



*Degree Project in The Built Environment
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Does PropTech Facilitate Liquidity in the Property Transaction Process?

A Qualitative Study on the Swedish Real Estate Market

BINGCHUN FU

Master of Science Thesis

Title	Does PropTech Facilitate Liquidity in the Property Transaction Process? – A Qualitative Study on the Swedish Real Estate Market
Author	Bingchun Fu
Department	Real Estate and Construction Management
TRITA Number	TRITA-ABE-MBT-22439
Supervisor	Bertram Steininger
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Abstract

This thesis is an exploratory qualitative study aiming at exploring and advancing the current knowledge of the Swedish PropTech industry. In this study, the investigations will mainly focus on how the Swedish PropTech companies improve the liquidity, for instance, higher supply, lower transaction costs and more accessible access, in the property transaction process. Besides, the impacts of Covid-19 on these companies and the challenges and opportunities they foresee in the post-covid situation will be investigated. To answer the research questions, first of all, five semi-structured interviews with the experts from the Swedish PropTech industry were held to gather their insights into the unique functionalities facilitated by PropTech in the property transaction process. Besides, the method of reviewing industry reports was applied to complement the findings from the interviews. To measure liquidity in the market, five main categories of measurement metrics, including (1) transaction costs, (2) volume-based measures, (3) price impact, (4) time-based measures, and (5) return-based measures, are considered. After that, the collected data material was compared and analysed by means of thematic analysis with the support of the query tool “NVivo” to explore the answers to the research questions “how do the Swedish PropTech companies facilitate liquidity in the property transaction process”, “what are the impacts of Covid-19 on these companies, and what challenges and opportunities do they foresee in the future” and “what is the future of the PropTech industry”. Lastly, by building a novel tool, this thesis could contribute to the research field of PropTech and give more instructions to the Swedish real estate market when adapting to innovations in the real estate industry.

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Stockholm, June 2022

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Sammanfattning

Detta examensarbete är en undersökande kvalitativ studie som syftar till att utforska och föra fram den nuvarande kunskapen om den svenska PropTech-branschen. I denna studie kommer utredningarna främst att fokusera på hur de svenska PropTech-bolagen förbättrar likviditeten, till exempel högre utbud, lägre transaktionskostnader och mer tillgänglig tillgång, i fastighetstransaktionsprocessen. Dessutom kommer effekterna av Covid-19 på dessa företag och de utmaningar och möjligheter de förutser i post-covid-situationen att undersökas. För att besvara forskningsfrågorna hölls först och främst fem semistrukturerade intervjuer med experterna från den svenska PropTech-branschen för att samla in deras insikter om de unika funktioner som PropTech underlättar i fastighetstransaktionsprocessen. Dessutom användes metoden för granskning av branschrappporter för att komplettera resultaten från intervjuerna. För att mäta likviditet på marknaden, fem huvudkategorier av mätvärden, inklusive (1) transaktionskostnader, (2) volymbaserade mått, (3) prispåverkan, (4) tidsbaserade mått och (5) avkastningsbaserade mått. åtgärder, övervägs. Därefter jämfördes och analyserades det insamlade datamaterialet med hjälp av tematisk analys med stöd av frågeverktyget “NVivo” för att utforska svaren på forskningsfrågorna “hur underlättar de svenska PropTech-bolagen likviditeten i fastighetstransaktionsprocessen”, “vad är effekterna av Covid-19 på dessa företag, och vilka utmaningar och möjligheter förutser de i framtiden” och “vad är framtiden för PropTech-branschen”. Slutligen, genom att bygga ett nytt verktyg, skulle detta examensarbete kunna bidra till forskningsområdet PropTech och ge fler instruktioner till den svenska fastighetsmarknaden vid anpassning till innovationer inom fastighetsbranschen.

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Abbreviations

AI – Artificial Intelligence

AWS – Amazon Web Services

CRMS – Customer Relationship Management System

IoT – Internet of Things

ML – Machine Learning

PC – Personal Computer

CAQDAS – Computer-assisted Qualitative Data Analysis Software

1. Introduction

This section will give an understanding of the background of this study firstly. Following the background, the purpose of this study is explained. Besides, the research questions that will be answered are covered. The delimitations of this study are presented to understand the investigated aspects. Lastly, the outline is offered to provide an overview of the structure of this study.

1.1. Background

Real estate plays an essential role in our daily life. According to Tostevin (2021), the Director of Savills World Research Team, the global real estate value was more than \$326.5 trillion in 2020, which indicates that investment in properties is a crucial component of the worldwide economy. However, the real estate market is regarded as one of the last asset types to adopt the changes caused by technologies and the following innovations (Baum, 2017). Such stiffness and illiquidity in the transaction aspect have become sore points for the stakeholders in this market and the industry itself. For instance, the end-to-end home buying and selling process is currently time-consuming (around several months), costly, and involves different types of fees and paperwork (Baum, 2020). Especially in recent years, people have also tended to require a more efficient and liquid real estate transaction market when Covid-19 hit the world and changed people's habits in property transactions. As a result, it is vital for the real estate industry to adapt to innovations driven by technologies and pursue a more efficient and liquid market.

Sweden, with a population of 10.44 million people (Statistics Sweden, 2021b) and a GDP of \$55,149 per capita, stands as the 12th of the highest GDP in the world as of 2020 (OECD, 2021). Due to the increasing number of immigrants and live births, with an increase of 900,000 people, the population of Sweden will grow to over 11 million by 2024 (Statistics Sweden, 2021a). Therefore, the demand for residential properties in Sweden will increase significantly due to the growth of the population, urbanisation and the trend of single households. Concerning demand, the supply of Swedish housing has been low, partly due to the low level of housing construction since the early 1990s (Emanuelsson, 2015). After experiencing a sharp decline in 2018, residential construction stabilised in 2019. Fifty-one thousand apartments were under construction nationwide in 2019, and 50,000 units were predicted in 2020. From a historical perspective, the volume is high but still below the estimated demand of 64,000 (CBRE, 2020). According to the Swedish National Board of Housing, Building and Planning (2015), the current rate of housing construction will not be sufficient to meet the upcoming population growth in Sweden even though the homes being built are increasing. In Sweden, the three primary housing forms are houses, cooperative apartments, and rental apartments (Fastighetsbyrån, 2020). Besides, other housing arrangements such as owner apartments and rental apartments also exist in the Swedish residential market. Residential properties are known as a low-risk asset class since non-cyclical factors drive the demand for housing, and the existing inventory and supply for future development are transparent. In Sweden, the residential

sector has been a mature asset class for decades, and high-quality assets have been highly sought after in the Swedish real estate market. An excellent interest can be seen from investors in all Swedish residential assets, covering both new developments and existing stock. The investment in residential assets in 2019 was 80bn SEK (€7.8 bn), the highest turnover ever recorded, accounting for 37% of the total investment (Savills, 2020).

PropTech, the abbreviation of “Property Technology”, refers to new companies whose business model connects innovative technological possibilities to the real estate industry (Catella Research, 2016). It plays an essential role in driving the real estate industry and consumers to shift their mindsets in data assembly, transaction, and technology-driven innovation in architecture and urban design (Baum, 2017). In the global panorama, the United States is the leading force in the investments in the PropTech industry. Within the European context, there are seventeen companies per million inhabitants in Finland, and therefore it is known as the country with the highest concentration of PropTech in Europe (Tagliaro, Bellintani and Ciaramella, 2020). Nevertheless, there does not exist much research into PropTech conducted within the Swedish market.

1.2. Purpose

The purpose of this study is to investigate how the Swedish PropTech companies facilitate liquidity, for instance, higher supply, lower transaction costs and more accessible access, in the property transaction process. Besides, the challenges and opportunities they foresee in the post-covid situation will be investigated. Lastly, by building a novel tool, this thesis could contribute to advancing the current knowledge on the Swedish PropTech market, which is still relatively “young” compared with the international scene, and give more instructions to the Swedish real estate market when adopting innovations in the field of real estate industry.

1.3. Research questions

This study aims to answer the following research questions:

Q1. How do the Swedish PropTech companies facilitate liquidity in the property transaction process?

Q2. What are the impacts of Covid-19 on these companies, and what challenges and opportunities do they foresee in the future?

Q3. What is the future of the PropTech industry?

1.4. Delimitation

Due to the purpose of this study, the research focus is limited to the Real Estate Fintech sector according to the nature of the research questions. Under this sector, an emphasis on the property

transaction field consisting of both commercial real estate and residential real estate is selected. To explore the Swedish real estate market, the companies and participants selected in this study are from Sweden with a business focus on the Swedish real estate market. These companies are located in big Swedish cities, three in Stockholm and one in Malmö.

1.5. Outline

The upcoming parts of this thesis are divided into the following seven chapters: (2) Literature review, (3) Methodology, (4) Theoretical framework, (5) Findings, (6) Discussion, and lastly, (7) Conclusion. The descriptions of each chapter are included in the overview of the outline of this study which is shown in *Table 1*.

Chapter	Topic	Description
1	Introduction	Presents the background of this study and the purpose, the research questions, the delimitation, and the outline.
2	Literature Review	Presents a literature review consisting of the articles and studies which have previously researched liquidity and PropTech.
3	Methodology	Presents the choice of methods of this study and data collection and analysis methods.
4	Theoretical Framework	Explains two theories relevant to this study, namely creative destruction and disruptive innovation.
5	Findings	Presents the findings from semi-structured interviews and industry reports.
6	Discussion	Presents the discussion of the results of the findings.
7	Conclusion	Presents the conclusions of this study.
	References	Presents a reference list of the sources.
	Appendix	Presents the appendixes.

Table 1. Outline of this study

2. Literature review

In this section, a literature review divided into two parts is presented. It includes the liquidity phenomenon and PropTech. Under the PropTech section, the evolution of PropTech, the size of the PropTech market and Real Estate FinTech are introduced.

2.1. The liquidity phenomenon

Liquidity is a phenomenon that is an important aspect of real estate investments but is hard to be observed directly (Marcato, Ametefe and Devaney, 2016). Defined by Brunnermeier and Pedersen (2009), there are two main aspects of liquidity which are trading (or market) liquidity - “the ease with which it is traded” and funding liquidity - “the ease with which [investors/traders] can obtain funding”. In this study, the focus is on trading (or market) liquidity and therefore, the word “liquidity” refers to trading (or market) liquidity in the following content.

According to Goodhart (2008), liquidity has many facets; within them, five main characteristics of liquidity are identified by Marcato, Ametefe and Devaney (2016) which are tightness, depth, resilience, breadth (Kyle, 1985; Hibbert *et al.*, 2009), and immediacy:

- (1) Tightness: the cost of even a small transaction;
- (2) Depth: the ability to buy or sell without causing price changes;
- (3) Resilience: the speed at which the marginal price effect increases with the increase in transaction volume;
- (4) Breadth: the overall size of the transaction volume;
- (5) Immediacy: the cost (discounts/premiums) applied when selling/buying quickly.

The main causes of trading (or market) illiquidity are the presence of market imperfections, consisting of participation costs, transaction costs, imperfect competition, asymmetric information, funding constraints, and search costs (Hasbrouck, 2007; O’Hara, 1995). When the market lacks liquidity and investors need to withdraw, there will be risks or costs of being unable to sell or having to sell at a discount at a specific time (Marcato, Ametefe and Devaney, 2016). Thus, measuring and improving liquidity in the market becomes an important issue.

Classified by Sarr and Lybek (2002), there are four selected liquidity measures which are (1) Transaction Cost Measures, (2) Volume-Based Measures, (3) Price-Based Measures, and (4) Market-Impact Measures. Based on the classification of Sarr and Lybek (2002), Marcato, Ametefe and Devaney (2016) extended the measures to five main categories of measurement metrics, which are (1) Transaction Costs, (2) Volume-Based Measures, (3) Price Impact, (4) Time-Based Measures, and (5) Return-Based Measures by separating Return-Based Measures and adding Time-Based Measures. This is because the last two metrics are widely used for real estate assets.

Numerous measures differentiate liquid marketplaces by the absolute or relative volume of transactions to understand the breadth and depth of a market or asset that falls under Volume-Based Measures. The measures can be built using the number of assets traded or the amount of money spent on the trade. Among the measures, the transaction volume, defined by the total number or value of trades over a particular time interval, is the most basic and widely available since most assets have volume data reported regularly. Another measure is the turnover ratio, which compares transaction volumes to the asset or market size (Marcato, Ametefe and Devaney, 2016).

Time-Based Liquidity Measures record the amount of time between transactions or the time it takes to trade an asset once a purchase or sale decision has been made. This category consists of the measures such as holding periods, trading frequency, volume volatility and time on the market. The time taken to transact, often depicted as “time on market”, has been studied extensively for residential real estate markets. There are various definitions of “time on market” in the residential real estate literature; typically, it is defined as beginning on the date when a property is advertised for sale. However, this definition excludes the time required to prepare a property for sale. And the endpoint for this period is defined as the date of price agreement, contract exchange, or formal completion, which is also ambiguous. The reason for this interest is the decentralised character of such marketplaces which needs participants searching for relevant assets and willing counterparties, whilst the physical, legal, and spatial variability of dwellings involves considerable due diligence by purchasing parties. Consequently, time on the market is non-trivial and uncertain, implying that both the price and the payment timing are uncertain (Marcato, Ametefe and Devaney, 2016).

2.2. PropTech

Defined by Baum (2017), PropTech is a set of verticals, including Real Estate FinTech, Shared Economy and Smart Real Estate, that support information, transaction or marketplace, or management or control. There are three verticals (sub-sectors) and three industry horizontals (drivers), as shown in *Table 2*.

	Real Estate FinTech	Shared Economy	Smart Real Estate
Information	Yes	Yes	Yes
Transaction/marketplace	Yes	Yes	
Management/control			Yes

Table 2. PropTech verticals and horizontals (Baum, 2017)

The three sub-sectors in which PropTech is mainly active are driven by construction technology, legal technology, FinTech, the shared economy movement, and exogenous technology (Baum, 2017). The Smart Real Estate sector refers to the technology-based platforms that facilitate the operation and management of real estate assets. This sector primarily supports real estate asset, property and facilities management. The second sector is the Shared Economy, which describes

the technology-based platforms that facilitate the use of real estate assets. The information of potential users and space sellers is provided by the platform simply. Besides, rent- or fee-based transactions may be facilitated or effected directly. The real estate occupier markets are supported by this sector. Lastly, Real Estate Fintech is the sector that consists of technology-based platforms to facilitate the trading of real estate asset ownership and supports the real estate capital markets. Within this sector, platforms may provide information to potential buyers and sellers, or they may more directly facilitate or influence asset ownership or lease transactions with a negative or positive capital value (Baum, 2020). The PropTech roots defined by Baum (2020) are shown in *Figure 1*.

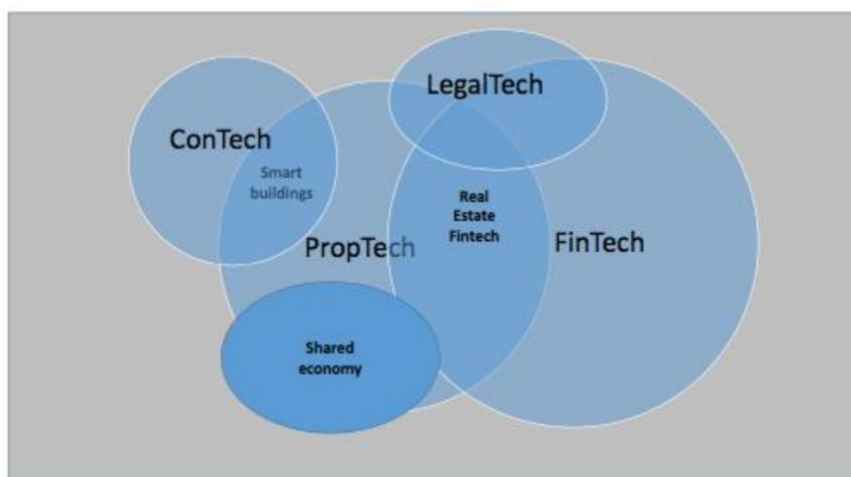


Figure 1. PropTech roots (Baum, 2020)

2.1.1. The evolution of PropTech

Since PropTech emerged, it has undergone several waves of evolution. The first wave of PropTech, known as PropTech 1.0, is the forerunner of the current PropTech boom, which occurred in the United States, the United Kingdom, and elsewhere in the mid-1980s. It was driven by the introduction of the personal computer (PC) in the late 1970s or early 1980s and lasted around 20 years. With the development of the PC, mainframe computers have become more efficient and affordable. In the mid to late 1980s, PropTech 1.0 began to impact real estate practices. In the late stage of PropTech 1.0, residential tech start-ups such as Rightmove, Zoopla, OnTheMarket, Zillow, and so on became active in the online residential market sector, which is also seen as the bridge between PropTech 1.0 and PropTech 2.0 (Baum, 2017).

PropTech 2.0 continued focusing on the residential market as PropTech 1.0. Except for being driven by breakthroughs in technology such as cloud computing, leaner coding, mobile devices, and sensors, PropTech 2.0 also originates from the frustrations with large, immobile, and illiquid asset classes and the vested interests of the companies that control it (Baum, 2017). PropTech platforms that emerged within this stage are located in many different countries. For instance, in 2006, PropertyGuru, an online real estate portal, was established in Singapore to

provide customers with the advantages they need when conducting real estate searches and help them make informed decisions about buying, selling, or renting real estate (Aihie, 2019). In the same year, PropTiger was founded in India, which offered similar services as PropertyGuru.

With the development of exogenous technologies, including the Internet of Things (IoT), Machine Learning (ML), Artificial Intelligence (AI), and Blockchain, PropTech 3.0 has emerged, which is also under the global pressures of climate change and rapid urbanisation (Baum, 2020). In the long run, the PropTech environment can provide many advantages to the real estate industry, such as “increased transparency, improved efficiency, enhanced flexibility and provision of employment opportunities for individuals with new skill sets” (Piazolo, 2018).

2.1.2. Size of the PropTech market

PropTech is a worldwide phenomenon that has expanded all over the world. *Figure 2* shows unique concentrations in California and the US east coast, Western Europe (especially the UK), and Asian urban areas such as Delhi, Shanghai, Beijing, Seoul, and Singapore. The map shown in *Figure 2* is made based on the locations of 6,428 PropTech companies. Each dot represents a PropTech firm, and the size of the dots corresponds to the amount of investment received by the company (Baum, 2020).

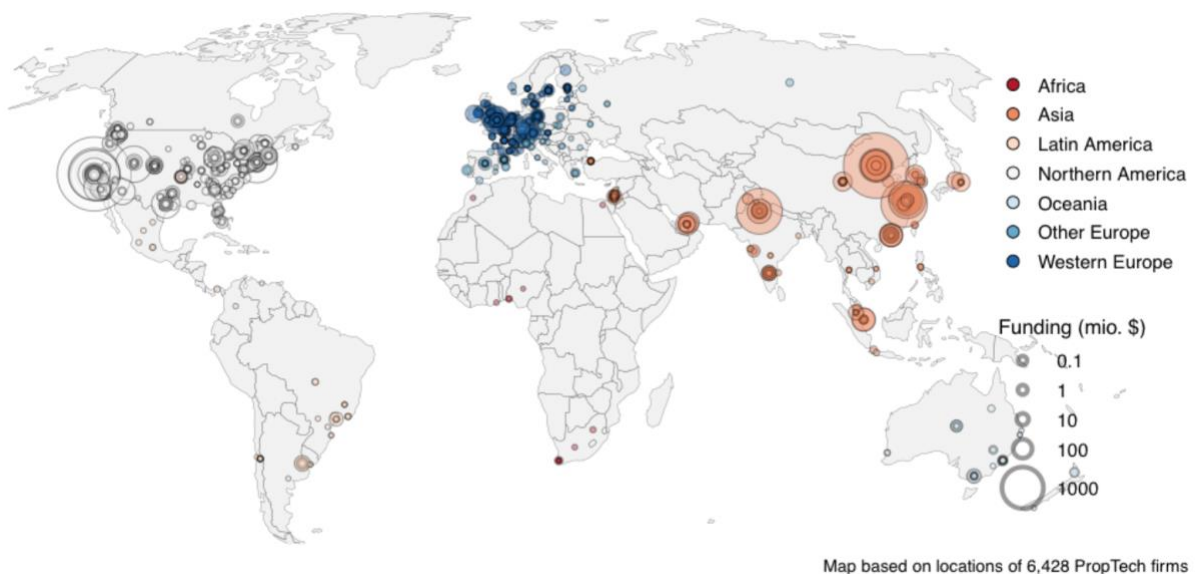


Figure 2. The global distribution of PropTech firms (Baum, 2020)

PropTech market in the U.S.

The U.S. is the most active investor in the PropTech industry among all the regions. According to Baum (2020), over 2,000 PropTech companies are registered in the Unissu database, consisting of 7,000 PropTech companies. It means that for every million people in the U.S.,

there are six PropTech firms at the moment. The United States has a large domestic market and much larger investment; therefore, its influence on PropTech is likely to grow.

Among all those US PropTech companies, 53% have their business targets in the residential sector. In the field of portals and online agencies, there are representatives such as Zillow and Realtor. Module and Blokable are two companies at the forefront of increasing the accessibility, affordability and sustainability of residential properties in the United States. The commercial side of the US PropTech industry accounts for 38% of the total registered US PropTech companies in the Unissu database. This sector is also in the process of transforming the way people value property. For instance, the company WiredScore has contributed to the measurement of commercial property’s digital connectivity and graded certificates based on the results (Baum, 2020).

PropTech market in Europe and the UK

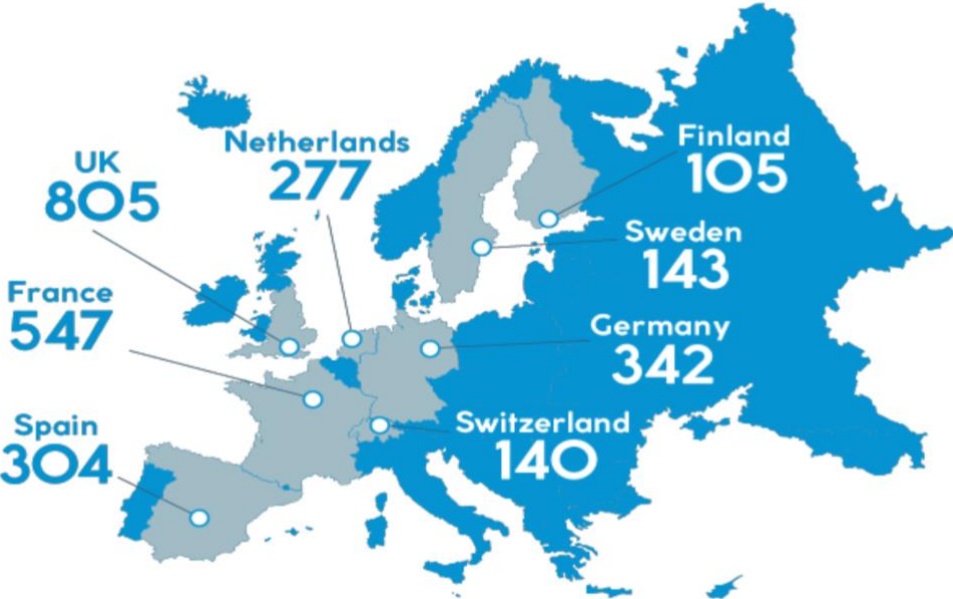


Figure 3. PropTech companies in Europe and UK (Baum, 2020)

In the European and the UK PropTech market, eight countries are home to 100 firms or more: the UK, France, Germany, Spain, Netherlands, Sweden, Switzerland, and Finland. The UK is the main force in European PropTech funding among the eight countries, receiving far more investment than any other European country. In just 58 reported funding initiatives, Germany raised more than \$1 billion, while France raised less in 148. Younger, less established start-ups have benefited from French finance, while German investors have demonstrated great faith in local businesses (Baum, 2020).

The Swedish PropTech industry has maintained a steady growth momentum over the past few years. Currently, 195 active PropTech companies are being operated in Sweden, according to

the Unissu database. However, it is believed that there are more than 350 unregistered PropTech companies out in the market operating in Sweden. From 2014 to 2017, the majority of the companies (40%) entered the market (Unissu, 2021).

It is no surprise that Stockholm acts as the heart of the Swedish PropTech industry since it is one of the most innovative and cosmopolitan cities in Northern Europe. The proximity to Stockholm is the key to currently promoting innovation and creativity. Among the companies mentioned above, around 55% have their origin in Stockholm, whereas 20% were born in Gothenburg, 20% are from Malmö, and the rest 5% are from Northern Sweden. It can be seen that many interesting new projects have started to kick off, and PropTech companies have a high potential for growth in other parts of Sweden except for Stockholm (Unissu, 2021).

PropTech market in Asia

Asia is a major global hub of PropTech events, with brokerage and leasing start-ups and property management platforms dominating the scene. Over 550 PropTech firms are currently being operated in Asian countries like China, India and Singapore. These three countries have the highest numbers of PropTech companies with 144, 170 and 84 respectively. Predictably, it is clear that Asia holds enormous potential to equalise the playing field with the United States and Europe as the world's leaders in the PropTech sector in the next five to ten years. For instance, India, which has a vibrant real estate market, is expected to have a market value of \$1 trillion by 2030 and contribute 13% of the country's overall GDP by 2025. At the same time, there are technological advancements such as 5G technology happening in China, positioning China to play a vital role in the development of innovative PropTech. This concept is expected to benefit China economically, environmentally, and socially. If China continues to lead in this industry, it may find itself in a powerful position in the future (Baum, 2020).

2.1.3. Real Estate FinTech

According to Baum (2017), Real Estate FinTech refers to the enterprise sector which enables the sale or leasing of real estate assets. The transactions horizontal, which accounted for 75% of all applications in this industry, were the most active in the Real Estate FinTech sector. As shown in *Figure 1*, PropTech and FinTech are defined as two separate groups; Real Estate FinTech is the shared overlapping area for these two groups. In this sector, the residential part is expected to play a significant role in any Real Estate FinTech survey due to its scale and the potential revenue associated with it. Within the residential real estate industry, Zillow, Trulia, Rightmove and Zoopla are successful tech-enabled information provider examples that started their businesses with residential sales and have lately expanded into lettings: for instance, Trulia launched its rental brand in 2017. All of these players emerged in the late stage of PropTech 1.0 and are now rather established, with a simple information aggregation strategy (Baum, 2017).

3. Methodology

In this section, the methodological approach of this study is presented. This section aims to explain the nature of the research approach, the method of data collection and analysis, research quality, uncertainty, and ethical considerations.

3.1. Exploratory approach

The purpose of the exploratory method is to explore the current state of the selected research field (Saunders, Lewis and Thornhill, 2016). To investigate and advance the existing knowledge within the Swedish PropTech market, insights into the professions from the Swedish PropTech companies are needed. The focus of their insights will be on the motivation to start the firm, the influences Covid-19 brought to them, liquidity and the PropTech business and the future of the PropTech industry. This study will use the exploratory approach since the previous studies within the Swedish PropTech field are limited. When a researcher is trying to find out the answers to what is wrong and what the new insights are, ask questions, and evaluate phenomena from a new perspective (Robson, 2002), this approach can be regarded as a vital tool.

3.2. Data collection

In this study, the data collection is divided into two sections, semi-structured interviews and a review of existing industry reports. The purpose of semi-structured interviews is to explore the Swedish PropTech market and gather close and valuable insights from the market participants. Whilst the review of industry reports provides the audience with a fundamental understanding of the impacts PropTech has on the property transaction process.

3.1.1. Semi-structured interviews

In the first section of the data collection, the data material was collected through semi-structured interviews based on a list of themes and critical questions with the professions within the Real Estate Fintech industry. The semi-structured interview is a method for gathering information from professionals committed to the research topic and active in the field of study, and who have objective knowledge of the questions being investigated. All participants in the study will be asked the same questions to obtain data that can be structured similarly in the findings section, allowing for comparison in both the analysis, discussion and conclusion sections (McIntosh and Morse, 2015). Even though the questions within semi-structured interviews are predetermined, in a conversational manner, participants can have the opportunity to explore the problems which are important to them (Longhurst, 2003).

In this study, the interview questions consist of three parts. The first part is the general part related to the motivation to start the firm, how the professionals define liquidity, the impact of Covid-19 on their businesses, their development vision in the post-Covid stage, and the challenges and opportunities that can be foreseen. The following part is part B, which includes

specific questions regarding the business target of each company, for instance, whether their business facilitates liquidity in the property transaction process, the value and volume of their trades monthly, etc. The last part is part C, which consists of several technical questions regarding the technology the company is using and the influences they think PropTech can bring to the real estate industry. The interviews were audio-recorded after getting permission from the participants and transcribed as the basis for further analysis and discussion (Saunders, Lewis and Thornhill, 2016). Different interview formats such as Zoom, Microsoft Teams, and Google Meet were used according to the participants' preferences.

Through extensive research on PropTech Sweden and Unissu, a group of Swedish PropTech companies whose business focus is on transaction and marketing were listed for further contact for interviews. Those companies were briefed on the purpose of the study by e-mail and asked if they would be interested in an interview. When contacted, the main themes of the interview and questions were provided to the participants to better understand the purpose of this study. The interview questionnaire can be found in Appendix 1. Five semi-structured interviews were conducted successfully after contacting all the companies on the list. Four companies participated in this study since two interviewees are from the same company. Other Swedish PropTech companies have refused to join for various reasons. An overview of the participants and companies is shown in *Table 3*:

Participant Code	Role, seniority	Company Code	Company Description
Participant A	Senior management role	Company one	A property buying and selling platform based on an app
Participant B	Senior management role	Company one	A property buying and selling platform based on an app
Participant C	Senior management role	Company two	A housing rental company
Participant D	Senior management role	Company three	A housing platform
Participant E	Senior management role	Company four	A rental insurance company for commercial real estate

Table 3. Participants overview

3.1.2. Review of industry reports

A review of the PropTech industry reports composes the other part of the methodology of this study. The purpose of this review is to gather insights on the PropTech industry from a broader perspective, providing support for future analysis.

3.3. Thematic analysis

After collecting all of the data, a thematic analysis approach was applied to analyse the collected data and therefore point out essential information as a foundation for further discussion and conclusion. Thematic analysis is commonly regarded as a broad approach to analysing qualitative data (Saunders, Lewis and Thornhill, 2016). According to Braun and Clarke (2006), this approach acts as a “foundational method for qualitative analysis”. The primary purpose of this approach is to find themes or patterns in a dataset such as a series of interviews and therefore support further analysis and discussions (Saunders, Lewis and Thornhill, 2016). The nature of the thematic analysis is systematic yet flexible and accessible (Braun and Clarke, 2006). It provides the researchers with a way to analyse qualitative data orderly and logically. Thus this approach could analyse both sizeable qualitative data sets and smaller qualitative data sets (Saunders, Lewis and Thornhill, 2016).

When applying thematic analysis, a six-phase process proposed by Braun and Clarke (2021) could be followed, which is shown below:

- (1) Familiarisation with data and the creation of familiarisation notes;
- (2) Data coding in a methodical manner;
- (3) Producing initial themes from data that has been written and compiled;
- (4) The creation and revision of themes;
- (5) Refine, define and name themes;
- (6) Conducting the study.

However, it is worth noting that this process is not intended to be strictly followed. It is possible to integrate these six phases as one’s analytical skills develop over time (Braun and Clarke, 2021). Furthermore, these phases are frequently contemporaneous and recursive in actuality rather than occurring in a simple linear progression, meaning the researcher will analyse data as they collect it; the researcher may also review past data and analyse it when coding and categorising freshly collected data and searching for analytical themes (Saunders, Lewis and Thornhill, 2016).

To avoid the biases caused by the subjective opinion of the researchers that occurred during the data analysis process, “NVivo”, which is a query tool, will be used to assist thematic analysis. NVivo is a computer-assisted qualitative data analysis software (CAQDAS) developed by QSR International that enables qualitative investigation beyond coding, sorting, and retrieving data. It was also designed to combine coding with qualitative linking, shaping, and modelling. NVivo has several advantages when it comes to analysing qualitative data, for instance, reducing the onerous task of data analysis that would otherwise be conducted manually, giving researchers more time to explore trends, identify themes and draw conclusions, and making qualitative data analysis more systematically and efficiently (Wong, 2008).

3.4. Reliability and validity

Due to the lack of standardisation nature of semi-structured interviews, there will be concerns about reliability. Replication and consistency are two aspects of reliability. If a researcher can duplicate an earlier research design and obtain the same results, the research is considered credible. The concerns brought by semi-structured interviews are also related to bias issues. Three types of potential bias, which are interviewer bias, interviewee or response bias and participation bias, are worth considering for researchers (Saunders, Lewis and Thornhill, 2016). In this study, four companies and five interviewees were chosen to gather data material for analysis. A researcher may not be able to duplicate this study and receive the same results due to the bias mentioned earlier. Thus there is a certain level of lack of reliability and validity in this study.

3.5. Ethical considerations

In this study, the data material will be collected through semi-structured interviews. The potential participants involved in this study will be contacted in advance via e-mail with illustrations of the purpose of this study, their rights, and how the data will be collected and analysed. Then, after gaining permission from the participants, the interviews will be conducted. The participants must be given a chance to be anonymous during the whole research process (Saunders, Lewis and Thornhill, 2016). Therefore, there will not exist any company name and the names, genders, positions, or any other personal information of the participants. The data materials will be kept for a period which will also be informed to the participants. The materials in the transcripts or audio recordings will be adjusted if they contain information that may violate the anonymity of the participants.

4. Theoretical framework

In this section, two selected theories, namely creative destruction theory and disruptive innovation theory, are presented to give the reader a clear understanding of the relationship between the innovations within the PropTech industry driven by technologies and the conventional real estate industry.

4.1. Creative destruction

Creative destruction is an economic innovation theory created by Joseph Alois Schumpeter (1883-1950) which refers to the continuous product and process innovation mechanism in which new production units replace outdated production units (Schumpeter, 1942). It seems to be tailored to describe the process of previous technological solutions being destroyed by information and communication technology and abandoning the old companies to make room for the new companies (Reinert and Reinert, 2006).

The process of Schumpeter's creative destruction permeates major aspects of both macroeconomic and microeconomic performance. At the macroeconomic performance level, the main aspects include long-run growth, economic fluctuations, structural adjustment, and the functioning of factor markets. From the microeconomic performance perspective, creative destruction is characterised by a myriad of complicated decisions which involve the creation and destruction of production arrangements by multiple parties. When failure at the microeconomic level interacts with the process of creative destruction, it can have serious macroeconomic consequences (Caballero, 2010).

The development of technology is constantly evolving; therefore, this theory can be helpful when revealing the logic behind the phenomenon of PropTech. As mentioned earlier, there are problems such as a lack of liquidity in the real estate industry caused by the nature of real estate. Generally, changes driven by technologies bring benefits to human beings and solutions to the problems in society. Therefore, creative destruction can be a means to understand the issues within the real estate industry and provide insights to solve them.

4.2. Disruptive innovation

The disruptive innovation theory was originally proposed and developed by Christensen in his book *"The Innovator's Dilemma"* nearly twenty years ago (Christensen, 1997). Initially, it was described as "disruptive technology", which mainly referred to technologies that consumers of mainstream technologies value secondary to major attributes but focus on some neglected attributes. And as technology improves over time, new technologies slowly overtake the dominant technology in a given market. It suggested that radical or cutting-edge technologies may not necessarily be the winning ones (Si and Chen, 2020). Later on, this concept was extended to "disruptive innovation", which is broader, referring to disruptions involved in more

aspects, including technology, products and business models (Markides, 2006; Christensen and Raynor, 2013; Hang, Garnsey and Ruan, 2015). It describes how small companies with fewer resources can successfully challenge existing companies. Specifically, since existing companies focus on improving their products and services for the current customers, they tend to exceed the needs of the current customers and therefore ignore the demands of other market segments (Christensen, Raynor and McDonald, 2015).

This theory has been used as a term in any new technology or start-up company that aims to change the fundamentals of the market or industry and change the way of competition (Christensen *et al.*, 2018). According to King and Baatartogtokh (2015), disruptive innovation has four key elements. The first one is “incumbents are improving along a trajectory of innovation”, which means existing companies in the market are making continuous progress along the track of continuous innovation. The second key element refers to the pace of sustaining innovation, almost always exceeding the customer’s needs. An example of this element is that typists needed to stop their typing work for the Intel 286 chip to catch up when people were first introduced to personal computers for word processing. However, mainstream customers are provided with much more speed than today’s processors (Christensen and Raynor, 2013). The third key element is that the incumbents can respond to the threats caused by their competitors with disruptive innovations. However, they are continuously unable to respond. This is mainly because the disruptive competitors target their businesses on new and lower-end customers instead of having head-to-head competitions with incumbents for their best customers. In this case, the incumbent businesses either ignore the threats when the disruption shows up in a new market or escape from the attack when the competitions are among lower-end customers. The last key element refers that the incumbents will end up in trouble due to the disruption. This is because performance oversupply opens up opportunities for simpler, cheaper, more convenient, and disruptive technologies. Companies with these technologies will continue to improve the performance of their products, thereby taking over old markets and crushing the incumbents at the end (King and Baatartogtokh, 2015).

Different from the creative destruction theory created by Joseph Schumpeter, the disruptive creation theory believes that leading companies can adapt and succeed in the new technology market, but the values and decisions to adapt to the new market are missed (King and Baatartogtokh, 2015). In this study, the main research objects are the Swedish PropTech start-up companies. Therefore, having a good understanding of disruptive innovation theory can also help understand the activities of start-up companies.

5. Findings

This section presents the semi-structured interviews and the industry report review findings. It maintains the parallel structure as the interview questions, from the motivation to start the firm, the impacts of Covid-19 on business, future challenges, opportunities and development vision, liquidity and the PropTech business to the future of the PropTech industry.

5.1. The motivation to start the firm

According to the semi-structured interviews, each firm was established based on different motivations. For some participants, the motivation came from their past education and work experiences. For other participants, awareness of the challenges within the real estate industry and willingness to create impacts on these situations is their motivation.

5.1.1. Past education and work experience

Participant E's motivation to start the firm came from his master's thesis, which was about optimising revenue streams for co-working operations. The original idea did not quite fit the motivation to start the company; however, over time, it evolved into the current motivation to contribute to a more straightforward and more flexible commercial rental market through insurance products. Besides, the desire to be an entrepreneur was also part of his motivation for starting the company.

Participant A held the same desire that he would become an entrepreneur and start his own company at some point in his life. This desire was born from his past work experience in innovation and business development as a management consultant after studying in business school. He also gained the experience of helping different big companies develop new products, services and business models. With the help of his previous experiences and insights, the steps of starting his own business became easier.

5.1.2. A vision to create impacts

Except for being driven by previous education and work experiences, some participants started their firms due to a vision of impacting the real estate industry and changing things for the better, which is the same idea as many entrepreneurs hold. Participant A mentioned some challenges and problems within the real estate industry and business that need to be addressed, both from an internal perspective and an external perspective (participant B), and they started their journey from there.

Underdeveloped Swedish property rental market

The Swedish property rental market was underdeveloped, and in some ways, it still is. There were few rental agencies in the market, but the demand from people to get help for renting out

their apartments or houses was high. This demand includes everything from safe rental payments to the way to handle lease details and housing associations and permission from the housing association. In other European countries, or even outside of Europe, there are many rental agencies in existence. Even though many other rental companies were showing up in the Swedish rental market over time, it is still relatively underdeveloped. In this case, there was, therefore, high demand for more rental agents in the market (participant C).

Consumers' perspective

From the consumers' perspective, one of the problems needed to be solved is that selling a property is still outdated and old, which is not only in Sweden but also in the rest of Europe. From a personal financial standpoint, selling a property is a significant transaction; thus, such a process cannot meet the expectations of the property sellers. Another problem within the residential property transaction market is the insufficient supply of residential properties, requiring easier access to properties. Most people considering entering the property selling process are still not in the phase of contacting a broker, signing a deal and listing their properties on the public platforms or portals such as Hemnet in Sweden or Zillow in the United States. The amount of these people accounts for four times the number of people who have started the selling process instead of still in the phase of planning to move to a bigger apartment or buy a house. This phenomenon occurs mainly due to the shortage of the supply of residential properties. People who would like to sell their properties cannot find a place to stay during the period listing their property on the market and testing. There is an increasing need for a transparent process and a market that allows an earlier open up and testing on homes (participant B).

Brokers' perspective – a healthier working environment

Building a company that provides a sustainable work environment for brokers is the other motivation to start the firm. The most common salary model for brokers in Sweden is a 100% commission-based salary model, meaning brokers won't get paid as soon as they stop working. On the one hand, it is not a healthy working environment for the brokers; on the other hand, the 100% commission-based salary model is not suitable for the consumers either. Under this salary model, the brokers tend to speed up the transaction process to get more earnings. However, it may not be the best type of transaction for the property owners (participant B).

5.2. The impacts of Covid-19 on PropTech business

The impacts of Covid-19 on PropTech businesses come from different dimensions; some are positive, some are negative, and some didn't influence the development of PropTech businesses significantly.

5.2.1. Positive dimension

Fewer terminations

Participant C stated there were fewer terminations on the market, which means the company was not affected by the pandemic as much as it had initially imagined. Even though it did not receive as many new transactions or leases as in the period before the pandemic, the demand and supply balanced themselves in the end. Besides, since its business primarily targets private people rather than company projects, it was also less affected (participant C).

A higher number of transactions

Many different real estate industry players experienced the same thing in Sweden, which is that there was a higher number of transactions in the market (participant A). The number of transactions includes both the volume of homes being sold and the prices of the homes being sold (participant B). This phenomenon appeared because when staying at home gradually became a norm; people realised they needed to upgrade their homes, i.g., moving into bigger places which are more suitable for work. The needs of the consumers triggered a lot of demand, which increased housing prices. Subsequently, the rise in housing prices made people more opportunistic, and therefore they became willing to sell their homes. In this case, more transactions happened during the pandemic than before the Covid-19, which positively impacted the company from a business perspective since its business focuses on selling apartments (participant A).

There was also an increasing demand for such insurance products for company four, a rental insurance company for commercial real estate. Its business model is to create an insurance solution that replaces the bank guarantee or deposit that requires the tenant to lock up a high amount of capital. Using its insurance product, the landlord can gain the same security, and the tenant does not need to put too much pressure on itself. When the pandemic outbreaked, more and more landlords realised such insurance products were an excellent plan for them when their tenants went bankrupt (participant E).

The increased adoption rate of technology

Another positive impact that Covid-19 brought to the PropTech industry is that the adoption rate of technology increased. This benefits tech-focused start-ups a lot when people become more accepting of technologies. It is known that it is risky to launch tech-focused products or services since the transaction in the real estate industry is quite trust-based. Due to the Covid-19, people were forced to experience different digital tools and new technologies to keep their life working smoothly. In this process, they became more and more open to digital devices such as Zoom, Microsoft Teams, etc., which brought opportunities to tech-based companies (participant A).

The real estate industry has a growing need for agility and innovation and is embarking on an emerging path of digitalization. One driver of this shift is certainly the Covid-19 and the rapidly changing environment that comes with it and new or more prominent demands. Besides, the commercial developers cannot afford to waste too much time and money on things like manual work, Excel spreadsheets, site visits, bureaucratic procedures and so on (Nicoară, 2022a).

5.2.2. Negative dimension

A lower demand

Even though the negative impact was not as severe as company two imagined, the demand for renting apartments did decline. This is mainly due to the nature of its clients, who are ex-pat tenants. People who came to Sweden during the pandemic may not be able to start their employment and therefore had to stop searching for apartments, which decreased the demand for renting apartments. Besides, people who planned to rent out their apartments did not move as much as usual due to the unknown future brought by the Covid-19. Thus it resulted in fewer new rentals or leases (participant C).

A struggle process to continue efficiency

There were negative impacts for companies like company one, such as a struggle process to continue efficiency in showing homes to as many people as possible during the pandemic. It was impossible to have separate physical viewings for a massive number of buyers (participant B).

Hard to find an insurance company to sell products due to unknown future

For company four, the pandemic made it challenging to find an insurance giver to take risks for its insurance product which took almost two years. The insurance companies were terrified of Covid-19 since it is hard to predict the unknown future, the possible outcome of bankruptcy, and the most and less affected segments (participant E).

5.2.3. Supply meets demand

There was also a voice from the participants that the pandemic did not cause significant impacts on their businesses. From the perspective of company three, it did not experience huge impacts on its business, either positively or negatively. The supply decreased at the beginning of the pandemic, but it shifted back to the level where supply met demand. This is partially due to the unique situation in Sweden, where the real estate market did not close entirely, and there was no lockdown (participant D).

5.3. Future challenges, opportunities, and development vision

5.3.1. Challenges

Keep the position and continue the development

For companies that act like an incumbent in the industry, one of the future challenges is to keep their unique position in the market. It needs to continue pushing its boundaries, developing and disrupting itself rather than just sitting and waiting. Another challenge is to understand the current and future trends in the market and keep on evolving to meet the customers' and consumers' expectations. New technology waves, such as blockchain, keep showing up, which requires the incumbents to act as soon as possible. However, incumbents will probably not always be the first mover to develop new features. Nevertheless, they need to keep delivering the best class experience in their products by taking other companies in the industry as a reference (participant D).

More competitors

Another challenge the rental agency market faces is not related to Covid-19; more and more competitors are coming and starting a new competence that has discovered the rental agency market (participant C). Nowadays, there are a lot of start-ups and smaller companies working with different parts of the property transaction process or the property portals. For instance, a wave about providing services around legitimising bidding, such as BankID in Sweden, showed up a couple of years ago (participant D).

The incumbents initially tended to ignore the newly coming PropTech start-ups, believing that they were just a blip in the market and not going to be anything significant. However, over time with the development of the start-ups, the incumbents started talking down on the businesses of PropTech start-ups. Eventually, the incumbents start taking measures the same as the start-ups, which is the current phase (participant B).

For any incumbent, the legacy problem is a tricky part that makes incumbents own less freedom. But in terms of start-ups, they are entirely free to take any steps they would like, making them unstoppable. It is clear that the risks are higher, but at the same time, it is easy for start-ups to make changes (participant B). PropTech start-ups can make fast decisions and try new concepts. For instance, a decision can be taken, and direction can be changed in a few seconds in a start-up. But for incumbents, adopting a new concept will bring high risk, which is also a long and capital-heavy process (participant E).

As more and more PropTech competitors enter the market, the biggest challenge entrepreneurs will face is creating a unique value proposition. It is no longer enough to assert that real estate transactions are being digitized or consolidated on a single platform. To attract consumers' attention, a clear benefit must make companies' technology stand out in a congested environment (Forbes Biz Council Expert Panel, 2021).

Uncertainty

Currently, people live in a VUCA (volatility, uncertainty, complexity and ambiguity) world. Goals exist; however, it is hard to plan their implementation in the long term since the future is unpredictable (Strzelecki, 2022). The only reality known is the unpredictable uncertainty, a challenge for everyone in the PropTech industry (participant A). For instance, in the current post-Covid situation, it is uncertain if the interest rates will be increased or not by the national bank. Thus the price of getting a mortgage could be potentially influenced, which will eventually affect the housing prices (participant B).

5.3.2. Opportunities

A more open market

One of the opportunities for the PropTech industry is that the market has been more open to the public. This can be seen from the current services provided on the market, such as radio and TV ads, which expand a broader knowledge of different types of markets. For smaller companies, even though they may not apply the previously mentioned services to market themselves, they can still gain insights from the current existing agents. It may take many years to get to the point where there is a mature open market, but people are becoming more and more aware (participant C).

A freer rental market regarding legislation

Having a freer rental market regarding the legislation is an opportunity to be expected. In cities like London, the apartment owner has 100% freedom to decide the usage of their property. However, in Sweden, the current legislation on renting out apartments is strict, e.g., rentals are only allowed for two years by the Housing Association, which restricts the development of the housing rental market. If the market is opened up to be freer, the size and volume of apartments or houses out for rental will be bigger and higher, which will help expand the rental market. This could cause problems for the rental market, but it can also open up the market (participant C).

A high adoption rate of products and services

The way people use commercial space has changed, which is a big game-changer for the PropTech industry. It is expected that people will work from home a few days per week. Due to this work-from-home trend, more insurance products and services will be adopted even though the physical office space is still required (participant E).

5.3.3. Development vision

The participants indicated that they hadn't made significant development plans regarding the development vision. The current situation may not have reached the post-pandemic stage yet;

it is more inclined to be an era where everyone gradually forgets the pandemic situation. In the short term, the development plan is to maintain the current development state (participant C) and continue developing (participant D). For instance, streaming services for open houses and new constructions were developed at the beginning of the Covid-19, and they will be continuously provided to the market (participant D). In the longer term, expanding the business to other cities within Sweden or outside of Sweden is expected (participant C).

5.4. Liquidity and the PropTech business

5.4.1. Peculiar Swedish real estate market

The Swedish real estate market is peculiar when buying and selling apartments and generating residential transaction liquidity. This speciality is due to several factors: (1) Sweden is one of the few countries where there are exclusive brokers, meaning one broker is responsible for any deals they make, which is beneficial for the transaction liquidity; (2) the purpose of buying and selling properties is for living rather than speculation; people move for reasons of changing life situations which is one of the biggest drives; (3) the real estate rental market in Sweden is not well-functioning; (4) last but not least, both the mortgage interest rate and the commission fee for brokers are pretty low compared to other countries (participant D).

5.4.2. Perceptions of whether the business facilitates liquidity

All five participants held the same opinion that their businesses facilitate liquidity in the property transaction process, both from the residential and commercial real estate sides. Their statements are based on the time, cost, and volume dimensions.

Time dimension

As mentioned by participant D, it is speedy to buy and sell a property in Sweden, which is twenty-three days on average, compared to other countries in the world, which may take months or even a year. In other countries, the property transaction process consists of many steps and bureaucracy, also a complicated part with agents. In Sweden, the agents are professional; each agent acts as the point of contact between the consumers and a hot market (participant D).

About 50% to 60% of all the transactions in company one are conducted before the properties are listed on the open market, e.g., Hemnet. It owns its marketplace, which is called pre-market, where a potential buyer could be empowered to make an offer on a home before it's listed on the open market, which increases the transaction speed. This service shortens the transaction time of a property that could have been six months or one year if it's listed directly on the open market (participant A).

The average time between two transactions for company one is a few hours. This company has several offices in different locations in Sweden. During the day, one transaction could happen in the Malmö office in the morning; then the second one could happen during lunchtime. There

could be the third and the fourth one in the Stockholm office in the afternoon. Several properties are sold every day, increasing the pace (participant A).

The average amount of time it takes to trade an asset once a purchase or sale decision has been made for company two is around one or two weeks for a landlord from when they decide to rent out the apartment until a lease is signed. The general renting period is twenty months, one year and eight months (participant C). For company one, it is difficult to indicate the exact hours since this time length is dependent on price expectations, availability and so on. If it is from the perspective that the home is on board until it is sold, the number is seventy days (participant A).

The average amount of time for an asset to be transacted varies. Some homes are sold within the first week they were listed, while some have been listed for two years but haven't been sold yet (participant A). For company four, the amount of time a customer decides to get rental insurance to sign a contract is two days nowadays. It is working on reducing the amount of time to be instant (participant E).

Cost dimension

The cost dimension is another angle to perceive if the businesses facilitate liquidity. There are different types of transaction costs included in selling a home, such as the commission fee paid to the broker, the fee paid to the online listing portal, etc. It is evident that all those transaction costs are hurdles when making a transaction happen since the number of transactions would increase, and the volume would be higher when there were no transaction costs at all (participant B). These costs can generally be relatively high. For instance, the average amount of money paid to the broker is 60,000 SEK in Sweden, which can be even significantly higher in Stockholm. Part of the business model of company one to facilitate liquidity from the cost dimension is that its fixed commission fee for selling a home is low, which is 30,000 SEK (participant A).

According to participant C, company two applies a monthly rental fee which helps to gain liquidity. The monthly fee percentage is 10%, which is included in the rent. It is challenging to indicate an exact number since the rental level varies over time. However, the fee is roughly 1,300 SEK monthly for its new trades. For company three, each user's average amount of money to pay for each transaction is 2,467 SEK (participant D). The exact number of the fee is also hard to predict for company four since it depends on the size of the insurance sum a consumer applies for. But it equals about 2% to 4% of the monthly rent (participant E).

Volume dimension

The average number of new properties traded monthly is fifty for company two, which works with rental apartments and lease primacy. However, it is pretty challenging to show the exact number for each month from a general perspective. The buying and selling process is dynamic;

some apartments have been listed for four years, and some are terminated (participant C). For company one, there are around twenty new listings onboarding every day; for the upcoming year, the number will reach 9,000 (participant A). The number for company four is around 30 different buildings in which many customers are in the same building (participant E). According to the statistics reported by SCB, more than 90% of the properties and transactions are passed through the company platform. It is believed that this company is playing a crucial role in facilitating liquidity in the market from the volume dimension (participant D).

The total value of trades monthly is also difficult to find. It is partly due to the same reason mentioned above, which is also because there are different rental agencies within company 2. But in terms of newly added leases monthly, the number is around 50,000 SEK (participant C). According to participant A, the value is around 250 million SEK per month currently. For company three, the net sales are 728 million SEK (participant D).

5.4.3. The products and services applied to facilitate liquidity

Over the last decade, numerous PropTech businesses have emerged to improve every aspect of real estate transactions, from data collecting and analytics to empower buyers and sellers to virtual tours of homes to allow distant purchasing (Valley Bank, 2022). Different products or services applied in the companies' businesses to facilitate liquidity in the property transaction process are listed below.

Choose apartments with suitable rental levels

The vision of company two is to make renting apartments safer and increase the supply of available rental apartments for consumers. Currently, it is difficult to find second-hand rental and reasonably priced apartments in the biggest cities in Sweden. To achieve this, this company works with apartments whose rents are suitable for the market rental levels (participant C).

Pre-market solution

Company A's business is based on creating the supply volume from a business perspective. The product applied by company one is called pre-market solution, which gives homeowners more opportunities to sell their properties faster. It enables consumers to easily list their homes for sale through technologies and the platform. Potential buyers are also empowered to decide to purchase the property on the pre-market marketplace, which increases the transaction speed. Besides, they are provided with a more excellent supply to look into and investigate. Applying this solution does not mean it avoids using Hemnet; properties will be listed on Hemnet when the sellers become stressed about the selling process or would like to reach the open market (participant A). This pre-market solution reduces barriers to properties for sale and increases the supply of homes in the market (participant A). It will also expand the market to some extent, meaning that some deals that would never happen in the open market could get the opportunity

to happen. Or they would at least happen earlier than they would have happened otherwise (participant B).

Lower commission fee service

Except for the pre-market solution mentioned above, company one also applies a lower commission fee service. The commission fee for each transaction is 30,000 SEK, which can be paid by a seller or a buyer. The first situation is that the buyer pays the fee when the transaction is conducted on the pre-market marketplace. The second situation is that the seller pays the fee when the property is sold on the open market, such as Hemnet (participant A). Compared to other traditional real estate brokers, this amount of money spent on a transaction is much lower. This service is provided because company one aims to reduce the fee people are paying for selling a property. Besides, the way to do the business it created for itself is efficient and productive. Therefore it can still make profits with half of the commission fee compared to the average or traditional broker commission fee out in the market (participant B).

Monthly premium fee service

The current two competing products on the market when leaving security for the lease that a consumer could use is either a deposit that locks up the capital 100% or the bank guarantees. Both of them are expensive and against liquidity on the market. Company four adopted the same concept but replaced the product with insurance through which a tenant pays a monthly fee. In this case, tenants have more freedom since they don't need to lock up the capital (participant E).

5.4.4. Technologies applied in the product and service

It is the technology behind the products and services mentioned above that underpins their operation and impacts of them. Technologies are applied to increase speed and reduce barriers both internally, i.g., for employees, and externally, i.g., for customers (participant A).

Type of technologies

There are several different types of technologies mentioned during the interviews. The first one is the own-built website which is specifically built for the company. This is because the company owns both the rental payment and invoice systems, such as Fort Knox, which cannot be built-in technology (participant C). A fully functional back-end system on a very high level was built for company one based on many different languages. It means that company one owns its software, CRMS (Customer Relationship Management System), database, APIs, the entire back office, etc. On the front-end side, it owns native apps both on iOS and Google Play and the static web (participant A). The only situation when company one connects to a broker system called Vtech is when it lists properties on an open market portal, which is the absolute last part of the process. The purpose of building 80% to 90% of the systems in-house is to have

control of the platform, the whole property transaction journey and so on (participant B). For company three, the basics of its platform consist of the web platform and apps both on iOS and Android. Besides, part of its platform is proprietary, which means it develops the vast majority of the platform itself (participant D).

Some external services outside the market have also been applied except for building platforms in-house. For instance, company three uses AWS, which stands for Amazon Web Services; elastic search is used for search function; live streaming services of open houses are adopted to support online listing; recommendation engines based on collaborative filtering and so on are used to ensure the customers have personalised experience (participant D). According to participant E, company four is in a stage to try to keep the applied technologies as simple as possible. Therefore there are not many technologies except for e-mails, Excel, and map folders on the Google Drive and CRMS.

Obstacles when applying technologies

One of the obstacles for company two when applying technologies is finding technologies that suit both its systems, the rental payment system and the apartment renting system (participant C).

For company one that builds all the systems in-house, the main issue is that it requires a lot of maintenance. This company is ambitious since it not only owns the real estate agents, the support function, and the marketing team but also owns its tech team. Compared to a traditional real estate agent who would only buy into existing CRM systems that are pretty basic, company one's developers build both the back-end and the front-end system from scratch to create a better, more transparent and more communicative experience (participant A). It is not that it did not consider using part of the system externally, such as the CRM system, but in this case, building the other parts of the process will become messy compared to building the system in-house completely (participant B). In this case, the workload of maintenance is high. For instance, there are focuses on ensuring the website speed is up-to-date, no issues on the website, prioritising all the time, and releasing new features versus just housekeeping, getting all the feedback into the system and so on (participant A).

Another obstacle when applying new technologies is that the willingness of the landlords and tenants to adopt a new system may not be as high as expected. It is noticed that not that many clients would use the interface if it had a login. Besides, many clients use different management systems, making it hard to implement a big system with a lot of investment that could connect to other systems. It is also hard to prioritise the systems which are used more frequently. There is a risk that clients tend to continue using tools such as Excel rather than adopting a simple new system (participant E).

The nature of the real estate industry is still a big obstacle to implementing new technologies; it is not an industry that acts fast to adopt changes. It is easy to open up discussions when people

hear FinTech and PropTech. However, many real estate players still regard these two terms as buzzwords and suspect that they can contribute value. The real estate industry has been a slow adopter of changes for a long time. One hundred years from now, it will continue this way, which is a big obstacle for PropTech companies introducing new technologies (participant E).

5.5. The future of the PropTech industry

It is nearly impossible for people to return to the traditional manner of doing things after technology improvements have been made to such a degree. Many of the procedures have been rewritten by innovation, allowing real estate players to grow, learn, investigate, create, and connect better and more frequently. The term “PropTech” will inevitably become part of the real estate lexicon. Real estate players will integrate technology deeply into their operations (Nicoară, 2022b).

5.5.1. More collaboration

One of the influences is that different PropTech players in the real estate industry are collaborating gradually. For instance, company two, which rents our apartments, is collaborating with storage PropTech companies to provide storage solutions for tenants. Besides, it also has collaboration with cleaning companies and insurance companies. This trend of collaboration will grow bigger and bigger (participant C).

5.5.2. Open the market to accept a new level of services

Real estate is a big theme, from construction, technology, and residential properties to commercial offices. It is also an industry that has been neglected mainly due to complications with the business model and traditional user behaviour. The incumbents have been dominating the communication within the real estate industry for a long time. Besides, moving into the PropTech industry requires a lot of capital for investment, especially as a service. But it is clear to see the trend that consumers will get used to a new level of service and experience brought by the PropTech industry as more and more companies adopt the technology within their business models. PropTech will become hygienic in the future to provide an excellent service for users (participant A).

The Swedish broker industry is quite open to adapting to changes when necessary. One example is that during the pandemic, services such as online open house viewing, which support property transactions, were applied immediately by the broker industry to maintain the operation of their businesses. Younger brokers use social media platforms such as TikTok and Facebook Live to examine how the market evolves. There will be a process of scanning and adopting new technologies that will be useful for the final customer. It is hard to predict how long the real estate industry will take to become digital. Still, the resistance to adopting new technologies will decrease if a specific technology is needed and proves to be convenient for the end-user (participant D).

5.5.3. More PropTech applied in the residential sector

It is interesting to see that 90% of all the innovations in the PropTech sector have been in the business-to-business (B2B) products that fall into the construction and commercial properties field. Residential properties are the most significant asset in the real estate industry; however, the innovations are relatively limited on the residential side. The most significant impact going forward is that the innovations in the residential sector will catch up, and more players such as Opendoor and Zillow in the United States and McMaster in Germany will show up in the market (participant B).

6. Discussion

This chapter summarizes the findings from the semi-structured interviews and industry insights. The reflection and comparison of the findings with previous literature reviews and theories are also presented in this chapter.

6.1. The liquidity in the property transaction process and the Swedish PropTech companies

As mentioned earlier, the interview participants define liquidity in the property transaction process from the time, cost and volume dimensions in the same direction as the literature review. From the time dimension, the speed of buying and selling a property in Sweden is fast. The average time between two transactions could be several hours for some companies. From the cost dimension, one company offers the customers a lower commission fee service of 30,000 SEK rather than 60,000 SEK, which is the transaction cost on the open market.

All the Swedish PropTech companies in this study believe that their businesses facilitate liquidity in the property transaction process with the support of their products or services, such as the pre-market solution, lower commission fee service and monthly premium fee service. Behind the products and services, the technologies such as CRM systems, elastic search, AWS, live streaming services and so on are applied. It is worth noting that many participants expressed their interests in the advanced technology blockchain. However, they are conservative about whether to apply the technology or not, no matter if the company is an incumbent or a start-up. This is due to an incumbent's complex organisational structure and processes, which require a long approval process to adopt new technology. Besides, the cost to test new technology for an incumbent is high. The reason for this phenomenon for a start-up is that it is uncertain if the consumers will trust the new technology and would like to bear the risks.

It is clear that the PropTech industry will not stop its pace of development, but there will be many obstacles that appear during the journey. Since these companies provide products and services to consumers and the real estate industry, it is important whether the users accept them or not. People believe that it is always beneficial to the real estate market when the PropTech companies facilitate liquidity in the transaction process. However, it is worth considering if the market reacts speedily and provides too much liquidity, whether there will be any negative impacts.

6.2. Covid-19 and the Swedish PropTech companies

As mentioned in the last section, whether the market embrace PropTech is a key impact on the future development of the PropTech companies. Before the pandemic, the real estate industry remained cautious and slow to accept new products and services. However, to some extent, the pandemic forced it to adjust itself to adopt new changes and become more digital. It is clear

that the pandemic brought many negative influences on society. Still, at the same time, it changed people's habits and behaviour and brought the market to a new level.

Nevertheless, the pandemic brought some challenges to the PropTech industry. One of the biggest challenges is the unpredictable future, even in the post-Covid stage. It is difficult to predict if there will be any outbreaks like the pandemic in the future, and the world is full of constant changes. The safest way for a company to develop is to stay where it is now, test new technologies in a low-cost way, and constantly benchmark against industry developments. Besides, the PropTech industry must understand the psychology of consumers.

During the pandemic, more and more companies entered the market due to the huge development opportunities that could be seen. On the one hand, the newly coming firms increased the competencies in the market, which might cause some companies to lose the competition. On the other hand, this will also enhance the market's screening of the PropTech companies and, in turn, retains companies that are competitive and could deliver good products.

6.3. The future of the PropTech industry

According to the interviewees and industry reports, it is certain that the real estate industry will not go back to the old times when there were fewer technology improvements. Thus it can be seen that the PropTech industry will have more and more opportunities for development in the future. Due to the pandemic, the consumers were forced to accept and experience new services and products. The real estate players were also forced to explore new and convenient ways to approach their consumers, such as Facebook ads, TikTok ads and etc. Through this procedure, both sides could see the increasing confidence in adapting to new technologies and improvements. All those factors laid a great foundation for the PropTech industry to continue developing in the post-pandemic stage. It is also certain that there will be more and more competitors entering the PropTech market, which will bring more competition and more collaboration at the same time.

7. Conclusion

In conclusion, this research and the followed analysis and conclusions are mainly based on the five semi-structured interviews with professionals from the PropTech industry. Industry reports were analyzed as a complementation of the findings. This study has examined three research questions: how the Swedish PropTech companies facilitate liquidity in the property transaction process, the impacts of the pandemic on those companies, the challenges and opportunities they foresee in the future and the outlook for the future of the PropTech industry. The findings from the semi-structured interviews answered the first research question from several perspectives, which are the products and services the PropTech companies applied to facilitate liquidity technologies applied in the services and products. For the second research question, an analysis of the impacts of the pandemic from positive and negative dimensions was presented. Due to the peculiar Swedish real estate market and Covid-19-related restrictions, some participants stated that the pandemic did not impact their business significantly. The last research question is regarding the future of the PropTech industry. According to the participants, there will be more and more collaboration between the PropTech companies and the real estate industry. Besides, the real estate market will be opened up to a new level, providing the customers with more options. As stated previously, this study aims to contribute to the relative young Swedish PropTech market through the exploratory qualitative method. Due to the nature of semi-structured interviews, there are certain limitations within this study and therefore require more careful consideration when drawing conclusions.

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Appendixes

Appendix 1 Interview questionnaire 1

Interview Question List

Interview structure:

- Part A – general part
- Part B – specific questions regarding the business target of your company
- Part C – technical questions regarding the technology your company is using

Part A:

- What was the motivation to start your company?
- What are the impacts of Covid-19 on your business?
- What is your development vision in the post-covid situation?
- What challenges and opportunities for your company, a PropTech company, can you foresee in the post-covid stage?

Part B:

- How do you define liquidity in the property transaction process?
- Do you think your business improves liquidity in the property transaction process? If so, how does it work?
- How do you see the competition/relationship between PropTech start-ups and incumbents?
- What is the fee a user needs to pay for each transaction?
- What is the total number of properties traded monthly?
- What is the total value of trades monthly?
- What is the average amount of time that has passed between two transactions?
- What is the average amount of users visiting your platform monthly?

Part C:

- What technology is your business based on?
- What are the obstacles when applying the technology/technologies in your business?
- What influences do you think PropTech brings to the real estate industry?

