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A numerus clausus rationale for the privity of contract: the protective function

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Abstract
We analyse the legal and economic background and implications of the destandardisation of digital contracts, with a focus on consumer protection and overall efficiency. We argue that firms can exploit destandardisation paired with asymmetric information to extract rents. We propose the introduction of a numerus clausus principle in the digital licensing realm (a limit to the contractual freedom of parties to create proprietary rights) as a way of reducing rent extraction by firms and increasing consumer surplus. With a simple economic model, we account for the trade-off between the benefit from reduced market power and the social cost of legally enforced standardisation, and show that some degree of enforced standardisation can be optimal.

Keywords Numerus clausus · Standardisation · Digital objects · Digital licenses · Privity of contract · Consumer protection

JEL Classification K11 · K12 · K24 · L15 · L24 · L51

1 Introduction

This paper examines the relationship between the standardisation of goods and forms of rights, and the smooth functioning of markets. In particular, it focuses on the impact of the large-scale de-standardisation of digital goods. To do so, we start from a brief overview of the framework that applies to digital goods to provide the reader with an essential background of the legal state of the art. We point out that the

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transition from ownership-based circulation models to access-based circulation ones usually results in a loss of transactional clarity. This is because we all have, as members of a complex society, a basic yet solid understanding of the meaning of actions such as *buying*, *owning*, *selling*. This is not equally true for actions such as *licensing* and *being licensed*. We explain with some examples what this means in practice. Subsequently, we move to the economic analysis of the *numerus clausus* doctrine, which has been heralded as a viable solution for the phenomenon of idiosyncratic licensing by the law and economics literature. It is important to flag out from the beginning that we are not using the "*numerus clausus*" doctrine in its strictly legal meaning (that is, as a closed list of rights that can amount to proprietary effects), but rather in a more nuanced and economic sense, pointing to its standardisation-inducing and externality-reducing effects. Accordingly, we discuss the law and economics literature about the *numerus clausus* doctrine and then check its compatibility with the structural features of digital markets. In doing this, we discuss whether the *numerus clausus* doctrine might be of some use in digital markets. This is questionable, since the structure of licenses—*in personam* and generally not transferrable—differs greatly from the structure of property rights—*in rem* and alienable. Building on these elements, we argue that the traditional economic justifications for the *numerus clausus* doctrine do not suit digital markets *in toto*. This is because they are mostly focused on the problem of potential successor in titles, a situation that is less frequent in digital markets, because of the personal and non-transferrable nature of digital licenses. However, we also claim that some aspects of the *numerus clausus* rationale might apply to the practice of digital licensing, where the boundaries of the *in personam* and the *in rem* are blurred in a form of "ex re" enforcement.

Acknowledging the limitations coming from the *in personam* and eminently contractual structure of digital licensing markets (even if with some grey areas), we propose an often neglected rationale for the *numerus clausus* economic doctrine, whose benefits can be detected even in the absence of a *ius sequelae* and limited in scope to the privity of contract. This is the *protective function of the numerus clausus*, which is mainly based on its 'competition effect', i.e. on the possibility to achieve economically more efficient outcomes. It is indeed possible that, in markets with asymmetric information and uneven market power, the legal standardisation of objects increases competition and, by that, consumer welfare too. Also, we are aware that other legal tools and institutions might tackle the problem of standardisation and consumer deceipt (notably, standardisation of contracts in consumer law or the general law of torts). However, the embedding of legal remedies in the design of digital objects] which is frequent practice when digital licensing is involved—creates the space for a potential *numerus clausus* analysis. We conclude by modelling this situation, taking the negative effect of stricter standardisation into account too.

2 Legal background

Digital markets have grown rapidly in the last decades. Digital products, such as embedded goods and digital contents, represent a massive source of wealth. They are exceptional innovations that allow us to do things we now consider crucial for

our well-being, professional and family lives. However, despite the crucial role they play in markets and everyday lives, the rules applying to them and their economic consequences are still mostly unclear to users.

The main issue is that both digital contents and embedded goods cannot be exchanged as *properties* in the technical sense. They cannot be bought, sold and owned. To summarise something that would require countless pages, this is because all property law systems in the Western legal tradition have requirements that things need to fulfil before being classifiable as properties and commercialised as such. This created considerable difficulties in the application of existing laws to the commerce of digital licensed goods (ALI-ELI, 2021) Germany, Greece, Italy, and France to some degree, require goods to be tangible in order to be classifiable as 'property'.[1] Similarly, the common law of property, even if not asking for the tangibility of objects, demands some specific requirements, such as the transferability and separability of the right (Candian et al., 1992; Penner, 1997, 2013), which cannot be found in the commercialisation of digital entities. Other accounts of the common law of property provide an approach that is even more restrictive (Douglas 2011a, 2011b; Pretto-Sakmann, 2005; Rostill, 2021), requiring possession, and thus tangibility, to access the status of property and proprietary remedies (see, e.g., the tort of conversion or trespass for moveables). This applies mainly to the English common law of property, whereas in the United States some case-law differ by allowing conversion for intangible personal property (Network Sys. Architects Corp. v. Dimitruk, 2007; Thryoff v. Nationwide Mut. Ins. Co., 2007).

This means that, in general, proprietary rules for the circulation and protection of property rights cannot apply to digital products.[2] As a consequence, their regime is defined by the interplay between default IP law rules and their contractually-defined exceptions, which can be set up by parties on a case-by-case basis.[3] Unfortunately,

[1] For Germany the requirement of tangibility is required by positive law (See BGB, § 90), in Italy tangibility is generally a requirement for property law to apply, even if the vagueness of the term '*cosa*' raises some doubts (Gambaro, 2012; Sganga, 2015). Similarly in France, despite some proprietary configuration of the concept of *propriété intellectuelle*, only tangibles can be properties (Candian et al., 1992).

[2] This is because property law taxonomies, and in particular the criteria to define the external boundaries of property law, were elaborated in a historical period where digitality and virtuality were de facto impossible to consider among the plethora of relevant economic interests whose circulation required some regulation. In the nineteenth century, that is the time were codification processes begun in France and Germany and where the dismantling of the feudal system truly started to show its effects in Britain, there were no reasons to think of digitality and virtuality as economically or legally relevant concepts.

[3] It is possible to find different licensing practices even in the same class of objects. See, for instance, FitBits, which are not resellable, and Apple Watch, which can be sold on second-hand markets at some specific conditions. FitBit's ToS recites: «You will not use, sublicense, copy, adapt, modify, translate, disclose, prepare derivative works based upon, distribute, license, *sell*, *rent*, *lease*, *assign*, *transfer*, publicly display, publicly perform, transmit, broadcast, or otherwise exploit the Fitbit Content, Fitbit Service or any portion thereof». (FitBit, 2018). Apple Watch's ToS affirms that: «You may not rent, lease, lend, sell, redistribute, or sublicense the Apple Watch OS Software. You may, however, make a one-time permanent transfer of all of your license rights on the Apple Watch OS Software to another party in connection with the transfer of ownership of your Apple Watch, provided that: (a) the transfer must include your Apple Watch and all of the Apple Watch OS Software, including all its component parts, original media, printed materials and this License; (b) you do not retain any copies of the Apple Watch OS Software, full or partial, including copies stored on a computer or other storage device; and (c) the party receiving the

this is not a mere legal technicality. It might well be said that what is at stake is nothing more than a legal label: of property law and ownership, or intellectual property and licenses. Surely, if the legal form changes in the face of an identical distribution of utilities in practice, there is no reason to be concerned.[4] However, this apparent technicality has several practical consequences.[5]

Since proprerty law is generally not applicable to digital products, they cannot be bought and sold, but only licensed. Licenses are highly-customisable contracts among two parties, where the licensee, in exchange for consideration, benefits from the permission to use the protected IP in some ways that are contractually determined by the agreement with the licensor. Subsequently, when paying for a purely digital good or an embedded one, consumers are not *buying* it—they are merely acquiring the right to *access* it. Therefore, legally speaking, the actual object of this transaction is not the ownership of the product, but a mere *license* to use it (Kim, 2003; Loos et al., 2011, p. 14). Hence, with respect to digital products, we are never *owners*, but *licensees*,[6] whose access to the product depends on the contractually-given permission of the licensor (Wenderhost, 2016, p. 202), who is the IP-right holder. As Winston (2006) said, commenting on the commercialisation of embedded goods and digital contents, the «consumer […] exchanged consideration for a chattel without purchasing or receiving title to the chattel. Instead, each received a *license to use* the chattel» (p. 98). Thus, what the alleged buyer gets from the transaction is *the permission to use* the product in question, for a given period of time and in predetermined ways (Perzanowski & Hoofnagle, 2017), which may range from more 'classical' uses to highly idiosyncratic ones.

This simple fact is crucial, as it reveals many things we are rarely aware of when interacting with digital products. The shift from ownership to licenses allows market-players to do something that rules of property law do not leave room for, that is customising the concrete object of the transaction on a contractual basis. This means that the utilities exchanged by parties can be crafted and customised *by contract.* It might be useful to formalise this situation with Honoré's (1961) jargon.[7] Resorting to his conceptualisation, digital licensing implies that, when it comes to digital

Footnote 3 (continued)
Apple Watch OS Software reads and agrees to accept the terms and conditions of this (License Apple, 2020).

[4] Excluding fairness reasons.

[5] A comprehensive analysis of the economic impact of this situation is far beyond the scope of this work. We do not consider, for instance, the impact of the impraticability of second-hand markets, nor the anti-competitive side of restraints to an object's interoperability. We will instead focus on the economic harm that may come from the inapplicability of default rules of property law. For a comprehensive analysis of the consequences coming from the shift from ownership to access see Perzanowski and Schultz (2011, 2016).

[6] This is true even for embedded goods. While technically owning the hardware, users are not owners of the software, which stays in the hands of the licensor. Dysfuctionality is evident since the software is what makes the good more valuable than its analogic counterpart. Without its digital component, in fact, the hardware is deprived of all its key functionalities: the 'owner' does not own the biggest part of the value of the good (Wenderhost, 2016).

[7] Despite the (basically, agreeable) critiques that the bundle theory of property has receveid in the last years, we will use it to formalise the situation. Notions such as 'prevedibility of bundles' and 'subtraction of sticks' perfectly fit the situation of digital licensing, where the licensor and the licensee can freely

products, what is commercialised is not the *bundle* (i.e. all the utilities of the thing, all its incidents), but only some of its *sticks* (some of its utilities). What is more, *bundles* can be freely crafted by parties and there are no predetermined forms of rights to comply with, which is instead the case in property law. There, the relative stability and prevedibility of *bundles* are achieved thanks the *numerus clausus* principle. This doctrine underlies property law systems in both the civil and common law traditions, and limits the parties' freedom to create new forms of property rights (Akkermans, 2017; Rudden, 1987). However, when the good is digital, in addition to defining the contractual terms of the agreement, parties have the power to design the object of the transaction itself[8]—*what they are selling* and *what they are buying*. Indeed, they can contractually subtract one *stick* from the *bundle* to the point of leading some to talk about licesed digital objects as «things by design» (Madison, 2005).

On the contrary, with tangibles this is not generally possible. In this case, in fact, property law applies, which means that parties can adjust the contractual condition of the transaction according to their will (e.g. they may set up penalties, conditions, *et cetera*), but the entity they are bargaining on—the bundle—must be defined according to a plethora of legally-predetermined set of utilities. In other words, when bargaining under the shadow of property rights, parties can be reasonably sure about the set of rights they are bargaining on, because the possible *forms of rights*—possible bundles—are pre-determined by the law. For instance, when purchasing chattels, buyers can be sure that the bundle they are acquiring corresponds to all the possible utilities stemming from the product in accordance with its physical nature, since property rules for chattels prevent post-sale restrictions as well as servitudes (Madison, 2005, p. 410). This is, of course, a rule of thumb, as the legal regime for the acquisition of tangible property varies across jurisdictions, and it is well possible that a chattle might be burdened, after its sale, by another person's legal title (see, for instance, the issue of sequential second *bona fide* purchases). However, these are only exceptional cases, and, most importantly, they modify the *bundle* ex post, not amounting to a proper burdening by "design" of the object traded.

In addition, not only are lawful *bundles* limited, but another significant facilitating factor intervenes, that is the fact that almost everyone shares a basic yet solid understanding of what ownership is and what rights it confers. This general understanding exists even for 'fancier' forms of real rights—e.g. so that, when closing a mortgage, even laymen know with a resonable degree of certainty what will happen.

In conclusion, the shift from property to intellectual property law is not a mere technicality without practical economic consequences. On the contrary, its implications are quite far-reaching.As we show below, the shift from standardised objects of bargaining to totally unstandardised ones is likely to impact our relation with the objects that surround us more than we would expect. The fact that parties can

Footnote 7 (continued)
decide what sticks are included in the license and which among them remain in the hand of the right-holder.

[8] It is important to stress that these limitations are *legal* and they all depend on the fact that ownership, as a normative concept representing total entitlement, has been substituted by access, which is a partial entitlement instead.

contractually shape the object—the set of utilities—they are bargaining on (so as to subtract one or more sticks from the bundle) and do so without any legal limitation is not a neutral arrangement at all.

3 Some real world examples

It may be useful to go through a few examples, starting with embedded goods. Suppose someone is buying a coffee-maker. As an average consumer and current owner, she would expect to be able to use the coffee maker for all the purposes she deems appropriate. This would indeed be true if the coffee maker were a traditional one. In such a case, she would have bought the coffee maker in its entirety, including all its possible uses. This is no longer the case when the coffee maker is a 'smart' product.

In 2016, Keurig launched an updated version of its coffee maker, which was capable of recognising coffee pods, thanks to a built-in sensor. When users tried to brew coffee with generic capsules (i.e. capsules without the code as the licensed sellers' ones), they were «greeted by a message on the device's display that politely refused to make their cup of coffee, instructing them to buy Keurig-brand coffee instead» (Perzanowski & Schultz, 2016, p. 36). This is because consumers who bought the Keurig coffee-makers had—legally speaking—bought the hardware only, and not the control unit, which, being digital and immaterial, could not be sold, but licensed only. Looking at the economic side of the coin, this means that the object of the transaction was *not* the coffee-maker *in its entirety* (i.e. all the economic utilities stemming from it), but all its utilities *minus* the possibility to freely choose the brand of coffee-pods to insert in it. If the good were fully material, this would not be possible, not only due to the physical absence of the sensor, but also because property law forbids customising products with post-sale restrictions[9]—*rectius*, it prevents removing that particular stick from the bundle. Given its intangibility and legal qualification under IP law, the coffee-maker can be lawfully burdened by post-sale restrictions instead, i.e. *that* very stick can be legitimately removed from the bundle.

While the coffee-maker case is the most striking one to get to the core of the problem, other examples are equally on the spot. For instance, John Deere tractors had a built-in DRM, set up to prevent farmers from repairing their own machinery or freely choosing a mechanic in lieu of authorised repairers (Perzanowski & Schultz, 2016, p. 144). To fix these tractors, access to their control units was needed. Considering that this access was precluded not only to non-authorised repairers, but also to the owners of the tractors themselves, we may argue that purchasers did not buy the tractor in its entirety. Other examples concern not lendable cameras (Winston, 2006, p. 96), not resellable smart watches (FitBit, 2018) and smart glasses (Kravets & Baldwin, 2013). Even seeds and woodworking tools have been the subject of similar claims from the seller/licensor (Mulligan, 2016, p. 1123; Winston, 2006, fn 20).

As explained above, the realm of digital products allows many more opportunities to apply the same logic. Think for instance of the case of Apple and Anders

[9] For an analysis of the doctrine of servitudes on personal properties, see below.

Goncalves Da Silva (Archer, 2018). Due to territorial copyright restrictions, this user was denied the access to three movies he *had bought* (paying for permanent access) on iTunes Store. When he got in touch with Apple's customer service, they explained that he had lost the possibility to re-download those titles, even though he had paid for a permanent and all-inclusive license. This because the movies had been purchased from an iTunes Store of a different country than the one Da Silva was then located in (even if they were actually available on both stores). Da Silva's is not an isolated case. Many people claim something similar happened to them (Archer, 2018). They bought 'something digital' and then discovered that some post-sale restrictions were in place, preventing them from enjoying the product they paid for. In sum, after the purchase they realised that they did not acquire the entitlement to all possible uses of the thing, but only the ones included by the interplay between IP law standards and EULAs. Furthermore, no general consensus exists on the minimum degree of freedom a user shall experience after having paid for an e-book, a PDF file, a MP3 file, a movie, a videogame, nor there is a minimum standard for their functionality. This leads to a great variety of rules and praxes. In the same legal context, «some e-books can be copied, printed and forwarded to friends; others will only play on selected devices, cannot be copied or borrowed or printed» (Loos et al., 2011, p. 15); the same is true for videogames, movies, music, and subscriptions to academic journals (with varying degrees of pdf functionality and different download policies).[10]

What did Da Silva 'buy', then? To be precise, what he actually paid for was the permanent access to some contents, minus the possibility to access them in nations different from the one where the purchase took place. What about Keurig's customers? They bought a coffee maker and all its utilities, exception made for the possibility to use different coffee pods from Keurig-certified ones. And John Deere tractors users? Not differently, they paid for something that is not the whole set of utilities of the tractor, since the access to the tractor's control unit was excluded.

4 Is the standardisation of digital licensing a viable solution?

All the unpleasant situations described above could have been avoided if intellectual property law provided a mandatory limit to the legal customisation of contract objects, similarly to what the property law system does. For instance, if a mandatory right to repair had existed, the John Deere case would have never become 'a case'. Similarly, if IP law stated that the set of licensed utilities must include the right to enjoy the content regardless of geographic location, the Da Silva case would have never happened. The same holds for the mandatory inclusion of the right to resell and the right to lend (Mulligan, 2013, pp. 275 ff.).[11]

[10] See above for the differences between FitBit's and Apple' ToS for smartwatches.

[11] As argued by Mulligan (2013), in the case of 'rights involving copies' the application of the digital exhaustion principle (i.e. the doctrine stating that once a copy of a work protected by IP law is lawfully exchanged for consideration on the market, the exclusive rights of the IP right-holder on the copy, in partiuclar rights concerning further distribution, are 'exhausted') might be sufficient. The problem, again,

More generally in modern economies, how markets are born, function and evolve is shaped by the law (Deakin et al., 2017), and digital markets make no exception. The fact that the legal foundations of markets can create welcome outcomes together with perverse incentives at the same time is well documented, both outside and inside the digital sector (Chander, 2014; Giraudo, 2021; Pistor, 2019). We claim that the current legal framework of digital objects could be adjusted to correct some of its shortcomings.

The anecdotes we provided might suggest the introduction of some kind of standardisation for licenses in the digital market. If the law demanded a standard set of utilities to be necessarily licensed when bargaining on digital products, the task of «buying a bundle that is useful to own» (Van Houweling, 2008, p. 903) would be much easier. However, as we said, this is not a simple operation. IP law, differently from property law, is characterised by a so-called '*numerus infinitus*' (Mulligan, 2013, p. 249). At the moment, the *numerus clausus* principle has no place in digital markets' regulation,[12] even though «intellectual property may be the area of law where the justifications for *numerus clausus* are at their strongest» (Mulligan, 2013, p. 237).

This view is not widely shared, or at least it has not been investigated as thoroughly as the *numerus clausus* principle in property law. Accordingly, we briefly discuss below the main explanations for the limitation of parties' freedom in the field of property law, in order to understand whether the same rationale can apply to digital licensing. For each explanation we try to highlight how they serve what in the law and economics literature is commonly called *the lubricating function of the law*. Subsequently, we consider whether the differences between the new context of digital licensing and the 'normal' context of property rights determine a structural incompatibility between the *numerus clausus* principle, as variously intended in law and economics, and the realm of licensing, or, alternatively, whether the principle simply requires some adjustments for the digital environment.

4.1 The 'organisational' view

The first economic doctrine rationalising the *numerus clausus* was the one by Michael Heller. He affirmed that property rights had to be limited in forms due to their potential to impair an efficient use of resources, arguing that, when more

Footnote 11 (continued)
is that exhaustion can work for tangible items only, because it applies only to sales – and, as said above, only tangible items can be *sold.* Furthermore, the principle of exhaustion covers the right to *redistribute* the good only. Therefore, even if exhaustion applied, the actions required to *resell* digital products would not be permitted under this principle, since redistribution only (and not reproduction) is permitted under the first sale doctrine (Schulze, 2014; Sganga, 2018).

[12] This means that there are virtually no legal limits concerning the composition of the set of licensed utilities when allegedly 'selling' a digital product – this can go from more standard limitations (no right to repair) to completely unreasonable and unforeseeable ones (the right to choose your favourite coffee pod, the right to plant your seed whenever you want, the right to lend your camera to strangers in order to take a family picture, the right to repair your tractor, the right to watch the movies you paid for et cetera).

than one person is entitled to use a given resource and, contextually, to reciprocally exclude others from it, it is likely that the resource will suffer from underuse (Heller, 1998, 1999; Mahoney, 2001; Parisi, 2002; Parisi et al., 2005).

According to this theory, a legal limitation of property forms is necessary in order to minimise the social cost of a suboptimal level of use of wealth.[13] Coordinating co-owners might in fact be impossible and, even when possible, it is not a costless activity. Collecting the consent from all right-holders increases transaction costs and diminishes the surplus generated by the activity. Accordingly, the standardisation of property rights can avert the so-called 'tragedy of anti-commons', both by reducing the number of rights that may offer a hold-up opportunity and by sketching less costly ways to acquire consents. In this view, the *numerus clausus* is an organisational principle for markets and society as a whole, promoting an efficient use of resources via the standardisation of the forms for exercising decisional power (Heller, 1999; Mahoney, 2001; Mezzanotte, 2012).

4.2 The 'informational' view

An alternative justification for the *numerus clausus* is reducing transaction costs (some argue that this is the ultimate goal of property law itself, see Merril & Smith, 2020; Smith, 2011). There is a general consensus on the fact that lower transaction costs are preferable, as their presence decreases the volume of transactions both in terms of quantity and value (Niehans, 1989). However, 'transaction costs' is a wide and generic formula, an umbrella term that easily turns evanescent when applied to concrete situations. Usually, the formula covers at least three categories of costs, each corresponding to a different phase of a transaction: (1) search costs, (2) bargaining costs, and (3) enforcement and verification costs. Most of these fall into the broad 'information costs' category, and thus point to a departure from the frictionless benchmark of perfect information.

This classification somehow corresponds to different transaction costs-based theorisations of the *numerus clausus*.[14] In the first place, there is Merril and Smith's (2001) theory, rationalising the *numerus clausus* with the goal of reducing measurement costs for bargaining parties and potential successors in interests. They believe that total freedom in legally customising the object of the transaction, given the *ius sequelae* of property rights, forces all parties (especially, second-hand transferees) to spend more time and efforts in *measuring* the object of their bargaining because of the acknowledged risk to transact on a bundle that is indeed limited, but not due

[13] Heller's view is not uncontroversial. *Contra*, see Merrill and Smith (2000, p. 53) and Davidson (2008, p. 1627).

[14] Whereas usually referred to as contrasting theories, we have decided to group them here due to their similar focus on transaction costs on third parties and to their complementarity, since they concern different phases of the transaction. Also Mulligan (2013, pp. 242 ff.) believes in the complementarity of such justifications (also including that by Heller). Mezzanotte (2012), instead, separates the anticommons theory by Heller from the informational theory, but still groups Merril and Smith's and Hansmann and Kraakman's theories.

to their contractual assent.[15] In the end, Merrill and Smith (2001) conclude that law should fulfil its lubricating function by setting up a *numerus clausus* that limits the 'bundles' parties can freely create up to an optimum point—which they single out thanks to a simple model—but not beyond that.

Usually depicted as opposed to the latter, Hansmann and Kraakman's (2002) theory grounds the *numerus clausus* in enforcement and verification costs. They herald the *numerus clausus* as the solution to sunk cost deriving from the necessity to coordinate various right-holders on the same resource and to check opportunistic vindication of rights. Accordingly, they suggest that the law should shape "accommodating" (i.e. low-cost) verification rules for those rights that create big benefits for users, are likely to be amply used, have low system costs and pose small costs for non-users (pp. 396–397). They conclude that the goal of the *numerus clausus* is to maximise the amount resulting from the subtraction of non-user costs and system costs from users' benefits, and that the law should explicate its lubricating function in this direction.

4.3 The 'synthesis' view

The 'organisational' and the 'informational' views are traditionally presented as opposite. However, along with others (Mulligan, 2013, 242 ff.), we believe this is too strong a conclusion. Whether focusing dynamically on 'anticommons' and the 'problem of the future' or on transaction costs, what really matters is that both theories claim that the true rationale of the *numerus clausus* of property rights is to reach efficiency. Their only—admittedly, not irrelevant—difference is how to achieve it. In the organisational view, this happens by materially reducing the choices of private parties; in the informational view, by reducing the efforts parties must put into measuring, negotiating, coordinating, and enforcing their rights. However, at a closer look, both views stand on common ground. On the one hand, transaction costs are somehow involved in the organisational approach; on the other, the efficient allocation of wealth is also the indirect goal of informational *numerus clausus'* explanations. In a frictionless market—i.e. one without transaction costs—there would be no problem in fragmenting property rights according to the desires of the parties, as there would be no costs in renegotiating property rights and first-best efficiency would always be at hand (as an example, see Arruñada, 2003).

On this basis, we believe that the classical view, which pits organisational visions of *numerus clausus* against transaction costs-based explanations, is unsatisfactory insofar as it does not allow us to understand these theories as complementary. A more comprehensive approach might in fact enhance our understanding of the

[15] To make a contractual right *run with the thing* it is necessary to contractually-structure it as an *in rem* right, meaning that a chain of contractual obligations should be created, so to oblige reselling parties to include, in the second-hand sale contract, both a restrictive clause and a clause that obliges the second-hand acquirer to include such a restrictive clause in any future contract of sale. The possibility to create «contractually-structured running rights» is explained by Hansmann and Kraakman (2002, p. 389, p. 391).

phenomenon and help us checking the compatibility of more classical *numerus clausus* rationales with the market of digital products (*rectius*, digital IP licenses). Combined, these theories claim that standardisation of property rights is a very good thing for resource allocation when markets are imperfect. Moreover, they also entail that no standardisation would be needed if markets were frictionless: in such a case, the possibility to renegotiate would be ensured, the collection of consents would not be costly and the erosion of welfare by measurement and verification costs would not happen.

5 The compatibility-check: *in rem* versus *in personam* rights.

It is now time to verify the compatibility of these theories of the *numerus clausus* with the practice of digital licensing. The theories are salient, but not entirely. The problem is that traditional property law justifications to the *numerus clausus* rely on two elements that are not present in the field of digital licensing. Both organisational and informational justifications are based on the *in rem* nature of property rights and the potential harms to successors in the idiosyncratic interests. Indeed, according to these theories, the main reason for limiting parties' choices is the persistent nature of property rights, which results in limitations even after the transfer of these rights to third parties. On the contrary, licenses are, by definition, rights of contractual nature (i.e. *in personam*) and non-transferrable to third parties. This means that they are not persistent in character,[16] they cannot harm more people than the original parties, and they are not able to have a permanent impact.

The question, therefore, is whether these differences—inalienability and *in personam* nature—suffice to determine an incompatibility between the standard *numerus clausus* approach and the realm of digital licensing. Differently put, while traditional justifications for the *numerus clausus* are strongly based on the third-party dimension of property rights' transactions (i.e. the alienability of property rights and their *ius sequelae*), the world of digital licensing is generally constrained within the an *in personam* dimension. The question, therefore, raises spontaneously: can the rationale of efficient resource allocation and minimal transaction costs (the latter meant as both measurement and verification costs) on potential transferees still justify a *numerus clausus* theory in a field where none of the aforementioned elements is present? This, of course, does not deny that other typical *numerus clausus* justifications might back the *numerus clausus* doctrine even in the field of digital

[16] We have decided not to examine the impact of these restrictions on successors in interest. This is because the legitimacy of digital products' transferability (*latu* sensu, including re-selling, sub-licensing and licensing transfers) is not clear. For sure, there are cases where it is possible to transfer embedded goods (see note 4 for the possibilty to make a one-time transfer of Apple Watches) and digital contents (see Mulligan (2013, p. 279), for a similar possiblity by Microsoft), but we still do not consider them here. The instability and imprevedibility of the possibility to transfer digital licenses makes it a highly unreliable argument. Furthermore, transfers are not permitted for the vast majority of digital products. Finally, we do not consider the transferability issue because it would be at best an *a fortiori* argument: even if true, it would only reinforce our main thesis.

licensing. Think, for instance, to the rationalisation of the legal design of rights and the outlawing of idiosyncratic and unfair/inefficient titles, or to the facilitative function that the *numerus clausus* has on reducing information costs even *within* the relative situations of contractual parties. However, the purpose of the following discussion will be to check whether, beyond these standard rationales, a justification based on externalities and the outside dimension of digital licensing transaction is available.

5.1 Chattels servitudes and the 'new servitudes'

We believe that useful insights for answering this question might stem from the dated—but still applicable in its policy takeaway—doctrine of servitudes over chattels. As it turns out, in fact, the majority of arguments in favour of a *numerus clausus* standardisation on digital products are based on an analogy with the structure of chattels servitudes.[17]

Simply put, servitudes on chattels are not allowed, and this holds valid in both the common law and civil law tradition. This means that, while it is possible to burden a portion of land with a legal restriction that is imprescriptible and enforceable against third parties, it is not possible to do so for pieces of personal property such as chattels. It is indeed possible to impose a contractual limitation on the use of a movable, but it cannot *run with the thing*, meaning that potential successors in interest have to expressly give their consent to the duty; otherwise, it will not be enforceable against them. Accordingly, the restriction can only be *in personam*, not *in rem*, since its enforcement is limited to the subjects who have agreed to it. This quite striaghfroward picture is complicated by the fact that for *some* chattels of higher value (e.g., work of art, racehorses, vehicles), the law has developed, in both civil law and common law jurisdictions, a plethora of institutions that allow burdens to run with the thing. However, this is not the case for objects that are the subject-matter of digital licensing transactions. Thus, this paragraph will stick to the standard baseline scenario where chattels servitudes are not allowed.

Examples of servitudes over movables can be various. Imagine a bag containing a warning that repairs can be made by authorised tailors only. Suppose this condition was not considered a 'personal'—*rectius*, contractual—duty, but a *real* one (i.e. a duty that runs with the thing and passing to the secondary owner even in the lack of a specific contractual provision). In this case, the bag would have been burdened by a servitude. Similarly, a table whose height is not modifiable due to an *in rem* obligation is legally considered to be burdened by a servitude. If a bookmark comes

[17] Servitudes are *in rem* duties running with things. They are legal tools tying rights and obligations to ownership or possession of land, so that they run with the land to successive owners and occupiers. The concept is similar in common law and civil law systems. In particular, both systems share two main features of servitudes (their real nature and the fact that they stick with the ownership of the [land]), see French (1998). In servitudes recognised by law, «whether or not they expressly agree to its terms, subsequent owners and occupiers are bound to follow the servitude», see notably Chafee (1956).

with the duty to be used on Russian novels only, it is regarded as burdened by a servitude.

But why are servitudes over chattels forbidden by law? The reasons for this restriction are two. In the first place, burdens on chattels are notoriously more difficult to discover, especially when compared to burdens on lands. While, the legal state of affairs of lands is registered, the publicity function of possession cannot serve as signal of burdens that are not immediately perceivable from the physical features of the good.[18] Accordingly, to make sure that, when buying a material thing, the bundle perfectly matches the *rerum natura* features of the thing, property law limits the legal customisation of objects. The second reason is that exchanges upon them are usually less valuable than the ones upon lands. This means that transaction costs are more easily compensated when it comes to lands compared to when movables are involved.[19] In the case of a high-value deal, the threshold level of transaction costs that would make the deal too costly and thus inefficient is also likely to be comparatively higher than in the case of small purchases. Hence, the net value of land bargains and the overall surplus coming from them are more likely to be above zero even in the presence of significant transaction costs.

5.2 The supporting view: lack of publicity and transaction costs

Again, we are confronted with the question whether this policy rationale is applicable in a market, the digital one, that is structurally *in personam* and does not allow reselling.

Undoubtedly, the internal structure of a chattel servitude has a lot to share with the digital product examples mentioned above. After all, why should we give a different legal configuration to the coffee maker that comes with the duty to only buy a specific type of pods with respect to a 'Russian novels only' bookmark? Why should judges enforce the duty, coming with the tractor, of only choosing authorised mechanics and not the obligation to have a bag only repaired by licensed resellers? Not to mention the duty running on a wardrobe to substitute its shelves with the ones produced by a specific company (likely, the producer's), which looks hardly different from the obligation to substitute the remote control of a garage door with the one made by the company that has manufactured the door itself. Indeed, the legal and economic structure of all these situations is remarkably similar.[20]

[18] This is, broadly speaking, the publicity function of the thing-by-nature (Madison, 2005). In the law of movables, the publicity is mainly fulfilled by the *nature* of the thing – in the sense that the legal limits of ownership on a chattel are the physical limits of the chattel itself – and its possession. See Hansmann and Kraakman (2002), describing possession as the most basic verification rule.

[19] In general, when the value of a transaction is high, market players can more easily recover the (often, less-than-proportional) transaction costs deriving from widespread destandardisation.

[20] A discussion of the related issue of self-enforcement is beyond the means and purpose of this work. Suffices to note here that when damaging others by the use of our properties, remedies in favour of damaged parts can usually be activated only after the alleged damage has taken place and, most importantly, only after a court has both sanctioned the actual existence of the damage and determined how it should be repaired – all through a due process. Apparently, this is not what happens when companies

In broad terms, digital markets and (what we might call) *digital chattels* might also be characterised by the same features that justify restrictions on chattels servitudes in comparable markets. Consider in the first place that digital goods account, on average, for low-value transactions. While in fact the overall revenue from digital products keeps growing, it is mainly composed of many everyday transactions of usually small value (especially when compared to, for instance, most transactions in real estate or finance).[21] Accordingly, the 'critical threshold' of transaction costs might be even lower in the case of digital chattels than for material ones (Van Houweling, 2008, p. 933). On top of this, allowing a high degree of legal customisation of objects would make the digital market even more uncertain than a hypotethical one of burdened chattels, because the digital realm lacks the minimum degree of publicity deriving from the objects' physical features. This circumstance is reinforced by the so-called *unreadness* phenomenon[22] and by the fact that in the digital context consumers are mostly unable to evaluate the consequences of post-sale restrictions (Van Houweling, 2008, p. 921). In short, the two features backing the standardisation on bundles for chattels (lower critical threshold of transaction costs and lack of publicity) are present in the markets for digital products in an even stronger way.Several authors have recently pointed at the possibility to introduce restrictions on digital objects by the same principles applicable to chattels servitudes. Robinson (2004) states, for instance, that the «ubiquitous use of restrictive licensing agreements has created the functional equivalent of personal property servitudes» (p. 1452). Van Houweling (2008) affirms that the class of digital products «exhibits a different mix of problematically servitude-like features» (pp. 949–950) and that «these contemporary licensing practices […] resemble problematic chattels servitudes in several respects related to notice and information costs» (p. 934). Consequentially, she advises to use the chattels servitudes taxonomy to find solutions to the problems posed by what she calls *the new servitudes*. Not differently, Mulligan (2016), by comparing traditional servitudes to new ones, argues that IoT servitudes are more similar to chattels servitudes than not, and that they might create social and economic harm if not adequately limited, for reasons not too far from what servitudes on chattels could have done in the past.

Footnote 20 (continued)
self-enforce their whims on consumers' properties. See in general Grundmann and Hacker (2018) and Robinson (2004).

[21] We can think of very few exceptions to this broad characterisation. These exceptions do not play a role in most consumers' lives (and sellers' profits) that is anywhere comparable to consumer electronics and online services subscriptions.

[22] Among the reasons for this well-known phenomenon consider that: (1) contracts defining the IP rights licensed to consumers are written by one part only, (2) consumers have no room to negotiate as it is usually a take-it-or-leave-it approach, (3) the enforcement of consumer contracts is highly inefficient from a cost–benefit analysis standpoint (Ben-Shahar, 2008).; According to Van Houweling (2008, p. 934), the *unreadness* phenomenon has a particularly negative impact in the field of digital licensing, as contracts involving digital products «typically arise out of relatively low-value, one-time transactions in which at least some non-drafting parties are unlikely to invest much time and attention». This aspect will be deeply investigated below.

Arguments for a *numerus clausus* for digital products exist too. Though not directly based on the chattels servitudes doctrine, they still advocate for a *numerus clausus* expansion due to a lack of publicity and information asymmetries in digital markets. For instance, Moringiello (2010) claims that the «justifications for [the *numerus clausus*] principle apply with special force to disputes over intangible assets» (p. 178). According to her view, the salience of the *numerus clausus* principle in the context of digital assets stems from the lack of publicity plaguing that market. The non-physical nature of digital objects, she argues, prevents a direct appreciation of the 'boundaries' of these objects—and of the bundles of rights upon them (p. 188). By predetermining the forms of rights, the *numerus clausus* then carries out a "notice function", which might be «particularly useful in an environment in which the predominant method of contracting is by online terms of use» (p. 190). Similarly, Mulligan argues that a *numerus clausus* principle for intellectual property rights involving copies should be recognised in the digital world. She believes that «the *numerus clausus* principle could significantly benefit this area of intellectual property law by eliminating the licensing of copies of digital works and software and replacing them with 'digital sales'», which would work similarly to chattels sales. In her view, this would be particularly important in the digital sector because of the information asymmetries characterising digital licensing.

5.3 The sceptical view: digital markets as personally-structured

In the previous subsections we have argued that the servitudes doctrine is still applicable today in the case of digital goods and that the *numerus clausus* rationale can also be found in the realm of digital linceses. Yet, there are good reasons to be somewhat pessimistic about such an assimilation, or at least to critically qualify it.

According to some authors, the *in personam* nature and inalienability of licenses determines a structural incompatibility between the *numerus clausus* doctrine and the world of digital licensing—which, it is remarked, affects parties in the original relationship only, i.e. IP holders and licensees. Akkermans (2008), for instance, states that the *numerus clausus* rationale can only be found in property law—the latter being defined as the domain of property rights (i.e. *in rem* and alienable ones). He argues that «only in a system where there is a distinction between property rights and personal rights and, connected to that, between the law of property and the law of obligations, does using such a filter [the *numerus clausus*] makes sense» (p. 409). This can be explained away by noting that Akkermans writes from a purely legal perspective, where the *numerus clausus* principle has a more restricted technical meaning, but Law and Economics scholars have similar doubts too. Mezzanotte (2012), for instance, claims that the loosening of the division between contract law and property law makes the *numerus clausus* more similar to mandatory clauses in contracts than to a principle regulating markets and enhancing their smooth functioning. Accordingly, it is necessary to draw a rigorous distinction between property rights and contractual rights on the basis of their *ius sequelae* and their alienability. When this boundary is blurred, and the proprietary character of an entitlement

is weakened, Mezzanotte believes that «the limits on contractual freedom […] end up losing any possible rational justification» (p. 13). Similarly, Arruñada (2017, pp. 758–59, p. 760) states that, in principle, there is no reason nor plausible justification for the limitation of parties freedom in a market that is made of single, one-off transactions upon *in personam* rights, since all benefits and costs originating from the contract fall on contracting parties. According to him, traditional justifications for the *numerus clausus* doctrine only make sense in markets made of subsequential exchanges bounded by derivative acquisition, since sequential exchanges and *in rem* rights «drastically change the nature of transaction costs, including what in the single-exchange world would be a perplexing interaction with property rights» (p. 759).

The reasons for such scepticism are easy to grasp. The *numerus clausus* justifications that we have analysed above are largely based on the *third-party dimension* inherent to property rights. All affirm that the *numerus clausus* is beneficial to markets because it reduces transaction costs on third parties, makes verifying and enforcing rights easier for third parties, and smoothens procedures for future renegotiations of rights. Instead, in the world of digital products, no third parties dimension *legally* exists for the vast majority of cases, which means that the reasons to give up a fuller *libertè contractuelle* look far less cogent. First, the legal customisation of digital products happens through a license, which means that only the contracting parties will bear the costs of an idiosyncratic and unreasonable license (Arruñada, 2017). Secondly, digital licenses are not subsequently transferrable, which eliminates at the root the transaction costs problem on potential successors in interest. Finally, digital resources are by definition highly replicable and suffer from quick obsolescence, which might alleviate the so-called «problem of the future» (Mahoney, 2001).

In conclusion, when moving from sequential exchanges to the privity of contract, traditional justifications of the *numerus clausus* could really lose ground. This is valid even when recognising, as Merrill and Smith (2001) did, that there is a grey area between contract and property where the features of both show up (notice that they did not include digital licenses or other forms of IP rights in this category). After all, if the rationale of that doctrine can only be found in the third-party dimension of property rights, then it is simply reasonable that it cannot be of any help in the personally-structured field of licensing in general. This holds true even for digital licensing, where contractually-shaped restrictions are built in the object—they *are* part of the object—and are therefore automatically enforced against consumers. What makes a right proprietary, at least in the context of *numerus clausus* justifications, is its permanence in the face of different titleholders; the fact that a particular attempt to breach the contract is prevented by the object itself does not mean that it is enforced *in rem*, but rather that it is enforced *ex re*.[23]

[23] These concepts are usually confused. But the importance of such difference should not be underestimated. An *ex re* enforcement can happen even *in personam.*

6 A simple economic model of enforced contract standardisation

The above-mentioned critiques sound convincing. Still, if the *numerus clausus* has no reason to exist in the privity of contract zone, why does allowing the marketing of non-reparable tractors sound so unreasonable? Why does «a coffee maker limiting your choice of grind seem as out of place as a frying pan dictating your egg» (Barrett, 2015)? We believe that a different rationale must exist for constraining the parties' freedom to legally shape the bundle of rights they are transacting on, even in personally-structured markets.

To illustrate the intuition behind a new rationale for a *numerus clausus* in the privity of the contract zone with a simple economic model, where one consumer can purchase contracts from a firm with market power. Under the assumptions that (i) standardisation can reduce market power (call this the 'competition effect'), and (ii) enforced standardisation can reduce a transaction's total surplus (call this the 'loss-in-diversification effect'), introducing stronger standardisation can result in an overall efficiency gain when market power is strong.

More in detail, we first show that in the market equilibrium without standardisation firms with market power will price by charging a markup on their cost, which leads to the textbook case of deadweight loss (inefficiency). We then show that this loss can be decreased by enforcing some degree of standardisation which decreases the market power of the firm. Finally we show that enforced standardisation is efficient (i.e. the competition effect is greatest compared to the loss-in-standardisation effect) when firms would otherwise charge high markups because they have considerable market power.

The economy is composed of two sectors. Each sector makes one offer to a representative consumer with CES preferences and endowed with W resources.[24] Contracts provide the consumer with streams of utility, so the consumer simply chooses how many contracts to accept from each firm and pays the price. Contract a is supplied competitively and its marginal cost is the *numeraire* (i.e., it is normalised to 1). Contract c is supplied monopolistically by a firm that faces a constant marginal cost ψ.[25]

The consumer maximises her utility by solving:

$$\max_{a,c} F(\varepsilon)\left(c^{\frac{\varepsilon-1}{\varepsilon}} + a^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}} \quad s.t. \quad a + pc = W \tag{1}$$

where $\varepsilon > 1$ is the elasticity of substitution and p is the price of contract c.[26] $F(\varepsilon)$ is a normalizing function that ensures that, for any given (c, a), the objective function

[24] Including firm profits into the consumer's budget constraint would not affect the results (since any profit above zero would imply some deadweight loss: more on this below), but would complicate the math.

[25] In the case of purely digital products, marginal cost is usually close to zero, while it is strictly positive for the case of chattels. Still, it is important to consider that this cost, as explained below, also depends on the degree of standardisation of the contract.

[26] ε captures how hard it is for the consumer to switch from one good to another given an initial consumption bundle. For example, if $\varepsilon \to \infty$ the two contracts are perfect substitutes.

takes the same value regardless of the ε. We assume that all agents take the value of $F(\varepsilon)$ as given. This normalizing function is needed because in the model we allow elasticity to change, but we do not want these changes to directly affect the consumer's utility level. We set the price of offer a equal to 1 since the offer is supplied competitively and its marginal cost is, as we said, the *numeraire*.

The monopolist maximises his profits by solving[27]:

$$\max_{p}(p-\psi)c \tag{2}$$

The social planner has the option of introducing an arbitrary degree $s \geq 1$ of standardisation in the monopolistic sector (up to $s \to \infty$), where $s = 1$ corresponds to minimum standardisation. Standardisation affects both costs and market power in the following ways:

$$\psi = \psi^* s \tag{3.1}$$

$$\varepsilon = \varepsilon^* s \tag{3.2}$$

In other words, standardisation has two effects: (i) it increases the marginal cost above its baseline ψ^*; (ii) it decreases market power by increasing the elasticity of substitution faced by the consumer above its baseline ε^*. This captures the idea that standardisation can benefit consumers by making transactions easier to understand and evaluate, thus reducing the market power of the supplier (since consumers are now more inclined to ditch his contracts). We called (3.2) the 'competition effect', which includes the protective effect for consumers. However, the benefits of the competition effect come at a cost, since standardisation potentially prevents parties from striking the optimal deal, thus reducing the transaction's overall surplus. We called this the 'loss-in-diversification effect': in our model, it is captured by (3.1) as a cost increase.[28]

The loss-in-diversification effect is modeled as a simple cost increase for analytical convenience. While it might even be argued that a standardised contract should cost *less* than a a tailored-to-customer one, results would be unaffected if, instead of increasing costs, we modeled standadisation as a decrease in the utility stream from c by a corresponding factor. Economically-speaking, it is in fact indifferent to think of a given amount of 'utility' costing k times more (cost increase) or of the utility that can be acquired for some given resources decreasing by the same k times (utility decrease).[29] In practice, we may think about the loss-in-diversification effect as a decrease in the overall surplus of the transaction, regardless of whether this comes from less utility for the consumer or higher costs for the supplier. Economic

[27] We assume a linear cost function (i.e. constant marginal cost) for simplicity's sake. Extending to a more general increasing and convex cost function is possible, but does not affect our results qualitatevely.

[28] For further discussion, see, respectively, Sects. 7.1 and 7.2.

[29] Or maybe a mix of the two, with costs *decreasing* by, say, a factor n (due to the 'scale economies' provided by standardization) and utility decreasing by, say, m, with k being the overall unfavorable loss-in-diversification effect obtained by combining m and n.

analysis allows us to treat these alternatives as equivalent, so we can look at the loss-in-diversification effect as being a cost increase only, without loss of generality.

6.1 Market equilibrium

The market equilibrium is characterised by the quantities c, a and the price p that solve (1) and (2). Without action from the social planner we have $s = 1$ (i.e. minimum standardisation), thus $\psi = \psi^*$ and $\varepsilon = \varepsilon^*$ (from (3)).

The CES properties of (1) yield the well known first order condition and conditional (on a) demand function:

$$c = ap^{-\varepsilon^*} \tag{4}$$

Substituting (4) into (2) yields the other well known first order condition of the firm problem:

$$p = \frac{\varepsilon^*}{\varepsilon^* - 1}\psi^* \tag{5}$$

Condition (5) makes it clear that, given $\varepsilon > 1$, the markup over marginal cost is decreasing in the elasticity of substitution. The underlying intuition is that, if it is easier for the consumer to substitute away from expensive products, the firm will be forced to charge a lower markup. So, if the monopolist could choose an arbitrary level of standardisation $s \geq 1$, he would always go for $s = 1$, since this maximises his profit margin. In other words, it is not in the monopolist's interest to encourage the competition effect, since this would affect his markup over marginal cost. Intuitively, more contractual flexibility allows suppliers with market power to make more profits by tailoring contracts to their clients.

In our context, the price p is not just what is paid when the offer is chosen. p represents all those transfers from the consumer to the firm that must take place when the buyer accepts a single contract c. In other words, p accounts for all those additional (costly) obligations that consumers face. In the model we assume perfect knowledge of p by the consumers. This captures the idea that consumers know they might be missing something costly when they sign a contract they have not read, but do it anyway.

To characterise the equilibrium, quantities c, a can then be obtained by substituting (4) back into the consumer's first order conditions and budget constraint. Note that this market equilibrium is not efficient because of the standard deadweight loss caused by monopoly pricing.

6.2 Social planner equilibrium

An equilibrium where the social planner sets s is still characterised, in addition to a value $s \geq 1$, by quantities c, a and by a price p set by the monopolist, just like the market equilibrium. Yet, the social planner who maximises consumer utility faces a tradeoff: as s increases, the monopolistic market gets closer to the optimal outcome

(i.e. $p = \psi^*$), but ψ increases too, meaning that the welfare gain from the competition effect might be offset by the welfare loss from the loss-in-diversification effect.

Note that, while the welfare gains from decreasing the markup are bounded because the price cannot fall below marginal cost, the losses from increasing the marginal cost are unbounded.[30] Let's visualise this in terms of an extreme case, where the law forces firms to offer only one specific contract (i.e. full standardisation, $s \to \infty$). In this scenario, the monopolist would have no room whatsoever to extract any additional surplus from the transaction (full competition effect), but many consumers would be very unsatisfied with the arrangement, either because this decreases what they get from the offer or—as in our preferred formalization—because it imposes such high costs on firms that prices become prohibitive.

Substituting (3) into (5) , and assuming that the social planner 'moves first', so that the firm and the consumer take s as given, yields:

$$p = \frac{\varepsilon^* s^2}{\varepsilon^* s - 1}\psi^* \tag{6}$$

Therefore, the social planner will choose s such that p from (5) is minimised, since, the lower p is, the closer it will be to ψ^* (which is the first-best outcome). Note that, regardless of the value of s, the scenario where $p = \psi^*$ is not attainable. In other words, the social planner can only achieve a second-best outcome, since the firm will never price below its actual marginal cost $\psi = \psi^* s$, which is clearly greater than ψ^*.

The second-best outcome is achieved by solving:

$$\min_s p$$

where p is the same as in (5), which is a well-behaved objective function. The solution to this problem is (remember that $\varepsilon^* > 1$ by assumption):

$$s = \begin{cases} \frac{2}{\varepsilon^*} & \text{if } 1 < \varepsilon^* \leq 2 \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

Condition (6) has an intuitive interpretation. If demand is very elastic (i.e. $\varepsilon^* > 2$), then the monopolist is weak, in the sense that he can only charge a low markup even in the market equilibrium, because the consumer can easily substitute away from an expensive contract. As a consequence, the benefit from standardisation (competition effect) is immediately offset by the increase in marginal cost (loss-in-diversification effect). Therefore, it is optimal not to enforce any additional standardisation. Instead, when the monopolist is strong and charges an high markup because demand is relatively inelastic (i.e. $1 < \varepsilon^* \leq 2$), setting $s > 0$ increases overall welfare, because the benefit from the erosion of the monopolist's markup can be greater than the cost of standardisation itself. In other words, standardisation is desirable when a party has

[30] Formally, from (5) take the limit as$s \to \infty$. Notice that we have $\lim_{s \to \infty} \frac{\varepsilon}{\varepsilon - 1} = 1$, but $\lim_{s \to \infty} \psi$ is unbounded. In other words, while the markup cannot go below zero, costs do not have an upper bound.

considerable market (and bargaining) power over the other. In practice, as we said, this market power could arise from asymmetric information about the content of the offer and the features of the object, which incentivises rent extraction from the better informed party, making standardisation more needed.

The intuition behind the social planner's optimal choice of s when demand has low elasticy can be visualised in Fig. 1.

As Fig. 1 shows, when elasticity is low and thus the monopolist has a greater ability to extract rent, standardisation can improve overall welfare by inducing an allocation which is closer to the first-best equilibrium (although not as good, since $p > \psi^*$). Therefore, an optimal level of standardisation exists that achieves the second-best outcome. This corresponds to the pair (S, P) in Fig. 1, which is the point where the monopolist's markup (from Eq. (5)), and thus his extra-profit, is minimised.

7 The protective function of the *numerus clausus*: a rationale for the 'privity of contract zone'

Would the *numerus clausus*, at least theoretically, achieve the optimal level of standardisation implied by the model in the sectors mentioned in Sect. 2, i.e. digital licensing? When reflecting on the Keurigg case, the first thought in our minds is not a meditated concern for potential subsequent buyers of second-hand coffee-makers (which would be the case if we were talking of a hidden burden over lands), but a sense of imbalance in the relationship between the 'seller' and the 'buyer'. It is true that the law has other tools and institutions than the *numerus clausus* to deal with the problem of deceived buyers. However, it is submitted here that this does not eliminate the need for the introduction of a *numerus clausus*-like principle in the market of digital licensing. This is because there is a relevant difference, in term of enforcement and verification costs, between taking care of deception through an ex post remedy (which would imply, depending on the jurisdiction of reference and the substantial relevance of the deception, to rescind or modify the transaction) and preventing it to occur through a careful ex ante design of legal entitlements and objects in a more consumer-friendly way.

One useful analogy might be the obligation to disclose some standard nutritional information on food labels. Without this, it would be too costly for buyers to acquire said information individually, leaving them with greater uncertainty about what they would buy anyway. The lack of information could be exploited by sellers, who might diversify their product lines to extract more surplus (e.g. by selling a selection of labeled food at a premium, in order to price discriminate between different types of consumers).

The urge for an alternative justification for the *numerus clausus* principle in the field of digital licensing also arises from the practical situation of digital markets. These markets do not in fact display any of the typical features of markets plagued by excessive transaction costs and resources' underutilisation. Historically and theoretically, the *numerus clausus* has been heralded as a tool to smoothen bargaining and trade. The paramount example of this is the abolition of the *dead hand,* in order

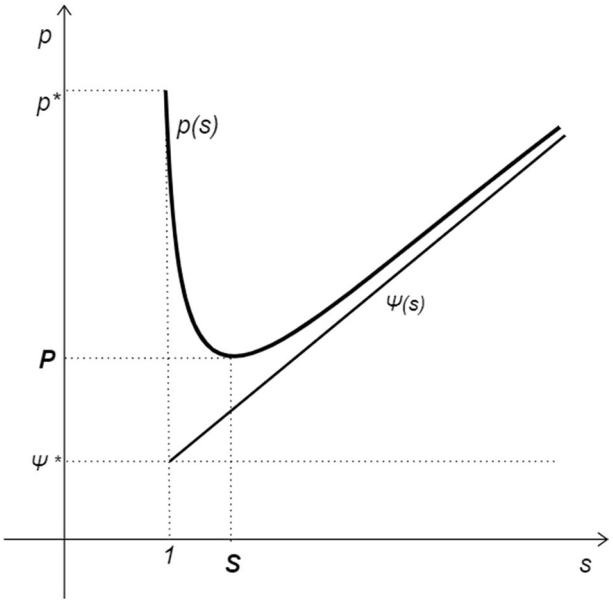

Fig. 1 Relationship between s and p when $1 < \varepsilon^* \leq 2$. The function $p(s)$ is described by (5), the function $\psi(s)$ id described by (3.1)

to facilitate land exchanges. However, digital markets do not appear to suffer from similar problems, which should translate into reduced sales volumes and constrained supply. On the contrary, they constitute an increasingly thriving and profitable part of today's economies. Furthermore, transactions involving digital products are rather frequent for most consumers and represent a growing share of their spending. It is therefore hard to consider digital markets as critically affected by the issues that have justified the limitation of freedom of contract in the past.

All these considered, we believe that the *numerus clausus* might—indeed, should—have a secondary function, not alternative but complementary to the ones discussed above, which activates under particular circumstances. We will call it the 'protective function' of the *numerus clausus*. In this sense, we believe that the mandatory standardisation of licensed bundles of rights might be a handful tool to promote competition, reduce mark-ups, increase consumer surplus and generally enhance the functioning of markets. This would be especially true in markets that display some specific characteristics, such as wide information asymmetry, uneven bargaining power and high concentration of market power. More importantly, such justification holds true even if limiting the analysis to the 'privity of contract zone', thus considering neither the costs on potential successors in interest nor the anti-commons problem.[31] A somehow similar intuition comes from Moringiello (2010)

[31] Obviously, this does not imply that, in markets where the third-party dimension plays a role, such protective rationale cannot be found. On the contrary, it will hold valid *a fortiori.*

and Mulligan (2013), who both state that a *numerus clausus* for digital licensing is needed so that people can actually understand «the extent of the rights they are acquiring» (Moringiello, 2010, p. 190), something that would otherwise take «an inordinate and unrealistic amount of time» (Mulligan, 2013, 276). The following subsections discuss this hypothesis, i.e. that a protective rationale exists for the *numerus clausus* doctrine and that it comes in handy when specific circumstances occur.

7.1 The consequences of destandardisation

Suppose consumers live in an extreme version of the world described by Omri Ben-Shahar, where they receive 'take it or leave it' offers for objects that are so difficult and costly to measure and screen that they simply renounce to understand what sticks are in the bundle (Ben-Shahar, 2008). Everyday experience suggests that many, if not most, transactions concerning digital products and services are not that far from this description. Consumers rarely know what they are really buying and/or agreeing to, but they are aware that there is a not-so-remote possibility to eventually discover that they have accepted something that will somehow harm them in the future (Van Houweling, 2008, p. 940). Yet they accept the offers anyway. This is actually sensible: digital products play such a crucial role in so many aspects of their lives that they are willing to sustain additional costs that are not (a visible) part of the price they pay when the contract is signed. At the same time, the lack of valid alternatives, either because almost all competitors offer similar contracts or because there are almost no competitors in the first place (*re* the issue of high concentration: see below), forces consumers to decide whether to blindly accept or refuse the offer as a whole.

In short, screening costs for these offers are prohibitive and therefore rationally avoided. Hence customers are better-off by sticking with these products, even if the risk exists of finding out that the object is contractually-shaped differently from what it was reasonable to expect. The willingness to accept clearly means that the expected harm consumers face for *not* screening is not high enough to deter most of them from buying. This trivial conclusion is also backed by evidence: if this were not the case, we would not witness a booming digital sector. From an economic perspective this is very good news, since the fact that many are willing to keep buying means that some degree of mutual gain still exists in the agreements that firms propose.

However, this is no lucky coincidence. Technology firms are well aware of consumers' preferences for their products and have considerable market power (Philippon, 2019). They are therefore in a favourable position to, at least potentially, exploit potential information asymmetries and increase their profits by extracting a big chunk of consumer surplus. In fact, the combination of high willingness to buy, low willingness to get information and the possibility to craft objects of contract leaves room for the behaviours we described in Sect. 2. Note that firms still walk a narrow path. They must be careful not to propose contracts with clauses that can *ex post* 'scare' customers away from future purchases by harming their reputation, as this would hurt future profits. Firms aim at elaborating offers—*rectius*, elaborating

objects—that consumers will accept again, *despite* persisting uncertainty and *despite* they might have been damaged by some clauses in the license they did not know about.

These considerations are likely to hold in a dynamic setting too. Over time consumers might learn about products (assuming they are able to do so), and put some competitive pressure on firms to offer less extractive contracts. However, firms would 'play' the dynamic game too, by adjusting their offers over time with the objective of maximising profits. Since, in settings with asymmetric information, the informed party has the ability to extract some information rent, we would still detect some consumer harm. In addition, it is possible to imagine a dynamic game where firms keep updating the contracts that they offer (even by paying a cost) in order to keep their valuable information advantage over buyers.[32]In some contexts entry could dampen these negative outcomes, but in the presence of endogenous sunk costs (such as the ones stemming from investmenting into the preservation of market power) there would still be market power in the dynamic equilibrium, even with completely free entry (Sutton, 1991).

The anecdotes of Sect. 2 suggest that technology firms are quite successful at this. Some harm to consumers is therefore inevitable: sellers can appropriate most of the surplus through direct transfers and obligations that strengthen their position. They create value for themselves not only through proper sales (i.e. exchanging products and services for a price), but also thanks to what customers unknowingly agree to, be it buying coffee capsules from one supplier only or not being able to repair their tractor autonomously (Mulligan, 2013, p. 264 argues that the issue of uniformed consumers is especially dangerous when digital licenses are traded). In practice, sellers exploit their market power by offering customers contracts with 'hidden' (since they are neither read nor understood) clauses, which, either directly or indirectly, grant them such additional value. When the Keurigg coffee machine is sold, the seller's profit come not only from the sale itself, but also from the additional earnings stemming from the future (forced) purchases of brand coffee capsules.

But, why don't sellers simply raise prices, without elaborating increasingly complicated contracts and restricted objects? The answer is that a contractual strategy is often preferable because it allows firms to insert clauses for multiple possibilities that need not arise *every time* the contract is accepted. For example, most e-reader users encounter minimal accessibility problems (thus face almost no additional costs) because their use of the product is compatible with the producer's profit-maximising strategy. Thus, it is more efficient for the latter to charge relatively lower prices and extract as much value as possible *when feasible*, rather than distribute a uniform and visible price increase among all customers.[33] This, we claim, is the

[32] The idea that firms invest to accumulate and preserve market power has been explored and its implications are not necessarily negative (Peters, 2020), but here we are restrincting our focus to pure rent seeking decisions.

[33] In economic jargon, the situation we are describing is closer to price discrimination. A monopolist capable of discriminating may extract even more consumer surplus, and thus further increase his profits, with respect to simple, uniform monopoly pricing. In our examples, the discrimination is performed via contract clauses, rather than via personalised prices.

reason why firms are incentivised to make as much use as they can of de-standardisation of objects through idiosyncratic licensing.

7.2 The protective rationale: the 'competition effect'

As we said, three elements appear necessary to make the above-mentioned rent extraction to happen: (1) market power, (2) asymmetric information, and (3) its exploitation through de-standardisation.[34] Market power is necessary because each seller needs to face soft competition to extract additional value from consumers. In the absence of it, consumers would easily switch to substitute products that are offered at more favourable conditions—which include more sticks of the bundle (or that offer the same sticks at a lower cost). Asymmetric information—with the customer being the uninformed party—is even more clearly necessary because, in the absence of it, consumers would not need any screening in the first place, leading to less market power and, thus, to a decreased ability to extract surplus. Finally, the possibility to de-standardise ensures that information stays asymmetric and that firms can contractually craft objects to maximise surplus extraction (in the given context).

Simply put, we argue that when these three elements are present, a *numerus clausus* doctrine might be helpful. More analytically, our claim is that standardisation, and in particular standardisation of objects, can be a costly but sometimes effective tool to decrease the extraction of consumer surplus by firms, taking as given the existence of significant market power and asymmetric information. Accordingly, in these last pages we show how a *numerus clausus* of licenses might be a useful tool to reduce some of the dysfunctional aspects of this situation, thus adding a new *protective rationale* to the *numerus clausus* doctrine as traditionally intended in the literature. The protective function arises when standardisation is conceived as a way to protect consumers from contractual situations that, given their factual features, would be likely to create a high risk of surplus extraction.

This new protective rationale works in the original contractual relation between parties (i.e. in the 'privity of contract zone') and thus perfectly applies in personally-structured markets as the digital ones. It is in fact based not on the costs beared by potential successors in interests, but rather on the generation of surplus within the single transaction and its distribution among parties. If some mandatory form of standardisation were enforced, consumers would be faced with more understandable offers and, therefore, with better chances to gain a larger share of the surplus. Moreover, our solution would allow the most extreme subtractions of essential utilities from a product—like e.g. choosing types of coffee, repairing tractors, lending cameras—to be directly outlawed, if so desired by law-makers. Mandatory rules concerning a hard core of sticks that must be necessarily included in the bundle—that

[34] Although made more specific to better suit digital markets, these characteristics are in the spirit of Schwarz (1995).

is, licensed—when 'selling' an embedded good or a digital content would then empower consumers and push companies to make less extractive offers.[35]

It is important to note, though, that our proposal is not just a matter of distributive effects. For sure, de facto outlawing the most damaging clauses and the subtraction of some essential sticks from the bundle would directly prevent the extraction by firms of (too much) consumer surplus. Yet, the fact that the *numerus clausus* works defensively *in the privity of contract* does not imply that its effects are limited to that zone and to parties directly involved in the transaction only. On the contrary, we argue that the *numerus clausus* of digital licensing would also positively impact overall market efficiency. This because, simply put, standardisation would enhance competition. While there are specific theoretical cases where the extraction of consumer surplus does not diminish overall welfare, the general result—and consensus—is that when firms earn supra-competitive rents, some deadweight loss ensues (see, for example, Mas-Colell et al., 1995, pp. 384–387). We group these beneficial consequences, for both consumers and markets, under the label 'competition effect of standardisation'. Therefore, even without considering the specific competitive structure of digital markets, a higher degree of contract standardisation could generally improve competition and thus market efficiency.

That standardisation may exercise a beneficial effect is easy to show. It is for instance a well-known result in economics that legal restrictions on private contracts can improve economic efficiency when bargaining power and information are asymmetric (Aghion & Hermalin, 1990). On this basis, with respect to digital products, introducing a *numerus clausus* for digital licensing would diminish inefficient rent-extraction. Moreover, when contracts become more similar and are better understood, consumers would be able to make more informed and flexible choices among alternatives, forcing firms to compete by offering better objects at better contractual conditions.

7.3 The 'loss-in-diversification effect' and externalities

Needless to say, introducing a *numerus clausus* on licenses that involve digital products would have a negative aspect too.[36] Restricting the ability of parties to strike the optimal deal can obviously decrease the overall welfare of the transaction. Therefore, the positive 'competition effect' can be—partly or completely—offset by the

[35] Examples of possible rules are many. For instance, it may be possible to make a list of mandatory sticks to be licensed when digital licensing, respectively, embedded goods (e.g. the right to lend, the right to transfer, the right to repair, the right to modify, but *not* the right to disembody the software and copy it) and purely digital contents (e.g. the right to make a one-time transfer, the right to make as many copy as necessary for personal use, the right to enjoy the content regardless of geographical limitations, the right to lend the content, but *not* the right to copy it for uses that are not strictly personal). Alternatively, it may be possible to govern the phenomenon through an open-clause rule, stating that all utilities necessary to use the *thing* according to its ordinary purpose should be included in the license. Indeed, it looks like the European Commission, with Directives 770/2019 and 771/2019, is going in the latter direction.

[36] We examine this tradeoff in the spirit of Merrill and Smith (2001)

'loss-in-diversification effect' that would be automatically induced by mandatory standardisation.[37]

The reason is not far from the «general scepticism shown by the traditional economic analysis of law towards any kind of authoritative restriction imposed on individuals' ability to define the contents of their property transactions» (Mezzanotte, 2012, p. 14). In the majority of cases, the personalisation of products is actually beneficial (Perzanowski & Schultz, 2016, pp. 81 ff.), in that it allows parties to better refine the object of the contract so to adjust it to individual needs (Coase, 1990, p. 12). As it has been said from a legal theory standpoint (Gaus, 2012; Grey, 1980), contractual freedom inevitably leads to fragmenting bundles of rights, which are increasingly crafted to better match our interests and desires.

The fact that the competition effect and the loss-of-diversification effect go in opposite directions entails that from the point of view of market efficiency too much standardisation can eventually be worse than no standardisation at all. We capture the tradeoff between the two effects with our simple economic model in Sect. 5. The optimal level of standardisation, at least ideally, could be enforced through the introduction of a *numerus clausus*.

Yet, one last effect of standardisation (not considered in the model below) does exist. It is the 'external effect' of standardisation. In simple words, this is the effect of the well-known Monday-watch example by Merrill and Smith (2001). According to them, not only does destandardisation increase information and measurement costs for potential successors in interests, but it does so for other market participants as well. If market players are made aware that there is the risk to pay for a covertedly idiosyncratic 'bundle', they will spend more time and efforts in trying to understand what they are buying *even if they do not buy from one of the parties of the original idiosyncratic transaction*. Hansmann and Kraakman (2002) too are aware of this issue when they consider the costs of standardisation for «nonusers of the right» (p. 396). Dealing specifically with digital markets and 'fancy' licenses, Perzanowsky and Schulz (2016, pp. 8–9) also argue that the simple fact of being aware that some other people have suffered from the unresonable effects of idiosyncratic licensing makes information costs higher for *all* market participants. On the contrary, if all actors could be sure that no objects exists that is legally-crafted in some unreasonable way, their willingness to buy would be higher and the surplus generated by an eventual transaction would be greater, since screening costs would affect it to a much lesser extent.

What we have just described as the negative external effect of destandardisation is likely to be relevant only in those markets where the process of acquiring information is extremely costly—which is exactly the situation in digital markets, at least in relative terms. The effect is not limited to the 'privity of contract zone', nor it is directly connected to the third party dimension. This because it

[37] In this sense, the 'loss-in-diversification effect' is not different from what Merrill and Smith (2001) called the 'frustration effect'. When warning about the negative effects of restrictions on objects, Robinson (2004), also appears to be referring to a similar mechanism.

is referred neither to potential successors in interest nor to bargaining parties, but only to the negative externalities of destandardisation. As we said, our argument in the following model does not rely on this effect, though it is likely that some negative externalities are present in digital markets too. If they are indeed present, our economic argument in favor of the *numerus clausus* in the digital context is actually reinforced, because there is an additional source of inefficiency we are not accounting for. In other words, the protective rationale for the *numerus clausus* can be invoked even in the absence of externalities.

In summary, we think that striking a socially beneficial balance between the positive 'competition effect' and the negative 'loss-in-diversification effect' in digital markets is feasible by incresing standardisation. In terms of policy, the say 'hell is in the details' clearly applies: badly designed stadardisation can be more harmful than the current system of no standardisation (as our model shows). However, since digital markets generally involve indivisible goods and no active bargaining between individual consumers and firms (e.g. a coffe-maker sold through a take-it-or-leave-it offer), we are convinced that most decentralised alternatives—including the current situation—might not be enough to solve the underlying problem of information asymmetry and market power.

8 Conclusion

Digital markets pose considerable challenges to legal scholars and regulators. In this paper we argued that the introduction of a *numerus clausus* for digital licensing could yield some benefits if properly implemented.

Our argument stems from some real world evidence of the dysfunctionalities of the current arrangement in digital markets. These issues seem to arise because sellers can destandardise objects in ways that increase the information asymmetry between them and their customers, so that more consumer surplus can be extracted from every transaction. Since surplus extraction through information asymmetry is a rent, this outcome is likely to be economically inefficient compared to the competitive benchmark.

Most of the existing justifications of the *numerus clausus* rely on third-party arguments that are hard to apply to digital markets. For this reason, we propose a new rationale for a *numerus clausus* specific for this context. Unlike previous accounts, our alternative justification for the *numerus clausus*, the protective rationale, operates in the *privity of contract*, without relying so heavily on the third party dimension, which remains as an *a fortiori* argument at most. According to this new rationale, the *numerus clausus* can be an effective tool to reduce the exploitation of informational asymmetries by one of the parties, because it can enhance the understanding of the contract by the less informed party and, therefore, curtail the extraction opportunities of the other. As a consequence of protecting the uninformed party, the *numerus clausus* can also decrease inefficient rents.

Limiting contractual freedom entails a clear tradeoff, though . Drawing from standard arguments about the negative economic effects of imposing such limitations, we concluded that legislation should aim at striking a balance between the

efficiency gains from reduced rent extraction and the welfare losses caused by decreased contractual freedom.

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References

Aghion, P., & Hermalin, B. (1990). Legal restrictions on private contracts can enhance efficiency. *Journal of Law, Economics and Organization, 6*(2), 381–409.

Akkermans, B. (2008). *The numerus clausus principle in European law*. Intersentia.

Akkermans, B. (2017). The numerus clausus of property rights. In M. Graziadei & L. Smith (Eds.), *Comparative property law: Global perspectives.* Edward Elgar Publishing.

American Law Institute, European Law Institute. (2021). *ALI-ELI principles for a data economy—Data transactions and data rights*. ELI Final Council Draft. https://europeanlawinstitute.eu/fileadmin/user_upload/p_eli/Publications/ALI-ELI_Principles_for_a_Data_Economy_Final_Council_Draft.pdf.

Archer, J. (2018). *Apple responds to disappearing itunes movie purchases issue. Forbes*. https://www.forbes.com/sites/johnarcher/2018/09/17/apple-responds-to-disappearing-itunes-movie-purchases-issue/.

Arruñada, B. (2003). Property enforcement as organized consent. *Journal of Law, Economics, & Organization, 19*(2), 401–444.

Arruñada, B. (2017). Property as sequential exchange: The forgotten limits of private contract. *Journal of Institutional Economics, 13*(4), 753–783.

Barrett, B. (2015). *Keurig's My K-Cup retreat shows we can beat DRM*. Wired. http://www.wired.com/2015/05/keurig-k-cup-drm/.

Ben-Shahar, O. (2008). *The myth of the 'opportunity to read' in contract law*. Coase-Sandor Working Paper Series in Law and Economics.

Candian, A., Gambaro, A., & Pozzo, B. (1992). *Property – Propriété – Eigentum*. CEDAM.

Chafee, Z. (1956). The music goes round and round: Equitable servitudes and chattels. *Harvard Law Review, 69*(7), 1250–1264.

Chander, A. (2014). How law made silicon valley. *Emory Law Journal, 63*, 639–694.

Coase, R. H. (1990). *The firm, the market and the law*. University of Chicago Press.

Davidson, N. M. (2008). Standardization and pluralism in property law. *Vanderbilt Law Review, 61*(6), 1597–1663.

Deakin, S., Gindis, S., Hodgson, G. M., Huang, K., & Pistor, K. (2017). Legal institutionalism: Capitalism and the constitutive role of law. *Journal of Comparative Economics, 45*(1), 188–200.

Douglas, S. (2011a). *Liability for wrongful interferences with chattels*. Bloomsbury Publishing.
Douglas, S. (2011b). The scope of conversion: Property and contract. *The Modern Law Review, 74*(3), 329–349.
FitBit. (2018). *Terms of services*. https://www.fitbit.com/us/legal/terms-of-service.
French, S. (1998). Servitude. *Encyclopedia Britannica*. https://www.britannica.com/topic/servitude-property-law.
Gambaro, A. (2012). *I Beni – Trattato di Diritto Civile e Commerciale*. Giuffrè.
Gaus, G. (2012). Property. In D. Estlund (Ed.), *The Oxford handbook of political philosophy.* Oxford University Press.
Giraudo, M. (2021). On legal bubbles: Some thoughts on legal shockwaves at the core of the digital economy. *Journal of Institutional Economics*. https://doi.org/10.1017/S1744137421000473
Grey, T. C. (1980). The disintegration of property. In R. J. Pennock & J. W. Chapman (Eds.), *Ethics, economics and the law of property.* New York University Press.
Grundmann, S., & Hacker, F. (2018). The digital dimension as a challenge to European contract law: The architecture. In S. Grundmann (Ed.), *European contract law in the digital age.* Intersentia.
Hansmann, H., & Kraakman, R. (2002). Property, contract, and verification: The numerus clausus problem and the divisibility of rights. *The Journal of Legal Studies, 31*(S2), 373–420.
Heller, M. A. (1998). The tragedy of the anticommons: Property in the transitionfrom Marx to markets. *Harvard Law Review, 111*(3), 621–688.
Heller, M. A. (1999). The boundaries of private property. *Yale Law Journal, 108*(6), 1163–1223.
Honoré, A. M. (1961). Ownership. In A. C. Guest (Ed.), *Oxford essays in jurisprudence.* Clarendon Press.
Kim, S. (2003). The reinforcement of international copyright for the digital age. *Intellectual Property Journal, 16*, 93–122.
Kravets, D., & Baldwin, R. (2013). *Google is forbidding users from reselling, loaning glass eyewear*. Wired. https://www.wired.com/2013/04/google-glass-resales/.
LicenseApple. (2020). *Apple watch terms of service*. https://images.apple.com/legal/sla/docs/AppleWatch.pdf.
Loos, M., Helberger, N., et al. (2011). *Final Report: Comparative analysis, Law & Economics analysis, assessment and development of recommendations for possible future rules on digital content contracts*. University of Amsterdam.
Madison, M. J. (2005). Law as design: Objects, concepts, and digital things. *Case Western Reserve Law Review, 56*, 381–478.
Mahoney, J. D. (2001). *Perpetual restrictions on land and the problem of the future*. Research paper, UVA. Available at SSRN: https://ssrn.com/abstract=291537.
Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). *Microeconomic theory*. Oxford University Press.
Merrill, T. W., & Smith, H. E. (2000). Optimal standardization in the law of property: The numerus clausus principle. *Yale Law Journal, 110*(1), 1–70.
Merrill, T. W., & Smith, H. E. (2001). The property/contract interface. *Columbia Law Review, 101*(4), 773–852.
Merrill, T. W., & Smith, H. E. (2020). The architecture of property. In H. Dagan & B. Zipursky (Eds.), *Research handbook on private law theories.* Edward Elgar.
Mezzanotte, F. (2012). The interrelation between intellectual property licenses and the doctrine of numerus clausus—A comparative legal and economic analysis. *Comparative Law Review, 3*(2), 1–42.
Moringiello, J. M. (2010). What virtual worlds can do for property law. *Florida Law Review, 62*(1), 159–202.
Mulligan, C. (2013). A numerus clausus prinicple for intellectual property. *Tennessee Law Review, 80*, 235–290.
Mulligan, C. (2016). Personal property servitudes on the internet of things. *Georgia Law Review, 50*, 1121–1168.
Network Sys. Architects Corp. v. Dimitruk, 987 N.E.2d 618 (2007).
Niehans, J. (1989). Transaction costs. In J. Eatwell, M. Milgate, & P. Newman (Eds.), *Money.* Palgrave Macmillan.
Parisi, F. (2002). Entropy in property. *The American Journal of Comparative Law, 50*(3), 595–632.
Parisi, F., Schulz, N., & Depoorter, B. (2005). Duality in property: Commons and anticommons. *International Review of Law and Economics, 25*(4), 578–591.

Penner, J. (1997). *The idea of property in law*. Oxford University Press.
Penner, J. (2013). On the very idea of transmissible rights. In J. Penner & H. E. Smith (Eds.), *Philosophical foundations of property law.* Oxford University Press.
Perzanowski, A., & Hoofnagle, C. J. (2017). What we buy when we buy now. *University of Pennsylvania Law Review, 165*(2), 315–378.
Perzanowski, A., & Schultz, J. (2011). Digital exhaustion. *UCLA Law Review, 58*, 889–946.
Perzanowski, A., & Schultz, J. (2016). *The end of ownership: Personal property in the digital economy*. MIT Press.
Peters, M. (2020). Heterogeneous markups, growth, and endogenous misallocation. *Econometrica, 88*(5), 2037–2073.
Philippon, T. (2019). *The great reversal: How America gave up on free markets*. Harvard University Press.
Pistor, K. (2019). *The code of capital: How the law creates wealth and inequality*. Princeton University Press.
Pretto-Sakmann, A. (2005). *The boundaries of personal property: Shares and sub-shares*. Hart Publishing.
Robinson, G. (2004). Personal property servitudes. *The University of Chicago Law Review, 71*, 1449–1523.
Rostill, L. (2021). *Possession, relative title, and ownership in English law*. Oxford University Press.
Rudden, B. (1987). Economic theory v. property law: The numerus clausus problem. In J. Eekelaar & J. Bell (Eds.), *Oxford essays in jurisprudence.* Clarendon Press.
Schulze, E. F. (2014). Resale of digital content such as music, films or eBooks under European law. *EIPR, 36*(1), 9–13.
Schwarz, A. (1995). Legal implication of imperfect information in consumer markets. *Journal of Institutional and Theoretical Economics, 151*(1), 31–48.
Sganga, C. (2015). *Dei beni in generale: artt. 810-821 – Codice Civile Commentato*. Berlin: Giuffrè.
Sganga, C. (2018). A plea for digital exhaustion in EU copyright law. *JIPITEC, 9*, 211–239.
Smith, H. E. (2011). Standardization in property law. In K. Ayotte & H. E. Smith (Eds.), *Research handbook on the economics of property law.* Edward Elgar.
Sutton, J. (1991). *Sunk costs and market structure*. MIT Press.
Thryoff v. Nationwide Mut. Ins. Co., 8 N.Y.3d 283, 290–293 (2007)
Van Houweling, M. S. (2008). The new servitudes. *Georgetown Law Journal, 96*, 885–950.
Wenderhost, C. (2016). Consumer contracts and the internet of things. In R. Schulze & D. Staudenmayer (Eds.), *Digital revolution: Challenges for contract law in practice.* Hart Publishing.
Winston, E. I. (2006). Why sell what you can license? Contracting around statutory protection of intellectual property. *Georgia Mason Law Review, 14*, 94–133.

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