



DE GRUYTER
OPEN

Administration, vol. 66, no. 2 (2018), pp. 59–82
doi: 10.2478/admin-2018-0018

Collaborative housing and blockchain

Sergio Nasarre-Aznar¹
University Rovira i Virgili, Spain

Abstract

Access to housing is a crucial issue worldwide. It is still under discussion whether collaborative economy is enhancing or, on the contrary, constraining access. In this context, the concept of ‘collaborative housing’ (collaborative economy applied to the funding, access and organisation of housing) arises to address a range of situations that might potentially help people to access housing, such as co-housing or the so-called ‘intermediate tenures’. Disintermediation through blockchain technology, and the resultant effect of a reduction in the transaction costs of access to housing, is one of those trends regarding collaborative housing. Accordingly, the adaptation of the disintermediation mechanism to the real estate conveyance and land registry, as in many other sectors of the collaborative economy, is timely. This can be achieved by exploring the potential of this mechanism in enhancing traditional methods of this sector through possible technological solutions. This paper presents a preliminary discussion on the different types of collaborative

¹ Sergio Nasarre-Aznar is Full Professor of Civil Law and Director of the UNESCO Housing Chair at the University Rovira i Virgili, Spain; Deputy Judge in the Court of Appeal of Tarragona; and a Corresponding Member of the Spanish Royal Academy of Jurisprudence and Legislation. This paper has been possible thanks to the project of the Spanish Ministry of Economy and Competitiveness ‘Collaborative housing’ (2018–20; DER2017-84726-C3-1-P) and the research award ICREA (2016–20) awarded to the author. This paper is based on the position paper by Nasarre-Aznar & Nigussie (2017).

housing and the potentials of the blockchain technology to facilitate access to housing in relation to real estate conveyancing and registration.

Keywords: Collaborative housing, access to housing, disintermediation, blockchain, collaborative economy

The concept of ‘collaborative housing’

The 2007 financial crisis had a substantial impact on many EU citizens’ housing situations. According to EU-SILC (European Union Statistics on Income and Living Conditions), 700,000 households (2007–12) lost their dwellings and there are 4.1 million homeless within the EU.² In addition, millions have lost confidence with governments, companies, housing gatekeepers, and financial and housing-provider (including social) sectors; all in all, millions have been left behind. Social inclusion is still a myth for many Europeans and migrants: the 2015 Housing Europe report states that there are not enough affordable homes available to cover the increasing demand. According to the Eurobarometer 2016 (European Commission, 2016b, p. 10), housing ranks eleventh out of EU citizens’ concerns.

Reckless lending practices and housing policies that used to prevail in EU peripheral countries (see Nasarre-Aznar, 2014, pp. 37–72) are now being overridden by consumer protection measures at EU level (see, for example, Directive 2014/17/EU). There is an increasing common sense and need that housing must become a true, tangible fundamental right (‘right to housing’) instead of merely considering housing space as a financial asset (see, for example, the case *Monika Kušionová v SMART Capital*³). The provision of housing by countries in an affordable and adequate way should be a key factor not only of every modern welfare state but also of a sustainable process of the EU integration. While the New Urban Agenda⁴ is to be implemented worldwide, including multi-level EU, housing was included by the European Commission as one of the twenty principles in the

² See the full discussion of these data and of the scope of evictions and homelessness in the EU in Kenna et al. (2016, *in toto*, but especially at p. 47).

³ *Monika Kušionová v SMART Capital*, 10 September 2014 [ECLI:EU:C:2014:2189]. The court stated that: ‘Under EU law, the right to accommodation is a fundamental right guaranteed under Article 7 of the Charter that the referring court must take into consideration when implementing Directive 93/13’.

⁴ Approved in 2016 at the United Nations Conference on Housing and Sustainable Urban Development (UN-Habitat III), it includes the concept of a right to the city, thus developing geared policies towards building of democratic and sustainable cities.

European Pillar of Social Rights in April 2017 (European Commission, 2017).

Due to the effects of the 2007 crisis, and with the aim to overcome them, people, particularly millennials, are nowadays more aware about sharing resources and thus different types of collaborative economy have emerged, which mostly rely on information technology as the main catalyst.⁵ Basically, it is a hybrid business model of the peer-to-peer direct transaction and manifests itself with significant levels of disintermediation in the key business lines. At this first stage, the digital marketplaces and platforms (e.g. Kickstarter, Deliveroo, Airbnb, Uber, Cabify, etc.) that directly connect peers facilitate the interaction between transacting parties with ‘shareable goods and services’.

This collaborative economy trend is also affecting access to housing, as it may also be considered as a ‘shareable good’.⁶ Yet it is still unclear whether it will facilitate or constrain the access to housing. Hence, there is increasing evidence that while collaborative economy has the potential to contribute to competitiveness and (sustainable⁷) growth, and to provide new employment opportunities, flexible working arrangements, new sources of income and increased services, extended supply and lower prices for consumers,⁸ it also causes blurring of legal frameworks in key areas such as consumers’ protection and labour law (even throwing away decades of fight for achievements for the working class⁹), and concerns on the quality of provided services and goods (55 per cent of consumers experienced such problems over 2015; Jourová, 2016). Determining whether collaborative economy helps or constrains access to housing is a crucial matter in every EU country, especially those more shocked by the 2007 economic and financial crisis, and more generally at global level.

Thus, on one hand, there are increasingly new ways of ‘collaborative housing’ (collaborative economy applied to funding, access and organisation of housing), such as intermediate tenures or co-housing (see Geron, 2013), that seem to be helping families to dwell in a more sustainable way. For example, new intermediate tenures introduced in Catalonia in 2015 favour access to housing

⁵ See Hamari et al. (2016, p. 10). For the concept of ‘co-utility’, see Turi et al. (2017).

⁶ See more on this concept at Benkler (2004, p. 276).

⁷ See Pickell (2015).

⁸ European Commission (2016a). See also Ranchordas (2015).

⁹ See ‘Über drivers’ (2016), ‘UK union begins’ (2017).

through fractioning homeownership both in value (shared ownership) and in time (temporal ownership), making it more affordable and thus avoiding households' overindebtedness (see Simón et al., 2017, pp. 63–78). In addition, the collaborative economy 2.0 (completely disintermediated economy) through the blockchain, which can act as a facilitator technology, might contribute to the redefinition of the usual role of real estate intermediaries and to reducing transaction costs (See 'Can blockchain technology', 2015). On the other hand, collaborative tourist accommodation is both pushing up rents in key European and worldwide cities such as Berlin, New York, Barcelona, Amsterdam and Palma de Mallorca,¹⁰ and negatively influencing the cohabitation in condominiums and neighbourhoods (Lambea-Llop, 2016; see also Schäfer & Hirsch, 2017, pp. 231–55). At the same time, crowdfunding applied to real estate and, more specifically, to housing, does not always seem to help in developing affordable housing (Kim & Hann, 2017), and even might be contributing to speculation with this human right (Pierce-Wright, 2016).

Finally, there is a need to answer the following set of questions that derive from the new 'forced' co-living phenomenon that is taking place in big key cities such as Barcelona: Is it fair to accept room rentals in Barcelona for 500 per month (Castán, 2017), disguised under the trendy word 'co-living', as this leads to a precariousness of housing? How would these families who share rooms in a flat because they cannot afford to rent a full one¹¹ fulfil their fundamental rights of self-development, intimacy and freedom in this context? Does this situation really fulfil the requirements of CESCR General Comment No. 4 (The Right to Adequate Housing),¹² which establishes a minimum standard for housing, especially those related to habitability, availability of services and cultural adequacy? Is this type of co-living another vein of precariousness that seems to be embedded into any field in which collaborative economy (or even the circular one) is being developed, such as co-working (smaller working space, less workers' rights), co-tourism (less facilities, safety and quality than

¹⁰ The OECD (2017, pp. 58–9) states that collaborative tourism pushes up rents in key cities and neighborhoods and contributes to reducing access to affordable housing, leading many cities, such as Amsterdam, London, Paris and San Francisco, to regulate private vacation rentals.

¹¹ See a full analysis of the problem of housing rentals in Spain, especially since 2016, in Nasarre-Aznar & Molina-Roig (2017, pp. 108–22).

¹² Full text available at <http://www.refworld.org/docid/47a7079a1.html> [30 October 2017].

good hotels), car-sharing (less trained drivers, who are deprived from labour rights), co-housing (less private space), in exchange for making available travelling, housing, ambulation and working to those who are excluded from regular markets? At what cost – lessening safety, training, free time, quality, rights, etc. of those involved? Are we reaching the extremes of disguise of precariousness reached by those who practise for some reason ‘freeganism’, ‘wardrobing’ and ‘nesting/cocooning’, or who need to become ‘doers’? In principle, ‘freeganism’ might sound good (related to anti-consumerism and anti-capitalism) but, at the end of the day, it is a way of eating (to survive in a context of crisis and deprived economy) through recovering wasted food from the trash (dumpster diving).¹³ In its turn, ‘wardrobing’ is a form of return fraud. It is the practice of purchasing an item, using it and then returning it to the store for a refund. It is most often done with expensive clothing – hence the name – but the practice is also common with tools, electronics and even computers.¹⁴ Leaving aside the fact that it is a fraud, does it really support circular economy or is it hiding again the precarious reality of the unaffordability of buying clothes or other daily items? ‘Nesting’, or ‘cocooning’ (see Cantó, 2017), promises more happiness to those who remain at home and water the plants or cook, rather than going out and socialising. It might disguise the crisis deprivation of not having enough free money to go out for dinner or going to the cinema. And, finally, according to the Cambridge dictionary, a ‘doer’ is ‘someone who gets actively involved in something, rather than just thinking or talking about it’. It is promoted as a lifestyle, something really good and desirable. But it usually entails much work (with less thinking) for a low salary and deprivation of the essentials (‘you eat a coffee for lunch’, ‘sleep deprivation is your drug of choice’ are slogans from Fiverr’s campaign in 2017; see Strutz, 2017).

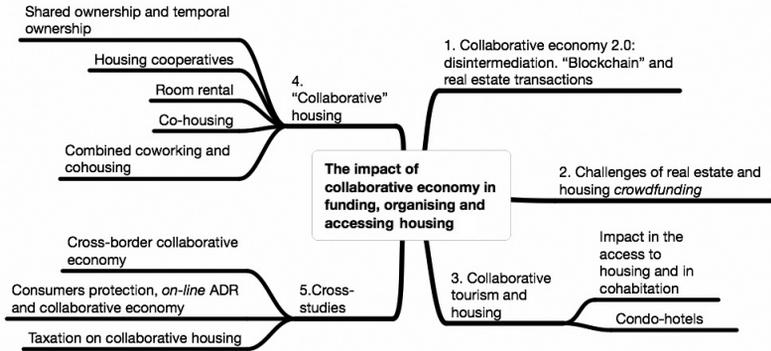
Therefore, the concept, types, features and consequences of ‘collaborative housing’ should be carefully scrutinised. Due to its different nature (e.g. technological base or not), socio-economic objectives (promoting the shared use of homes or groups of owners, favouring investment, tourism, etc.) and legal configuration (with different distribution of rights and obligations of the parties or the use of rights in rem or simple rights of use) of ‘collaborative phenomena’ that impact on access to housing, they necessarily deserve

¹³ <https://en.wikipedia.org/wiki/Freeganism> [1 March 2018].

¹⁴ <https://en.wikipedia.org/wiki/Wardrobing> [1 March 2018].

differentiated treatment. Figure 1 shows the impact of collaborative economy in accessing, funding and organising housing.

Figure 1: The impact of collaborative economy in accessing, funding and organising housing



Source: Own elaboration.

This paper focuses on no. 1 of Figure 1, that is, on how full disintermediation can contribute to fulfilling true collaborative housing.

Disintermediating in collaborative housing

In plain words, disintermediation refers to the process of reducing the chain of interaction by diminishing or even avoiding the use of intermediaries (distributors, brokers, wholesalers, agents, etc.) between transacting parties. It is one of the manifestos for the so-called peer-to-peer economy, resulting in an efficient utilisation of the previously underutilised resources. This is through the direct involvement of the digital society in the value creation process, known as the value co-creation principle (see also the co-utility principle for the self-enforcing and mutually beneficial forms of interaction) (Domingo-Ferrer et al., 2017, pp. 148–58; see Turi et al., 2018).

Apart from the operational efficiency, the value co-creation principle, through the disintermediation of the traditional models, significantly helps to reduce the consumption, production and distribution costs, and to increase profit margins. Note also that disintermediation is one of the key marketing strategies used for the cost minimisation even in the traditional business models.

Accordingly, the adaptation of the disintermediation principle to real estate conveyancing and registration, as in many other sectors of

the economy, is timely. This can be achieved by exploring potential mechanisms that can enhance the traditional methods of this sector through possible technological solutions. This part of the work explores the potentials of blockchain technology in true disintermediating the real estate conveyancing and land registration process. The blockchain technology refers to the public, mutually distributed ledger used in the cryptocurrency. Beyond the cryptocurrencies, the key benefits of the blockchain technology to transactional networks such as asset management and real estate conveyances are that (i) it is decentralised, (ii) it is secured with cryptographic validation of transactions, (iii) it is reasonably efficient, (iv) transaction records are transparent and (v) it helps to minimise counterparty risk. Therefore, blockchain technology can be applied to transactional record systems other than the cryptocurrencies, some of which include securities settlement, currency exchange, crowdfunding,¹⁵ supply chain management (see Kolesnichenko, 2017), trade, P2P transfers, asset registration and correspondent banking.¹⁶

Therefore, this technology has the potential to be efficient and hence economically viable in achieving the disintermediation of real estate conveyancing and land registration processes, thus reducing time, burdens and costs for accessing housing in a legally safe manner. For the first time, blockchain can automatically undertake part of what intermediaries in the real estate market usually do today, such as the verification of the parties' ID (authorship), its existence, its integrity and the date of any act with legal relevance. In addition, virtual disintermediation in real estate transactions will contribute to the design of future platforms to encourage cross-border real estate transactions within the EU, thus fulfilling EU goals of free movement of persons (Article 3(2) of the Treaty of European Union) and capital (Article 63 of the Treaty on the Functioning of the European Union).

This technology guarantees efficiency in time because it lets all the stakeholders work in a common data set and the transaction data are efficiently organised. It also allows easy exchange of information with

¹⁵ According to Ayril (2014), 'Crowdfunding platforms powered by blockchain technology remove the need for this trusted third party. They allow start-ups to raise funds by creating their own digital currencies and selling 'cryptographic shares' to early backers. In more intelligible words, this means that investors in a crowdfunding campaign get tokens that represent shares of the startup they support and can actually benefit from the token value appreciation.' See, for example, Swarm at <https://www.swarm.fund>.

¹⁶ See Mainelli & Milne (2016), Reese (2017), Tolentino (2016), Adam (2017), Crosby et al. (2016), Snow et al. (2014), Kakavand & Kost De Sevres (2016), Oh & Lee (2017).

a one-time data entry in a distributed way, without a double and separate record of events, which results in a significant reduction of data reconciliation, checks and transfers costs. Furthermore, the potential of the blockchain technology to support smart contracts makes it attractive to the real estate market, because it can be extended with additional features (see below). The technology facilitates a collaborative system, which is mutually beneficial by allowing rational (selfish) players to interact in a self-enforcing and distributed way.

This technology's pilot trial in Sweden in the land registry (April 2017) is predicted to save about €100 million. This is due to the digitisation and disintermediation of the sector with the blockchain technology that will dissolve the traditional tick transaction layers of the sector (see Wong, 2017).

The conventional real estate conveyancing market

A study made in 2007 by Schmid & Sebastian regarding the conveyancing services market shows the inefficiency in the property transfer system applied in some EU countries. By examining four different regulatory models in the conveyancing services market (i.e. the Latin notary, deregulated Dutch notary, Scandinavian licensed agent and the lawyer–notary hybrid systems), the report argues that a deregulation in price, geographic coverage of notaries and allowance for additional players like attorneys and tax consultants can result in a more cost-effective service.¹⁷ It affirms not only that Latin Notary countries are more expensive¹⁸ but also that Latin Notaries do not provide a better service.¹⁹ Fees, taxes and costs are important barriers

¹⁷ 'The study finds that the traditional Latin notary system, which has the highest levels of restrictive regulation, including the use of fixed fees scales and *numerus clausus* performs the worst on all counts' (Schmid & Sebastian, 2007, p. 15).

¹⁸ 'When fees are adjusted by net earnings across countries, or, alternatively, when fees are measured relative to the average house price in each country a similar picture emerges: relative fees are generally lower in Scandinavian countries, followed by many lawyer-system countries and some Latin Notary countries (including the Netherlands). The Latin notary countries of France, Belgium and Italy are found to have relatively high legal fees' (Schmid & Sebastian, 2007, p. 8).

¹⁹ 'Not only does the empirical assessment of service in EU countries, by professionals, associations and consumers not support claims of 'better' service in more regulated systems, it indicates that the opposite seems to be happening – namely, that better service in less regulated countries represents the norm' (Schmid & Sebastian, 2007, p. 9).

for safe access to housing through ownership, especially for millennials (those keener on using new technologies): according to Eurostat 2009, around 44 per cent of Europeans aged between fifteen and thirty considered that young adults could not afford to move out from the parental home and 28 per cent agreed that there was not enough affordable housing available.

Accordingly, the report proposes the opening of the market to more potential agents (hence, avoiding the entry barriers and allowing competition), which can improve the competitive structure of the notary-monopolised conveyancing services market. Updated information is provided by the World Bank's *Doing Business 2018* (World Bank, 2017), where it is shown that only eight of the first-ranked twenty countries in efficiency in registering property (reliability of the infrastructure, transparency of information, geographic coverage, land dispute resolution and equal access to property rights) belong to the International Union of Latin Notaries.²⁰ This also leads to the discussion on whether the conveyancing real estate market should be opened without losing the quality of the service (basically, legal certainty of the transaction).²¹

Their proposal, however, did not take into account the possibility of a mechanism through which the parties, by themselves or with a limited intervention by an authorised third party, could achieve the desired degree of legal certainty with the lowest possible cost (among other reasons, because blockchain started with a very low scope – basically, bitcoin – and impact, one year after the report was released, in 2008; see Nakamoto, 2008). It must be borne in mind that with the digitalisation and automation of the global ecosystem, disruption in this sector is possible. With the demographic shifts from the digital immigrants to the digital natives, irreversible consumer behaviour emerges and the transformation of the traditional service sector to the modern digitalised service will be naturally smooth by itself as the millennials hold the market through time and the baby boomers retire (Nasarre-Aznar & Nigussie, 2007). Automation and digitalisation

²⁰ See members at <http://www.uinl.org/notariados-miembros> [31 October 2017]. They are Lithuania, Georgia, Estonia, Slovak Republic, Russian Federation, Armenia, Switzerland and Moldova. When it comes to cost, Italy is in 95th place, Spain is 138th, Germany is 146th and France is 158th. Of the first ten, in relation to the cost, only two (Georgia and the Slovak Republic) belong to the International Union of Latin Notaries.

²¹ Schmid & Sebastian (2007, pp. 9–10) state that 'consequently, the empirical results do not support the argument that high prices are needed to assure high levels of service assessment (quality in a broad sense)'.

have added much to big data processing, and hence have eased data analysis and reporting, and further facilitated a direct transaction between transacting peers through the use of digital technologies. In this regard, in order to advance the application of the potential technologies in the mostly conservative conveyancing market there is a need to bridge the gap in the housing act and information technology with extensive applications and adaptation of the recent technologies to this sector (Nasarre-Aznar & Nigussie, 2017). Here, it is important to note that technology costs if innovative solutions are not adopted, whilst its adoption costs the incumbent players (e.g. real estate conveyancers, lawyers, notaries, land registrars, etc.).

But in addition to cost-efficiency of real estate conveyancing services, the European Parliament was worried in 2015 in regard to EU member state citizens' difficulties in acquiring real estate (homes in particular) in another member state, which is against the creation of a true cross-border land-acquisition internal market, which negatively affects the very essentials of the EU foundational goals – that is, the free movement of persons and capital. The result was a report issued in 2016 (Sparkes et al.), which showed that the lack of pre-contractual and contractual information (i.e. due to different intervening agents and legal frameworks in every country and even inside some countries depending on the regions and municipalities) and the existence of different land conveyancing systems (including registration and cadastre organisation, efficacy in providing physical and legal status of the property, functions and effects upon registration, taxation, urban and condominium laws), financing rules (e.g. mortgages are different throughout Europe; even rights and burdens on land are different) and intermediaries (e.g. liberalised through lawyers hired by the parties *v. numerus clausus* Latin notarial system; role, duties and liability of real estate conveyancers related to rules for the sales contract,²² hidden defects, multi-flat schemes and even family law) within EU countries affects the creation of a true pan-European real estate market, thus hindering the economic and social convergence among EU member states.

Blockchain technology can help to give an alternative, efficient and technological answer to the two aspects discussed in this point, i.e. the

²² A simple question such as 'When am I the owner of a property?' after a successful sales contract ends up having different answers in different EU member states: when the sales contract is arranged (French system), when the delivery of the property after the sales contract is arranged (Spanish system) or when registration of the sales contract occurs (German system).

cost of security of real estate transactions and registration, and the achievement of a true cross-border conveyancing market within the EU. Thus:

- a) In relation to the first, Schmid & Sebastian (2007, p. 18) stated that while it is true that the study reveals that the conveyancing services market of (at that time) twenty-one EU countries ‘shows that the signing of a house deed is indeed “girded or safeguarded by the strongest guarantees” even when the market is deregulated’, the questions still to be answered are: ‘must this guarantee come at a disproportionately high cost and are there better ways of delivering this guarantee to consumers?’ Blockchain technology has the potential to provide for guarantees that contribute to providing a legally binding document (‘quasi-deed’) at very low cost and time requirements and few burdens.
- b) And, in relation to the second, through smart contracts, blockchain technology allows the automation of many operations linked to the conveyancing system itself: connections and registration to the land register and the cadastre, checking of abusive clauses, urban charges or permits, payment of the price to the seller and taxes to authorities, physical access to property, etc. Because blockchain is a decentralised system (blockchain is trust in itself), it encourages and facilitates cross-border transactions.²³

In the next section, these two aspects are covered in more depth.

The blockchain-technology-enabled business model for the real estate conveyancing market

In this context, blockchain technology has the potential to transform the current real estate conveyancing and land registration processes (see Figure 2), and may help to facilitate access to housing. The disintermediation of the conveyancing services market can be achieved by rethinking the role of the middlemen in the sector (e.g. determining what will be the added value to the automatised system), and thus allowing a direct technology-supported interaction between the transacting parties. This will have a significant effect in making the

²³ De Filippi & Hassan (2016) say that ‘Blockchains are transnational, because they bypass the need for a central server’.

traditional business model²⁴ obsolete (though Luddism is expected²⁵), and will help in tackling the underlying problems with this business model. However, blockchain is not a disruptive technology²⁶ but has the ‘potential to create new foundations for our economic and social systems. But while the impact will be enormous, it will take decades for blockchain to seep into our economic and social infrastructure’ (Iansiti & Lakhani, 2017, p. 3).

Figure 2: Standard traditional system of preventive justice in land conveyancing

Pre-contractual phase. Phase of the private contract	Phase of production of the public deed. Role of a notary (in a Latin Notary system)	Land registration phase
a) Marketing and precontractual information (including, urban requirements, taxation, contractual rights and duties, price, etc.) b) Consumers' protection c) Home , as a special object of law (human right)	a) Checking the id. of the parties, their legal capacity or authorization to contract b) assessing the real intentions of the parties and effects that they want to achieve with the contract c) assuring that the outcomes of the agreement are according to law (eg. checking abusive clauses in mortgage loan or lease contracts) d) explaining the parties legal effects of agreement and if they really want them e) checking the facts that are happening before her (eg. payment of the money and of the taxes)	a) The deeds and other public documents can directly access the Land Registry because they are legally valid b) Registration might have up to 3 effects depending on the jurisdiction: necessary for acquiring the ownership (DE), publicity to third parties of the new ownership (ES) or a collection of titles (FR)

Source: Own elaboration.

The disintermediation of the real estate conveyancing system through this technology will help to rethink the role of middlemen like brokers, escrow companies, notary publics, land registrars, civil servants and agents. It further helps to tackle fraud problems (e.g. money laundering, hidden charges, misrepresentation, consumers’ protection, rental scams) through the unique digital ownership certificates assigned to every ownership (or charge) transfer of block records.

²⁴ Corluka & Lindh (2017, p. II) affirm that there are ‘inefficiencies within the real estate market that might cause the crises, such as problems with transparency and liquidity, high transaction costs, personal biases and slow transaction processes’.

²⁵ See, in relation to bitcoin, the criticism by Jamie Dimon (CEO, JPMorgan) in Cheng (2017).

²⁶ One that is capable to change things dramatically and quickly.

Blockchain is today capable to safely²⁷ provide evidence of the existence of the document (e.g. contract), its integrity, its authorship (the parties involved in the transaction) and the date it was created/modified. It is also important to know that the document is kept in a block (within the chain of blocks; it is encrypted and it is given a hash,²⁸ hence each block is unique and cannot be replicated²⁹), which cannot be altered without the parties' consent, is validated (and then added to the chain) and kept safe in all computers that sustain (thanks to the reward received by the miners³⁰) the chain (no central authority is needed), which keeps a historical record of the block (so it can be tracked back and traced) and is public to anyone who has the hash and the authorisation to see the contents of the block. The transaction and the title are then registered. In fact, some experiences in different parts of the world include the pilot trial projects of land registration through blockchain in Sweden,³¹ Republic of Georgia³² and Honduras,³³ and secured blockchain platforms for the real estate recordings like Ubitquity³⁴ in the US and Reidao³⁵ in Singapore.

²⁷ The main risk to the integrity and security of blockchain is the 51 per cent menace, which basically means that 51 per cent of computers have to agree to cheat the system. See <https://www.investopedia.com/terms/1/51-attack.asp> [8 November 2017].

²⁸ See Chow (2016) for the security function of hashing.

²⁹ For legal purposes, this function is essential: goods and property should be able to be transferred only once. Virtually replicating either the good or the property or allowing double or more sales would make the whole system useless to provide legal certainty.

³⁰ They keep servers to keep the chain up and running, which needs important amounts of energy. In exchange, they receive bitcoins. See a miner's servers farm in Iceland at <https://www.youtube.com/watch?v=SJgWqbZBn6I> [6 November 2017].

³¹ Lantmäteriet is the Swedish Mapping Cadastre and Land Registration Authority, and is involved in a project 'to study and test the possibilities of using blockchain as a technical solution for real estate transactions and the mortgage deed processes'. See Kairos Future (2017) and also Corluca & Lindh (2017, p. 37), who say: 'To ensure safety within systems and on the real estate market in general, Lantmäteriet needs digitalization and that is the reason why they have started to evaluate and work with blockchain, according to Mats Snäll. He further argues that blockchain technology can provide guarantees that the quality of the information is good and true. There are plenty of other technologies that can make systems faster or more secure, but no one like blockchain.'

³² See some news on this project in Shin (2017).

³³ This project was announced in 2015 and abandoned by the end of that year for non-technological reasons (see https://www.reddit.com/r/factom/comments/6692ai/what_is_the_current_status_pf_the_honduras_project/ [7 November 2017]).

³⁴ Ubitquity 'offers a simple user experience for securely recording and tracking property with our Software-as-a-Service (SaaS) blockchain platform. We help e-recording companies, title companies, municipalities, and custom clients benefit from a clean record of ownership, thereby reducing future title search time, and increasing confidence/transparency'; see <https://www.ubitquity.io/web/index.html> [7 November 2017].

³⁵ <https://www.reidao.io>.

In addition, linked to third-party software, blockchain is capable of increasing consumers' information and protection,³⁶ facilitating the certification of data,³⁷ comparing the contents of two documents and revealing whether they mean the same even if the wording or the type of information they contain is different,³⁸ etc. Thanks to all these features, the court validity and strength of a contract contained in a block of a blockchain dramatically increase. The doubt still remains, though, whether a block document achieves the level of certainty of a public deed or document or the one of a record in a public land registry, which might imply an alteration of the law in certain jurisdictions.

Cryptocurrency-supported features, transparency in transactions and smart contracts are also other important features underlying this technology (See Lifthrasir, 2016; see also Oparah, 2016; Miguel, 2017). Cryptocurrencies (not only bitcoin, but also ether³⁹ and others) are essential in this field as transactions with blockchain are supposed to be done through them (e.g. the payment of the rent, the price of the property in a sales contract, the instalments of the mortgage or the taxes). This fact might ballast today's expansion of blockchain but there are already progresses linking cryptocurrencies with today's banking systems.⁴⁰ The second essential concept to understand is smart contracts, which help the automatization of complex transactions (e.g. checking the validity of certain clauses or the actual undertaking of the required payments of the price, fees, payment of taxes, title registration, etc.). One of the best-known decentralised platforms that run smart contracts is Ethereum (<https://ethereum.org>). Ethereum defines smart contracts as 'applications that run exactly as programmed without any possibility of downtime, censorship, fraud or third party interference'. For example, Aragon (<https://aragon.one>) is a way of running an organisation on Ethereum. Now they have organised the so-called Aragon Network, which 'will be the first DAO [decentralised autonomous organisation] whose goal is to act as a digital jurisdiction that makes it extremely easy and friendly for

³⁶ See, for example, how simple standard contracts can be filled for starting up at Starting Legal website (<http://www.startinglegal.com>) [6 November 2017].

³⁷ See, for example, Stampery (<https://stampery.com>) [6 November 2017].

³⁸ See <https://www.kirasystems.com> [6 November 2017].

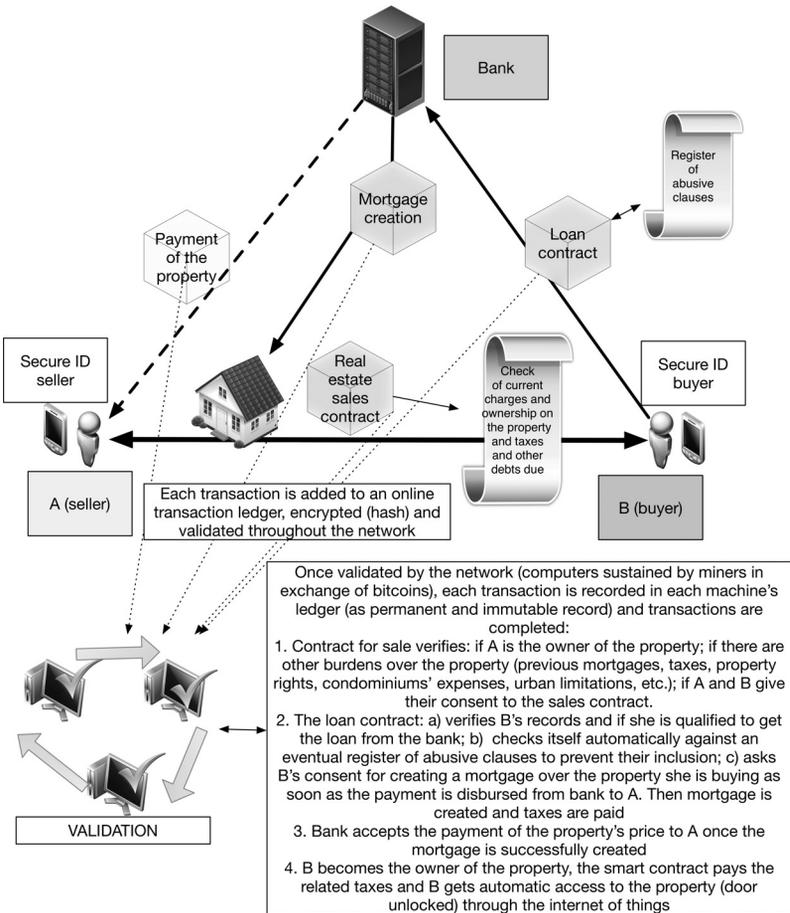
³⁹ <https://ethereum.org/ether> [8 November 2017].

⁴⁰ See <https://www.abra.com> and <https://cryptopay.me/bitcoin-debit-card>. See also <https://wirexapp.com/use-bitcoin-send-receive-international-money-transfers/> [7 November 2017].

organizations, entrepreneurs and investors to operate’ – that is, an opt-in court of arbitration to solve issues on a democratic basis, especially for start-ups and DAO companies.

Figure 3 shows how an advanced smart contract linked to blockchain can work in a standard real estate sales contract, financed with a mortgage.

Figure 3: Sale of a property, financed with a mortgage



Source: Own elaboration.

Clearly, Figure 3 shows an example of what De Filippi & Hassan (2016) say is a process of law progressively turning into code: ‘Blockchain technology reinforces the tendency to rely on code (rather than on the law) to regulate individual actions and transactions. The blockchain enables a whole new type of regulation by code, which — combined with smart contracts — also promotes a new way of thinking about the law’. Blockchain is progressively acquiring the status of ‘regulatory technology’ (i.e. ‘a technology that can be used both to *define* and *incorporate* legal or contractual provisions into code, and to enforce them irrespectively of whether or not there subsists an underlying legal rule’).⁴¹ While it is questionable that law is made by programmers and mathematicians through algorithms without any democratic legitimacy, it seems true that blockchain, through assuring the existence, the integrity, the non-centralised record, the authorship, the tracking back and the date of any document or fact with legal relevance, may contribute to:

- a) Reducing the intermediation costs by rethinking the role of the middlemen in the traditional conveyancing market and therefore facilitating access to housing. For example, properly trained real estate agents may use blockchain to achieve a professionalised and advanced use of ‘proptech’.⁴²
- b) Enabling individuals to transfer value (money and assets) in the fast speed of a transaction (commonly in minutes or seconds, in which a given transaction deal between seller and buyer takes place) in a cost-effective way and through online direct transaction between sellers and buyers.
- c) Enabling every property to have a digital address that corresponds to it indicating ownership title, including financial, legal and physical characteristics, with all the transaction records associated to it, which is especially true for the semi-public permissioned blockchain (e.g. under the supervision of a public authority).⁴³

⁴¹ De Filippi & Hassan (2016) add, ‘What makes the blockchain different from other technologies is that smart contracts are actually meant to replace legal contracts. They are no longer regarded as a mere support or enforcement mechanism to existing legal rules, rather, their code is intended to have the effect of law as its primary function.’

⁴² In principle, the ‘proptech’ (property+technology) sector promotes real estate transactions, such as leases, buying and selling, to be automated digitally, as well as the management of condominiums, the process of housing construction and its energetic efficiency improvement.

⁴³ See Adam (2017), Crosby et al. (2016), Snow et al. (2014), Kakavand & Kost De Sevres (2016), Oh & Lee (2017).

Blockchain also helps to generate a universal, digital checked identity of those operating within the network, thus favouring trustless (i.e. no need to have trust in another), legally binding interactions.

- d) Facilitating individuals' access to housing. This is mainly due to the current trends in the collaborative economy in which the digital society (digital immigrants and natives) has a shift in the consumption preference, and to the resulting emergence of irreversible consumer behaviour (for example, averse to home ownership by the millennials), which can only be addressed through the adaptation of these mechanisms.
- e) Linking to smart contracts, which allows tokenisation of property rights – that is, the creation of a parallel (in virtual world) way of creating and transferring rights over land, either full ownership or any other limited real or personal right over or related to it. For example, there is no problem in 'attaching' a usufruct (or an easement, or a mortgage) to a 'token', which is sold through a block, converting its buyer into a usufructuary; the token would allow her all rights and duties inherent of that condition (basically, to use and to take profits from land), including the right to lease the property to a third party through selling another token (with less rights entailed) to a third party that becomes her lessee. According to the *lex rei sitae*, though, those tokens might fulfil some requirements (i.e. to be called an usufructuary, a token holder might have all faculties that a 'usual' usufructuary would have – that is, the right of use and to the fruits generated by the thing).
- f) Promoting cross-border real estate transactions within the EU, thus reducing intermediation charges and costs through P2P transactions, in line with EU foundational goals of free movement of persons and free movement of capital. This is part of the *Europe 2020* strategy, which states: 'Further integrating the single market, including removing remaining barriers, increasing competition and improving the business environment is key to Europe remaining an attractive location for businesses, both domestic and foreign. In order to move Europe's productivity frontier, it is necessary to increase innovation and human capital formation and to ensure an integrated well-functioning digital single market. Increasing the uptake of information and communication technologies by both consumers and businesses

can contribute to creating a borderless digital Europe and increasing productivity’ – that is, a ‘strategy for smart, sustainable and inclusive growth’.

All in all, in this first general approach of blockchain technology applied to real estate transactions, a range of limitations are perceived, although to some there already exist palliative solutions:

- a) Precontractual relationships and consumers’ protection (preventive justice). While smart contracts have a possibility of checking (through the proper APIs,⁴⁴ which are commonly known as ‘oracles’) some relevant issues about the legal and physical situation of a given property prior to the contract (urban limitations, cadastral physical description, prior burdens, actual ownership, etc.) and may also contain the requirements needed by legislation (e.g. Directive 2014/17/UE for mortgage loan contracts), it is difficult to conceive a complete protection of consumers in a B2C relationship in a peer-to-peer disintermediated system such as blockchain. A public authority should (e.g. notaries, authorised real estate conveyancers, etc.) have a relevant role at this phase of a real estate conveyance, assessing the parties (especially consumers). Finally, it should be taken into account that if today’s contracts are increasingly difficult to be fully ascertained by the parties (especially if a consumer is involved), the situation will definitively not improve with smart contracts, which do not use regular language but use computer code and algorithms instead.
- b) While it seems clear that the implementation of blockchain in land transactions in developing countries, or countries with a non-computerised or underdeveloped land conveyancing and registration systems, will provide many advantages (see Tapscott & Tapscott, 2017, pp. 278–81), it is under question whether it can provide relevant advantages in other contexts. While many routine functions provided by common law notaries (scarcely trained and professionalised) and many of the services provided by Latin notaries (seen in Figure 2) might be automatised through blockchain in a safe way, some others provided by the latter, such as guaranteeing the legality of the contents of the contract, assessing the parties to ascertain their true will, the checking of

⁴⁴ https://en.wikipedia.org/wiki/Application_programming_interface [1 March 2018].

the legal capacity (age and soundness of the other party), the perdurability⁴⁵ and the enforceability of their deeds, might not be covered today by blockchain technology and might hinder its development and wide use (e.g. in a business such as the one represented in Figure 3). However, progresses are being made in these fields, such as machine learning contract analysis⁴⁶ and more evolved captcha.⁴⁷ In its turn, the procedural strength as an evidence of a block will depend on the strength (credibility) that a judge or the legislation gives to it, taking into account that they will need to adapt to this new reality. Another issue is how conflicts will be solved/settled through a virtual smart-contract-based arbitration court, such as the aforementioned Aragon Network.

- c) Blockchain cannot succeed in achieving the actual transfer of a physical thing (yes, if it is only virtual, such as a computer file of a song) nor in identifying whether it is defective.⁴⁸ However, mechanisms might be found to ascertain this. For example, the Internet of things (IoT) might help to give access to the good/property to the acquirer and forbid it to the seller from the very same moment that the transaction is successfully completed. In addition, legally speaking, it is usually clear in the different systems when any acquirer becomes the owner of the property (either upon the agreement, or when the real transfer takes place or when the registration is completed), regardless of the form that the contract takes (therefore, including smart contracts linked to blockchain). In relation to the defects of the asset, legal systems usually foresee mechanisms to react in relation to hidden defects or when consumers' rights (e.g. misrepresentation, mistake, fraud, *dolus*, undue influence, etc.) have been trespassed; for example, in distance contracts (e.g. the European Directive on Consumers Rights 2011/83/EU). In addition, the legal efficacy in each

⁴⁵ The loss of a block in a blockchain, although rare, would entail the disappearance of any trace of the transaction.

⁴⁶ See the aforementioned Kira system mechanism but also see Cellan-Jones (2017) for details on robot-lawyers already performing better than human lawyers.

⁴⁷ <https://en.wikipedia.org/wiki/CAPTCHA#Accessibility>

⁴⁸ According to De Filippi & Hassan (2016), 'the blockchain alone is unable to ascertain whether the property has actually been transferred in the real world (e.g. whether the car has been physically and legally transferred to the new owner), or whether it was perhaps faulty or defective, etc.'

jurisdiction (which one?⁴⁹) of smart contracts must be also discussed,⁵⁰ especially in issues such as who is liable in case losses occur due to the working of the smart contract itself (e.g. it retrieves wrong or insufficient information from connected databases, such as the cadastre); but this is a similar discussion that arises with liability of autonomous cars and robots taking decisions by themselves (an issue recently raised by the EU Parliament in Resolution of 16 February 2017 [2015/2103(INL)]⁵¹), which sooner or later should be addressed.

Conclusion

This paper centres in the term ‘collaborative housing’ to refer to the different ways in which collaborative economy is applied to the funding, access (including conveyancing) and organisation of housing, such as real estate crowdfunding, co-housing, room rental or the intermediate tenures (such as the shared ownership). Sometimes these new collaborative techniques may help people to access housing but, as is happening with online platforms that facilitate collaborative tourism, sometimes they do not and they may even lead to a precarious state.

After that, the paper focuses on one of these forms of collaborative economy and its potential impact into real estate conveyancing and accessing housing – one really without intermediaries through the blockchain technology. The results of the aprioristic analysis are that this technology has the potential to facilitate access to housing through the reduction of costs and time and re-thinking the role of possible conveyancing intermediaries. It can also become a strong driver to boost cross-border real estate transactions, also within the EU. Blockchain can assure the existence, the integrity, the non-centralised record, the authorship, the tracking back and the date of any document or fact with legal relevance, which adds value to real estate transaction in all jurisdictions. In addition, linked to smart contracts, it has the potential to check against legal and physical features of the

⁴⁹ Ideally, the parties should agree upon a jurisdiction to solve their disputes. An alternative would be the aforementioned digital arbitration system, such as the one developed by Aragon One.

⁵⁰ See some discussion in Giancaspro (2017).

⁵¹ [http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+ A8-2017-0005+0+DOC+XML+V0//EN](http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2017-0005+0+DOC+XML+V0//EN) [7 November 2017].

land prior to the transaction, to undertake due payments between the parties and the payment of taxes, to tokenise real rights, to check whether there are abusive clauses included in the terms of a loan contract or to even solve a legal issue in a digital arbitration court. And through the Internet of things, blockchain can give physical access to the buyer to her new home, all in a fast, safe, automatic, low-cost and at-a-time way. Although legal issues are arising, new technical and legal solutions are also appearing.

References

- Adam, K. (2017). *White Paper: 'Project Hurricane' – or how to implement blockchain technology in German real estate transactions*. Retrieved from <https://www.econbiz.de/> [12 March 2018].
- Ayral, S. (2014). *Bitcoin 2.0 crowdfunding is real crowdfunding*. Retrieved from <https://beta.techcrunch.com/2014/10/17/bitcoin-2-0-crowdfunding-is-real-crowdfunding/> [12 March 2018].
- Benkler, Y. (2004). Sharing nicely: On shareable goods and the emergence of sharing as a modality of economic production. *The Yale Law Journal*, 114 (2).
- Can blockchain technology send notaries on vacation... for good? (2015). Retrieved from <https://medium.com/@Stampery/can-blockchain-technology-send-notaries-on-vacation-for-good-4b99df14de7d> [21 February 2018].
- Castó, P. (2017). *Cinco nuevas palabras en inglés que nos quieren colar para que vivamos peor*. Retrieved from https://www.elconfidencial.com/alma-corazon-vida/2017-07-19/trabacaciones-friganismo-doers-nesting-wardrobing-coliving_1417280/ [31 October 2017].
- Castán, S. (2017). *Se alquiler habitación en Barcelona a 500 euros: 'Abstenerse guarros, juerguistas y teleadictos'*. Retrieved from <http://www.elperiodico.com/es/barcelona/20170501/se-alquiler-habitacion-en-barcelona-a-500-euros-abstenerse-guarros-juerguistas-y-teleadictos-6009462> [30 October 2017].
- Cellan-Jones, R. (2017). *The robot lawyers are here – and they're winning*. Retrieved from <http://www.bbc.com/news/technology-41829534> [7 November 2017].
- Cheng, E. (2017). *Jamie Dimon is betting big on the technology behind 'fraud' bitcoin*. Retrieved from <https://www.cnbc.com/2017/10/16/jpmorgans-dimon-betting-on-blockchain-even-as-he-calls-bitcoin-stupid.html> [2 November 2017].
- Chow, J. (2016). *Blockchain underpinnings: Hashing*. Retrieved from <https://medium.com/@ConsenSys/blockchain-underpinnings-hashing-7f4746cbd66b> [6 November 2017]

- Corluka, D., & Lindh, U. (2017). *Blockchain: a new technology that will transform the real estate market*. Retrieved from <http://kth.diva-portal.org/> [12 March 2018].
- Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology: Beyond bitcoin. *Applied Innovation*, 2, 6–10.
- De Filippi, P., & Hassan S. (2016). Blockchain technology as a regulatory technology: From code is law to law is code. *First Monday*, 21 (12).
- Domingo-Ferrer, J., Martínez, S., Sánchez, D., & Soria-Comas, J. (2017). Co-utility: Self-enforcing protocols for the mutual benefit of participants. *Engineering Applications of Artificial Intelligence*, 59, 148–58.
- European Commission. (2016a). *A European agenda for the collaborative economy*. Brussels: European Commission.
- European Commission. (2016b). Public opinion in the European Union. First results. *Standard Eurobarometer*, 85.
- European Commission. (2017). *The European Pillar of Social Rights in 20 principles*. Retrieved from <https://ec.europa.eu> [12 March 2018].
- Geron, T. (2013). *Collaborative housing aims to build housing for the sharing economy*. Retrieved from <https://www.forbes.com/> [12 March 2018].
- Giancaspro, M. (2017). Is ‘smart contract’ really a smart idea? Insights from a legal perspective. *Computer Law & Security Review*, 33 (6), 825–35.
- Hamari, J., Sjöklint, M., & Ukkonen, A. (2016). The sharing economy: Why people participate in collaborative consumption. *Journal of the Association for Information Science and Technology*, 67 (9), 2047–59.
- Housing Europe. (2015). *The state of housing in the EU 2015*. Brussels: Housing Europe.
- Iansiti, M., & Lakhani, K. (2017, January–February). The truth about blockchain. *Harvard Business Review*.
- Jourová, V. (2016). *Key findings about problems consumers face in the collaborative economy*. Brussels: European Commission.
- Kairos Future. (2017). *The land registry in the blockchain-testbed*. Stockholm: Kairos Future.
- Kakavand, H., & Kost De Sevres, N. (2016). *The blockchain revolution: An analysis of regulation and technology related to distributed ledger technologies*. Retrieved from <https://ssrn.com/abstract=2849251> [12 March 2018].
- Kenna, P., Benjaminsen, L., Busch-Geertsema, V., & Nasarre-Aznar, S. (2016). *Pilot project – Promoting protection of the right to housing. Homelessness prevention in the context of evictions*. Brussels: European Commission.
- Kim, K., & Hann, I. (2017). *Housing prices, collateral, and online crowdfunding*. Retrieved from <https://ssrn.com/abstract=2334590> [12 March 2018].
- Kolesnichenko, A. (2017). *Food and medicine supply chain blockchain tracking system*. Retrieved from <https://medium.com/koles-coin-news/food-and-medicine-supply-chain-blockchain-tracking-system-8bd1d3d16c90> [8 November 2017].

- Lambea-Llop, N. (2016). A policy approach to the impact of tourist dwellings in condominiums and neighbourhoods in Barcelona. *Urban Research & Practice*, 10 (1).
- Lifthrasir R. (2016). What is blockchain and how does it apply to real estate? *Realcomm, Advisory Topic: Business Solutions*, 16 (13).
- Mainelli, M., & Milne, A. (2016) *The impact and potential of blockchain on the securities transaction lifecycle* [SWIFT Institute Working Paper no 2015-007]. London: The SWIFT Institute.
- Miguel, J. (2017). *Blockchain tech can deliver significant advancements in real estate industry*. Retrieved from <http://techwireasia.com> [12 March 2018].
- Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved from <https://bitcoin.org/bitcoin.pdf> [12 March 2018].
- Nasarre-Aznar, S. (2014). A legal perspective of the origin and the globalization of the current financial crisis and the resulting reforms in Spain. In Padraic Kenna (ed.), *Contemporary housing issues in a globalized world*. Franham: Ashgate Publishing.
- Nasarre-Aznar, S., & Molina-Roig, E. (2017). A legal perspective of current challenges of the Spanish residential rental market. *International Journal of Law in the Built Environment*, 9 (2).
- Nasarre-Aznar, S. & Nigussie, A. (2017, August 28). *Collaborative housing: Disintermediating the real estate market through the blockchain technology*. Presentation at the COST workshop 'Digital platforms for the collaborative economy', Sheffield–Hallam University, Sheffield.
- OECD. (2017). *The governance of land use in the Netherlands*. Paris: OECD.
- Oh, S., & Lee, C. (2017). Block chain application technology to improve reliability of real estate market. *Journal of Society for e-Business Studies*, 22 (1).
- Oparah, D. (2016). *3 ways that the blockchain will change the real estate market*. Retrieved from <https://techcrunch.com/> [12 March 2018].
- Pickell, J. (2015). *How the sharing economy helps in the fight against climate change*. Retrieved from <https://www.huffingtonpost.com> [12 March 2018].
- Pierce-Wright, C. (2016). *State equity crowdfunding and investor protection*. *Washington Law Review*, 91, 847–86.
- Ranchordas, S. (2015, Winter). Does sharing mean caring? Regulating innovation in the sharing economy. *Minnesota Journal of Law, Science & Technology*.
- Reese, F. (2017) *Land registry: A big blockchain use case explored*. Retrieved from <https://www.coindesk.com> [12 March 2018].
- Schäfer, P., & Hirsch, J. (2017). Do urban tourism hotspots affect Berlin housing rents? *International Journal of Housing Markets and Analysis*, 10 (2).
- Schmid, C. (2016). *Cross border acquisitions of residential property in the EU: Problems encountered by citizens*. Brussels: European Parliament.
- Schmid, C., & Sebastian, S. (2007). *Conveyancing services market* [COMP/2006/D3/003]. Retrieved from <http://ec.europa.eu/competition/>

- sectors/professional_services/studies/csm_study_complete.pdf [12 March 2018].
- Shin, L. (2017). *The first government to secure land titles on the bitcoin blockchain expands project*. Retrieved from <https://www.forbes.com/sites/laurashin/2017/02/07/the-first-government-to-secure-land-titles-on-the-bitcoin-blockchain-expands-project/#39cb78074dcd> [7 November 2017].
- Simón, H., Lambea, N., & Garcia, R. M. (2017). Shared ownership and temporal ownership in Catalan law. *International Journal of Law in the Built Environment*, 9 (1).
- Snow, P., Deery, B., Lu, J., Johnston, D., Kirby, P., Sprague, A. Y., & Byington, D. (2014). *Business processes secured by immutable audit trails on the blockchain*. Retrieved from <https://cryptorum.com/> [12 March 2018].
- Sparkes, P., Bulut, D., Habdas, M., Jordan, M., Moreno, H. S., Nasarre-Aznar, S., Ralli, T., & Strutz, M. (2017). *What everyone got wrong about Fiverr's 'Doer' campaign*. Retrieved from <http://www.thedrum.com/opinion/2017/04/12/what-everyone-got-wrong-about-fiverr-s-doer-campaign> [31 October 2017].
- Tapscott, D., & Tapscott A. (2017). *La revolución blockchain*. Barcelona: Deusto.
- Tolentino, J. (2016). *How blockchain is transforming business models*. Retrieved from <https://thenextweb.com> [12 March 2018].
- Turi, A. N., Domingo-Ferrer, J., & Sánchez, D. (2018). Problems in the undertakings of the collaborative economy: Co-utile solutions. In J. Domingo-Ferrer & D. Sánchez (eds), *Co-Utility – Theory and applications*. New York: Springer.
- Über drivers are joining nationwide ‘fight for \$15’ protests on Tuesday. (2016) Retrieved from <http://fortune.com/2016/11/28/uber-drivers-fight-15-protests-wages-union/> [30 November 2017].
- UK union begins battle for workers’ rights at Deliveroo. (2017) Retrieved from <http://uk.reuters.com/article/uk-britain-deliveroo/uk-union-begins-battle-for-workers-rights-at-deliveroo-idUKKBN18I2S3> [30 November 2017].
- Wong, J. I. (2017). *Sweden’s blockchain-powered land registry is inching towards reality*. Retrieved from <https://qz.com/947064/sweden-is-turning-a-blockchain-powered-land-registry-into-a-reality/> [31 October 2017].
- World Bank. (2017). *Doing business 2018*. Retrieved from <http://www.doingbusiness.org/reports/global-reports/doing-business-2018> [12 March 2018].