *The Juridical Review*, 1978, 216-32; Sally Falk Moore, Law and Anthropology, *Biennial Review of Anthropology*, 1969, 252-300.

*institutionalization*.[11] The institutionalization process rarely avails itself of social norms in a "pure state". The authorities of a given society frequently count on the legal rules previously institutionalized by other authorities, in other societies and at other historical times, as a prominent source of inspiration for the creation of their own rules. Said institutionalization process – which in practice is slow, gradual and at times done in an unreflective fashion – is in open contradiction to the frequently advocated model of a rational discussion conducted within a legislative process, which itself is structured on the basis of higher norms under a pyramid-like arrangement leading to a *grundnorm*.[12] The institutionalization process – which involves the reception, elaboration and or modification of certain social norms or certain legal norms created in other societies and historical times – can be lead, depending on the specific juridical tradition, mainly by legislators, judges or doctrinal writers.[13]

Economic analysis of the law proceeds in various stages, though some of these are not always explicitly articulated by the investigator. First one has to stipulate a given concept of well-being and how it can be attained in the context of a given interaction. Then one has to adopt a given theory of rationality which will serve to clarify both the question of the interacting parties' preferences and the question pertaining to their cognitive abilities or limitations. Then one tries to foresee human behavior, based on the previously assumed theory of rationality, through the elaboration of specific models of interaction in specific situations (game theory). One analyses people's interaction in the absence of a "legal" norm, but ideally not in the absence of a "social" norm, and see if the given interaction tends to decrease or increase social welfare, considering the set of strategies which the parties are likely to adopt. In case said interaction is believed to reduce social welfare, the scholar then tries to study which kind of legal rules could be devised to induce the parties to interact in a way to increase their own welfare and or to increase the welfare of third parties. Once potentially beneficial rules are identified, one has to evaluate the cost of their implementation by the authorities responsible for the administration of the law. Only rules whose adoption would bring more benefits than harm, considering their implementation cost, should be welcomed by the legislator or by the authority responsible for the administration of the law.

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[11] Neil MacCormick, *Institutions of Law: An Essay in Legal Theory*, 2008.

[12] Cf. James Gordley, The Future of European Contract Law on the Basis of Europe's Heritage, *European Review of Contract Law*, 2005, 174 (discussing the lack of understanding on the part of the French legislator with regard to the content of the civil code which it was promulgating). A similar pattern can be seen in the enactment of the Brazilian civil code of 1916 and, for that matter, the civil code of 2002 as well. Most of criticism directed at and the amendments made to the civil code of 1916, before it went into force, had nothing to do with the content of said code but were rather related to its linguistic style. One can remember here the notorious polemic between Rui Barbosa, on the one hand, and Ernesto Carneiro Ribeiro, on the other.

[13] Cf. R. C. van Caenegem, *Judges, Legislators and Professors: Chapters in European Legal History*, 1987; id., *Uma introdução histórica ao direito privado*, 2nd ed., 1999.

Under the analysis conducted in the next sections, we will assume, for the most part, that parties will prefer to pursue strategies which are less costly to them or which brings them greater expected benefits. It is not entirely clear, however, whether we would be relaxing this assumption, or more likely, whether we would simply be enlarging the notion of costs and benefits by positing, for instance, that in certain contexts parties will be more altruistically motivated or that social norms will significantly alter the balance of costs and benefits attached to a given action. We will not be assuming that there are significant cognitive limitations or errors incurred by the parties in the assessment of the costs and benefits of their actions or that there are such significant limitations and errors in the assessment of the likelihood of the materialization of remote risks, a theme which has been extensively explored since the work of Kahneman and Tversky.[14] Some of the conclusions we have drawn in the remainder of this paper may (or may not) have to be modified in the light of new assumptions about certain cognitive limitations and biases. We will also assume, for the most part, that assigning liability to the injurer – whenever the sum of harm avoidance costs is lesser than the expected amount of harm – is both conducive to the creation of a *greater share* of endowments and resources, thus increasing social welfare, as well as to a *fair allocation* of the costs which would have to be incurred in order to produce this "public good". This assumption can be relaxed in many different ways, such as, for instance, by assuming that, in certain situations, there is a fundamental asymmetry when it comes to who is likely to find himself or herself in the role of the injurer or the victim, calling for different measures to redress the imbalance. Or, for instance, by assuming that the conduct of the injurer creates greater benefits (possibly even to the victim) than the protection of said victim against the risk of harm, or that the victim would be in a better position to avoid her own harm and that it would be just to allocate the prevention costs to her.

## IV. Clarifying the concepts

Generally speaking, a person might be held liable to another's damage under two very broad and somewhat different criteria: negligence and strict liability. We are well aware of the subtleties surrounding the notions of negligence (also known as *faute* or *culpa*) and strict liability in different jurisdictions,[15] as well as about the employment of certain ideas such as the concept of the *duty of care* in the common law world,[16] but we think that these are

[14] Daniel Kahneman, Paul Slovic and Amos Tversky (eds.), *Judgement Under Uncertainty: Heuristics and Biases*, 1982.

[15] On their historical origins, cf. Reinhard Zimmermann, *The Law of Obligations: Roman Foundations of the Civilian Tradition*, 1996, 1004-1013, 1033-1035, 1095-1142.

[16] Certain authors criticize the concept and consider it to be an empty vessel, designed to accommodate and give

peripheral issues which do not prevent us from developing a relatively uniform conception of the respective criteria of liability.[17] Under the first one, presuming the damage is somehow linked with the active or passive conduct of the defendant, there will be liability only if said person actually fails to take the necessary steps to prevent the accident/damage from occurring. One thing which need not concern us now is how to allocate the burden of proof regarding the adoption or non-adoption – by the defendant – of such necessary steps, should said burden be placed on the plaintiff/victim or on the defendant/injurer? In either case, we will be talking about the negligence criterion of liability if the defendant's liability is said to be based upon the non-adoption of certain necessary steps to avoid the danger of an incoming accident and its ensuing damage.[18] Under the second one, again presuming the damage is somehow linked with the active or passive conduct of the defendant, there will be liability as long as the accident/damage is the result of the materialization of a type of risk which, according to the law, should be borne by the defendant regardless of his fault. Another standard of liability, albeit less commonly used, holds the defendant liable only if the damage is intentionally caused by him.[19] This is a way to alleviate the defendant's responsibility, giving him greater control over when he will be held accountable for the damage caused, for accountability depends on his will alone. Moreover, intentions are harder to prove in court. One could say that such standard is of no use if the defendant is already considered liable either for negligence or in a strict way, since liability will be found regardless of the presence or absence of the intention to cause harm. This standard will therefore be employed only in a residual manner, when neither negligence nor strict liability is employed. One question which should not be confused with the preceding discussion –which was concerned with the identification of the existing criteria of liability – is related to the need, under certain circumstances, to somehow punish those who intentionally cause harm through, for instance,

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expression to different policy concerns. Cf., e.g., Jane Stapleton, Duty of Care Factors: a Selection from the Judicial Menus, in: *The Law of Obligations: Essays in Celebration of John Fleming*, ed. Cane and Stapleton, 1998, 59-95.

[17] Though the roman jurists provided many different examples of negligent conduct, the concept of negligence itself has never been defined with any degree of accuracy in the romanist tradition. From the examples, however, one can catch glimpses of the underlying concept. Cf., on attempted definitions, James Gordley and Arthur Taylor von Mehren, *An Introduction to the Comparative Study of Private Law: Readings, Cases, Materials*, 2006, 353-364.

[18] What are these steps is a question which will normally have to be answered case by case, according to the existing circumstances. However, different branches of the law and special regulations may mandate the adoption of specific steps which are designed to reduce the risk of an accident. One can consult the rules clearly articulated in the Principles of European Law on Non-Contractual Liability Arising out of Damage Caused to Another, cf. Christian von Bar (ed.), *PEL Liab. Dam.*, Article 3:102.

[19] One should bear in mind here the fact that "intention" is an ambiguous concept. It might refer to the fact that the injurer intended to engage in a dangerous conduct without taking precautions to avert the risk of harm to the victim, knowing that there was a not insignificant chance of it occurring, even though he did not intend that the victim suffer that kind of harm. Or it might refer to the fact that the injurer wanted the victim to suffer a given kind of harm. Cf. Christian von Bar (ed.), *PEL Liab. Dam.*, Article 3:101.

an increase in the amount of damages which should be indemnified.[20] Whether or not such punishment should be exacted has nothing to do with the question of what was the standard of liability of the injurer. It could have been negligence, strict liability or intentional harm. There are still other standards or criteria of liability besides the ones which have already been alluded to.

Let us focus on negligence. Someone who is in a position to abate the risk of an accident and its ensuing damage by taking certain preventative measures, diminishing the chances that such accident/damage will ever occur, has a duty to do so under certain circumstances. If these measures are not taken, assuming the circumstances which require them are present, then the person might be held responsible for the resultant damage. We will consider his omission to be culpable or negligent conduct. On the other hand, if certain preventative measures – which could have impeded the accident – are not taken because they are not required under the circumstances, then there will be no negligence and consequently no liability for the ensuing damage. The reason there is no liability under the last scenario is the fact that the defendant has presumably done everything which was required of him to prevent the accident from occurring. The real problem is ascertaining when certain preventative measures, whose aim is to diminish the likelihood of an accident, should be taken. Based on the famous Hand Formula widely used by the economic analysis of law literature,[21] but with some modifications, we suggest that a given range of preventative measures should be taken when the cost of these measures, through the employment of certain accident prevention technologies, is lesser than the expected amount of damage without such measures minus the expected amount of damage with their employment.[22] The expected amount of damage would be calculated by its likely extent multiplied by the probability of its occurrence. The first part

[20] Cf., e.g., Brazilian civil code, arts. 1.258 and 1.259 (which provide for liability up to ten times the amount of damages suffered by the victim when the injurer is a neighbor who deliberately erects a building which invades the victim's land). It doesn't matter what was the injurer's criterion of liability towards his or her neighbor, which seems to be strict liability since indemnity will be due even if the incident could not have been avoided. However, punishment will be triggered by the establishment of bad faith on the part of the injurer.

[21] Which was explicitly articulated by Judge Hand in *United States v. Carrol Towing Co.*, 159 F.2d 169 (2d Cir. 1947).

[22] To illustrate the point in a mathematical notation let us suppose that the likely extent of the damage, if it were ever to occur, would be approximately 10.000. Let us also suppose that if no preventative measures were to be undertaken, said damage would materialize in 10% of the cases in which the defendant engaged in a given conduct or activity. Then the expected amount of damage, without any preventative measure, would be 1.000 (= $10.000_{ext}$ x $0.1_{p}$). Suppose the probability of the damage's occurrence falls to 6% if preventative measure A, which costs 300, is undertaken; to 4% if preventative measure B, which costs 500, is undertaken and to 3% if both measures are undertaken. We would have the following formulas: $300_{cost} < 400$ (=$1.000_{ED\ no\ M} - 600_{ED\ with\ M}$); $500_{cost} < 600$ (= $1.000_{ED\ no\ M} - 400_{ED\ with\ M}$); $800_{cost} > 700$ (=$1.000_{ED\ no\ M} - 300_{ED\ with\ M}$). Precautionary measures A or B, when employed alone, produce a net gain in social welfare equivalent to 100 which is the amount left after we deduct the cost of such precautionary measures from the amount of the saved costs in expected liability ($400_{saved} - 300_{cost} = 100$; $600_{saved} - 500_{cost} = 100$). Unless the victim is risk averse – as it frequently happens – or other policy objective dictate otherwise, the injurer should not be found negligent if he chooses to adopt precautionary measure A instead of B.

of the equation represents the costs which would have to be incurred through the adoption of certain precautionary measures. The second part of the equation informs us the size of the decrease in expected damages when such precautionary measures are employed. Obviously, a decrease in expected damages means an increase in the welfare of the victim. However, absent special considerations such as redistribution of wealth or the need to provide insurance to the victim, social welfare would only be increased if the cost of those measures to the injurer, the first part of the equation, was smaller than the benefit to the victim, the second part of said equation. If different preventative measures were cost-justified on their own, but could not all be pursued at the same time due to various reasons, or if their combined employment would no longer be cost-justified, then the defendant should employ those measures which prove to be most effective in the task of preventing accidents.

## V. Incentive structures and welfare

The tort regime might try to achieve three different goals which are not always compatible with each other, namely, *incentives* for the injurer and the victim to behave more carefully, *risk sharing* between them and *insurance* against harm to the victim.[23] We'll concentrate on incentives, especially for the injurer/defendant, who is assumed to be both rational and risk-neutral. Incentives are meant to steer the parties' behavior towards the fulfillment of some desirable social objective, such as the maximization of social welfare, through the reduction of the sum of precautionary measure costs incurred by the parties, expected damage costs suffered by the victim and the administrative costs involved in the use of the legal system and the courts to settle disputes. These incentives can be created by two devices, either by manipulating the criteria of liability – specially the choice between negligence and strict liability – or by manipulating the amount of the damage award to be given to the victim. Let us assume, for the moment, that the damage award or indemnification will be roughly equal to the actual damage suffered by the victim.

Under a regime of strict liability, depending on the circumstances, the defendant may or may not have sufficient incentives to try to prevent the occurrence of an accident. If he tries to do so by taking some preventative measures the likelihood of an accident taking place as well as the expected amount of harm for which he would be responsible will certainly decrease. The problem is that, unlike the regime of negligence, even if he takes these preventative measures he will almost always be responsible for the remaining risk of harm to the plaintiff/victim. Therefore, when deciding whether or not to take the aforementioned

[23] Cf. Steven Shavell, *Foundations of Economic Analysis of Law*, 2004.

measures, he will certainly compute not only their cost but also the remaining expected damage. Both negligence and strict liability can provide incentives for the adoption of existing as well as new accident prevention technologies as long as their overall cost, plus the remaining risk of liability in the case of strict liability, is lesser than the expected amount of damage without their employment. Otherwise the defendant will prefer to be held liable rather than incurring higher prevention costs. Punitive damages – that is, increasing the damage award above the actual damages suffered by the victim – and other kinds of sanction, such as penal sanctions, can solve this incentive problem. Incentives towards more careful conduct can sometimes be backed by the law even if the precautionary measures which they call for are apparently not cost-justified, because said incentives are deemed important for the fulfillment of different policy objectives such as the redistribution of wealth or the provision of insurance to the victim, thus increasing social welfare in non-obvious ways. One should bear in mind the fact that these same policy objectives might also require a weaker response from the law. They might demand only that the injurer bears the victim's harm, not that he takes steps to try to prevent such harm from occurring, thus diminishing the importance of providing incentives for the adoption of more careful conduct.

There is a difference between the ideal cost of precautionary measures relevant to the negligence inquiry as formulated in this article and as traditionally formulated in the economic analysis of law literature. The latter formulation is slightly simpler, since it seems to assume that precautionary measures will reduce the risk of an accident and its resulting damage to almost zero. Thus the well-known Hand Formula states that the injurer should take certain precautionary measures whenever their cost is lesser than the expected amount of damage without their employment. On the other hand, we suggest that such measures should be taken whenever their cost is lesser than the expected amount of damage without their employment minus the expected amount of damage with their employment. According to our suggestion, both negligence and strict liability would continue to provide incentives for the injurer under similar circumstances since the sum of the remaining expected amount of damage – after the implementation of the prescribed precautionary measures – and the cost of such measures would never surpass the expected amount of damage without their employment.[24] According to the traditional formulation, strict liability would cease to provide

[24] One could argue that both standards are equivalent and that negligence could, therefore, be abolished. Three factors, however, militate against this view. First, each standard has a different effect on the level of activity of the parties. Second, the risk of harm covered by strict liability may be more narrowly defined than that covered by the negligence standard and/or the indemnification due to the victim may be capped. Third, the negligence inquiry could come back through the back door when deciding questions related to causation. The latter is due to the fact that, on a psychological level, people tend to attribute a causal nexus only to events for which one can be

incentives while negligence would continue to do so if the sum which was previously referred to were to become greater than said expected amount of damage while the cost of precautionary measures remained below it. Such a negligence standard would be considered a more stringent one, setting out a more demanding duty of care. Since the definition of negligence is something which is left to the discretion of the legal system and the courts, which might try to pursue different policy objectives, and given the possibility of judicial error in the application of the standard, however it may be defined, such standard can be made even more stringent. However, such negligence standard would cease to provide incentives if the cost of the precautionary measures demanded by it were to exceed the expected liability of the injurer without any such measures. If we were to consider only the cost of precautionary measures, disregarding how difficult it would be to verify compliance with them by the courts, it would be possible to say, adopting the formulation of negligence as traditionally found in the economic analysis of law literature, that it will continue to provide incentives over a wider range of circumstances than strict liability. This is the case when the cost of preventative measures alone is lesser than the expected amount of damage without their employment, but greater than such expected amount of damage if said cost is combined with the remaining risk of damage. In such a case the injurer who is held liable for negligence will have incentives to take preventative measures while the one who is held strictly liable will have no such incentives. On the other hand, if precautionary measures are hard to verify, strict liability – or even negligence with a reversal of the burden of proof – may on average provide incentives over a wider range of circumstances than negligence. Obviously, incentives are interpreted here as incentives to take care, for under strict liability the party who is held liable will always have incentives to reduce the level of his activities up to the point where his marginal gains from said activities equals his marginal costs, assuming that the risk of harm for which he would be liable increases as the injurer engages in the dangerous activities more frequently. The negligence criterion of liability does not have a similar impact on the injurer's activity level.[25] Both criteria can therefore provide incentives for the injurer to take care, albeit with some differences, but the same cannot be said about incentives for the injurer to

held responsible, cf. Steven Pinker, *The Stuff of Thought: Language as a Window into Human Nature*, 2007, 65-73, 83-87, 208-233.

[25] One could make a distinction, following the economic analysis of law literature, between the level of care of the injurer and his level of activity. There is no clear meaning attached to the two notions within said literature. Some equate the level of care with the question of how careful a person conducts his affairs and the level of activity with the question of how often a person engages in a given conduct. Others equate the level of care with the range of precautionary measures which can be verified by the courts and the level of activity with the range of precautionary measures which cannot be so verified. We are using the distinction while employing the first meaning identified above as can be readily seen by the context. Cf., on the distinction and its meaning, Giuseppe Dari-Mattiacci, On the optimal scope of negligence, *Review of Law and Economics*, 2005, 331-364.

reduce his activity level: only strict liability can provide the latter kind of incentive. Sometimes we have to make a trade-off between both kinds of incentives: to take care and to reduce one's activity level. Considering only the latter incentive, we can say that social welfare will be improved by the adoption of strict liability if it is more important to reduce the injurer's activity level rather than the victim's.

Questions related to the provision of incentives can get even more tricky if we take into account the fact that, sometimes, the law may try to subside the activity of the injurer for various reasons, reducing the level of care demanded of him or not attempting to reduce his activity level while, at other times, the law may try to vigorously discourage his activity. This is the case when his conduct generates asymmetrical positive and negative externalities. Any conduct or activity – such as driving, erecting a building, operating a power plant, extracting oil and other mineral resources, using pesticides, manufacturing and utilizing all sorts of products, etc. – creates risks as well as benefits to others outside of an exchange setting; that is, such risks and benefits are not created through market transactions or contracts. Those affected by the activity do not agree to be harmed in exchange for money, nor do they pay the one responsible for the activity to give them a benefit. The law has to deal here with the problem of negative and positive externalities. Generally speaking, absent special considerations, negative externalities should be discouraged while positive externalities should be encouraged by the law. We bump into difficulties, however, when both kinds of externality are generated by the same conduct and, moreover, when there are no other ways to generate the positive externalities without also generating the negative ones. When said conduct, which creates a given risk of damage, also confers some benefits on the victim or on third parties we have to balance the opposing factors and correspondingly adjust the required level of care or level of activity of the injurer to reflect a workable compromise between them. For instance, to denounce a possible car theft to the authorities creates the risk that the innocent person in possession of the possibly stolen property may suffer unjustifiable economic, emotional and reputational harm by being the subject of an investigation, but it also helps to diminish crime and secure a healthy second-hand car market which benefits everyone, including the victim of harm. That is why Brazilian case-law apparently will only hold the injurer liable if he acted with the intent to cause harm.[26] This is a way of encouraging the beneficial, but potentially harmful, act of denouncing crimes to the authorities. Besides the case of beneficial risky conducts, we can also identify the closely related category of risky

[26] Cf. Processo nº 01196872434, 1ª Turma do JECC/RS, Santa Maria, Rel. Dr. Claudir Fidélis Faccenda, j. 28.08.1996. Cf. also Apelação nº 112587-5, 5ª Câmara Cível do TAMG, Muriaé, Rel. Juiz Garcia Leão, unânime, 27.05.1991.

precautionary measures as problematic for the establishment of proper incentives. These are precautionary measures which not only reduce one type of risk, thus creating a benefit, but also increase another type to the victim or to third parties.[27] For instance, to vaccinate someone may prevent this person from contracting a given disease as well as help to arrest the dissemination of said disease among the population, but it may also create the risk of collateral or unintended effects. Even if the decision to vaccinate the specific individual was considered to be negligent because she faced a higher risk of suffering from the vaccination's side effects than the risk of contracting the disease, the injurer's liability should be decreased taking into account the beneficial effects of vaccination to the population at large. On many occasions the law has to provide incentives for the adoption of the least risky precautionary measures while not entirely disregarding the beneficial effects produced by the more risky ones, such as when a medical treatment can be effectuated through the administration of two different drugs which pose a higher and a lesser degree of risk of side effects. When there is a reversal of the burden of proof the injurer might even be tempted to adopt a more risky precautionary measure, which can be verified by the courts, instead of a less risky one, which cannot be so verified, in order to escape liability. Establishing the proper incentives can also be a tricky matter when we have to confront issues like the insolvency of the injurer, his responsibility for the conduct of third parties, uncertainties regarding causation or the amount of harm, the abnormal vulnerability of a particular victim which causes her a greater than average harm, etc.

## VI. Choosing between negligence and strict liability

The proper choice between negligence and strict liability can be illuminated by, at least, two different theories. Under the first one, what matters is an imbalance in the degree of reciprocity between the risks and benefits created by the conduct of the injurer and the conduct of the victim, combined with the need to reduce the activity level of one of the parties.[28] Both aspects – lack of reciprocity between risks and benefits as well as the need to control activity levels – are mutually reinforcing justifications for the imposition of strict liability. The activity level of one of the parties should be reduced if the probability and, consequently, the risk of accidents increases at a greater rate when said party's activity becomes more frequent. Let us consider the conduct of the injurer. The risk of harm and the benefits created by the injurer's conduct can be felt directly by the victim or by third parties. If, assuming reasonable care, the externalized benefits are roughly equal to the external costs,

[27] Cf. Ariel Porat, Offsetting risks, *Michigan Law Review*, 2007, 243-276.
[28] Keith N. Hylton, Duty in tort law: an economic approach, *Fordham Law Review*, 2006, 1501-1528.

there is no net external harm on average associated with the injurer's activity when conducted reasonably. Let us assume the same can be said about the conduct of the victim. If we also assume that there is no need to reduce either the injurer's or the victim's activity level, then the injurer should be liable for negligence. The victim would of course unnecessarily reduce her activity level if she is considered to be the residual bearer of the harm, but that negative consequence would be offset by a corresponding reduction in litigation and collection costs which would have to be incurred if the injurer were to be considered the residual bearer. On the other hand, if the injurer's conduct externalizes risk of harm to a significantly greater extent than benefits, even if he takes reasonable care, while the victim's conduct externalizes roughly the same amount of risks and benefits, and if there is also a need to reduce the injurer's level of activity, then said injurer should be held strictly liable for the harm he causes. Observe here that both criteria of liability are assumed to produce similar incentives for the adoption of more careful conduct by the injurer, so that the choice between them hinges only on the factors identified above regarding reciprocity of risks and benefits and the proper level of activity of the parties. If we were to relax that assumption, then we would have to make a trade-off between the fulfillment of the objective of providing incentives for the adoption of more careful conduct by the injurer and the objective of providing (or not providing) incentives for the reduction of his activity level, in order to decide which criterion of liability would be the most suitable under the circumstances.

Under the second theory, strict liability should be imposed whenever the costs associated with the implementation of the negligence standard by the courts, such as the information costs which would have to be incurred in order to verify the injurer's compliance with the precautionary measures demanded by said standard, are greater than the benefits brought about by the application of the referred standard (like improved incentives towards the adoption of more careful conduct). In fact, when the compliance with the prescribed precautionary measures is very hard to verify, the injurer might have no incentives at all to take these measures. The application of the negligence standard would then fail to provide the necessary incentives to the injurer.[29] We are assuming here that, whenever information is costly, strict liability is better than negligence in terms of providing incentives towards the adoption of more careful conduct. However, such incentives can also be generated by applying the negligence criterion of liability with a reversal of the burden of proof. If the injurer/defendant is charged with the task of proving that he did take the prescribed precautionary measures, then he will have an incentive to take them. Thus both strict liability

[29] Cf. Dari-Mattiacci (note 25).

and negligence with a reversal of the burden of proof can provide proper incentives for the injurer to behave more carefully. We have said nothing so far about the provision of incentives for the reduction of the injurer's activity level. Only strict liability will serve, however, if we take the need to provide the latter kind of incentive into account, since negligence – even with the reversal of the burden of proof – might not provide incentives for the injurer to reduce his level of activity considering the fact that he may very well escape liability altogether if he is able to prove that he took the necessary precautionary measures.

If, after considering the two theories discussed above, we opt for the negligence standard, we will then have to identify which precautionary measures should be taken into account in order to evaluate the injurer's conduct. On that matter all we can say is that the injurer should take the set of measures which prove to be the most efficient in the task of reducing the overall social costs associated with an accident such as the sum of precautionary measure costs incurred by the parties, expected damage costs suffered by the victim and the administrative costs involved in the use of the legal system and the courts to settle disputes. Legal counsel for the parties as well as judges deciding cases should try to discover the root causes of the accident, the probability of it occurring, which measures could have avoided such accident, the cost and degree of effectiveness of these measures, the cost of verifying compliance with them by the court, as well as other pertinent issues. In so doing they could avail themselves of expert testimony from scientists, engineers or anyone in a position to clarify the relevant issues. The use of statistical data would be welcomed. One could also consult the growing literature on accident prevention and analysis.[30] The task of finding out which precautionary measures should be taken could be made easier by consulting building regulations, traffic regulations, waste disposal regulations and all sorts of regulations issued by public authorities. One could also consult the vast repertoire of technical standards for many different kinds of activity which are published by organizations such as the International Organization for Standardization (ISO) and its national counterparts such as the Associação Brasileira de Normas Técnicas (ABNT) as well as many others, several of these standards contain safety rules which are sometimes copied by governments when they issue regulations; though one should bear in mind the fact that these standards do not exhaust the whole range of precautionary measures which should be taken and, thus, compliance with

[30] Cf., e.g., for a general theoretical treatment of accidents and a good overview of the literature, Erik Hollnagel, *Barriers and Accident Prevention*, 2004. Cf., for the treatment of safety issues on some specific contexts, Philip Hagan; Gary Krieger; John Montgomery; James O'Reilly (eds), *Accident Prevention Manual for Business and Industry: Engineering and Technology*, 12th ed., 2000; Gary Krieger (ed), *Accident Prevention Manual for Business and Industry: Environmental Management*, 2nd ed., 2000; Barbara Plog and Patricia Quinlan (eds), *Fundamentals of Industrial Hygiene*, 5th ed., 2001.

them should not automatically be considered careful behavior. We should also be aware of the fact that if the cause of the accident had nothing to do with the non-compliance with the measures prescribed in those standards, the injurer should not be held liable solely for the fact that he did not comply with them (unless, of course, policy reasons require otherwise). Precautionary measures should be deemed relevant only when they contribute to the enhancement of social welfare as clarified above. Once the court identified which precautionary measures were required under the circumstances to comply with the negligence standard, it could make a creative allocation of the burden of proof as well as make ample use of special presumptions in order to settle the various issues relevant to a finding of negligence. One can see that the administrative costs involved in the application of the negligence standard, as well as the possibility of judicial error, can become significant depending on the degree of refinement and attention to detail devoted to it.

**VII. The impact of new accident prevention technologies on civil liability**

We can imagine a few scenarios created by the development of improved accident prevention technologies. The cost of precautionary measures which employ them can be higher or lower than the cost of those measures which do not yet do so. We have to identify the best set of precautionary measures, prior to the advent of new accident prevention technologies, in order to ascertain whether or not the new precautionary measures which employ such technologies will be desirable. Once we do that, we can compare the net gains in terms of social welfare – relative to a state without any precautionary measures – produced by the adoption of the older and the newer sets of precautionary measures. Such gains in social welfare, for the sake of the simplified analysis we are doing here, will be the sum we find after deducting the cost of a given set of precautionary measures from the size of the reduction in expected damages generated by its adoption. If the gain in social welfare produced by the newer set is greater than the equivalent gain produced by the older set, then the overall level of social welfare will be increased by the adoption of this newer set of precautionary measures. On the other hand, if such gain is actually smaller than the gain produced by the older set of measures, than the adoption of the new set of measures would in fact decrease the overall level of social welfare compared to the previously adopted optimal set of measures. When evaluating these issues we have to focus on, at least, two factors: what is the cost of a given set of precautionary measures and to what extent does it reduces the likelihood of the occurrence of a given type of accident and its ensuing damage. If we reach the conclusion, after a careful examination of the pertinent issues, that the new set of precautionary measures should in fact be adopted, then

we will have to analyze which doctrinal devices would be the most suitable ones to achieve the goal of welfare maximization. First we will focus on the two factors identified above: the cost of the new set of precautionary measures, on the one hand, and the degree of their effectiveness in reducing the likelihood of harm, on the other hand. We will try to identify different scenarios created by the interplay of these factors and how they affect the adequacy of the legal regime governing civil liability. Then we will briefly mention the question of the ability of the courts to verify compliance with the prescribed precautionary measures and its impact on the suitability of the previously cited legal regime.

Whenever the cost of new precautionary measures remains equal to or becomes lower than the cost of older measures, while decreasing the likelihood of an accident, the injurer should be held responsible for the resulting harm if he does not adopt them. He will probably have a natural incentive to adopt the newer measures. Whenever the cost of the new measures increases in comparison with the older ones, but the decrease in expected damages more than compensates for that rise in cost, the injurer should also be liable for the resulting damage if he does not employ those measures. Here however the law has to provide a little bit more encouragement for the injurer to actually employ them, since his immediate costs will rise. On many occasions the law is a little hesitant to hold the injurer liable, especially if he has some sort of stable relationship with the victim and has the ability to shift the cost increase onto her shoulders. Perhaps the law does not want to disrupt a possible contractual solution to the problem. One can remember here the example of the car industry which was sued by disgruntled customers and consumer advocates in the 1960's over safety issues. Back then the plaintiffs' demands met with success. Closer to our time the demands of consumer groups in the United States that said industry incorporates an improved tire pressure monitoring system on some new car models have not been so successful.[31] In poorer countries the car industry reserves the use of air-bags, which can save many lives, mainly to luxury model cars. Considering that the cost of these precautionary measures would ultimately have to be borne by the victims, one can see why the law is so hesitant to intervene. There is yet another scenario which is bound to cause even more controversy. Suppose the cost of a new precautionary measure undergoes a sharp decrease in comparison with an older one, but at the cost of a slight increase in the risk of accident. Let us also suppose that social welfare would be increased by the adoption of the new measure, despite an augmentation of risk to the victim. Should the injurer be considered negligent if he abandons the older and more robust measure in favor of the newer and less effective one? There seems to be no clear answer, for

[31] Cf. http://www.automedia.com/Trouble_with_Tire_Pressure_Monitoring_Systems/dsm20080401tp/1 (accessed on 04.29.2011).

if we say no then this appears to befuddle our intuitions concerning acquired rights to safety and the preservation of the status quo. Controversies apart, let us suppose that the injurer should indeed be liable under one of the scenarios identified above, we would then have to consider which criterion of liability would be the most suitable one under the circumstances. The choice between negligence and strict liability should be made only after weighting the relevant factors such as the need to control the activity level of one of the parties or the need to provide incentives to take care when the adoption of precautionary measures cannot be easily verified by the courts. We will not repeat here all of the arguments developed in the previous section of this work. We should note, nonetheless, that new accident prevention technologies, by altering the weight which had presumably been accorded to those factors in the face of older precautionary measures, will certainly affect the adequacy of old laws, regulations and judicial precedents when it comes to the choice between negligence and strict liability. These rules may have been elaborated at a time when the available precautionary measures – and their verifiability by the courts – dictated a criterion of liability which is no longer optimal under current circumstances. It may have become much easier or harder for courts to assess the conduct of injurers and or victims. The frequency in which the parties engage in a given activity may have a different correlation with the proportional increase (or lack thereof) in the risk of accidents than it had when the old rules were fashioned. The very precautionary measures prescribed by the old rules, used in the assessment of negligence, may have become ill-adapted to the present circumstances.

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Address: Flávio Henrique Silva Ferreira, Juiz de Fora / Brazil.

Faculdade de Direito – UFJF

Rua José Lourenço Kelmer, s/n.

Juiz de Fora – MG

Brazil

CEP: 36036-900