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REGULATION FOR INNOVATIVENESS OR REGULATION OF INNOVATION?

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Key words:

Innovation, technology, regulation, law

Abstract:

Whilst there is widespread agreement in policy circles that fostering innovation should be a priority, there is far less consensus on what this entails and how to achieve this objective. This lack of consensus is echoed in the academic literature on innovation. In this paper, we seek to reconcile two lines of literature with which lawyers are most familiar: the law and economics (broadly defined) and law and technology literature streams seem to exist in parallel and largely non-intersecting inter-disciplinary silos, which prevent the cross-fertilization of insights between them and the realization of synergies. This paper is a modest attempt to connect these silos and to identify how these two streams could complement each other. Synergies between these literature streams would contribute to a more comprehensive and multi-faceted understanding of the complex relationship between law and innovation that is a pre-requisite for effective political and regulatory decision making in relation to innovation.

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1 INTRODUCTION AND APPROACH

Whilst there is widespread agreement in policy circles that fostering innovation should be a priority,[3] there is far less consensus on what this entails and how to achieve this objective. This lack of consensus is echoed in the academic literature on innovation. There exist a number of established lines of literature (with their attendant academic communities) on this issue, and they often seem largely independent of one another. Even in matters of terminology, little consistency can be observed across the board. Furthermore, many academic communities – save perhaps for 'innovation studies' – are not necessarily primarily concerned with innovation as such, but rather with the relationship between innovation and some other concept(s).

In this paper, we seek to reconcile two lines of literature with which lawyers are most familiar, but which are not often put in contact with one another. The first one is law and economics, as it concerns innovation, which is largely examining the effects of innovation, and the (mostly economic) mechanisms to stimulate innovation in a market economy.[4] The second one is law and technology, which often investigates either technology as a regulatory focus and rationale for regulating, or regulation by technological means; on that basis, law and technology also deals with the regulation of innovations.[5] These literature lines seem to exist in parallel and largely non-intersecting inter-disciplinary silos, which prevent the cross-fertilization of insights between them and the realization of synergies. Whereas the current research paper does not solve the existing discrepancies and differences between these literature lines, it makes a modest attempt to reconcile them and to build bridges between the silos, thereby contributing to a more comprehensive and multi-faceted understanding of the complex relationship between law and innovation that is a pre-requisite for effective political and regulatory decision making in relation to innovation. In so doing, we also identify areas where these lines could learn from each other.

As the result of such synergetic exercise, we establish two possible dimensions of interaction between regulation and innovation, and namely: regulation for innovation (innovativeness) and regulation of innovation and technology (innovation and technology as regulatory targets).[6]

After a brief section dedicated to definitional issues (2), the paper discusses the central issue of each of these two lines of literature, in the light of the other line. Law and economics is concerned primarily with the effect of regulation on innovation (regulation for innovation) (3), whereas law and technology focuses on how to regulate innovation (innovation as a regulatory target) (4). Avenues for further research are presented in the conclusion (5).

[3] Communication from European Commission (2010), Phelps (2013)
[4] Greenhalgh and Rogers (2010), Aghion and Howitt (2009), Scotchmer (2004)
[5] Marchant (2013), Bennett Moses (2013), Brownsword and Goodwin (2012)
[6] In the current paper we do not regard the third possible dimenstion, and namely that of techno-regulation (or regulation by technology). See Brownsword and Goodwin (2012)

2 DEFINITIONS

As correctly pointed out by Bennett Moses, the differences detected in the relevant literature are often due to the differences in the application of terms and concepts. [7] Whereas it is outside the scope of the current paper to engage into a full-scale elaboration of the concepts, it is nevertheless worthwhile to clarify the terms used throughout this paper for the purposes of consistency. As a first step, it is noted that the very definition of innovation varies as between the different literature streams:

For the business and the economics literature that underpins law and economics, the emphasis lies in the distinction between mere ideas and real innovations. Many authors insist that having a good idea is not sufficient: history is littered with brilliant inventions. In order for them to qualify as innovations – and thus to be worth studying – these inventions must be successfully taken to the market. An innovation is therefore made up of (i) an novel idea, i.e. an invention, that is (ii) successfully taken to the market, or diffused – to use the terminology of the relevant literature.[8] From this point onwards, authors vary in how they further specify sub-elements. For instance, Govindarajan and Trimble, in the business literature, argue that a successful model for innovation within an organization is idea + leader + team + plan.[9] A similar argument is presented by Scotchmer who states that 'an innovation requires both an idea and an investment in it'.[10] This line of reasoning is supported by Verspagen, who states that innovation is not necessarily the first 'idea for a new product or process', but rather 'the first successful attempt to carry it out in practice'.[11] Similarly, Greenhalgh and Rogers refer to innovation as 'the application of new ideas to the products, processes, or other aspects of the activities of a firm that lead to increased value'.[12]

In the law and technology stream, innovation is generally taken as an exogenous phenomenon, which occurs at a steady rate; the key issue is then how to regulate it.[13] In a sense, the law and economics literature on innovation plays upstream of law and technology. The latter is primarily concerned with ensuring that innovation – more specifically technological innovation – does deliver all the expected benefits, and as much as possible without any of the feared harms. At this juncture, we can leave it open whether the desirability of innovation – and by implication the success of regulation – is assessed on utilitarian, deontological, public policy or rights-based grounds; all of these are present in the literature.[14]

Where law and technology does not define innovation so precisely, the literature does dwell upon the definition of 'regulation'.[15] Often regulation is contrasted with 'law', as a narrower concept, and

[7] Bennett Moses (2013)
[8] Rogers (2003)
[9] Govindarajan and Trimble (2010)
[10] Scotchmer (2004)
[11] Verspagen (2007)
[12] Greenhalgh and Rogers (2010)
[13] Brownsword and Somsen (2009)
[14] See the developments in Brownsword and Goodwin (2012)
[15] Bennett Moses (2013)

'governance', as a broader concept.[16] Sometimes these three concepts are used as equivalents.[17] On the more restrictive, narrow, end of the spectrum the definition of regulation 'as a specific set of commands', involving the promulgation of a binding set of rules, is found. [18] Examples of a somewhat broader definitions include regulation 'as sustained and focused control exercised by a public agency over activities that are valued by a community'[19] and regulation 'as deliberate state influence', where 'regulation has a more broad sense and covers all state actions that are designed to influence business or social behavior'.[20] At the other end of the spectrum, broad interpretations of regulation are found, such as regulation 'as all forms of social or economic influence', and namely 'all mechanisms affecting behavior- whether these be state-based or from other sources (e.g. markets)',[21] and regulation as 'any instrument (legal or non-legal in its character, governmental or non-governmental in its source, direct or indirect in its operation, and so on) that is designed to channel behavior',[22] as well as regulation as 'the intentional influencing of someone's or something's behavior'.[23] For the purposes of this paper, we do not need to enter into this discussion, and we use the broadest view of regulation, which is akin to governance.

Already at the definition stage, it is apparent that the two perspectives can be usefully combined in a general working definition of innovation, which would comprise three elements:

(i) a *novel idea or invention*;

(ii) its *diffusion* or adoption by users, customers or citizens – as the case may be; and

(iii) a *positive social impact*, in the form of an increase in welfare or a contribution to the achievement of public policy aims – here as well as the case may be, depending also on the analytical perspective.

While the first element is relatively uncontroversial, the same cannot be said about the second one, originating in the law and economics literature. It is concerned with the social and economic (market) processes whereby inventions are actually adopted; these are neither obvious nor given. This element is typically downplayed, if not ignored outright, in a law and technology perspective. The third element introduces some normativity in the definition – genuine innovation is 'good' innovation – and it is taken from the law and technology literature. Law and economics literature on innovation simply assumes that innovation is good, without more, conveniently leaving aside very difficult issues of how to deal with situations where an invention might be well-received by its target group, but would nevertheless be harmful to society as a whole, on balance.[24]

[16] Bennett Moses (2013), Brownsword and Goodwin (2012)
[17] Ranchordás (2014)
[18] Baldwin et al. (2012)
[19] Baldwin et al. (2012) based on Selznick (1985)
[20] Baldwin et al. (2012)
[21] Baldwin et al. (2012)
[22] Brownsword and Somsen (2009) based on Black (2005)
[23] Koops (2010)
[24] Law and economics is not alone in doing so; innovation studies, for instance, have an acknowledged pro-innovation bias: see Soete (2013) and the reactions of Fagerberg et al. (2013) and Lundvall (2013) in the same volume.

These three elements are best seen as a triad or triangle, wherein they are all related. The interplay between invention and diffusion has been thoroughly explored in law and economics (including how these two elements are not always so easy to tell apart). The link between innovation and its social impact is at the core of law and technology. However, the relationship between diffusion and social impact is underexplored and would deserve closer attention. For instance, it is clear that, for innovations that require heavy infrastructure investments (e.g. fiber optics) or touch upon sensitive goods (e.g. medicines and human health), the analysis of social impact weighs heavier and diffusion is sometimes simply assumed.[25] On the other side, certain innovations – especially in the ICT sector – are perceived to be socially more benign, and in their case diffusion comes to the fore.

3 REGULATION FOR INNOVATION (INNOVATIVENESS)

It is noted that in the relevant literature the distinction between innovation and innovativeness[26] is often blurred.[27] Indeed 'innovation' is used – sometimes loosely – to mean a specific outcome (an innovation), or the process by which that outcome is reached, or even, more generally, a state of the world whereby innovation (in either of the first two meanings) regularly obtains in a given economy or society. There is no need to differentiate sharply between the first two meanings in this paper; the third meaning is sometimes called 'innovativeness' as opposed to just 'innovation'. For the purposes of this paper, we will use this distinction to articulate sections 3 and 4. The present section is concerned with regulation **for** innovation – that is, regulation introduced with the specific aim to stimulate (allow for) innovation, i.e. to achieve innovativeness – whereas section 4 touches upon regulation **of** innovation and technology, in which case innovation and technology act as 'regulatory targets',[28] or the focus of regulation, with its traditional aim of maximizing the benefits and minimizing the risks.

Ranchordás correctly points out that regulation can act as an enabler of innovation, but it cannot impose it.[29] She sees a role for regulation in positively influencing the motivation and the ability of firms to innovate, by creating 'an atmosphere conducive to innovation'.[30] However a question arises: what are the regulatory means available to create such an atmosphere?

The law and technology literature tends to ignore or discount the effect of regulation on innovativeness, simply assuming that innovations are exogenously generated at a steady rate, irrespective of the state of the law. Yet regulation is based on the past and present technologic and economic reality, as well as upon socio-cultural preferences, and on the other hand, regulation impacts these realities and preferences.[31] Inevitably then, regulation affects which inventions are

[25] This outcome is not always guaranteed, as illustrated by the slow take-up of fiber-based broadband or by the reluctance among patients towards certain medicines.
[26] Bennett Moses (2013)
[27] See for example Ranchordás (2014)
[28] Bennett Moses (2013)
[29] Ranchordás (2014)
[30] Ashford and Hall (2011)
[31] Künneke (2008), Künneke and Groenewegen (2009)

made, which are developed, and which are not, as well as which take off, and which do not.[32] In other words, innovation is partially pre-determined (intentionally or unintentionally) by the existing structure of the regulatory environment, such as e.g. competition and market organization rules, rules on consumer, health and environment protection, torts and patents, etc.[33] Law and technology literature provides no clear answer on how regulation can foster innovativeness; the answer largely depends on the type of innovation, the sector, the nature of the issue innovation addresses, the socio-cultural and economic, as well as political preferences, etc.[34]

In contrast, this question has loomed large in the law and economics literature: As is customary in such literature, the starting point is that the operation of markets, under general laws (contract, tort/liability, property, etc.) goes a significant way in fostering innovativeness. Yet most authors will readily acknowledge that markets do not always deliver.[35] Hence market failure, defined as the situation when 'the market system, guided by the independent actions of private firms, will not lead to the optimal outcome',[36] is the main rationale for regulation.[37]

Two types of market failures are often put forward in relation to innovation in the law and economics literature: first of all, the presence of market power which can be used to distort the functioning of markets and, secondly, the presence of externalities arising from the nature of information as a public good. These types are investigated in turn:

3.1. **Market power**

As a starting point of exploring the relationship between market power and innovation, many authors have examined which of the idealized models of monopoly or perfect competition would be more conducive to innovation. This relationship could be regarded from a number of perspectives:

On the one hand, Schumpeter, in his later writings, argued that monopolistic companies are in the driving seat of the technological progress, and much better positioned to innovate compared to firms on a perfectly competitive market, largely due to the resources the former can dedicate to research and development.[38] Indeed, a monopolist has an incentive to innovate even in absence of competition:[39] first, by applying a process innovation, the monopolist decreases the production costs and thereby increases producer surplus (given that the market price stays the same), and secondly, by introducing a new or a changed product the monopolist maintains its monopoly situation, and possibly obtains new customers. Schumpeter argued that there is a trade-off between economic

[32] Bennett Moses (2011)
[33] It is important to note that the law and technology literature does point to the role of regulation as the fundamental rights filter, which could be equally applied to inventions and innovations at the stage of diffusion/ adoption. It is silent, however, on the role of this filter, simply assuming that innovations which do not pass it would not take off, which is not necessarily the case.
[34] Ranchordás (2014), Bennett Moses (2013), Brownsword and Goodwin (2012), Bennett Moses (2011), Brownsword and Somsen (2009)
[35] Baldwin et al. (2012), Francis (1993)
[36] Greenhalgh and Rogers (2010)
[37] Baldwin et al. (2012)
[38] Schumpeter (1942)
[39] Greenhalgh and Rogers (2010), Aghion and Howitt (2009), Scotchmer (2004)

growth and market competition, as 'tighter anti-trust legislation would reduce the scope for earning monopoly profits, which would lower the reward to innovation, which should reduce the flow of innovation and hence reduce the long-run growth rate'.[40]

On the other hand, Arrow and others have argued the opposite, producing 'evidence that more competitive societies and industries tend to grow faster than their less competitive counterparts'.[41] Arrow stated that firms operating in competitive market structures have a better incentive to innovate compared to the monopolists, because the latter are already enjoying excessive profits, and hence 'the returns to innovation offer only a small extra profit'.[42]

In this century, Aghion et al. have brought the discussion one step further by attempting a synthesis of Schumpeter and Arrow.[43] For Aghion and his co-authors, the relationship between competition and innovation follows an inverted-U curve: starting from a point where there is no competition on the market, increasing competition would lead to more innovation, until an inflexion point is reached where more competition would decrease the rate of innovation. The key is the expected gain from innovation, which leads to two possible incentive effects: on the ascending part of the inverted-U curve, innovation is a means to escape competitive pressure (the 'escape-competition' effect identified by Arrow) and achieve rents.[44] At some point, however, more competition only means that competitors are more likely to catch up with the innovative firms, in which case the gains from innovation are rapidly dissipated and innovation becomes less attractive (the point made by Schumpeter).[45]

The inverted-U curve hypothesis has withstood scrutiny and criticism so far, and it is becoming the state-of-the-art. However, it is still far from clear how the inverted-U curve can be mapped upon real markets: in particular, short of working backwards from market data with the kind of analysis that led Aghion et al. to their hypothesis, it is not clear how the point of inflexion can be reliably identified. The Aghion et al. model is therefore not yet fully operationalizable in competition policy or regulation. In policy circles, the consensus view seems that only in exceptional cases will more competition be counter-productive for innovation. In other words, policymakers consider that they generally find themselves on the upwards-sloping or left-hand part of the inverted-U curve.

3.2. **Externalities following from the public good nature of information**

Next to market power, the very nature of information also creates difficulties that can negatively influence the innovation outcome. Any innovation is in fact new information,[46] and 'the regulation of

[40] As formulated in Aghion and Howitt (2009)
[41] Arrow (1962); see also Christensen (2011), Greenhalgh and Rogers (2010), Govindarajan and Trimble (2010), Scotchmer (2004)
[42] Greenhalgh and Rogers (2010) based on Arrow (1962)
[43] Aghion (2005)
[44] Arrow (1962)
[45] Schumpeter (1942)
[46] Of course some innovations also presume a unique know-how, which cannot easily be reproduced (for diverse reasons). However, as to simplify the discussion, it is assumed that the share of such innovations is negligible. For an interesting perspective upon this see Christensen (2011), Sinek (2009)

innovation can be regarded as a form of regulating information.[47] Information generally qualifies as a public good, because it is non-rival and non-excludable. Non-rivalry means that 'any single use of public good does not affect its availability to other users', and non-excludability means that 'its use by one party implies access for all, which cannot easily be blocked'.[48]

Non-rivalry and non-excludability lead to externalities: Information that has been generated by one firm, once it is public, can be used by a second firm for the benefit of that second firm (as it is non-rival and thus still valuable). Because of non-excludability, the second firm cannot be prevented from using the information without compensating the first firm, hence creating an externality, i.e. a mismatch between benefits (to the second firm) and costs (to the first firm only).[49] As a consequence thereof, the first firm has no incentive to generate more information, seeing that it will bear the costs but see the benefits flow to other firms, at least in part.[50] Society will be worse off because of this outcome. Hence, the policy solution is to ensure that the first firm can appropriate the benefits from its activity, or somehow be compensated adequately for its efforts. This can be addressed by regulation in two ways: by directly funding the production of information, or by rewarding it.[51]

In general, government funding is 'more appropriate for the scientific end of basic research', and much less well suited 'for near-market commercial research, where firms will have competing interests'.[52] However, in some cases, regulation might offer some (limited) funding or rewards to the innovating companies, where a problem of appropriability arises due to the indivisibility of some innovations. Indivisibility implies that the average costs of production are large in comparison to marginal costs, and 'the project cannot be broken down into smaller, more manageable units'.[53] An example thereof is the long and expensive research and development (R&D) effort required in order to develop a medicine for a very small percentage of population with an extremely rare disease. In such cases the government might be willing to partially subsidize such innovations (e.g. R&D funding, subsidies, tax waivers, compliance waivers). However, there is a number of potential problems with such regulatory intervention: first, there is a difficulty in identifying the firm's expenses 'which merit the tax concession or subsidy', as opposed to the regular firm's expenses (e.g. marketing).[54] Moreover, the questions arise in regards to subsidizing the 'right' kind of R&D: in many cases forecasting which project will be successful is not possible, and the government may end up subsidizing the projects without positive externalities.[55] Finally, there is a major difficulty in 'filtering out' the projects that would have taken place even without regulatory intervention: in such cases 'the government contribution represents a gift' to these firms.[56]

[47] Ranchordás (2014)
[48] Greenhalgh and Rogers (2010)
[49] Greenhalgh and Rogers (2010)
[50] Unless of course the first firm decides to keep the information secret, but in most cases it will not be possible to exploit the information without disclosing it, even if only indirectly (e.g. in the design of the product itself).
[51] Greenhalgh and Rogers (2010), Scotchmer (2004)
[52] Greenhalgh and Rogers (2010)
[53] Greenhalgh and Rogers (2010)
[54] Greenhalgh and Rogers (2010)
[55] Greenhalgh and Rogers (2010)
[56] Greenhalgh and Rogers (2010)

Targeted and blue sky prizes offer an alternative funding scheme: Targeted prizes are announced ex ante and 'they reward solutions to needs that originate with sponsors, and the sponsor's needs are formalized in performance standards that must be met to claim the prize'.[57] Blue sky prizes are announced ex post, and are 'offered for innovations that are not identified in advance'.[58]

Outside of cases of direct public financing, the problem of appropriability can of course be corrected by the introduction of intellectual property rights (IPRs), whereby information is made excludable by virtue of the law.[59] IRPs create incentives for the firms to engage in innovation by ensuring that these firms can 'appropriate the returns of their innovation for themselves'.[60] Essentially, IPRs provide (temporary) exclusion rights to the innovating firms in exchange for innovation. However, this comes at a price for society, since if an innovation relies on information protected by IPRs, the holder of that IPRs obtains some amount of market power, sometimes going as far as dominance or monopoly power if there is no substitute on the market for the innovation. Dominance or monopoly power is in itself a market failure, because it produces 'reduced output, higher prices, and transfer of income from consumers to producers' compared to perfect competition.[61] Hence, the main challenge for the regulation of IPRs is to define exclusive rights carefully enough to provide sufficient incentives for firms to innovate, without conferring on firms more market power than is necessary, in order to avoid socially inefficient outcomes.[62] In addition, this static analysis must be compounded to take dynamic aspects into account: in retrospect, with perfect hindsight, chances are that spending on research leading to innovation will be found to have been excessive, as in e.g. patent races.[63] Whereas a detailed discussion on the design of IPRs is beyond the scope of the current paper, it is worth noting that the protection of intellectual property is just one of the means available to the regulators in stimulating innovation.[64]

In the light of the above, a crude rule-of-thumb can be put forward: the more positive externalities and general societal value are expected from the generation of information potentially leading to innovation, the stronger the case for government support, and the 'heavier' that support can be. This rule-of-thumb is illustrated in Figure 1 below:

[57] Scotchmer (2004)
[58] Scotchmer (2004)
[59] Greenhalgh and Rogers (2010), Scotchmer (2004)
[60] Greenhalgh and Rogers (2010)
[61] Baldwin et al. (2012). A full discussion on the pitfalls of monopolistic market structure is beyond the scope of the current paper, as it can be found in a wide range of economic literature.
[62] Greenhalgh and Rogers (2010)
[63] Greenhalgh and Rogers (2010), Scotchmer (2004)
[64] A more detailed discussion can be found in Greenhalgh and Rogers (2010), Scotchmer (2004)

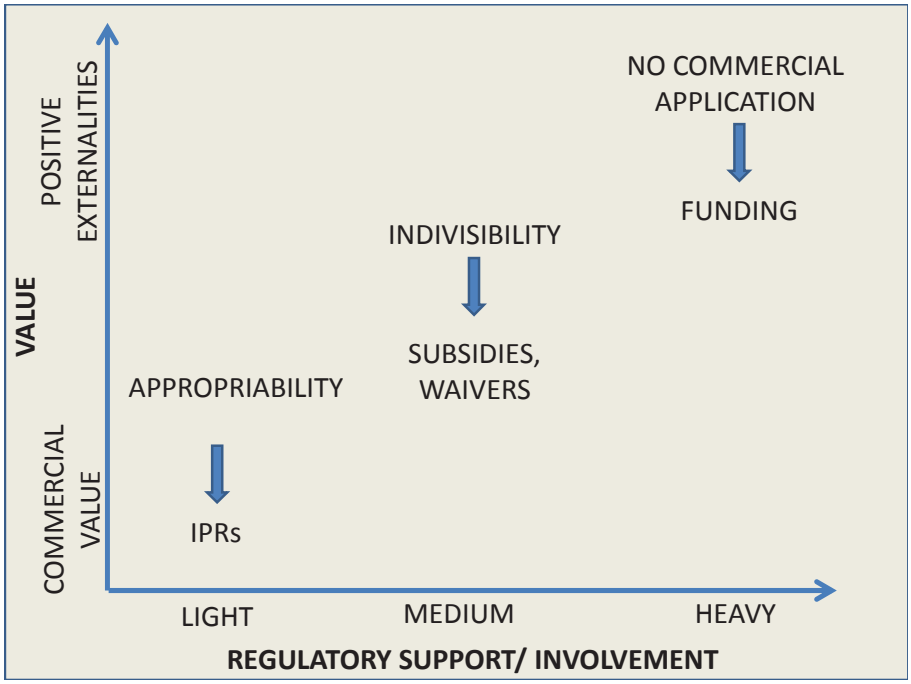

Figure 1: Illustrative relationship between positive externalities and regulatory support
Sources: own analysis, mainly based on Greenhalgh and Rogers (2010), Scotchmer (2004)

3.3. **Beyond market failures**

Law and economics literature often assumes that innovation is positive in and of itself: once market failures have been addressed and innovativeness has been *enabled*, the role of regulation is exhausted. This line of literature downplays the normative or welfare dimension that could be involved in innovativeness.

As mentioned earlier, regulation can influence innovativeness, not just by fostering it, but also by steering innovation in a specific direction or away from another direction – often as a side-effect of regulation for safety, health, environmental or consumer protection (SHEC). Some business authors consider that such steering effect can be positive:[65] For instance, one of the leading business authors, Porter, proposed the 'Porter hypothesis',[66] according to which where stringent and narrow regulation – of any kind – is imposed on firms, the latter will innovate in order to escape the regulatory requirements – this is referred to as 'circumventive innovation'.[67] The regulation giving rise to circumventive innovation is usually highly technology-specific, such as performance standards: for example, a modification in the functionality of a financial product might place it outside the scope of stringent transparency regulation. Such type of innovation is not driven by productivity gains, but rather by the firm's ambition to avoid the regulatory burden.[68] It has both positive and negative

[65] Ashford and Hall (2011), Porter (1990)
[66] Porter (1990)
[67] Stewart (2010). In principle, this effect is not unlike the 'escape-competition' effect identified by Arrow (1962), except that it is prompted not by competition on the market, but by regulatory pressure.
[68] Stewart (2010)

sides: on the positive end there is added value from innovation, but on the negative end such type of regulation might have the reverse effect of stifling innovation, as the firms would spend significant time and resources on ensuring compliance with detailed requirements.[69]

The 'Porter hypothesis' also includes 'compliance innovation', arising when firms need to comply with hard targets (e.g. emissions reduction, efficiency improvement), however the means to do so are flexible and more technology-neutral.[70] It is commonly argued that such innovation is desirable in the fields where the firms are not 'naturally' motivated to innovate to obtain productivity gains, however such innovations are in public interest, or even tie in with a public good – such as clean(er) environment.[71]

Besides Porter and others around him, most economics, business or law and economics authors are rather concerned at the prospect that SHEC regulation can influence innovativeness. This concern is often summed up in the motto that 'the State should not be picking winners',[72] and instead leave it to the market to effectively decide the fate of inventions and their eventual diffusion and adoption (or the opposite).[73]

In marked contrast, law and technology literature considers that it is a State duty to regulate so as to 'filter out' innovations which (potentially) violate fundamental rights (e.g. human rights, dignity, ethical standards) or clash with public policy objectives. In the end, despite the reluctance of law and economics literature to admit this, it seems unavoidable that SHEC and other types of regulation will also influence innovation, this time not by addressing market failures and fostering innovativeness, but rather by steering innovation, either by prohibiting certain courses of action or incentivizing actors to dedicate their resources in priority towards certain objectives. This is one of the central concerns of the law and technology line of literature, which considers innovation as a regulatory target, and this is also where the insights of law and technology literature could be used to enrich law and economics.

4 REGULATION OF INNOVATION (INNOVATION AS REGULATORY TARGET)

According to law and technology perspective, the effects of innovation could include three possible outcomes, and namely benefit, status quo or harm.[74] Therefore, the role of regulation in relation to innovation as seen in this literature stream is threefold: ensure compliance of innovation with fundamental rights, maximize the positive effects, and minimize the negative effects.[75] Let us examine these functions in turn:

[69] Ranchordás (2014)
[70] Stewart (2010)
[71] Ranchordás (2014), Stewart (2010), Porter (1990)
[72] Stronger versions include an outright denial that the State can ever 'pick winners' or even an assertion that the State is above all good at picking losers. See Chang (2010) and Chang (2008)
[73] Thaler and Sunstein (2008)
[74] Edgell and Vogl (2013)
[75] Brownsword and Somsen (2009)

As noted earlier, from the perspective of law and technology, State's duty is to regulate so as to 'filter out' innovations that (potentially) conflict with fundamental rights and/ or with the goas set by the public policy. As Brownsword and Somsen put it, 'in democratic societies, technological development and application operates […] with a social license – a license which itself is subject to the overriding restraints of respect for human rights and human dignity'.[76] This argument is pushed even further by Prosser, who states that next to dealing with market failure, regulation should also protect human rights and further social solidarity.[77] He argues that even in the situation where market failure is involved, the role of the regulation is not limited to simply correcting this failure, but often also to organize the markets along the lines of fundamental rights and solidarity.[78] It is also worth noting that in this perspective 'social objectives […] are sometimes furthered by regulating even where this involves overruling the preferences of market players and acting paternalistically'.[79]

Moreover, the function of regulation as the guardian of fundamental rights is usually connected to the potentially novel moral and ethical issues, unforeseen hitherto, as was the case with human reproduction and cloning. In this case a kind of a feedback loop is taking place: the innovation occurring within the framework of regulatory filter brings with it new moral and ethical issues earlier not addressed in the regulation; and these new issues are in their turn fed back into the regulatory filter, the latter being constantly updated as the new issues arise. A number of responses on behalf of the regulatory environment to the arising issues are possible, and more specifically: the innovations leading to ethically unacceptable or problematic outcomes might be categorically prohibited, or subjected to various degrees of limitations (e.g. licensing, restriction of use).

There is an overarching consensus within the academic community that besides filtering out or restricting ethically unacceptable or problematic innovations, regulation should aim at maximizing the benefits of, and minimizing the harms from, innovation.[80] Yet because of the uncertainty surrounding innovation, benefits and harms are often unpredictable.[81] This uncertainty is compounded by the 'exponential or near-exponential pace' of technological progress,[82] and the parallel increase in complexity. Moore's Law notoriously states that the 'functional capacity of ICT products roughly doubles every 18 months', with the same dynamics manifesting in biotechnology, and namely in sequencing human genome.[83] As a result, regulating innovation involves what is called a 'pacing problem' in the academic literature from the US,[84] or the 'challenge of regulatory connection' or 'regulatory disconnection' in European-based scholarship.[85] It is noted that this concept also appears in other formulations in the relevant literature, such as the 'fit between

[76] Brownsword and Somsen (2009)
[77] Prosser (2006), Prosser (2010)
[78] Prosser (2006), Prosser (2010)
[79] Baldwin et al. (2012), see also Thaler and Sunstein (2008)
[80] Ranchordás (2014), Mandel (2013), Bennett Moses (2013), Brownsword and Goodwin (2012)
[81] Mandel (2013)
[82] Marchant and Wallach (2013)
[83] Allenby (2013)
[84] Marchant et al (2013), Marchant et al (2011)
[85] Brownsword and Goodwin (2012), Brownsword and Somsen (2009)

technology and instutitions' in the institutional economics literature,[86] and as 'faster depreciation and obsolescence of legal solutions' in legal literature.[87]

4.1. **The pacing problem or the challenge of regulatory connection**

The 'pacing problem' commonly refers to the situation when technology develops faster than the corresponding regulation, the latter hopelessly falling behind.[88] The metaphor of 'the hare and the tortoise' is often conjured.[89] As summed up by Marchant and Wallach, 'at the rapid rate of change, emerging technologies leave behind traditional governmental regulatory models and approaches which are plodding along slower today than ever before'.[90]

As articulated by Brownsword,[91] the challenge of regulatory connection refers to the widening gap between the current regulatory environment based upon the 'technological landscape of the past' and the occurring innovations revolutionizing this landscape.[92] Regulatory connection refers to both the situation when technologies enter a regulatory void or encounter certain gaps in legislation (pacing problem or legal disconnection), and the situation when the current regulatory framework is no longer adequate because of technology-enabled social norms (as with digital music copying and breach of copyright). [93] Regulatory connection therefore covers more than just pacing, and we use that concept henceforth.

Regulatory disconnection can appear in a number of ways, namely:[94]

- Regulatory void or gaps;

According to Brownsword and Goodwin, 'although there might be no part of the regulatory array that is specifically dedicated to the emerging technology, and although there might be gaps in the array, it will rarely be true to say that an emerging technology finds itself in a regulatory void'.[95] The regulatory void is therefore somewhat of an extreme scenario, potentially applicable only to 'black swan' technologies.[96] Regulatory gaps, on the other hand, are more likely, given the uncertainty surrounding innovations and their attendant risks and benefits.

- Ambiguity in the application of existing regulations;

A fairly likely scenario is that the innovation itself, or the new social and economic behaviours and norms linked to it, cannot be readily classified in the regulatory environment.[97] On one hand,

[86] Künneke (2008), Künneke and Groenewegen (2009)
[87] Hadfield (2007)
[88] Marchant et al (2013), Marchant et al (2011)
[89] Bowman (2013), Kuzma (2013), Bennett Moses (2013), Bennett Moses (2011)
[90] Marchant and Wallach (2013)
[91] Brownsword and Goodwin (2012), Brownsword and Somsen (2009)
[92] Bennett Moses (2013)
[93] Bennett Moses (2013)
[94] Bennett Moses (2011)
[95] Brownsword and Goodwin (2012)
[96] Taleb (2007)
[97] Bennett Moses (2007)

emerging innovative technologies are displaying an unprecedented level of complexity, and often span across a number of various technological fields (e.g. nanotechnology).[98] On the other hand, these technologies often give rise to polarized debates in society, and hence amongst policy- and lawmakers. In addition, such ambiguity could be the result of three different types of mismatch. First, there could be 'a mismatch between the description of the technology in the regulation and the characteristics of the technology as now constituted (arising from technological development)'.[99] Second, uncertainty could arise due to 'a mismatch between the assumptions underlying the regulation as to the range of uses of the technology and the uses that are now made of the technology (arising from a changing use of the technology)'.[100] Finally, there could be 'a mismatch between the presumed business model on which the regulation was predicated and the model of business that actually obtains'. [101]

- Regulatory over- or under-inclusiveness;

The existing regulatory environment could prove to be either too over- or under-reaching in the context of the new or changed technology. This could be the result of one of the types of mismatch described above.[102]

- Regulatory obsolescence.

Finally, as the existing technologies change and new innovations emerge, the existing rules could become obsolete, either because of the innovations themselves or of the socio-economic norms and behaviors that they enable.

4.2. **Assessing the extent of regulatory disconnect**

Before investigating regulatory disconnection further, it is worth noting that according to the law and technology literature it is neither inevitably bound to happen nor inherently bad. First, many innovations could fall comfortably within the scope of existing regulatory framework,[103] notably the 'existing legal frameworks that regulate the liability of manufacturers, the conduct of retailers, the rights of inventors and the rules of competition, among other things'.[104]

Second, it is rather simplistic to assume that the 'consistent sluggishness' of regulation is necessarily detrimental.[105] The reality is usually more complex: Indeed, it could be argued that it is perfectly normal and expectable that regulation falls behind in some cases. After all, regulation is based on assumptions about reality that no longer hold, once change in that technological and socio-economic reality has occurred.[106] This is exacerbated by the goal of legal certainty: regulation 'is meant to last

[98] Abbott (2013), Mandel (2013)
[99] Brownsword and Goodwin (2012)
[100] Brownsword and Goodwin (2012)
[101] Brownsword and Goodwin (2012)
[102] Brownsword and Goodwin (2012)
[103] Brownsword and Goodwin (2012), Bennett Moses (2011), Koops (2010)
[104] Bennett Moses (2011)
[105] Bennett Moses (2011)
[106] Bennett Moses (2013), Künneke and Groenewegen (2009), Künneke (2008)

since [it] is commonly depicted as a source of stability and predictability'.[107] This struggle between legal certainty and the need to reflect ongoing changes in the society is the ever-present dilemma of the regulatory environment, and hence arguably does not present a challenge that is new in its nature.[108] This argument is nicely summarized by Brownsword and Somsen who state that 'the law can never rival the innovativeness of technology, and nor should it try to do so; for, there is a conservative element to the law that accounts for its attraction as a calculable regulator of human interactions and transactions'.[109] Moreover, the regulatory environment itself changes regularly, so one could just as well argue that as it evolves it becomes less rather than more effective.[110]

Hence, it can be concluded that the challenge of regulatory connection in fact depends not on the presence of disconnect as such, but rather on 'whether sufficient mechanisms are in place to ensure that legal issues resulting from technological change are identified and resolved soon after they arise'.[111] In other words, the attention to this challenge 'can be seen as an expression of frustration with the speed with which law changes in response to particular types of dilemmas'.[112]

Disconnect may be seen as an expression of broader characteristics of law and regulation in general; as such, disconnect might not be an exclusive feature of the relation between law and technology. The analysis of disconnect, in the law and technology literature, could be made sharper through a stronger focus on innovation. Indeed, part of the critique leveled at law and technology throughout this paper stems from its failure to grasp the endogeneity of innovation. In other words, law and technology deals with technology as a general phenomenon.[113] As mentioned above, it tends to consider technology as an exogenous factor: technological developments over time are just deemed to happen, irrespective of regulation.

In addition, because it applies to technology in general, law and technology analysis does not differentiate between innovation – with its elements of novelty/invention and diffusion – and other technological phenomena worthy of regulatory attention, for instance a change in social norms surrounding the use of a technology, or the discovery of new risks or benefits attached to existing and established technology. A number of the problems debated in the law and technology literature are not specific to innovation, but are generic problems on the interface of law and technology.

Therefore, applying law and technology analysis to innovation implies that innovation is reduced to a merely technological phenomenon. In other words, innovation equals technological innovation. Whilst the popular perception is that innovation is primarily a result of technological change, innovation scholars – and informed policymakers – are well aware that there is much more to innovation than technological change. In particular, innovation can arise from changes in management, organizational or even marketing processes, without any significant technological

[107] Ranchordás (2014)
[108] Ranchordás (2014)
[109] Brownsword and Somsen (2009)
[110] Allenby (2013)
[111] Bennett Moses (2011)
[112] Bennett Moses (2011)
[113] Bennett Moses (2013)

advance.[114] By way of example, the introduction of postpaid mobile subscriptions in the EU, in the mid-1990s, was mostly a marketing innovation, but it thoroughly changed the fate of mobile communications in Europe, turning it into a mass service. It is not clear how law and technology analysis can apply to non-technological innovations, and even whether it can apply at all outside of technology-related issues.

4.3. **The horizontal dimension of disconnect: timing of regulatory intervention**

According to Brownsword and Goodwin, the challenge of regulatory connection has three main facets, largely overlapping with the stages of innovation, and namely: the challenge of getting connected to the invention, the challenge of staying connected as the innovation diffuses and the 'knowledge, understanding and use of technology spreads', and, finally, the challenge of getting reconnected as the innovation has a positive social impact.[115] From the perspective of the law and technology literature, with its emphasis on regulatory effectiveness and economy, the optimal situation is when regulation connects with its target – innovation – at an early stage, and evolves with it through the later stages.[116]

However, more often than not that ideal is not met in practice. This could of course be due to the lack of necessary expertise and resources, and other 'regulatory failures',[117] but more fundamentally regulation faces what is known as the Collingridge dilemma.[118] On the one hand, at the early stages of technological development, there is insufficient information regarding potential harms and benefits, but on the other hand, in later stages it can be very difficult, if not impossible, to alter the status quo once the technology has matured, diffusion has taken place and it has become an innovation.[119] In other words, as technological systems acquire momentum and grow larger, and more complex, they also become 'more resistant to regulatory prodding'.[120] At the same time, the potential implications of many innovations are 'not only difficult to predict but are fundamentally unknowable'.[121] If regulators want to achieve results, they should act early, but then the full range of risks and benefits is unknown; and if they wait until the risks and benefits are clear, the situation solidifies in the manner which makes it difficult and expensive to introduce regulatory changes.

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[114] See the official Oslo Manual (OECD and European Commission (2005)), which considers this point well established.
[115] Brownsword and Goodwin (2012)
[116] Brownsword and Goodwin (2012), Brownsword and Somsen (2009). In order to simplify the analysis in this paper, we do not seek to break innovation down into chronological stages, but we rather emphasize that it comprises both an invention and a diffusion element, which may be synchronous or not. The various lines of literature contains many different chronological models of innovation stages, and it is beyond the scope of this paper to seek to reconcile them. As a general remark, however, we can point out that, given the inherent uncertainty linked with innovation, the more sophisticated the chronological model, the less likely it is to correctly capture innovation in general.
[117] Baldwin et al. (2012)
[118] Collingridge (1980)
[119] Collingridge (1980)
[120] Bennett Moses (2013) based on Hughes (1994)
[121] Paddock and Masterson (2013)

Within law and technology, there is broad consensus[122] that the regulation wishing to influence innovation should act at an early stage of technological development 'when the situation is more malleable',[123] as this window of opportunity will not remain open indefinitely.[124]

This is the insight behind the precautionary principle,[125] according to which, when the potential harm of a specific invention is large and irreversible (even if the risk of such harm occurring might be small), such invention should not be allowed to be diffused unless it is proven to be safe. [126] Whereas this approach has positive sides (such as minimizing potential harm, better public support in some cases, etc.), its two main criticisms are the limitations of the technological imagination of the regulators, and the constraining effect it could have on innovation.[127]

The proposed law and technology timeline is illustrated in the Figure 2 below:

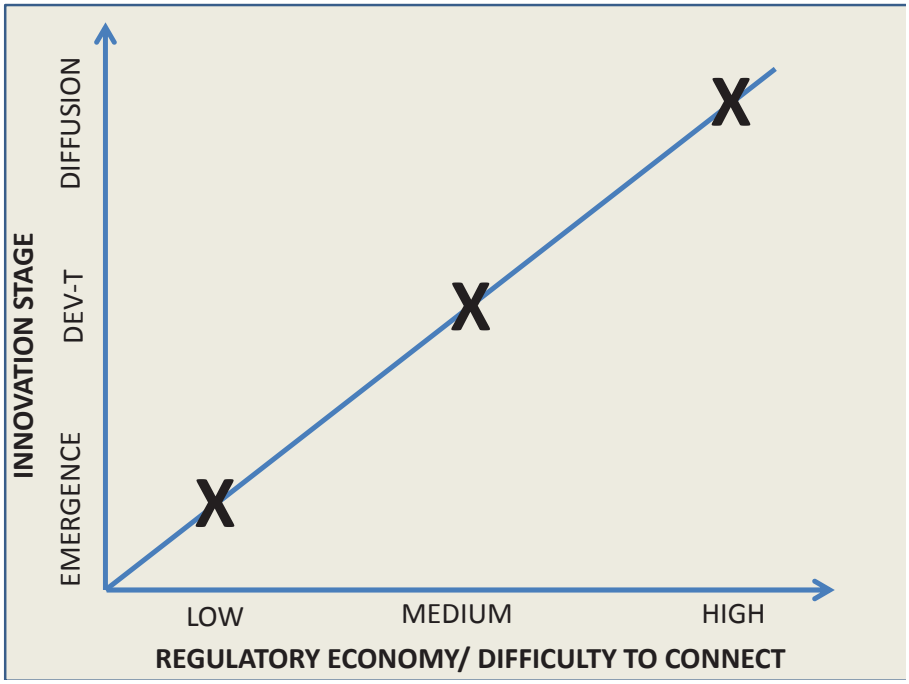

Figure 2: Illustrative relationship between regulatory disconnection at different stages of innovation, and the regulatory economy

Sources: own analysis, mainly based on Brownsword and Goodwin (2012), Bennett Moses (2013)

The above figure illustrates the law and technology perspective that the difficulty and the expenses associated with making a regulatory connection between the regulatory environment and its target – innovation – are the lowest in the 'ideal' situation, when the regulatory connection is established in the stage of invention and maintained throughout the adoption and positive social impact stages. The costs and the level of difficulty increase, but remain at the medium level, in the situation when

[122] Bennett Moses (2013), Mandel (2013), Mandel (2009), Hughes (1994), Winner (1980), Collingridge (1980)
[123] Bennett Moses (2013)
[124] Mandel (2009)
[125] Bennett Moses (2013)
[126] Harding and Fisher (1999)
[127] Ranchordás (2014), Sunstein (2005)

regulatory connection is established for the first time in the diffusion stage.[128] Consequently, both the level of difficulty and the expenses are the highest in the situation when the regulatory environment remains disconnected from the innovation throughout the stages of invention and adoption, and attempts making a connection only at the stage of positive social impact, when this innovation is relatively mature and the stakeholders involved are used to the status quo.

As noted earlier, however, the assumption 'that (ex post) regulatory disconnection is necessarily and inevitably a bad thing and that, when it happens, every effort should be made to close the gap' is not completely accurate.[129] Indeed, as Bennett Moses suggests, the metaphor of hare and tortoise in many cases 'suggests a need for urgent new legislation, despite the advantages in some cases of delay', such as better-drafted regulation or regulation better reflecting the actual risks/harms and benefits of a particular innovation.[130]

As a result, many law and technology authors support what is called 'risk-based regulation', whereby the – early – intervention is modulated according to the perceived risk.[131] Black and Baldwin, for example, argue that risk-based regulation is well-suited to address innovations, which are characterized by changes in regulated products, understanding of risks and evolving public perceptions.[132] Brownsword and Goodwin suggest a similar solution, where the regulatory connection should be established according to the perceived potential risk profile of an innovation:[133] Where an innovation is thought to have a high or an unknown risk profile, the regulatory inquiry as regards to the fit with the current stock of regulation should 'focus on the existing regulation concerning health, safety and the environment'.[134] Where the risk profile of an innovation is acceptable, such an inquiry should 'focus on the regulation of (compensation) liability'.[135] And finally, where the innovation is perceived as risk-free, the focus should be placed 'on the adequacy of the relevant facilitative regulation – whether this is patent law or contract law'.[136]

This insight of law and technology scholars points to a more fundamental problem, which can be better grasped with the help of law and economics. In essence, the timeline is more complicated than law and technology scholarship seems to acknowledge. It is true that regulation can be more effective in achieving SHEC or other objectives if it intervenes in the early stages of invention, before any innovation has even arisen. But two other time dimensions are missing: first of all, the timing of regulatory intervention affects the impact of regulation on incentives and therefore on innovativeness. Secondly, it cannot be presumed that regulation is always successful and adequate: error-cost analysis reveals that the timeline matters.

[128] This logic equally applies to the situation when the regulatory environment is connected to the invention, gets disconnected in the diffusion stage, and attempts reconnection again once positive social impact takes place.
[129] Brownsword and Goodwin (2012)
[130] Bennett Moses (2011)
[131] Brownsword and Goodwin (2012), Black and Baldwin (2010)
[132] Black and Baldwin (2010)
[133] Brownsword and Goodwin (2012)
[134] Brownsword and Goodwin (2012)
[135] Brownsword and Goodwin (2012)
[136] Brownsword and Goodwin (2012)

As mentioned earlier in this paper, regulation influences the incentives of firms and individuals to dedicate resources to activities, such as research and development or market surveys, which can lead to socially beneficial innovation. Early regulatory intervention, at a stage where very little has been accomplished and very little is known, sends a powerful signal. Especially if the signal is negative – a prohibition – it implies that the lawmaker or regulator considers that, in spite of the lack of concrete knowledge or experience, a certain course of action is deemed to be detrimental to society. This will powerfully discourage any further efforts along that course of action. Even if the signal is positive – an early encouragement in the form of a subsidy or preferential treatment – it also has a large effect, in the opposite direction of course: a positive signal from the lawmaker or regulator will channel efforts towards that course of action.

The magnifying effect outlined above would not be so dramatic, were it not that it is linked with a higher risk of error when intervening early. Indeed, applying regulation at a later stage, when inventions are being diffused and it becomes apparent that they could become innovations, offers considerable advantages. First of all, more is known about the invention, so that the regulatory assessment is better grounded in evidence and the regulatory error risk – Type I or Type II – is reduced. Secondly, some inventions are eliminated because they fail at the diffusion stage; no regulatory scrutiny is then needed, thereby saving on resources. Accordingly, early 'filtering out' through SHEC regulation should be allowed only in the extreme cases, such as experiments involving humans and human cloning. Otherwise, it might be wiser to delay regulatory scrutiny as long as possible (contrary to what is generally advocated in the law and technology literature).

As an alternative to decisive intervention at an early stage, it is conceivable to work in an 'incremental, reflexive, and cooperative approach'[137] via 'experimentalism'[138] or 'experimental legislation', as well as temporary legislation. Experimental legislation is defined as comprising 'statutes but, in most cases, new temporary regulations with a circumscribed scope that, derogating [from the] existing law or exempting a number of existing legal requirements, are designed to try out novel legal approaches or to regulate new products or services so as to gather more information about them'.[139] Temporary provisions (or sunset clauses) are defined as 'dispositions that determine the expiration of a law or regulation within a beforehand determined period'.[140] The legislative flexibility offered by experimental and/ or temporary legislation arguably 'contributes to the advancement or, at least, facilitation of innovation'.[141]

4.4. **The vertical dimension of disconnect: the level of specificity and technological neutrality**

Next to the horizontal dimension (timeline), there is also a vertical dimension to regulatory connection, namely the level of technology specificity. Regulation can be either specifically targeted at the invention in question, in other words be 'technology-specific' (e.g. relating to human cloning),

[137] Marchant et al (2008)
[138] Sabel and Simon (2011)
[139] Ranchordás (2014)
[140] Ranchordás (2014)
[141] Ranchordás (2014) based on Cherry (2008), Ranchordás (2014) based on Wolters and Schuite (2002)

or rather 'technology-neutral', indicating general principles of universal application, without specifying the technological context (e.g. relating to consumer protection).[142]

The law and technology literature often presumes a high degree of technology specificity. Technology-specific regulation can in some cases be desirable from a societal perspective: 'if there is a moral objection to a technology as such, then the prohibition needs to target that technology' (e.g. human cloning).[143] One may wonder, however, whether these SHEC objectives are always addressed in the most efficient manner by technology-specific regulation: for example, it makes little sense to have different laws applying to someone who commits bank robbery with a gun and to someone who does so by hacking the bank IT system. Therefore, the default regulatory focus on technology is not justified, as in most cases 'there is nothing about technology, no hidden element […] that explains why technology needs to be regulated more than other kinds of social activities, or why it presents unique regulatory problems'.[144]

There is an additional element to technology-neutrality, and namely regulatory certainty. In this context the general rule-of-thumb, formulated by Brownsword and Somsen applies, and namely: 'the more the law strives to be precise and comprehensive, the sooner it is likely to become disconnected from rapidly changing technologies that are its regulatory targets'.[145] In other words, the higher the degree of technology specificity, the shorter the lifetime of the regulation.[146] The opposite holds as well: the more technology-neutral the drafting style of a regulation, the more future-proof it is.[147]

Whilst law and technology literature is ambivalent towards technological neutrality, that principle features more prominently in the economic analysis of law.[148] For instance, the literature suggests ex ante regulation for innovativeness by the means of rather technology-neutral instruments, such as IPRs. The same is true of the eventual correction of eventual failures by technology-neutral laws, such as those relating to competition and consumer protection.

Technological neutrality can be interpreted as a duty incumbent upon the legislature or regulatory authority to try to enact laws and regulation that are sustainable over time, instead of requiring review at frequent intervals. An even stronger interpretation turns it into a duty not to pre-empt technological choices that are the province of market actors, first and foremost. In line with these two interpretations, regulation should therefore be formulated using non-technological – i.e. either functional or economic – concepts.[149] General enactments – framework legislation, soft-law guidelines and notices – would then steer largely clear of technological concepts. Technology-specific reasoning, if at all necessary, should be entertained at the lowest possible place in the chain of

[142] Bennett Moses (2013), Koops (2006)
[143] Bennett Moses (2013)
[144] Bennett Moses (2013)
[145] Brownsword and Somsen (2009)
[146] In such context the reader might be temped to suggest a 'quick fix', and namely that the regulatory environment in the age of swiftly developing innovations should strive to be as technology-neutral as possible. Whereas this quick fix provides some relief, unfortunately it does not offer a panacea: the technology-specific regulation can be preferable in cases. Moreover, in some cases the requirements that are technology-neutral do not offer sufficient clarity and are expensive to evaluate, monitor, and enforce. See Bennett Moses (2013)
[147] Koops (2006)
[148] Van der Haar (2008)
[149] Hancher and Larouche (2011)

implementation and enforcement, for instance in the individual decisions of regulatory authorities, which are bound to be subject to frequent review in any event.

Indeed technological neutrality has institutional and even epistemological implications, as seen in the following section.

4.5. The institutional dimension of disconnect: updates and reforms, regulatory authorities

The horizontal and vertical dimensions of disconnect concern mostly the substance of the law, both over time (horizontal) and in terms of generality or specificity (vertical). When both dimensions are combined, the resulting issue is how to exploit both these dimensions in order to reach a result where public policy objectives are achieved, without unduly impairing innovativeness.

In the law and technology literature, that issue is discussed by some authors, yet from a mostly substantive perspective, using the categories of 'regulatory update' and 'regulatory reform'.[150] Regulatory 'stock' undergoes a continuous process of change 'whenever a statute is enacted or a regulation is promulgated, and often when judicial and tribunal decisions are handed down'.[151] Such process includes both the growth of the body of law and regulation, and its updates as to better suit the progress of a complex society. In relation to innovation, 'regulatory update' means that the norms and values stay largely the same whereas technology changes, and by doing so places strain on the regulation to either change (update) or expand as to accommodate the technology evolution (e.g. in case of a regulatory gap).

In contrast, a 'regulatory reform' is usually perceived to have a larger impact; it is defined as 'enacting entirely new regulatory regimes or substantially overhauling existing laws',[152] usually changing the regulation for the better.[153] Bennett Moses argues that 'there is value in considering the law's response to changes in social and cultural attitudes and changes in knowledge and understanding separately':[154] Therefore, it is fair to say that regulatory reform is usually a response not so much to technology change itself, but rather to the norms and values shift which might or might not be the result of technology evolution. Moreover, regulatory reform presumes substantial legislative changes, and could involve 'a costly, resource-draining, lengthy and highly uncertain process with no guarantee of an outcome that is more protective or efficient than the existing structure'.[155]

According to the law and technology literature, in order for regulation to stay connected through both technological change and the evolution of norms and beliefs, both regulatory updates and timely and appropriate regulatory reforms are necessary. Therefore, there is a risk of mismatch between the form of regulatory change and the extraneous change that triggers it: conducting a

[150] Bennett Moses (2011), Mandel (2013)
[151] Bennett Moses (2011)
[152] Mandel (2013)
[153] Bennett Moses (2011) based on Kirby (1983)
[154] Bennett Moses (2011)
[155] Mandel (2013)

regulatory update in a situation where in fact a regulatory reform is in order (e.g. because of a shift in norms and values) might leave regulation in a worse state than initially.

However intriguing, the distinction between regulatory updates and reforms remains centred on substantive law, and, in doing so, fails to fully exploit the range of institutional tools available to deal with regulatory disconnect.[156] Indeed, the law and technology literature remains by and large concerned with the balance between a monolithic 'regulator' on the public side, and private actors:

For one, Bennett Moses argues that disconnect could be partially addressed by 'involving experts [and] improving understandings of how regulators can manage different types of uncertainty'.[157] At the other end of the spectrum, one finds 'self-regulation and, concomitantly, a softer form of law'.[158] Academics advocating 'a free market, or fully voluntary, approach to emerging technology' usually do so by arguing that 'emerging technologies and their attendant risks are no different from previous concerns'.[159] Whereas there are a number of advantages to self-regulation (e.g. it helps alleviate the information asymmetry between the regulators and the regulated firms), the public is usually less than enthusiastic regarding 'voluntary or self-regulatory approaches to emerging technologies', as the latter are not perceived as full substitutes for the mandatory requirements of regulation.[160]

Against that background, a consensus is emerging among law and technology academics[161] that innovation needs an 'incremental, reflexive, and cooperative approach'.[162] Such flexible approach to regulation is interpreted by some scholars as a softer form of regulatory environment: 'a governance process rather than intractable regulatory rules'.[163] This interpretation often relies on the assumption that 'the development and governance of emerging technologies are inevitably and dynamically intertwined: these technologies cannot develop without providing researchers freedom to innovate, but too much freedom can lead to a calamity that forecloses future opportunity'.[164] In other words, it is argued that besides the State (regulator) 'many other stakeholders have an interest and responsibility in the safe development of emerging technologies'.[165] This is mainly because the actual or potential harms associated with a specific invention – and most importantly the public perception thereof – can have detrimental consequences for the development of such an invention. Hence, largely acting out of self-interest, non-government stakeholders often take up regulatory roles: the void left by the withdrawal of the government is filled by 'an increase in non-state actors within the regulatory paradigm'.[166]

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[156] See Brownsword and Goodwin (2012), who delve into some of the issues discussed below, such as capture, yet without setting this against an explicit and sophisticated institutional model, choosing instead an abstract 'regulator'.
[157] Bennett Moses (2013)
[158] Brownsword and Goodwin (2012)
[159] Mandel (2013)
[160] Mandel (2013)
[161] Marchant et al (2013), Mandel (2013), Mandel (2009)
[162] Marchant et al (2008)
[163] Mandel (2009)
[164] Mandel (2013)
[165] Marchant and Wallach (2013)
[166] Bowman (2013)

It is at this juncture that the law and economics literature can enrich the reflections of law and technology on the institutional dimension of regulatory disconnect. Indeed, there is a long thread of economics research on the institutional aspects of regulation. It runs along two normative perspectives:[167]

Pursuant to the classical one, the *public interest* school, public authorities are deemed to be above the fray and to pursue public policy objectives for the greater good.[168] The study of regulation is then focused on identifying market failures (as set out earlier), designing the proper mechanisms to remedy them and assessing the effectiveness and efficiency of intervention.

The later *public choice* or *private interest* school, on the other hand, assumes that public authorities are market actors like any other; they are organisations populated by individuals pursuing their self-interest and responding to incentives.[169] Public choice theory has introduced the notion of government failure – to mirror that of market failure: government failures include capture (the regulator becomes informationally dependent from the regulated firms) or shirking (the agent in charge of regulation deviates, intentionally or not, from the mandate given by its principal). In addition, information asymmetries might cause the regulator to err in its decisions, either by intervening when unnecessary (Type I) or failing to intervene when necessary (Type II). Public choice analysis suggests both that careful institutional analysis is needed to avoid that regulation fails to meet its objectives, and that there might be instances where, because of government failure, regulatory intervention cannot improve upon a situation where market failure is present.

The tension between these two perspectives has produced a rich scholarship on the institutions of regulation. A central element in that scholarship is the regulatory authority or agency. The authority is an institutional device designed to address the difficulties identified in the scholarship, as regards both solving market failures and preventing government failures. The salient features of a regulatory authority – for the purposes of this discussion – are that (i) it is independent from market actors and from the rest of the State authorities; (ii) it nonetheless remains accountable; (iii) it holds a well-defined legislative mandate and it has the necessary powers to carry out that mandate; (iv) it possesses both the material resources and the expertise to fulfill its mandate; and (v) it is required to respect certain principles in its work, among others transparency, necessity and proportionality.[170]

Each of these features ties in with the discussion in the literature, and they can all be useful in dealing with regulatory disconnect:

Whilst the *independence* of the regulatory authority towards market parties is self-explanatory,[171] its independence towards the executive and legislative powers is more controversial. Independence shields the authority from the imperfections of the executive and legislative processes, both of which can be plagued by lobbying and opacity, especially once the level of decision-making is specific

[167] Viscusi, Vernon and Harrington (2005)
[168] Baldwin (2012)
[169] Stigler (1971)
[170] See for a broader discussion Hancher, Larouche and Lavrijssen (2003). See also Larouche (2014), Larouche, Hanretty and Reindl (2012).
[171] It serves to ensure impartiality, and in that respect the regulatory authority is simply put in the same position as any other public authority.

enough that winners and losers are made.[172] It also enables decision-making to be made outside of the typically short-term political horizon of the legislative and executive powers, thereby contributing to reduce a prevalent problem of commitment.[173] At the same time, lest an independent regulatory authority becomes a loose cannon, it is part and parcel of the design of such an authority that it remains *accountable*, via various means that do not impinge upon its independence.[174]

An independent and accountable regulatory authority allows organizing the *vertical* dimension of regulatory connection, by enabling a layered approach: the general decisions – the main policy orientations, the fundamental principles – are taken by the legislative power, with the executive one playing a supporting role. These general decisions can then be formulated in technology-neutral terms, since they play out at a level of generality such as should apply across the board to all technologies.[175] The authority has the task to develop these general decisions further and progressively reach individual cases; as the analysis becomes more specific, technology-specific considerations may enter the scene.[176] Similarly, such layering allows for a more subtle timeline: the most general decisions are not subject to frequent revision – even if politics are unstable – and they are found in instruments that cannot be altered so readily.[177] As the decisions become more specific and more technology-oriented, they rest in the hands of the regulatory authority, which can modulate its own timeline according to circumstances.[178]

With an independent and accountable regulatory authority, the *horizontal dimension* of regulatory connection can also be more satisfactorily addressed. The general decisions are typically known in advance of any invention: they do not change so often, and inventors are usually aware of them, or can be presumed to be so. The regulatory authority can then be content to wait for an invention to diffuse and become an innovation before intervening (should there be a policy concern), so as not to pre-empt innovations. This combination of a set of policy orientations and fundamental principles known in advance, with the specific application being carried out later if issues do arise, offers a good compromise to deal with the Collingridge dilemma, as outlined above.

In addition to independence and accountability, if the regulatory authority has a *clear mandate* and *is endowed with sufficient powers*, it will not be hampered by formalistic considerations and will be able to focus on carrying out its mandate. To that end, it needs to hold the requisite *resources and expertise*, in order to conduct a thorough analysis and not be swayed by superficial arguments. Finally, if it complies with *general principles of good governance*, there is a good chance that it will correctly spot market failures and avoid government failure, through capture or shirking.

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[172] Hancher and Larouche (2011)

[173] The vagaries of politics make it difficult for political actors to commit to a position much beyond the term of their political mandate, even if this would sometimes be socially beneficial.

[174] Lodge and Stirton (2010), Larouche, Hanretty and Reindl (2012)

[175] Using privacy and personal data as an example, the most general level would include determinations of whether a society want to protect these, whether these are tradeable goods or interests, whether the data subject owns his or her personal data, etc.

[176] For instance, in order to assess whether a specific technological system meets the general requirements set out in the legislation.

[177] That would then constitute a 'regulatory reform', to use the terminology introduced above.

[178] By way of what would be a 'regulatory update', again using the terminology introduced above.

The resulting institutional model is rich and integrative,[179] and it can address the horizontal and vertical dimensions of regulatory disconnect not solely via substantive law,[180] but rather via an institutional model allowing greater freedom in the design of substantive law, so as to pay heed not just to disconnect, but also to innovativeness. That model has already proven its worth in areas such as competition law or the regulation of electronic communications, and it would be worth integrating it into the law and technology analysis.

5 CONCLUSION

As noted earlier, the law and economics (broadly defined) and law and technology literature streams seem to exist in parallel and largely non-intersecting inter-disciplinary silos, which prevent the cross-fertilization of insights between them and the realization of synergies. This paper is a modest attempt to connect these silos. Throughout this paper, we sought to identify how these two streams could complement each other. Whenever possible, we tried to put forward ways to reconcile them.

At the very outset, even the *definition* of innovation needs to be recast in order to integrate both streams: it is best seen as a combination of three elements, namely (i) an invention, (ii) which is diffused and adopted and (iii) which has a positive social impact.

One of the main shortcomings of law and technology lies in how it sees innovation as an essentially technological phenomenon, and one that is largely exogenous to the regulatory process. Law and economics literature pays closer attention to *regulation for innovation (or innovativeness)*: market failures have been identified, mainly market power, and externalities flowing from the public good nature of information. The legal instruments to remedy these failures – competition policy, economic regulation, intellectual property, subsidies and public funding – are well analysed in the literature, even if not conclusively. Yet law and economics literature assumes that innovation is good for welfare, without more.

Law and technology can usefully help to make up for that weakness in the economic analysis of law as it relates to innovation. It takes a more critical view of innovation and is rather concerned with the *regulation of innovation*. Perhaps the most interesting part of that literature concerns regulatory *disconnect*, i.e. the difficulty for regulation to keep up with the pace of technological change (hence including technological innovation). Within regulatory disconnect, one can distinguish a *horizontal* dimension (time) and a *vertical* dimension (level of generality). Whilst not unanimous, the law and technology authors tend to advocate early regulatory intervention, in order to avoid the Collingridge dilemma, where the knowledge required to intervene is acquired only when the effectiveness of intervention has dissipated. Similarly, most authors would prefer technology-specific intervention, for the sake of effectiveness. In contrast, a law and economics analysis would emphasize the need not to intervene too early and the importance of technological neutrality – in both cases, in order to avoid distorting innovation incentives more than is strictly necessary.

[179] Hancher and Larouche (2011).
[180] For instance, *ex ante* technology-specific regulation.

Once an *institutional* dimension is also brought in the picture, law and economics literature offers insights into institutional models that allow a balancing of the concerns arising from each stream of literature. Indeed, over the decades, that literature has studied regulatory authorities and set out key elements – including independence, accountability, a clear mandate and sufficient powers, resources and expertise, and principles of good governance – that allow these authorities to police market failures and avoid government failure. Regulatory authorities, by introducing a layered institutional structure, allow *ex ante* general decisions made by the legislature and executive to be implemented *ex post* by a forceful and competent authority. They also help to concentrate technology-specific intervention at the lower ranges of the decision chain, where technological change can more easily be dealt with, whilst the general decisions remain technology neutral.

Ultimately, reconciling the law and technology and law and economics literature streams will also require a deeper, epistemological convergence. As mentioned at the outset, law and technology posits innovation as an exogenous phenomenon, in a way that seems not to fully account for the richness of innovation. In epistemological terms, this implies a blank page: innovation (insofar as it is based on technology) is 'terra incognita', containing unknown risks and possibilities for misuse and abuse.[181] Such innovation must therefore be first digested and comprehended fully,[182] and from that comprehension legal concerns are expected to emerge. These concerns are then analysed and lead to regulatory proposals. The path set out in this article would support another epistemology, where the starting point would be the public policy objectives and the fundamental principles set out at the most general decision level. This is where the expertise of lawyers lies. Instead of endeavouring to comprehend technology – let alone innovation as more broadly defined here – lawyers would rather test whether these policy objectives and fundamental principles are somehow affected by innovation, and henceforth assess whether any intervention is required. The former epistemology is technology-centred, the latter is policy- and principle-centred. Whilst the difference between the two might not always be large, it is not insignificant. A technology-centred epistemology might be adequate for legal advisors imbedded in innovative teams, but for public authorities, only a policy- and principle-centred epistemology can lead to the right balance between regulating for innovativeness and regulating innovation.

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[181] Bennett Moses (2013) based on Brenner (2007)

[182] Which for lawyers is often seen as a major challenge. The satisfaction of having understood technology can give rise to some of the biases identified in the relevant literature, for instance the availability bias or hindsight bias: see Kahnemann (2011).

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