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**WORKING PAPERS**

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The case of Sweden

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# Is a Blockchain-based conveyance system the next step in the financialisation of housing? The case of Sweden

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## **Abstract**

This paper investigates the social and economic mechanisms of a blockchain technology in the area of land administration. In particular, it focuses, first, on an emerging blockchain-based solution in Sweden to change and improve its land administration system (LAS), and, second, on the ‘upgraded’ LAS’ potential impacts to create more complex financial derivatives based on land and the built environment. We investigate how these changes influence housing markets at the interface with financial markets and how these changes impact on the economic organisation of the different stakeholders involved in these processes. The argument is developed using the case of Sweden, where *Lantmäteriet*, a government agency, is pioneering the use of blockchain technology for real-estate conveyance.

*Keywords:* Blockchain; land administration systems; conveyance workflow; housing; financialisation.

*JEL classification codes:* G28; I30; K11; L14; O43; O52

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# 1 Introduction

This working paper seeks to better comprehend the emerging, blockchain-based solutions for land administration systems (LAS) and their (potential) impacts on the ‘production’ of financial assets based on land and built environment (derivatives). This is important because this new technology – also called ‘institutional technology’ (De Filippi & Wright 2018) with reference to its novel quality of having societal restructuring potential, similar to the internet – has the capacity to redefine long-established socio-economic systems such as land and property markets. Yet, whilst blockchain’s potential for change is widely acknowledged in a growing body of literature (Baum 2017, Graglia & Mellon 2018, PwC and the Urban Land Institute 2017), the degree, character and directions of change are uncertain. LAS are context dependent. Sweden, the example at hand, has introduced a new blockchain-based solution for LAS, and this paper seeks to shed light on the form, drivers and new power configurations behind this new dynamic. The aim is to better comprehend how the revamped organisational architecture of Sweden’s LAS will be affected and what potential implications it might have for the various economic actors along the LAS’ specific value chains.

There are numerous definitions of what constitutes a LAS. Here, we follow Williamson *et al.* (2010) and define it as an integrated infrastructure that facilitates the process of determining, recording and disseminating information needed to implement land policies and the sound functioning of land markets. It is subordinated to the national land policy and land tenure arrangements and is institutionalised through administrative, regulatory, fiscal and other networks of incumbents.

Innovative technologies such as blockchain as well as new state policies in land markets have initiated dynamics that seek to not only break up current structures and implement full transparency in the opaque value chains of land and other abstract land-based commodities (derivatives) but also to reduce transaction costs. This new state-led development is expected to affect established organisational models that make up parts of the LAS, groups of incumbents, and their established routines. Taking the example of Sweden, where the nearly 400-year-old government agency *Lantmäteriet* is pioneering the use of blockchain technology for conducting real property sales, this paper elaborates on the extent and broader societal implications of these mechanisms.

*Lantmäteriet* is the Swedish state's central mapping, cadastral and land registration authority. It has been working on this innovative blockchain project for the last two years. This was done against the backdrop of the ongoing house price correction after years of double-digit house price gains alongside rising household debt.

Based on an exploratory qualitative research design, this paper discusses how the blockchain technology through LAS optimisation could further affect the process of financialisation of Sweden's land and housing markets. Specifically, this work investigates, first, how blockchain-based solutions integrated with LAS will affect the production and transactions of abstract land-derived commodities, and secondly, potential implications for housing markets and their various stakeholders. We therefore hypothesise for this work that *LAS infrastructure is a key element in the creation of real properties, their transactions and financing life cycle, and blockchain-integrated LAS will hence generate new opportunities in the financialisation process of housing.*

The remainder of this paper is developed as follows. Section 2 scrutinises the literature on financialisation dynamics in the realm of housing. Building on this literature, section 3 engages with the specifics of the Swedish housing market. Section 4 discusses the process of transformation of land into a financial asset, the role of the LAS in this process and the potential effects of a blockchain integration with LAS on this process. Section 5 presents some first empirical findings, before section 6 concludes the main findings and provides a critical outlook.

## **2 Financialisation of housing and its implications**

Sweden has the highest rate of housing loan penetration in the world (Badev *et al.* 2014). The majority of the population are homeowners with mortgages. Even though this situation is exceptional, it is not unique. Over the last 50 years, a peculiar style of home ownership, also known as *owner-occupation tenure*, became globally widespread (Smith 2009: 233). In a nutshell, it could be described as a package of housing services linked to investment vehicles. Today, such a form of tenure is used routinely by about two-thirds of OECD countries' households, while the equivalent of about three-fifths of all U.S. households account for the largest share of overall household debt. There are several reasons why owner-occupation tenure became so popular, perhaps the most prominent being rapidly growing housing prices (Smith 2009). Indeed,

as long as house prices continue to increase, a leveraged homeowner would realise a significant gain. Moreover, home ownership provides a sort of insurance or hedge against rapidly rising house prices in the future. In addition, it is the only type of investment for which ordinary people can secure so much leverage and pay comparatively little capital gains tax. As a result, the returns on home equity in many developed economies have outstripped other kinds of investments, e.g. pensions, and made housing a preferred asset-base for welfare (Smith 2009, Watson 2009, see also Picketty 2014). Hence, an increasing number of households in more advanced economies tend to look on home ownership as an investment opportunity as well as a retirement arrangement (Ryan-Collins *et al.* 2017). As a result, between 1914 and 2010 mortgage loans in OECD countries have increased from 20% to 64% of GDP and today investments in the housing market account for about half of all private investments (Jorda *et al.* 2016: 110). Currently, the volume of total global lending against real estate as collateral is astonishing: in the US alone, mortgages account for more than US\$14 trillion (Federal Reserve 2018). Sweden is on the crest of this wave.

Since homes have become an investment asset for families, continual expansion of the housing market and its value-sustainability have become crucial. However, in economies like Sweden, where housing provision is routinely linked to mortgage investment vehicles, a certain contradiction exists.

On the one hand, low or reduced mortgage costs expand the supply of and demand for housing, thus fuelling housing development. On the other hand, mortgage credit increases asset prices and values housing as ever-higher collateral, which in turn feeds back to provide the basis for even more lending. This has consequences far beyond the land and property markets. To leverage funds and finance cheaper mortgage loans, banks and other lenders bundle loan obligations into portfolios, a process known as securitisation, and sell them to investors in the form of debt securities, that is, bonds (Ashcraft & Schuermann 2008, Purnanandam 2011). These financial practices have created an alternative funding source and offer an even wider array of low-cost mortgage products (Sassen 2009). In this way, homes have turned into securities for financial instruments traded on global markets (Aalbers 2016). Bonds are both underwritten by fixed-income from steady loan repayments and secured by the collateral real property provides. Thus, by selling mortgage loan securities, banks and other lenders clear

not just their balance sheets to meet the minimum capital requirements demanded by regulators, they are also able to issue even more loans as well as to pass on the loan repayment risk to the investors who buy these securities (Ryan-Collins *et al.* 2017). For the banks and other lenders, the main source of profit is not the fixed income from the mortgage itself but the sale of the securitised financial asset packages on the secondary financial markets. This *originate-to-distribute* business model of banks and other lenders has further fuelled expansion of the housing market.

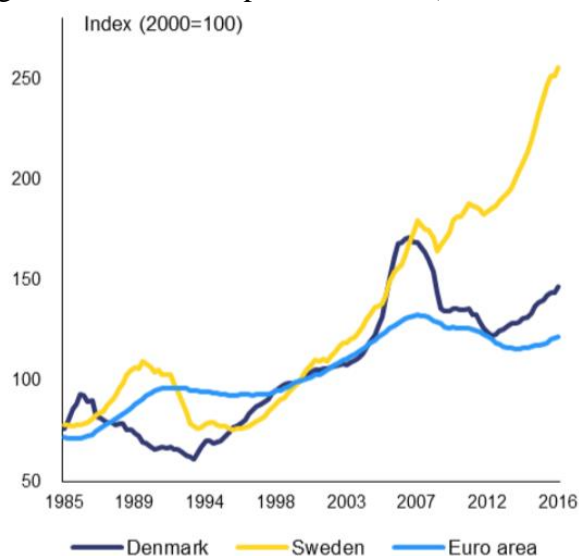
At the intersection of national housing finance with global finance, with the latter being keen on new investment opportunities, the demand for real property is no longer limited by people's income or by the amount of capital circulating in the domestic economy at a given time (Ryan-Collins *et al.* 2017). This trend is often taken to be part of a trend known as financialisation (for example, Aalbers 2016). It illustrates a structural transformation in contemporary capitalism, where capital accumulation is no longer centred on commodity production and trade but on finance (for example, Lee *et al.* 2009), thus transforming a variety of goods, firms and economic activities into financial assets (Leyshon & Thrift 2007). Put differently, financialisation is described as a regime under which "profit-making occurs increasingly through financial channels rather than trade and commodity production" (Krippner 2005: 181).

Financialisation is inherently spatial in nature and characterised by a constant search for a spatial-temporal fix in the attempt to postpone an unavoidable crisis (French *et al.* 2011, Harvey 2014). As a result, local housing markets, national mortgage markets and global finance have become increasingly interconnected (Aalbers 2009). The accumulation of private debt, however, is neither infinite nor without frictions, and house prices and debt service costs cannot, ultimately, be completely decoupled from household income levels (Fernandez & Aalbers 2016). Hence, borrowers may end up unable to honour their obligations, in which case the collateral underlying their loans would need to be sold. The collapse of the subprime mortgage market in the US exemplified how such event can leave both hugely indebted households and banks short of liquidity. In addition, the danger of contagion may bind very different geographies together when securities are purchased by large institutional investors

such as pension funds and insurance companies. Their losses can ultimately affect people who invested their life-savings with these institutions even if they live geographically far away from the housing market gone bust (Aalbers 2009, Martin 2011).

The aftermath of the recent financial crisis revealed not only how profoundly interconnected local property markets, national mortgage lenders and international financial markets have become, but also how geographically uneven the spread of the debt-driven financialisation model is (Aalbers 2009, Fernandez & Aalbers 2016, Lee *et al.* 2008: 2009). At the same time, the crisis did not affect every housing market in the same way. Sweden is among the few advanced economies that emerged from the crisis of 2007-2008 almost unscathed (Stenfors 2014, Swedish Bankers' Association 2017, Whitehead *et al.* 2014) and, after only minor corrections, house prices continued their unbroken, 20-year-long ascendance (Gaál 2017; see also figure 1).

Figure 1: Real house price increase (Index 2000=100)



Source: Gaál (2017)

Why, then, despite significant household indebtedness, has mortgage lending in Sweden not [yet] generated significant losses for the national financial system? The next section engages with these questions and seeks to give some first answers.

### 3 The case of Sweden

Between the post-war years and the collapse of the Bretton Woods system, Sweden had built a strong international economic position characterised by a high GDP and



export growth (De Vylder 1996). During this period, the activities of banks relying mostly on traditional, deposit-based funding and that of investment funds like insurance companies, pension funds and mortgage institutions, were subject to tight regulations. State policies obliged these lenders to invest in government and housing bonds, and therefore channelled deposit savings to areas of high priority, e.g. housing and infrastructure. This resulted in a quite stable but static banking system (Englund 2015). However, the average ratio of household debt to consumption between 1965 and 1983 rose to 117% in Sweden as compared to 84% in the US and 56% in the UK (Jappelli & Pagano 1989). This bond-based, government-sponsored systems of housing finance as well as loans for university studies fed the relatively high level of indebtedness (Englund 2015). While the ‘Swedish model’, balanced by commercial competition and social planning, is often referred to as an exceptional economic model, this debate has largely overlooked the fact that household debt has always been a constitutive part of it.

The neo-liberalisation of the state and the ascendance of a market-based style of governance, including corporate income tax cuts and large-scale privatisation programmes, reformed Sweden’s financial system. From the mid-1980s, loans started to be traded like any other form of commodity, thus, giving Swedish banks access to a variety of new funding sources. Hence, as Sweden’s credit market grew substantially, Swedish banks regained much of the national loan market share and became more competitive. Englund (2015) argues that, while increased lending activities did not affect credit constraints in consumption or investment, they fuelled an unprecedented rise in prices of both financial assets and real estate. They also triggered a vicious cycle where highly leveraged investments fuelled both asset prices and collateral values alike, which in turn implied even more lending (Sandal 2004). Price growth was exacerbated by opportunities of ‘profitable’ tax-deductions and low real interest rates that incentivised further borrowing. These financialisation dynamics transformed one of the developed world’s most regulated and protected financial systems into a nation of home-investors and risk managers that has been dependent on credit flows and boom-bust property cycles since the 1980s (Stenfors 2014).

Eventually, in the late 1980s, unrestrained borrowing opportunities and a lack of judicious risk assessment in financial institutions led to overheating of the Swedish

economy. A number of shocks caused by both international economic events and domestic policy drastically inflated financial and real asset prices. They amounted to large-scale insolvency, especially among corporate borrowers (Englund 2015), and eventually led to a major banking crisis in Sweden. Measures taken by the Swedish government enabled swift recovery of the banking system and real estate industry. In the absence of deposit insurance or any other administrative structure in place to handle systemic crises, two remedies, besides depreciation of the Krona after abandoning the fixed exchange rate policy, were of particular importance (Englund 2015). First, the government provided credible state loan guarantees. This solved Swedish banks' short-term liquidity problems and enabled them to continue supporting demand. Second, the government nationalised failed banks and set up a special state organisation to deal with their 'bad assets'. Their divestment took about five years. At the same time, interventions by Sweden's central bank ensured a decline of interest rates that boosted demand for new, more affordable, mortgages (IMF 2011).

As a result, the final net cost of assistance to the banks was near 0% of GDP (Sandal 2004). The successful prevention of fire sales was hence one of the key measures that permitted the Swedish government to bear only minor losses and to avoid a dramatic price crash of real property. Fire sales refer to a situation where a large number of real estate investors sell their property assets in unison. As a result, supply becomes excessive, asset prices start to fall, and lenders may face severe liquidity shortages. Fire sales are therefore a precondition for paralysed banking systems and economic recession as seen during the 2007/08 financial crisis.

The Swedish case set a precedent for the government bailouts in 2008 around the world (Englund 2015). Moreover, the lessons learnt by Sweden included measures to deal better with information asymmetries, uncertainty and risk that might hinder the stability of housing finance. As a result, first, Sweden's government focused on major projects to integrate the land administration infrastructure with the credit information system. The underlying logic was that a better coordination between both infrastructures would enable a faster connection between the property owner, the creditor, the investor, and property rights over collateral securities, and would therefore enhance the government's capacity to monitor the interaction between the national real estate

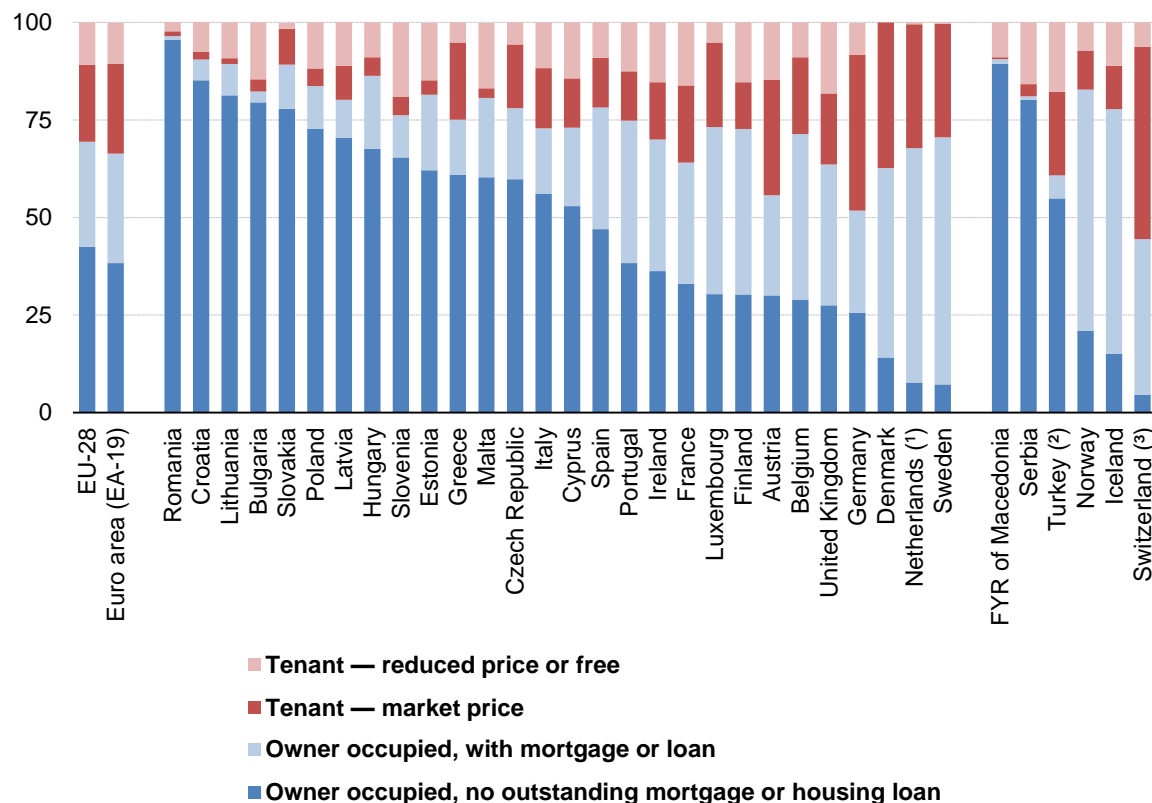
industry and the financial system. Second, these measures implied policies and legislations that focused on supporting both an abundant supply of accessible mortgages and high demand for owner-occupation tenure (Englund 2015).

The integration of these different databases resulted in the creation of a centralised electronic database (Holm 2011), largely finished by 1995. Today, this organisational upgrade plays a key role in structuring the property and credit markets in Sweden for a number of reasons: it facilitates the establishment of standardised information on the borrower and on the property; it helps to determine a property's market value; it provides necessary data to create collateral securities and to monitor their life-cycle and performance; it identifies priority of creditors in case of insolvency, to name but a few advantages (ASCB 2018). The Swedish Cadastral and Land Registration Authority, *Lantmäteriet*, merged the country's property-related information with its spatial information (see also figure 8). This new and unprecedented transparency, together with state guarantees on the relevance of this data, propelled Sweden's property transaction and property financing life cycle to one of the most secure in the world, thus also assuring creditors as to the safety of their loans (IMF 2011, World Bank 2017). The Swedish *Covered Bond Act* (2003), for example, introduced a double recourse for investors. It implies that investors have recourse to both the pool of collateral that back the specific, covered bond program, and to the estate of the bank in case of its default. Before the integrated LAS infrastructure, tracking current mortgage certificate holders, the underlying collateral, and a creditor's priority over them, was a cumbersome and time-consuming task. The new *Covered Bond Act* opened new funding sources for Swedish financial institutions. In 2015, about six years after its implementation, the outstanding stock of covered bonds had risen from 40% to over 160% of GDP (IMF 2011: 15). Most importantly, the combination of policies and legislation created during the Swedish financial crisis of the early 1990s and afterwards enabled strict control and quality of credit-standards, uninterrupted growth of property prices and stable demand for housing. It earned Sweden the status of a safe haven for real estate investments (IMF 2011).

Today, Sweden is a country with one of the fastest rates of house price growth in the world (Gaál 2017). Some 70% of Sweden's population are owner-occupiers and

an astonishing 90% of them have achieved this status through a loan or a mortgage (figure 2). The share of this kind of ownership type is the highest in the EU-28.

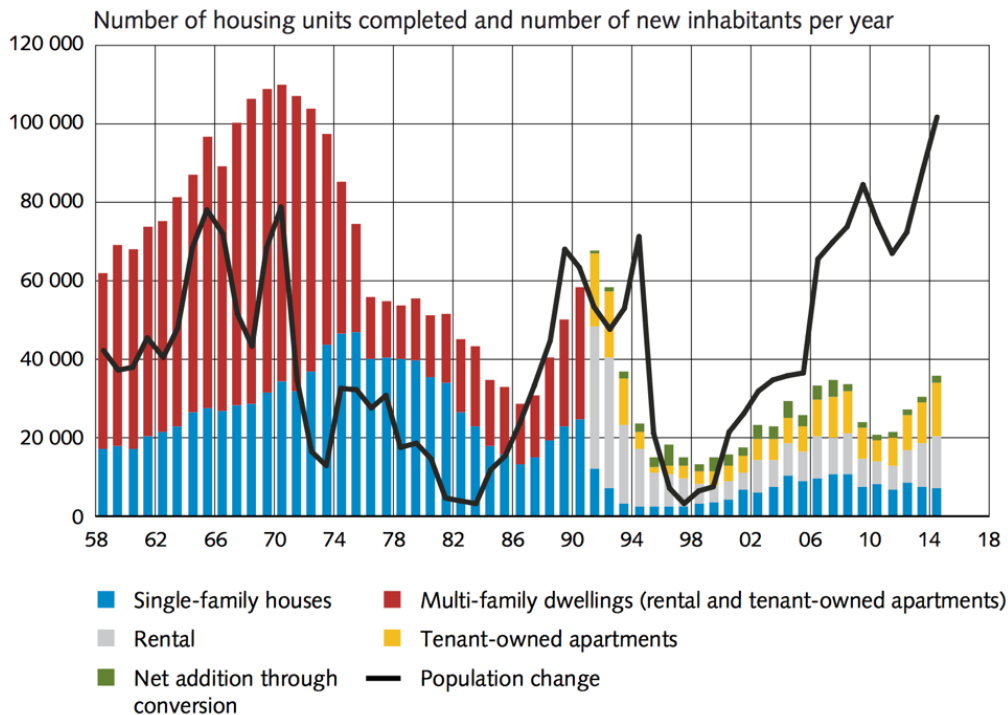
Figure 2: Distribution of population by tenure status, 2015



Source: Eurostat (2015)

In Sweden, demand for homes is stable not least due to one of the highest rates of population growth coupled with low construction activity, which particularly affects available housing on the highly regulated rental market (figure 3). In Stockholm, for example, in 2017, the average waiting time for an apartment in the city’s primary rental market was 12 years, and more than half a million people had registered on a waiting list (Bostadsförmedlingen 2017). Given this tense situation, for many owner-occupier tenure remains a sensible – and often the only – available option.

Figure 3: Housing contracting and population changes in Sweden



Source: Sveriges Riksbank (2015: 12)

However, house prices have risen more quickly and steeply than household income. For example, within the last 10 years, real estate prices in Stockholm increased by 60%. This is more than twice as fast as income growth, placing Stockholm second in the UBS *Global Housing Bubble Index* (UBS 2017). In addition, Sweden has the longest period of loan amortisation in Europe because the majority of borrowers only pay the (admittedly low and sometimes negative) interest and not the principal loan (EMF 2017). For reasons of profitability, lenders have encouraged this behaviour of slow repayment and the trend of a growing proportion of vulnerable mortgage loans (Gaál 2017) has led to the Swedish economy's significant exposure to the housing market and a disproportionately high household debt of 88 % of GDP. Between 1995 and 2015, household debt rose from 90% to 179% of households' disposable income (Hull 2017). All this makes Sweden's economy more vulnerable to external shocks (Gaál 2017). In 2017, despite a sophisticated mortgage system and policies that promote favourable financing and tax conditions for borrowers, – and therefore make it prone to accumulate housing-related debt, – house prices started to fall (Nordea 2018).

Around two-thirds of household loans are with housing credit institutions. Since 2014, lending secured on single-family homes, tenant-owned apartments and apartment buildings has grown by 24% and at the end of June 2017 amounted to a total of 3,824 bn SEK (Swedish Bankers' Association 2017: 7). Lenders primarily finance these loans by issuing mortgage bonds, two-thirds of which are held by Swedish investors (Swedish Bankers' Association 2017). The largest Swedish investors are insurance corporations and pension funds who hold about 25% of the outstanding stock. Banks and investment funds hold 19% and 15%, respectively (Statistics Sweden 2016). It seems inevitable that an unstable housing market carries risks for the Swedish welfare system, for households, and for the national economy as a whole, and to offset these the Swedish government took a series of counter-measures recently and introduced, for example, mandatory mortgage amortisation rules. Scholars like Hull (2017), however, doubt that they will have a big impact.

Against this backdrop, the Swedish government has yet again engaged in an innovative optimisation project, e.g. testing a blockchain solution for its LAS. The aim is to enhance both transparency and the efficiency of transactions involved in property ownership. In parallel with this purpose, the government also seeks to have better – centralised – supervision over financial activities. To understand the implications of this innovation on both the housing and mortgage markets better, section 4 explores the LAS' role, workings and rationale.

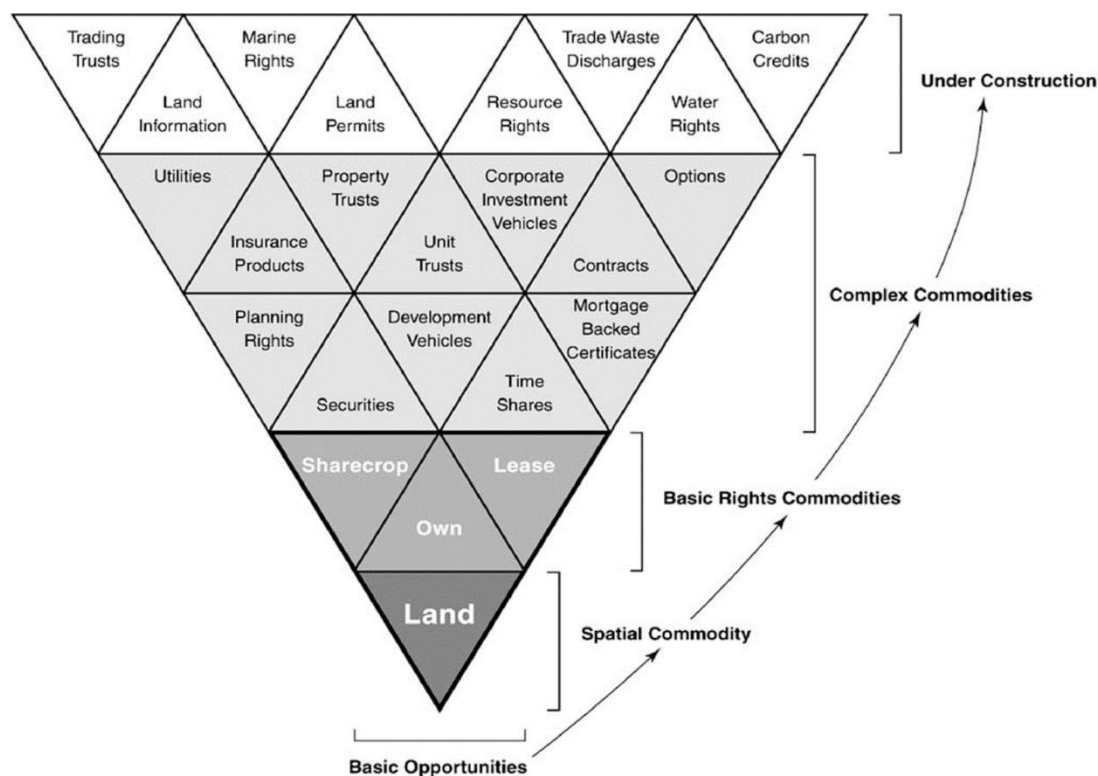
## **4 Sweden's Land Administration System and blockchain solutions**

### **4.1 Processes of abstraction and 'derivatisation' of property and land**

A prospective homeowner can obtain mortgage credit from a lending institution only on the condition that there is a mechanism in place that allows the physical parcels of land or a building to be reclassified rapidly and securely into a tradable asset (Bouckaert 2010, Williamson *et al.* 2010). Wallace & Williamson (2006) distinguish two types of such assets and refer to them as abstract, tradable commodities: (1) simple commodities, e.g. ownership, leases and mortgages, and (2) complex commodities, e.g. ownership titles in multi-occupancy buildings, in mortgage bonds and in other kinds of com-

commodities that have no direct relationships with land anymore (figure 4). Such a commodity is hence a derivative, i.e., a contract that derives its value from the performance of the underlying land or property.

Figure 4: Development of complex commodities: land-based derivatives of different degrees



Source: Wallace & Williamson (2006: 134)

The range of commodities available for trade within a given national jurisdiction depends on the development stage of its land market. Before the development of the subsequent stage is possible, as suggested in figure 4, all preceding stages must operate successfully. Wallace & Williamson (2006) define five stages in land market development. Each is characterised by a different degree of separation between land and the land-derivative. To ensure the stability of complex derivatives, a record of previously established relationships with the respective lower level of the derivative is kept. For example, if a buyer wants to purchase a piece of land and needs to finance it by borrowing, s/he needs to deposit a security. Thus, a new mortgage deed or an obligation to give up his/her property right on this land parcel in case of default is created. To design such an abstracted property right, the parcel of land needs to be *singularised* and *objectified* (Callon & Muniesa 2005) in relation to the rest of land, which is located, measured and valued. In addition, the relationships between the parcels of land

and their owners, as well as with the rest of the derivatives' stockholders, needs to be established and recognised by society. In order to achieve such wider recognition and establish respective property rights, the materialised – or real – entity and its derived (abstracted) commodity are separated through a chain of consecutive re-classifications depicted in a chain of contracts (cf. figure 4). Millo (2007) calls this interactive process *qualification*. It involves networks of different agents who establish and re-establish the *relationships* between existing and emerging derivatives each time a derivative is traded. Thus, this sequence of qualifications helps to turn land into a collateral security against a bank loan, and the agents involved in this process comprise notaries, valuers and bankers. Cooperatively, they ensure the relationships between the derivatives and their stockholders, thereby using evidence from previous qualifications kept in numerous databases. Once a transaction is finalised, the new derivative is tradeable and ready to be re-qualified into yet another, more complex, derivative. Both basic and complex derivatives are connected and constantly evolving qualifications established through a consensus between different groups of stakeholders.

The qualification process is rarely linear. Administrative, legal, fiscal and other institutional networks depend on each other's classifications and the precise synchronisation between these classifications. The speed of identifying the old and new relations between the different land derivatives relies on the reliability of the synchronisation process. This is especially important in the cases of a legal dispute, or the insolvency of a borrower, when the entire qualification supply chain needs to be traced back to source. Both speed and the costs with which the creditor can establish property rights on the collateral used to secure the loan and recover liquidity by disposing of it depend on how the relationships between land derivatives and ownership is managed. This situation defines a need for an infrastructure, that is, a credit information system. It brings together the required data to secure these relationships, and the institutional networks to operate the infrastructure.

In a nutshell, the more reliable and efficient the combination between the infrastructure and the operating network, the easier for lawyers, bankers and notaries to manage and mitigate risk in the qualification processes. These processes range from simple land commodities, such as an ownership right to a plot of land or the right to



lease it, to more complex land derivatives, such as land-based securities or a mortgage-backed certificate (Warnock & Warnock 2008).

## **4.2 Context matters: the geographies of qualification approaches**

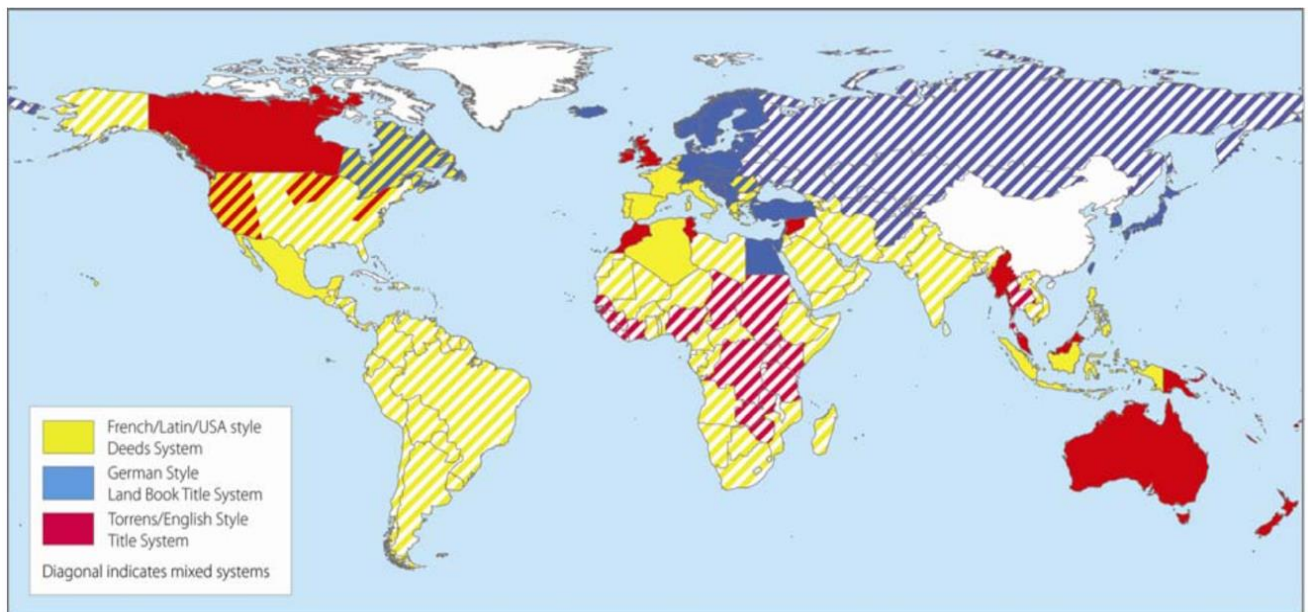
The practices that define how property rights are linked to land and land derivatives vary across jurisdictions and reflect the different legal foundations on which these lineages are built. Below, we provide a brief example to illustrate the significance of context and geography.

Two practices can be discerned, namely a recording and a registration procedure (Arrunada & Garoupa 2005). Originating in old English law, the *recording* procedure was widespread in common law countries. It is still widespread in the US. The *registration* procedure, in contrast, originated in Roman law and was initially common in countries influenced by the German civil law. It then spread to England, Wales and other countries, which eventually implemented the Torrens system. One of the main distinctions between both practices is the way they deal with uncertainty in the transfer of property rights (Bouckaert 2010).

The logic of “dispute resolution” and “compensation for damage” (Damaska 1986) informs common law-based *recording practices*. A registrar accepts the conveyances and records the entirety of claims and liabilities related to a particular property without searching for possible legal defects (Bouckaert 2010). That means that a record entry does not validate the ownership title. Rather, it *informs* the public about the transaction. This logic originated in the qualification routines common in England up until the beginning of the 20th century. Prior to that, the physical transfer of all title deeds related to the property from the seller to the purchaser ensured the transaction of property ownership, which was cheap, safe and private (Bouckaert 2010). The title papers were transcribed in the local authorities’ public record of the claims and liabilities. Such record did not imply, however, that all existing claims were recorded and hence, even a recorded title to real estate was subject to all defects in its entire recorded history. Hence, for self-protection, purchasers of land relied on a professional to ensure the warranty with regard to deeds, mortgages, restrictions and claims on the property. The buyer, however, had to ensure the validity of all documents, therefore allocating an essential role also to the solicitors in this process (Bouckaert 2010).

By contrast, the aim of the *registration procedure* is more thorough. It follows the logic of prevention and strengthens the performance of a contract that results in the constitution of a valid title (Limmer 2013). Registration produces a constitutive effect. The registrar is obliged to search for possible title defects and only in *absentia* is a valid title awarded. These two distinct qualification practices gave birth to the three main styles of land and property registration systems: the German, the Torrens/English, and the French/Latin approach (see further figure 5).

Figure 5: The world map of land registration systems



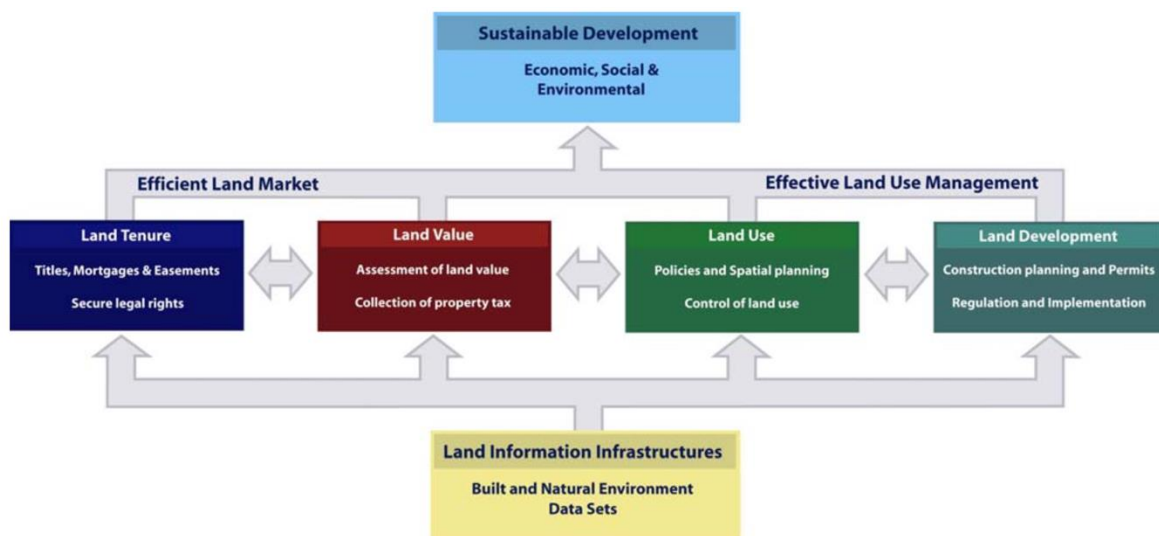
Source: Williamson et al. (2010: 61)

The geographical spread of these systems relates closely to the history of colonisation. However, mixing with local contextual settings, new configurations of the institutional networks responsible for enacting the qualifications were created. Whilst it is widely believed that the recording system is more cost-efficient than the registration system, the registration system is deemed to be more effective (Bouckaert 2010: 199). With the growth of the market both the recording system's inherent risks of conveyancing and its costs have increased (Limmer 2013). Both regimes, however, affect the developmental stage of the housing market, the type of housing finance (Blackwell & Kohl 2017), and the connection between local housing and global finance. Technology might affect the different organisational models of housing and finance. The questions therefore remain, how and to what degree.

### 4.3 Technology and LAS

Significant advances in information technology found, for example, in geographical information systems (GIS), digital land registration systems, and spatial data infrastructures, have helped to develop new qualification techniques used to establish the relationships between land, the built environment, other complex land derivatives, and people. IT also made the information transfer needed for land qualification faster and more secure, while ensuring both information integrity and the consistency of land-related arrangements (Williamson *et al.* 2010). As outlined in section 4, contemporary LAS enable the commodification of land, the provision of the infrastructure for land management strategies, and resolutions for competing interests in land. LAS therefore provide an essential infrastructure that facilitates the integration of four central land administration functions, i.e., land tenure, land value, land use, and land development (figure 6), and rely on an extensive network of service providers like surveyors, lawyers, valuers, planners, and other professionals. The Land Registry and Cadastre constitutes the basis of any modern LAS; their legal origins are reflected in the respective LAS architectures (Williamson *et al.* 2010). Hence, on the one hand, a LAS’ design affects the range and stability of markets and commodities, while on the other hand, context reflects their organisation and efficiency.

Figure 6: A global land administration perspective.



Source: Enemark (2004: 8)

In Sweden, LAS developed alongside the historically bond-based mortgage type of housing finance, which relies on the public land registry to ensure that banks and

other lenders would rank as higher-tiered creditors in case of a foreclosure (Blackwell & Kohl 2017). While the *Lantmäteriet* is one of the oldest public authorities in Sweden, it was the first authority in the world to initiate the digitalisation of its land registry in the 1970s. By 1995, the registration part, traditionally maintained in books and held by the numerous Swedish district courts, was fully transformed into a centralised electronic database (Holm 2011). Its sophisticated registration mechanisms are unique. Moreover, supporting the development of a secure and rational national credit market, *Lantmäteriet* is not only responsible for the management of the digitised *Real Property Register* but also for the administration of the *Mortgage Deeds System* for real estate and the *Corporate Mortgage Certificate System* for businesses. Both the *Mortgage Deeds System* and the *Corporate Mortgage Certificate System* are the result of a new law on computerised mortgage certificates implemented after the housing crisis in 1994, which made the process of transferring mortgage certificates between creditors faster, cheaper and more efficient. They are managed in close co-operation with banks, credit institutions and the major property companies (ASCB 2018).

However, the sheer size of information has increased significantly as the scale and scope of housing and the underlying real estate markets, not only in Sweden but in the world, have grown. This in turn has increased the volume of transactions, whilst transaction efficiency decreased. New intermediaries emerged to capitalise on those inefficiencies and to mitigate risk resulting from conflicting qualifications, such as title insurers in the US, and brokers, notaries, and valuers in other countries. As these intermediaries spread, transaction costs to coordinate the synchronisation between them rose steeply, thus, encouraging opacity, information asymmetries, and speculative behaviour. The biggest frictions and costs of transactions result therefore from services such as price determination, contract negotiation, and risk assessment (Zewenbergen *et al.* 2008), whilst the operation and maintenance of the infrastructure by these service providers imply additional costs. The resulting increase in transaction time and expenses contributed to the housing market illiquidity, a dangerous combination when pooled with the uncertainties from price corrections caused, for example, by fire sales and their consequences.

It was not least these same inefficiencies that led governments and supranational bodies to nudge crucial innovation and optimisation (Muniesa 2017). Respective

measures focussed, first, on reducing the frictions responsible for slow, opaque property transactions (Zevenbergen *et al.* 2008). Second, they aimed at harmonising and standardising qualification practices and categories in order to make land derivatives consistent both nationally and internationally (MSCI 2018). Third, and to facilitate further market expansion, they targeted reductions in cost and time to produce and transact new kinds of products derived from land (Graglia & Mellon 2018).

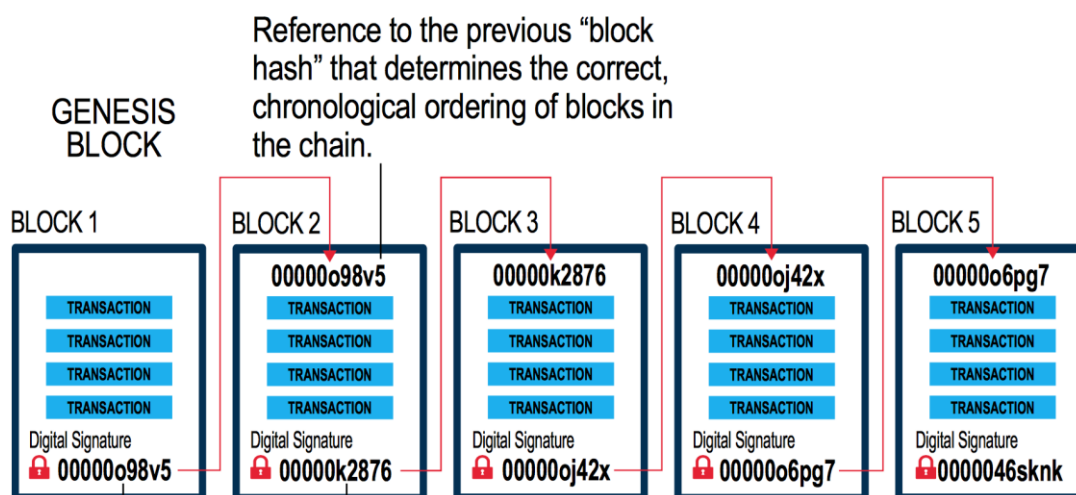
New synchronisation and validation systems based on new information technologies such as blockchain, the internet of things, artificial intelligence, and big data have made it easier to collect, share, link, interpret and sell data needed for the sound functioning of the sector (Vos 2018). A growing number of privately and publicly supported start-ups have been capitalising on the opportunities to generate a variety of blockchain-based products and business models known as *PropTech* (property technology) (Baum 2017, Graglia & Mellon 2018). The applications of *PropTech* comprise processes such as the synchronisation of the workflow of real estate development, management and trade, and the creation of fractionalised property rights via disaggregated and standardised property rights, to name but a few examples.

These new interventions create a virtually unlimited number of land-derived products and further enable unprecedented levels of efficiency in and expansion of real property markets. However, social systems are inert and integrating technical solutions that potentially alter difficult power relations in existing socio-economic systems touch upon the sensitive relationships between social actors and social orders. They therefore relate to power plays between incumbents and challengers (Fligstein & McAdam 2012). For that reason, amongst other, many states have slowed down the full-scale expansion of *PropTech*. This has reduced the functionality of many of these novel technical solutions and kept them and their providers at the level of private niche services. At the same time, over the past two years, the largest supranational development organisations and a growing number of land administration authorities have embraced these new technical opportunities and have begun to integrate blockchain into their information infrastructures and LAS (Graglia & Mellon 2018).

Blockchain constitutes a technical core innovation designed to work as an effective medium of interaction between parties (Greenfield 2017). Blockchain is a type of

distributed ledger technology (DLT) that refers to a fast-evolving approach to recording and sharing timestamped and cryptographically secured data across multiple data stores (Natarajan *et al.* 2017). The spectrum of DLT models and their designs is broad. Depending on the needs of business models, they vary in their degree of centralisation, types of access control and procedures for agreement consolidation. Digital signatures (a means for the cryptographic verification of identity) serve to control who does what in a shared ledger. One application of a blockchain technology involves creating verification records for digital files and entities, e.g. documents with a cryptographic hash<sup>1</sup>. Such verification services enable to digitally represent binding contracts, to share them and to prove their original validity when registered on the blockchain (see also figure 7).

Figure 7: Blockchain structure



Source: Natarajan *et al.* (2017: 9)

Because each subsequent block receives a hash, i.e., a verification, of the previous block it is difficult (if not impossible) to create an alternative version of what was contractually agreed. As long as hashes match across the chain, all parties can trust their copy of the record.

Such an information infrastructure that weaves with each preceding block into a subsequent data block shows a similar logic to that of the previously discussed production of land derivatives. It is important to recall that complex land derivatives gain

<sup>1</sup> A cryptographic hash is a unique code that consists of a string of characters generated from a digital file using a specific algorithm. Hence, one original input allows exactly one hash value. Multiple hashes can be converted into one hash. Put on blockchain, verification records become tamper-proofed and time-stamped. A blockchain is in fact a hash chain that contains a hash chain of transactions (Waldman 2018).

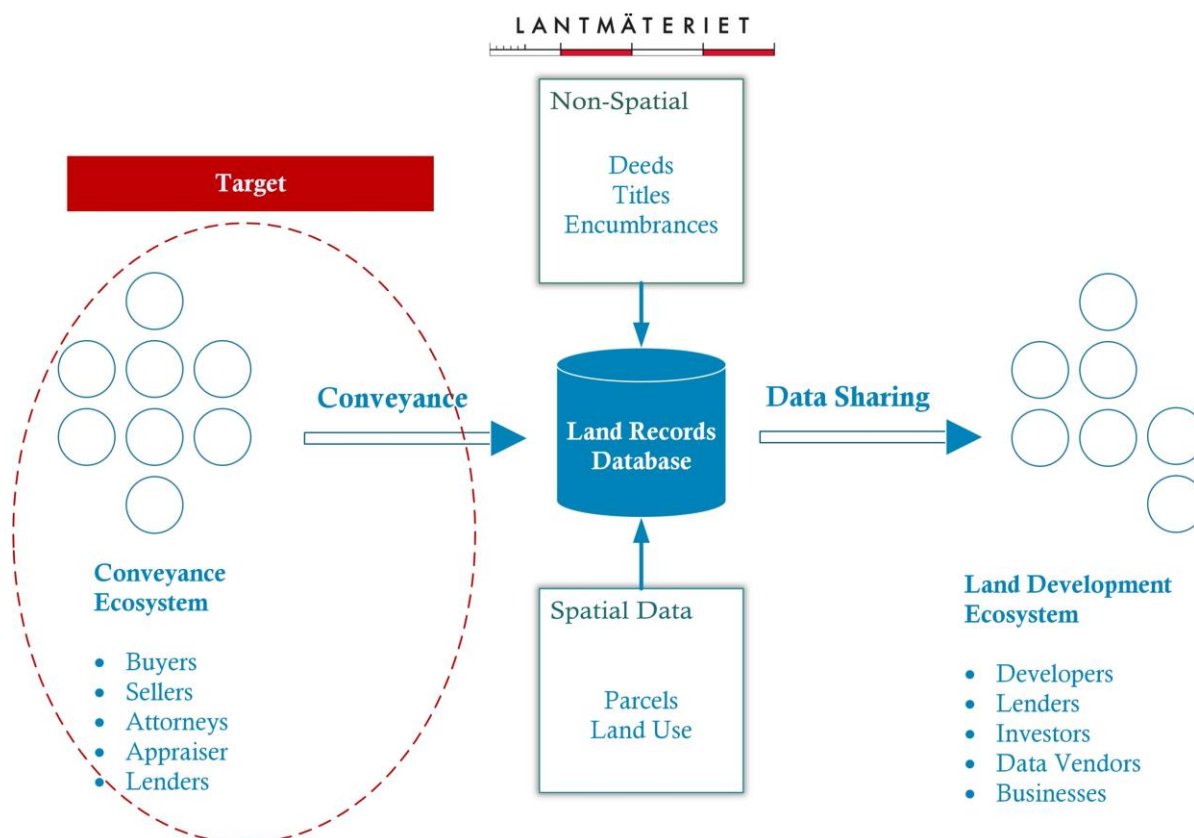
their characteristics when establishing relations with more basic land derivatives in the ‘lower part’ of the chains of qualification (cf. figure 4). Yet, the coordination and synchronisation between the involved incumbents and their databases is cumbersome, expensive and error-prone, all of which potentially exacerbates information asymmetries. The accumulation of disagreements in a multitude of databases that condition the production of both simple and complex land derivatives can therefore increase costs (McFarland 2012) and destabilise land derivatives, in particular.

Hypothetically speaking, if all the relationships ever established to qualify land into different products had been instantly accessible to the parties involved in qualification and their authenticity had been easily proved, the production and transaction of land derivatives could be done within seconds and at virtually no cost. Such massive integrated records of all qualifications ever done would enable unprecedented standardisation of the techniques used to establish relations between people and land. This could potentially lead to automatised qualification practices via computer code (Graglia & Mellon 2018) depriving many incumbents of their power to set the parameters and characteristics that reflect their view of reality (Greenfield 2017). Today, such applications of blockchain technology are becoming increasingly widespread. A computer code with a predefined set of rules running on top of a blockchain, also known as a smart or *embedded* contract (Kempe 2017), is used to secure multistage processes, where a number of geographically divergent actors have to confirm their actions at various stages of the agreement. If and when these predefined rules (which can mean executing a rent payment, issuance of a loan, deposits or property transfer) are met, the following set of instructions is automatically enforced by a computer system. In practice, a chain of messages is saved in a private blockchain which can execute the transaction between parties and share the resulting verification records automatically.

Sweden is one of the first countries in the world to embrace the opportunities offered by blockchain and is currently experimenting how to integrate blockchain in its LAS. Although Sweden’s land registration process is fully digitised, documents such as purchase agreements, IOUs (I owe you), and bills of sale are still paper-based. Consequently, updates on real estate transactions and their information take long and some updates even remain in the shadow. The *Lantmäteriet*, the private developer

*Chroma Way*, two major banks *SBAB Bank* and *Landshypotek*, and *Telia Company*, who deal with digital IDs in Sweden, are in the process of investigating blockchain as a technology to process property conveyance (figure 8).

Figure 8: Sweden’s land registry and its blockchain project to modernise the LAS



Source: Hjelte (2018)

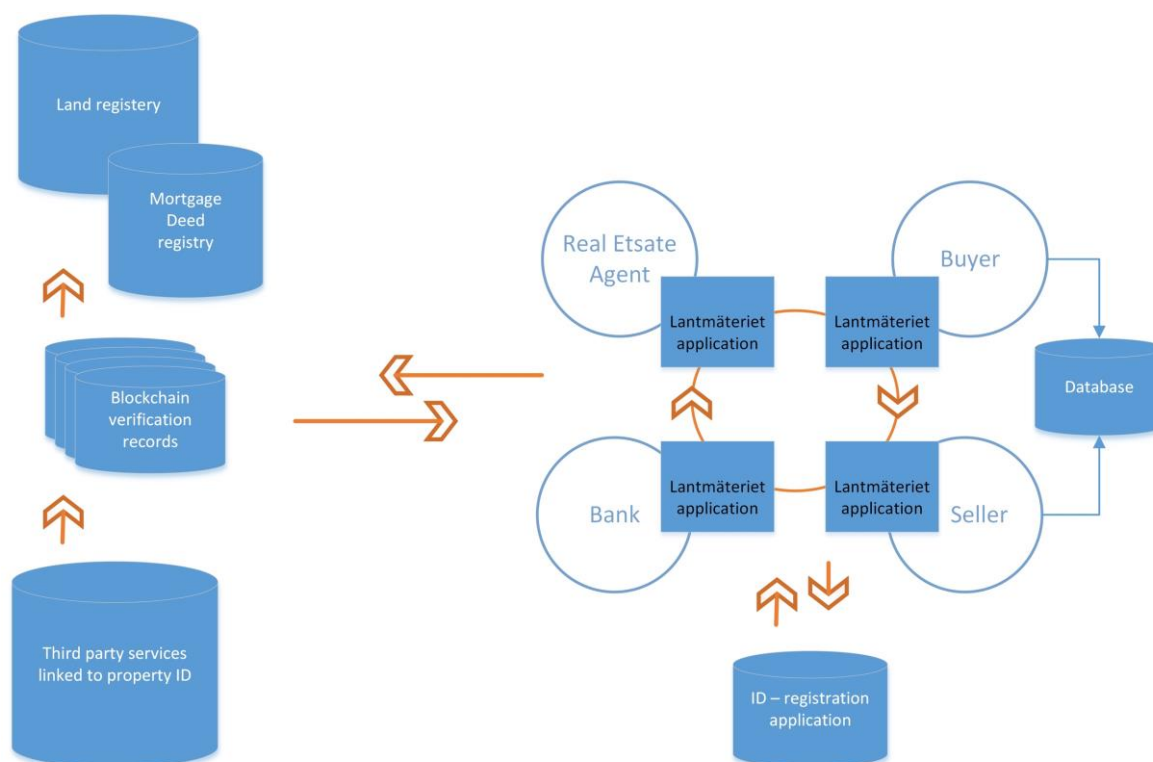
The applications of blockchain designed for Sweden should move the Swedish land registration process very close to an entirely digitised workflow based on self-executing contracts and enforced by the system’s participants.

As discussed for the logic of the blockchain technology, resulting contracts and transactional data will be retrieved from the blockchain and recorded in the real property registry and other databases, i.e. mortgage deed registry, in real time. As depicted in figure 8, it includes transactions related to property transfer, life cycle financing, insuring origination, servicing and securitisation (Graglia & Mellon 2018). This new system is based on a consortium database that represents a convergence of different commercial databases with a private blockchain (Kempe 2017). The consortium’s database combines a private blockchain with a relational database (i.e. SQL database)



that contains information entries on property rights, mortgage deed certificates, etc. Hence, the blockchain needs to interact with existing land registry, mortgage, banking and third-party provider systems such as the loan origination system and other systems using the database (Graglia & Mellon 2018, Kempe 2017, see also figure 9).

Figure 9: Organisation of a conveyance workflow.



Source: Kempe (2017: 60)

A blockchain is only as good as its underlying data and processes (Vos 2018) and therefore reflects both its context-specific information infrastructure and institutions. Hence, each country, following their own specific development trajectories, will implement a solution that can differ significantly in its range and scope from other countries. The next section probes empirically whether Sweden’s blockchain-based conveyance system is yet another step in the financialisation of housing.

## 5 Empirical findings

The literature often features Sweden as a first mover. To gain a deeper comprehension of how blockchain technology will alter the above-discussed transaction processes in

and the organisational architecture of the socio-technical LAS, we mapped and compared both the current and the future blockchain-based conveyance procedures in Sweden (figures 10 and 11).

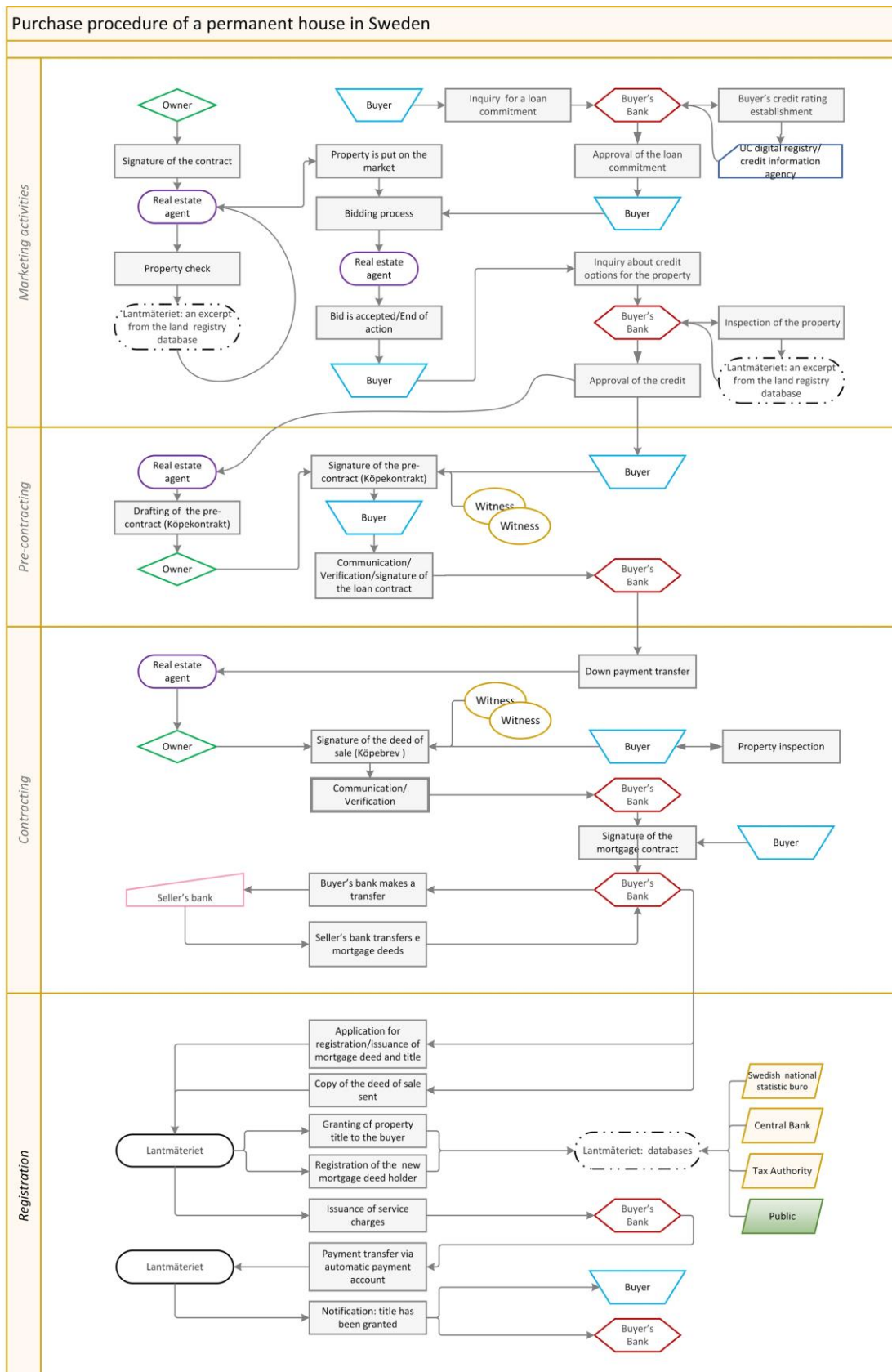
Explorative empirical research was conducted in April and May 2018 in two phases. In the first phase, findings from grey and academic literature (Holm 2011, Högberg 2006, Kempe 2017, Osterling 2017; Zevenbergen *et al.* 2008) as well as reports and videos helped to understand the technology-induced alterations in the organisation of property conveyances in Sweden as portrayed in the previous sections and sections 5.1 and 5.2. In phase 2, we interviewed experts to help interpret our empirical findings with regard to potential market implications. As discussed in section 5.3, this research is only a first step toward deeper scrutiny into blockchain-based LAS and their implications for governments and regulators, for the entire real estate ecosystem, and for society in years to come.

## **5.1 Empirical phase 1: understanding LAS' current organisation**

Sweden's conveyance procedure is one of the most advanced in the world (World Bank 2017). Its highly standardised process makes buying property and getting a mortgage simple and quick as compared to other jurisdictions. The process does not require a notary because the register managed by the *Lantmäteriet* reliably indicates the current ownership of land and secures the registered owner against third parties. The computerised public system is an infrastructure that facilitates contact between all relevant parties and provides required data promptly upon request.

The average time for listing a property on the market in Sweden takes less than three weeks and about one week in Stockholm. Currently, four parties are actively involved in the transaction process, i.e., the buyer, the seller, the seller's agent, and the buyer's credit institution. *Lantmäteriet's* involvement and supervision is minimal. It only gets involved at the end of a transaction, when the buyer's bank applies for the title and mortgage registration, as well as pays duties. Each transaction starts with the seller hiring a real estate agent for a commission of around 1.5% on the sale price. Only licensed agents can broker real estate transactions. The sale mechanism is a sequential open auction, during which a buyer represented by his/her agent bids for the property. Bids become binding as the seller and the buyer sign a purchase contract.

Figure 10: Flow chart of the current house buying procedure in Sweden



Source: own illustration, based on Zevenbergen et al. (2008)

Given that in 90% of all cases home ownership is enabled through mortgage loans, banks have a self-interest to actively support the buyer during the transaction. The loan document serves as the recognition of debt but is a private contract and is therefore not recorded in the property register. The mortgage deed (*pantbrev*), issued by *Lantmäteriet* upon application of the new owner of the property, insures the security over the mortgage. The new owner can choose the amount of the mortgage deed on which a stamp duty of 2% is due. Usually, on behalf of the buyer, the bank applies for the registration of the new ownership and requests the mortgage deed. The mortgage deed remains with the bank until the loan is repaid. Once the debt is paid off, the property owner can re-use the mortgage deed as a security for a new loan. However, several mortgage deeds can cover the same property. Real estate profit made by the seller is taxed at 22% but may be illegally circumvented in some cases. Zevenbergen *et al.* (2008) distinguish the following four basic components of the conveyance procedure in Sweden: marketing activities, pre-contracting, contracting, and registration. We introduce each of them in the following. The actions of the buyer's bank are crucial for each consecutive stage of the procedure.

#### *Marketing activities*

The seller of the property starts the transaction by signing an agreement with an appointed estate agency. After signing, but prior to listing the property on the market, the agent procures an excerpt from the *Lantmäteriet* database to confirm ownership. For the buyer, the transaction usually starts when reaching an agreement with the bank, which – after establishing the buyer's credit rating – commits to financing the loan. Once a bid for a property is accepted, the buyer requests loan options. The buyer's bank inspects the property by searching respective databases and evaluates credit options for the buyer. The marketing phase finishes with the buyer's bank's informal approval of the purchase price and the loan.

#### *Pre-contracting phase*

During this stage, the buyer and the seller sign a purchase contract (*köpekontrakt*). The purchase contract binds the parties towards the final agreement. Although formal requirements for the contract exist, negotiation is possible. As soon as the buyer's bank receives a copy of the signed purchase contract, it provides the buyer with the credit documents. Next, the buyer signs the loan agreement and pays a deposit of around 10%

of the final purchase price into the agent's escrow account. When the buyer's bank receives the signed loan agreement, it transfers the commission to the agent, which marks the beginning of the contracting phase.

#### *Contracting phase*

At this point, the buyer may inspect the property if inspection conditions were stipulated in the purchase contract. The agent then remits the deposit to the seller after deducting the agreed fees. Both buyer and seller sign the final deed of sale (*köpebrev*), in the presence of two witnesses. This document contains only the minimum information required by law in relation to real property conveyance. It is made public once filed with the *Lantmäteriet* for registration of new ownership. The buyer signs the mortgage and any other pre-existing deeds on the property and can also negotiate the acquisition of existing loans on the same terms that apply to the seller. This payment is made via direct deposit between the buyer's and the seller's banks, while the mortgage deed held by the seller's bank is transferred to the buyer's bank. The buyer can now move into the property. After signing the pre-contract, it could take up to three months before the buyer's bank makes the final payment (Kempe 2017).

#### *Registration*

Once the possession of a mortgage deed is transferred from one bank to the other and/or if it is necessary to obtain further mortgage deeds, the buyer's bank requests the entry with *Lantmäteriet*. Meanwhile, the seller's bank will release the mortgage deed to the buyer's bank. *Lantmäteriet* registers the property that grants the buyer the title, while the buyer's bank is registered as a deed holder in the mortgage deed system. After completion of registration, *Lantmäteriet* invoices the buyer for the administrative handling and stamp duty.

In summary, the current workings of LAS suggest that the buyer's bank acts as a gatekeeper at each transaction in the housing financing supply chain. *Lantmäteriet* is only involved in the later – though important – stages of final approval and the publication of the purchase contract but also to collect duties. LAS, as an *intermediary* between buyer, seller, and banks, merely acts as a provider of reliable information on the property's status and is not involved in the decision-making process. Over and above this particular constellation of actors, the entire process, as described in figure 10, is

error-prone, slow and inefficient. Many documents in this process still require signatures on paper copies and are exchanged via regular mail, which prolongs the necessary synchronisation of the actions between different stakeholders (Kempe 2017). Uneven access to information during a prolonged synchronisation process potentially incentivises speculation (Osterling 2017), which can also affect housing market uncertainties and inefficiency.

## **5.2 Blockchain-based conveyance: a new technology to improve LAS**

Figure 11 demonstrates the blockchain-based far-reaching alterations in the organisational architecture of Sweden's upgraded LAS. The entire transaction chain occurs in the digital consensus space of an application (digital app) owned by the *Lantmäteriet*. Each registered property has an account accessible with an existing, active Swedish electronic identification solution, designed as 'permissioned' by trusted partners exclusively. Hence, only verified records become part of the blockchain. The individual electronic identification system, key in this new process, is based on social security numbers and IDs currently provided by a private firm called *Telia*. The new digitised process influences the organisation of Sweden's LAS as illustrated in the following.

### *Marketing activities*

The seller logs on to the system to verify that there is no impediment for the sale of his/her property. Now, the house sale can be processed without an agent's involvement. If an agent were still to be required in an unusual situation, the seller sends an invitation and the agent accepts by entering his/her electronic key. Additional parties can also be invited subsequently into the transaction process. The buyer uses the app to request a property loan from the bank, which is no different from the original procedure where the bank performs credit checks against the digital register. The system notifies the seller/agent about all prospective offers. Once the seller/agent accept the offer, the buyer is invited to confirm her/his commitment. The buyer then completes the financing contract with the bank, also via the digital app, but access to the credit documents can be encrypted concealing the borrowed sum from the other parties.

Meanwhile, the system allows both the buyer and the financing bank access to the digital property account in order to complete any further required assessment. Importantly, however, the property account contains additional information on the property that could affect the valuation. The bank ratifies its preliminary approval with a digital signature and all parties are notified instantly about the new status in the transaction and the ability of the buyer to pay for the house.

#### *Pre-contracting/contracting phase*

The new blockchain-based process blends the pre-contracting phase with the contracting phase. Digital signatures have already concluded activities, e.g. commitment flagging and the bank's mortgage approval, required in the 'old' process. Moreover, the agent does not need to draft the purchase contract nor negotiate its conditions as some pre-generated digital fields have already fulfilled the formal contract requirements. All parties need to fill in their required fields, add extra information if needed, and sign the resulting form with the electronic *Telia* key, resulting in a tamper-proofed copy of the agreement and a verification record in the blockchain. At this point, *Lantmäteriet*, which monitors the whole process, registers the pending property title and publishes the respective house purchase information before any payment made or before a final deed of sale is signed. Eventually this step could be automated entirely via smart contracting.

Simultaneously the mortgage deed transfer starts. The seller engages the manager of the contract, usually the buyer's bank. The bank examines the current state of the mortgage deed and enters the details of the future holder/s, their priority in case of insolvency (cf. page 8 in this paper), and possibly any secondary holders. Holders' identities are encoded in the publicly available electronic key and the respective counter-parties digitally sign the contract. However, the execution of the contract is conditional. The *Lantmäteriet* makes only a pending registration, indicating that the transfer of the mortgage deeds will only be legally finalised once the land title is successfully transferred. Meanwhile, the lending agreement between house buyer and financing bank is signed and attached to the app. It triggers the deposit order that is digitally signed and transferred to the seller. Access to the entire credit document can be encrypted and/or restricted. If an agent was involved in the transaction the buyer's bank pays the deposit to them directly.

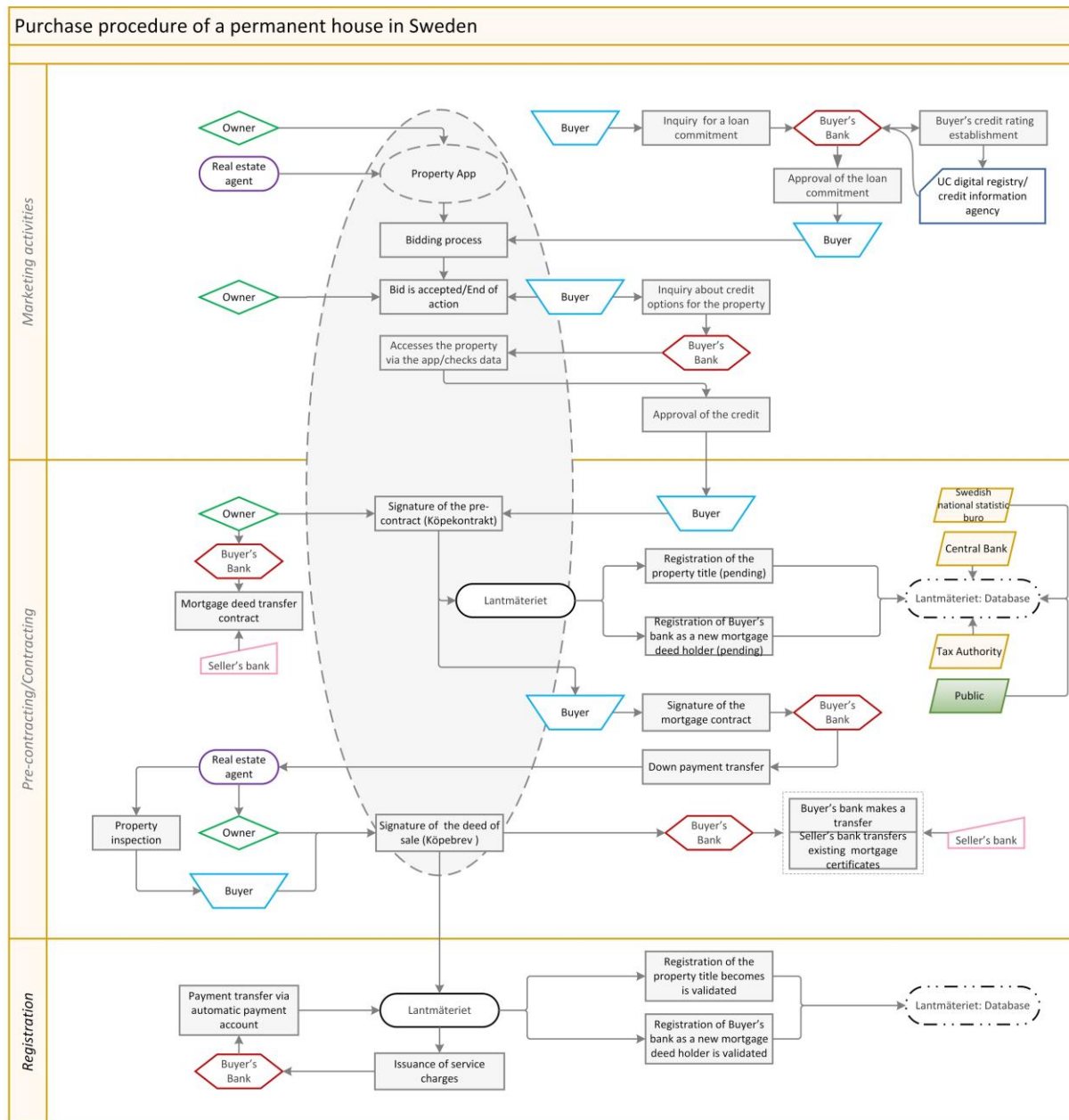
At this point, the deed of sale can be signed. The risk of an incorrect contract is minimal as the bill of sale, including all the necessary pre-given information, is already pre-configured in the app. Hence, extra information is verified automatically. Once signed, each party has access to the tamper-proofed copy protected through the verification code registered on the blockchain. The buyer's bank transfers the purchase amount to the seller's bank, while *Lantmäteriet* automatically registers the land title with the new owner. It then finalises the transfer of the mortgage deeds to the buyer's bank. These operations are interconnected and ensure that the mortgage deeds are actually transferred to the buyer's bank only once all payments for the title are assigned to the owner.

### *Registration*

All documents that confirm the transaction are available via the app. *Lantmäteriet* sends the invoices for the transaction fees and taxes. The pending property title registration also becomes valid and shared with all parties via the app. The advantages of this digitally overhauled system are clear: all transactions can occur simultaneously and in real time since they take less than a few hours to be completed. In the future, Sweden's title registration phase could in fact be automated via smart contracts. The entirely managed workflow and validated data entry via digital signatures and pre-configured contracts provide significantly higher protection against fraud. We illustrated how these smart contracts execute the mortgage deed practice by making the payment conditional on the transfer of the mortgage deed. This process solves a crucial problem for the buyer's bank: the current system allows the seller's bank to hold on to the security, i.e., the mortgage deed, for up to six months after transfer completion (Kempe 2017: 57).



Figure 11: Flow chart of blockchain powered purchase of house procedure in Sweden



Source: own illustration

In summary, with the introduction of the new system the actors involved remain the same. The way they interact, however, is as much about to change as their power positions in the house buying process is shifting. Qualification routines are predefined by computer code, and decision-making processes are audited. The new system gives greater power to the *Lantmäteriet* due to its more frequent involvement and adds gains in oversight. Other actors can claim instant access to a finalised transaction, i.e., Sweden's Central Bank, the tax authorities, and the national statistics bureau. Real estate agents, for their part, stand to lose their power in the bidding and negotiation processes

between buyer and seller, while real estate agents are merely involved in the marketing activities.

The implication of the new process for the credit providers such as the banks is less clear at this stage. Some observers suggest that the app allows further formalisation of the lending process, thus making it easier for unconventional lenders to participate and increase competition for banks. In the new system, *Lantmäteriet* is a far more active participant in the process from the very beginning to the very end and is hence in a much better position to manage all aspects. Property rights, i.e., mortgage deeds, are transferred promptly. All the steps involved in a transaction between buyer, seller and their respective agents will now benefit from greater transparency as each action is subject to particular preconditions that allow or restrict action. Potential tax fraud on property transaction will be prevented. The number of new digital signatures, each of them indicating a step in the chain of various transactions generates new volumes of metadata and inscribes this evidence in the electronic chains of blocks. With this long chain of evidence, *Lantmäteriet* will not only have a deep understanding of the current real property status registered in its database, but also of its history. These are favourable preconditions to oversee – and, if necessary, intervene in – the land and property markets and therefore also in the mortgage market.

### **5.3 Empirical phase 2: expert interpretations of LAS’ structural alterations**

Four semi-structured interviews helped to obtain this data. Interviews were conducted between April and May 2018 and employed techniques of purposeful sampling and snowballing (Hay 2016). We used online databases such as *Google* and *LinkedIn* to identify the ‘right’ experts. Initially, we identified and contacted eight experts; this resulted in four successful interviews conducted both face-to-face and via Skype. The experts (table 1) either were professionals and academics working in a specific field of the real estate industry, or familiar with the Swedish context, or both. The interviews took one hour on average (see questionnaires in the annex).

Table 1: Interviewees sample

<b>Respondent</b>	<b>Sector</b>
L1	In-house legal counsel at a Swedish investment fund
L2	Researcher in the field of urban and regional planning in Sweden
L3	Specialist in mortgage securitisations structuring
L4	Economist specialising in housing markets research

*Source:* own research

We presented both flow charts (figures 10 and 11) to the interviewees. Discussions helped, first, to better comprehend Sweden’s contextual setting, in which the reconfiguration of LAS is currently taking place, and, second, to shed light on the impact this new blockchain-based conveyance procedure might have on both the supply chain of land-based financial assets and the broader society. The flow charts presented helped to switch the interview focus from what blockchain technology is to what it might help to do with regard to the LAS in the future, therefore enabling the interviewees to visualise threats and opportunities from their own professional perspective. Interviews were recorded, transcribed and analysed. As outlined below, interview data helped to gain a more holistic understanding of the blockchain-integrated LAS’ potential implications on the housing market and its stakeholders. Vital methodological steps also included a systemisation of observations and interview information, like the identification of key facts, threats and opportunities, while remaining open to surprising facts interviewees might reveal.

It must, however, be noted that this study’s sample size is small and necessarily incomplete. Conducted as an exploratory first study into these new processes, we missed to include key experts directly concerned with the LAS integration project. Moreover, as the literature on this topic is thin, it did not provide much direction for our empirical study. Nevertheless, we believe that these first empirical results provide a useful starting point for a more comprehensive research on blockchain and its potential effects and alterations of the world’s property markets.

The presentation of our flowcharts was highly useful. Interviewees expressed much interest in them and reflected keenly on the possible implications. All the interviewees agreed that a blockchain solution for conveyance procedures would be beneficial to the housing market, in the sense that it would increase liquidity, as compared to the current situation in Sweden, and that, in general, transparency is commendable.

Liquidity creation is difficult in a market inherently illiquid due to the characteristics of property and land. While the interviewees all felt quite positive about the changes they also expressed a series of concerns summarised below (tables 2-4).

Table 2: How would the new blockchain-based procedure affect the housing market?

<b>Re-spond-ent</b>	<b>Examples of interview sequences (direct quotes)</b>
L1	This new procedure would make housing market more structured and predictable. With the procedure that needs to be followed, you know exactly who the owner of the real estate is and what other rights might be attached to it... If a transaction involves parties that have different power, a much stronger party usually tends to take advantage over the weaker party... And by having this [formal requirement for a contract], you ensure that the real estate market is functioning in an orderly fashion instead of being like the Wild West where people buy and sell, and nobody really knows who owns what.
L2	On one side, it will be safe, and there will be no corruption. It's good to make things safe. But, of course, there are more processes prone to corruption in Sweden then people like to believe...
L3	A standard contract would be perfect for securitisation. That would make things faster and cleaner... Usually, we receive the information from the bank in the file and then convert it to adjust to each [rating] agency's demands. If everybody can access information and there is no asymmetry, it is always good for the market.
L4	The market will work well, and matching demand and supply will be much more efficient. You will not have information asymmetries as it's all there... If you connect everything, the incomes of these people will be known. The Central Bank will be able to do an immediate stress test of the whole financial system. It's perfect... It's good that it's transparent and you really know what is happening. No need to guess.

Source: own interviews

When reflecting on the broader societal implications that blockchain conveyance would have, interviewees foresaw several positive aspects. At the same time, two of them pointed out that innate human irrationality could be a possible new source of risk. Another also suggested with regard to the changing organisation structure of the housing transfer chain that some people would lose their jobs.

Table 3: If the upgraded LAS was to speed up time and increase transparency, what might be the direct and broader societal implications?

<b>Re- spond- ent</b>	<b>Examples of interview sequences (direct quotes)</b>
L1	That would lower the transaction costs, so I guess it would be in everybody's interest and that would make the whole transaction process much smoother. I'd imagine there are only advantages to this... Sellers could sell their property on a whim..., spontaneously, without really reflecting on the consequences... One of the positive aspects of the fast procedure is that it would be much easier to optimise the sale and purchase of two different properties. If you speed up this process, you would also minimise that time when you could be either sitting on two properties or not at all, until you bought the new one... On the other hand, if the transaction happens this fast, maybe there is a certain risk that you don't have to walk through all these steps, consider them... Such liquidity could increase the risks, operational risks... but in any case, I do not think there will be any reasons to hold on to bureaucratic [transactions]...
L3	I think people will be fired as their work will be no longer needed. For instance, if I am the person that prepare the files [for security] and now they are all standardised, my work is not needed anymore... Usually, this job is done by an analyst, even though they of course do more than just prepare files. But so it goes with the digitalisation. It is normal that things get standardised, and these people should do other things, increasing value...
L4	I think actors must become more responsible. Things happen smoothly, but of course people are prone to irrationality. It is a change in an economic system. When you think of only neo-classical theory, then it's about the governments that have to be sure that you have a well-functioning market, and the government should make sure that there are no information asymmetries. And when all is in place then it's perfect. But all actors are humans, so you have a component that is too hard to predict.

Source: own interviews

On a less enthusiastic note, all respondents agreed that liquidity of the real estate markets does not necessarily have positive implications, as it is likely to lead to a market that is more speculative.

Table 4: (Why) Is real estate market liquidity a good thing?

<b>Re- spond- ent</b>	<b>Examples of interview sequences (direct quotes)</b>
L1	Not necessarily. I mean there is so much speculation with real estate in Sweden. ... These measures to make the real estate market more liquid would have to also come with other measures such as having more requirements on a paying off mortgages, because if you don't need to amortise your mortgage, that would still mean that there would be a lot of speculation. And if property becomes even more liquid, then obviously, it will be even easier to speculate than today. So I guess that

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	if you want to make the real estate market more liquid, you would have to insert other safety measures.
L2	I think buying should not have this big an influence in [Swedish] society and the rental market should be bigger instead.
L3	It depends. If things are liquid, you have more information on market dynamics, then instruments [hedging of growth and fall of houses prices] could exist, and people would cover [risks] in this way. But there could be other agents who might benefit more from this.
L4	Yes, but it has two sides: If people believe that Sweden is great and more and more people arrive, prices will grow and everyone will be optimistic and perhaps prices will grow even faster because people are more aware of it. But it will also be faster realised when things change as it will be immediately recorded. Now we have time and people don't know and it's slow. So, faster ups and downs could be triggered.

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Source: own interviews

## 6 Discussion and outlook

This research's aim was to better comprehend and initially outline the potential impacts of blockchain-integrated LAS, which we understand could be a new, persisting dynamic in both land and property markets worldwide. For the example of Sweden, the frontrunner in this field, we established a preliminary conceptual framework to depict both the creation of land-based financial derivatives and the socio-technological system that performs these tasks.

The framework was set at the intersection of two strands of literature, that is, financialisation and land administration theory. We utilised these two bodies of literature as the majority of the literature on blockchain and its application heralds the emergence of new financial and real estate markets because of blockchain's potential to generate new – 'disruptive' – business models, products, and in our case, *fractionalised property rights*. Our initial assumption therefore was that the Swedish authorities and lenders involved in the 'blockchain solution for LAS'-project were aiming to facilitate a new step in the financialisation process of housing.

The case study of Sweden confirmed that this technology could indeed help to eliminate many challenges in the housing market. Major factors mentioned in our empirical investigation were the property markets' lack of liquidity, the generation of

new, large datasets that would enhance market transparency, and new business opportunities from the reduced time and costs following on LAS' reconfigured organisation (illustrated in figure 11).

Moreover, an aspect frequently mentioned by our interview partners, but not discussed in detail here, are the new opportunities the simplified, standardised and relatively cheap transaction processes could eventually realise by creating alternative *fractionalised property rights*. In fact, fractionalised property rights would allow a buyer to buy/own only a fraction of his/her new property (Graglia & Mellon 2018). Owning a fraction in a property would therefore introduce entirely new opportunities to transform these fractioned property rights in a whole series of new financial outlets, and it allows *direct* investments (as opposed to indirect investments in real estate investment funds) in a fraction of real property. Further research that sheds light on such new financial instruments and their manifold implications is in high demand and an indication toward our initially formulated research hypothesis (page 2 in this paper).

With regard to our research hypothesis, the results from our inquiry into Sweden's context and the design of the blockchain-based solution for the *Lantmäteriet* suggests that this project is currently more about regaining State control over financial activities in the housing markets as well as supporting the stability of a future-oriented welfare system based on property ownership. This project can be interpreted as a logical continuation of the re-regulation trends that started to emerge back in the 1990s, when the Swedish government took over a collapsing financial system and defaulted housing collaterals to prevent private debt accumulation on a massive scale. Since then, even though liberalisation and re-regulation continued, the State constantly enhanced and integrated information infrastructures that service credit and real estate markets. This allowed Swedish State agencies to ensure better control over property and financial markets, and hence to sustain housing market expansion, on which Sweden's welfare model thrives.

The blockchain-based conveyance procedure introduces changes on different levels. Here, we concentrated primarily on the understanding of its new organisational architecture that defines different economic and public actors with varying levels of power among the housing transaction chain. We discussed how the State in the form of *Lantmäteriet* is among the biggest winners as it enhances its power of control in the

sense that the altered LAS will provide a more exhaustive overview over the markets' health. It can share this information with the Central Bank and with regulators, although Mats Snäll, a *Lantmäteriet's* official in charge of the blockchain project, has stressed that they “are not implementing, we are innovating”.

Other actors, such as some of the intermediaries, will become redundant in the newly digitised processes. Another crucial level of analysis, which we have merely touched upon in this research, concerns the implications of the new organisational models for the liquidity creation for property markets and their wider implications for Swedish society and market behaviour. This second issue also includes scrutiny of Sweden's regulatory environment, i.e., to what extent its legal system is prepared and ready to adapt in order to meet the new challenges created by new market opportunities.

This research is further intended to illustrate how the blockchain-based conveyance procedure pre-configures and standardises new connections between land and financial products derived from this land. The LAS constrains and optimises the qualification practices, therefore regulating the creation of the links between new financial products and (a potential rise in) speculative behaviour through smart contracts that are the core of the blockchain. These processes also allow State actors like Sweden's central bank and tax authorities to tap into the recorded transactions instantly and at virtually no cost. In times of crisis when house prices continue their correction, fast transaction procedures and accessible information would allow the market to clear faster, to reduce the risk of accumulating excessive supplies of collateral, and to prevent fire sales. Hence, so far, and with our specific analytical focus, the blockchain-based conveyance system in Sweden cannot yet be regarded as a next step in the process of housing financialisation. It represents rather a mechanism of change and new State power in Sweden's housing market. The largest beneficiaries of the aspects discussed above are *Lantmäteriet*, Swedish citizens in general, but potentially also financial intermediaries (both directly and indirectly).

This working paper has set out to start disentangling the new blockchain technology from its old/new social system with regard to land and real property in order to gain first evidence that underpins our understanding not only of the potential consequences but also the mechanisms of change themselves. It shows how complex real



estate and land administration processes are and how markets and businesses depend on information and activities related to them. The growing mutual understanding and recognition of the capacity of a blockchain to optimise these processes will make the development of blockchain-based LAS more dynamic in the future, as its implementation may unfold in other countries, jurisdictions and administrative systems once its advantages are becoming clearer. To unlock blockchain potential for LAS beyond the tamper-proofed archives of a transaction's verification records, the full value chain of land derivatisation should be re-examined. While *Lantmäteriet's* innovative endeavour only marks the beginning of that process, we are convinced that Sweden has set not only a precedent in LAS for other countries but also designed a potential blueprint for a new socio-economic system of other blockchain-based, largely illiquid financial markets, of which land, housing and art are the most prominent examples. It remains to be seen how societies take charge of this watershed moment that blockchain technology offers.

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## Appendix: Questionnaires for semi-structured interviews

### Questionnaire 1

#### *Part I: Background and Housing market in Sweden*

1. You are researching processes of digitisation and smart cities. What fascinates you on that issue?
2. I understand that currently banks, the *Lantmäteriet*, and real estate agents, are key players in the real estate industry in Sweden. Are there other important actors I might have forgotten?
3. What are the most important, recent dynamics in the Swedish housing market?
4. If you were able to influence the State or other actors, what kind of initiatives would you propose to deal with the issues we have just discussed?

#### *Part II: The evolution of property rights*

5. Within the last 15 years, Sweden introduced some new kinds of 3D property rights. Is that good? Why?
6. In this regard, do you see any signs of concern regarding the Swedish housing market in the action of the State, major banks, etc.?
7. Why do these new types of property rights emerge? Why now?
8. What (kind of) effects may these changes imply?
9. Having discussed all that, would better accessibility to mortgages and the recent shifts in the industry affect your own decision to buy/rent?

#### *Part III: Blockchain register*

10. After two years of testing, the *Lantmäteriet* announced that the first blockchain property transaction would be conducted soon. What do you think about this initiative?
11. A big question, we learnt in each of the financial crises, is risk. What is the biggest risk in this setting?
12. The new blockchain land registry will bring a drastic change in terms of transaction costs, time and related risks. Would it help to improve the housing market in Sweden?
13. Are there other, more pressing, risk-related issues we forgot to discuss?
14. What will be the broader societal implications if the professionals, banks, real estate agents, *Lantmäteriet*, etc. were to speed up time and enhance transparency? How will the housing market be affected?
15. Surely, some agents in the chain will become redundant and lose their business model. Will they fight to keep it?

## Questionnaire 2

### *Part I: Background and Housing market in Sweden*

1. In which field do you work?
2. Do you see any signs of concern regarding the Swedish housing market in the action of the state / major banks?
3. Do you think the way property ownership is currently governed affects this situation negatively?
4. If you had the power to change the way property transactions are managed what would the first thing you would change? Why?

### *Part II: The evolution of property rights*

5. Within the last 15 years, Sweden introduced some new kinds of 3D property rights. Is that good? Why?
6. How do individuals and the real estate market as a whole benefit from liberalisation of property division procedures/fracturing of property rights?

### *Part III: Blockchain register*

7. After two years of testing, the *Lantmäteriet* announced that the first blockchain property transaction would be conducted soon. What do you think about this initiative?
8. A big question, we learnt in each of the financial crises, is risk. What is the biggest risk in this setting?
9. I mapped the current transaction process. In your opinion, the optimisation of which step within the old process is the most pressing? Why?
10. I also mapped the new transaction process, which step in your opinion is the most innovative here? Why?
11. What will be the broader societal implications if the professionals, banks, real estate agents, *Lantmäteriet*, etc. were to speed up time and enhance transparency? How will the housing market be affected?
12. How might the implementation of the blockchain register affect housing valuation practices?
13. Is it possible that some new kinds of 3D property or other alternative rights could be framed through the new Blockchain land register / smart contracts?
14. Is there a way of hedging house price fluctuations in Sweden?

