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# Can P2P Platforms Disempower Macroprudential Regulation in Europe?

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**Abstract**

This thesis examines P2P lending´s ability to undermine Macroprudential regulation, in this case the LTV cap used to restrain household leverage and real estate prices. By utilizing an LTV cap tightening in Finland I was able to use a dataset from the online lending platform Bondora to run a difference-in-differences analysis to see how home-buyers are using the platform to circumvent the LTV cap relative to the control area in Estonia and Spain. The average amount of each loan on the Platform increases in the treated area, in line with the idea that borrowers are using the platform to circumvent the LTV cap tightening. I also find that there are fewer good rated (AA, A, B) on the platform in Finland after the LTV cap tightening, which is consistent with the idea that it will be lower rated borrowers turning to the platform for the required equity for a mortgage through the bank. Despite the decrease in the rating of borrowers, there is only a slight insignificant rise in default rate after the introduction of the LTV cap, suggesting that investors on the platform are able to censor out the riskiest borrowers. Bondora verifies the information provided by fewer borrowers in the treated area after the regulation change but makes up for it with shorter loan periods reducing the risk for their investors. The results of these tests present empirical evidence to the fact that P2P credit platforms have the ability to undermine LTV caps, which is something regulators have to take into consideration during policy decisions.

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# 1 Introduction

The first marketplace lending firms were founded around 2005, but the industry was very small for the first few years. Peer-2-peer lending platforms serve as intermediaries between investors and individual borrowers and the growing market for small businesses. After a slow growth in the first few years, it wasn´t until after the financial crisis of 2008 that industry started growing exponentially.

The relationship between macroeconomic performance and household leverage has also seen growing attention from economists and regulators after the 2008 financial crisis. The LTV cap has been one of the major macroprudential tools used to prevent bubbles in real estate prices and to try and smooth the business cycle. LTV (loan-to-value) caps are used to limit the fraction of the amount that a borrower can borrow the value of the property being bought. As LTV caps usually only cover the conventional financial market and not the P2P lending market. When the LTV cap is altered in a country it allows me to explore if households are using this P2P market to circumvent the regulation by borrowing additional capital through this channel. By using the P2P credit market and using the credit from there for equity in the home, the home-buyer would be able to buy their desired house right away instead of having to save for longer to cover the equity required after the introduction of the LTV cap. If this is the case, the effects of the LTV cap are questionable when it is easily bypassed.

To date, quite a few studies have been conducted into this relationship between macroprudential tools, the traditional financial institutions, and the P2P lending market. However, most of this research has focused on the US and China markets, whereas this paper will focus on the European credit market where there hasn't been as much research to date. The European credit market is unique, there is one regulatory agency in the European Union and then many small ones which are supposed to adhere to the

EU regulation, who then also have some power to regulate certain aspects of their economy. The LTV cap is one of those that each country can control itself.

Braggion, Manconi & Zhu (2019) find evidence that marketplace lending platforms can undermine LTV caps. They also introduce three crucial features that make the p2p industry viable for research. First, the level of anonymity the borrower receives is much higher than of the traditional financial institution, as well as the industry being a lot less regulated. Second, the p2p lending pool is infinitely large, virtually any lender or investor on the platform in addition to any future investors possibly joining the platform. Third, unlike the traditional financial institution, the p2p platforms carry out most of their business online and thus can reduce the costs of giving out the loans. By having virtually no physical branches they are able to save on overhead costs and provide the borrower often with better credit rates.

This study makes some important contributions to the currently existing literature. Firstly, it gives some insights into how the marketplace lending intermediaries operate and especially some needed understanding of the European P2P lending markets. Secondly, it gives investors and borrowers some information on what to expect and such when they invest/borrow on the platform. Thirdly, and most importantly, it provides some insights into financial regulation and implications their macroprudential tools (LTV cap) can have on the economy.

The data employed in this study comes from the marketplace intermediary Bondora, which operates in Estonia, Finland and Spain. The law set in place in Finland on maximum LTV ratios on July 1st, 2016 allows me to see if this change in the equity requirements in residential real estate has any effect on marketplace lending demand, where Finland is the treated group and Estonia and Spain the control groups in a difference-in-differences model. Bondora provides very detailed data on their borrowers and the details of each loan, publically available to the user. This data provides

researchers with an opportunity to study p2p lending in Europe and is particularly unique in a way that it has multiple countries on the same platform. It can also be interesting for policymakers to study the rising demand in p2p lending and the impact of their macroprudential decisions, especially with the increasing need to regulate the marketplace lending industry.

I find that the P2P market is an unregulated resource for credit with the ability to disempower macroprudential regulation. This rise in the amount per loan in Finland is proven through both a visual check in Figure 1, which plots the changes around the regulation change for both the treated (Finland) and the control area (Estonia and Spain). The regression analysis then confirms this visual check in table 3 and also strengthens them by employing both borrower and country controls, as well as year and country fixed effects. The rating of borrowers decreases in 2 specifications, but when more detailed controls are added the results disappear. The results also suggest that Bondora fails to adjust for the altered environment by not keeping up with their verification procedures, but makes up for it in a way by reducing the average loan duration. Despite the rating of borrowers decreasing, the default rates don't increase significantly suggesting that the investors on the platform are able to censor out the risky borrowers through the information provided on the platform.

The rest of this paper is organized as follows. Section 2 reviews the current and existing literature on the subject of marketplace lending, the LTV ratio and other relevant macroprudential tools. Section 3 explains the data gathering, variable construction needed and the methodology behind the model. Section 4 then presents, interprets and discusses the results of the study. The paper then finishes with a further discussion into the limitations and the future opportunities for further research in the field, followed by a conclusion.

# 2 Literature Review

In this segment, first some brief history of alternative financing to the traditional firm will be provided as well as some existing literature on marketplace lending and other forms of crowdfunding. Following that will be an examination into the existing literature on Macroprudential tools and the LTV cap. Then, it will look into literature that combines the two and look at how crowdfunding affects those macroprudential tools. Lastly, the LTV cap that was introduced in Finland is discussed, as well as the hypotheses development and the goals of this thesis.

## 2.1 Alternative Finance

Alternative financing can be explained as any other way for an individual or a corporation to obtain financing from another source than the traditional finance institution (banks, private equity and mutual funds). With the emergence of the Internet in the late 20th century, the traditional finance institutions started slowly utilizing it to try and offer its clients better service, but it wasn't until the early 21st century when the conventional households started using the Internet that fintech took off. With this surge in fintech innovations, alternative finance became a viable option for small corporations and individual consumers. The revolutionary aspect of this new alternative finance innovation is the fact that individuals seeking credit have an infinite pool of capital available to them, every person on the planet is a potential investor or borrower. According to a report on alternative finance by Segal (2016), the three major crowdfunding forms are (1) donations and rewards-based crowdfunding, (2) peer-to-peer lending and (3) equity crowdfunding. She also states that two models have emerged recently that have great potential, revenue and profit-sharing crowdfunding and invoice trading. This thesis will focus on the peer to peer lending model.

In a report on the alternative finance market in Europe, Wardrop, R., Zhang, B., Rau, R., & Gray, M. (2015), the authors awarded the prominent success of the alternative finance market mostly to the financial crisis of 2008 and the conventional financial institutions not being able to give out as many loans to small enterprises and individuals as before the crisis. This was especially apparent in countries that experienced the full force of the crisis and many of those countries have been the driving force in the expansion of the alternative finance industry.

In a more recent report on alternative finance markets in Europe, the authors Ziegler et al. (2018) cover the industry in a little more detail. In 2016 the alternative finance market grew from €1,019m to €2,063m or by 101%, excluding the UK which is by far the biggest market in Europe with around €5,608m in market cap. The P2P consumer lending market is the biggest alternative finance market in Europe, the model accounted for about 34% of total volume with a market cap of €697m in 2016 and a 90% year-to-year growth. Of those countries relevant in this study, Estonia ranked first in all of Europe in alternative finance per capita €62.28, Finland 4th with a €25.88 alternative finance per capita and Spain 17th with €2.82 alternative finance per capita.

These numbers show how the alternative finance market in Europe is growing rapidly where it is often experiencing year-to-year growth above 100% and the fact is that it already plays a huge part in the financing environment in the region. Even though most platforms operate internationally, there are very few cross-border transactions with all platforms reporting less than 10% of their volume to be cross border. That could probably be attributed to the lack of common regulation across the European Union and each country having to regulate its markets, these differences in regulation and added risk can often be discouraging to investors.

The biggest alternative to P2P lending is crowdfunding. Belleflamme et al. (2014) state that there are two main models of crowdfunding that dominate today's market, the

pre-ordering and profit-sharing models. In the pre-ordering model, the entrepreneurs allow customers to pre-order the product to raise enough capital to launch the product. In the profit-sharing model, the entrepreneurs raise capital by offering equity in their business for a fixed price until they have raised the necessary capital. They find that the entrepreneurs favor pre-ordering when the initial capital requirement is relatively small and when requiring larger amounts the profit-sharing model becomes more viable.

### 2.1.1 Marketplace Lending

Peer-to-peer lending is the leading credit application of crowdfunding. It is known under quite a few names, marketplace lending, social lending or crowdfunding lending. Due to the relatively young age of the P2P lending industry, most of the existing literature on the topic is very recent. Aveni et al. (2015) state that to date peer-to-peer lending remains an ill-defined innovation despite having existed for over 10 years, possibly since the term covers such a wide spectrum of P2P lending models. However, they go on to describe peer-to-peer lending as the “loan-making between borrowers and lenders who are directly matched via online marketplaces.” The marketplace lending institutions are able to bypass the regulation that most traditional financial institutions have to adhere to by acting as a disintermediate, as they act as loan originators but the lender is eventually taking on all the risk of default on the loan when they choose to invest.

Almost all p2p lending platforms operate on the same basic concepts. According to Greiner & Wang (2009), platforms act as an intermediary as they connect investors willing to lend on their platform with borrowers applying for loans. Both parties seek options that would be the most beneficial to them, borrowers seeking the best possible interest rates and maturity given their credit ratings and loan history. While lenders seek for the best possible investment options that provide them with the highest investment yield considering a risk level they are comfortable with. The credit rating that the interest rate is most often based on is decided by the platform depending on factors related to

the borrower's loan history, public credit scores (FICO scores in the US), wages etc., but no platform officially publishes how they achieve this credit score. However, originally with the earliest platforms investors were able to bid on each loan and the interest rate and amount they offered, in the end the borrower would decide which offer to accept which generally was the one offering the lowest interest rate. This proved to be very problematic in some cases, which was why the platforms moved into the lending process used presently. Balyuk & Davydenko (2019) address this issue how the P2P lending platforms have changed from only bringing together the borrower and the lenders, without any banks acting as middlemen to where now they perform almost all tasks related to loan evaluation and screening. They found that this potentially creates a moral hazard as lenders are profoundly passive and therefore automatically fund almost all loans offered on the platform, due to that the platform may alter their loan evaluations and rate more loans in a bracket where they earn a greater commission. Furthermore, their findings suggest that in markets where private information isn't available on the loans, the platform's ability to analyse the data is more important than that of the investor, thus potentially limiting the investor´s ability to earn excess returns on the market. Analysing the impact of such changes, Ryan & Zhu (2018) find that after changes in its interest rates determination, funding whole rather than fractions of loans and reducing the extent of soft information available to lenders, with this Prosper.com was trying to speed up the lending process and increase the platforms lending volume. By creating their own credit-rating model, the distribution of interest rates shrank and the ability to predict loan default depending on interest rates decreased. Freedman & Jin (2011) further address this information asymmetry issue and how through time when investors learn by doing and learn from their mistakes, the gap between market players diminishes. They find that those early lenders on the platforms didn't perfectly understand the market risk at first, at least not relative to offline markets where lenders would provide collateral for default on their loan. As a result of learning over time by the investors, subprime lending has decreased and therefore they conclude that the P2P

lending markets are moving more and more towards the population served by traditional credit institutions.

Vallee & Zeng (2019) find that the information each borrower provides with their loan application directly influences what kind of investor chooses to invest in their loan and the direct performance of those loans. They find that more sophisticated investors and robot investors outperform the monitor-only accounts, but as the information provided diminishes the outperformance shrinks as well. As P2P lending becomes a more established investing option it is very important to know how different investors perform on the platforms and who can use the informational edge of big data, in this case the sophisticated and robot investors. Morse (2015) discusses how the crowdfunding platforms mitigate information frictions so that at least some borrowers and investors' outcomes are improved by utilizing the platforms. Investors can capture the benefits due to the removal of costs associated with financial intermediation. The borrowers gain because through the P2P lending platforms they can access a wider pool of potential credit and also due to the removal of some costs related to financial intermediation. Aveni et al. (2015) state that marketplace lending has a few unique positive effects on economies. First, it creates a relatively distinctive asset class for investors to consider, through the platforms they can invest in different loans with different risks and thus being able to design their portfolio to their desired risk and diversification easily. Secondly, borrowers are often able to attain loans with lower interest rates than through the more traditional financing routes. Lastly, P2P markets are often less complicated than traditional financial institutions and therefore simplifying the process of procuring loans for many users.

There are several risks to consider when it comes to P2P lending. Aveni et al. (2015) discuss those risks in depth and concludes that any investor should carefully consider the following risks when holding P2P lending assets:

- Credit risk: As P2P platforms aren't subject to government regulation and investors are therefore not covered by deposit insurance.
- Collection risk: In the case if the platform would fail, who would collect on the loan? Some platforms have continued to collect on delinquent loans, but most have completely stopped collecting in case of bankruptcy.
- Liquidity risk: In theory, when an investor enters into a contract for a loan, they will hold the investment until the maturity of the loan. If the investor would then require an early exit, they could only sell the claim in a secondary market which although being small has seen enormous growth in recent years.
- Privacy risk: Because P2P lending operates solely online, it can be subject to cyber-attacks or identity theft where both investors and borrower's information is vulnerable. However, privacy risk is present in almost all modern businesses.

How an investor should build his P2P lending portfolio and how to best diversify has been highly debated by researchers. Luo et al. (2011) built a model where an investor can evaluate investments based on their preferences towards risk, experiences and past performance. This model proved successful in indicating investment value and improving investment performances in experimental results on real-world P2P lending data.

## 2.2 Macroprudential policies

Much like alternative finance, macroprudential regulation became very relevant after the 2008 global financial crisis. In the 20 years leading up to the financial crisis, there was a period of much deregulation in many countries. After analysing the crisis, there was much discussion on the build up that led to the global crisis, how regulators could better identify those financial imbalances to prevent future crises and balance the economy. However, Claessens (2015) proclaims that macroprudential policies aren´t the

only policies aimed at financial and economic stability, among others are monetary, fiscal, competition and microprudential policies[1]. There is much need to coordinate macroprudential policies with those other tools and some macroprudential tools are used to correct for distortions caused by those other types of policies. Galati & Moessner (2013) assert that the main objective of macroprudential policy is financial stability, but experts define this financial stability differently. One describes financial stability as the financial economy´s robustness to external shocks and the other one as the system's resilience to shocks or its vulnerability to those shocks originating within the system itself. They also state that the main goal of macroprudential policy is to limit both the risks and costs of a systematic crisis and to try and force banks to not take excessive risks with government insured deposits. According to Landau (2009), the main problem with macroprudential policy is that bubbles are very difficult to detect and are most often only apparent after the event. Therefore the macroprudential tools are heavily based on past shocks where regulators try to prevent those from happening again, this makes the system vulnerable to new kinds of threats. Landau (2009) also states that there are two ways of implementing macro financial policy. The first would be to use automatic stabilizers which constrain all institutions regardless of their individual situations, for example cyclical capital requirements. The second approach is a discretionary top-down intervention from regulators. They would step in and either impose or ease those constraints whenever they believe that threatening imbalances are developing or unreeling.

Because macroprudential tools aren't always clearly identified and therefore information on the actual use of them is limited. Claessens[2] (2015) using data collected by the International Monetary Fund identifies the most commonly used macroprudential tools as loan-to-value ratio (LTV), debt-to-income ratio (DTI), limits on credit growth, limits on foreign lending, reserve requirements, dynamic provisioning, and

[1] In the lead up to the 2008 financial crisis, regulators focused more on microprudential regulation rather than macroprudential.
[2] Stijn Claessens is employed by the research department at the International Monetary Fund

countercyclical capital requirements. He finds that countries use the LTV and DTI ratios the most and predominantly in advanced economies who try and restrain inhabitants from building up too much leverage. Emerging economies utilize more policies and impose them for longer than advanced economies, the emerging markets tend to favor more liquidity and foreign exchange policies, perhaps in regards to concerns over systematic risk and unpredictable capital flows.

Dell´Ariccia et al. (2012) find that macroprudential policy has proven to be a success in containing booms and limiting their repercussions in the past. Which is mainly thanks to the buffers those policies have created. They assert how important it is especially for monetary and macroprudential policies to be coordinated, which might increase the effectiveness of both policies. It is also important for countries to coordinate their policies, otherwise multi-national corporations are easily able to circumvent the policy in each country reducing its effects. Claessens et al. (2013) use a panel data regression to analyze how the balance sheet of over 2000 banks in 48 countries changed over the period 2000 - 2010 in response to certain macroprudential policies. They find that few, if any policies can help stop declines if implemented in unfavorable times, but can mitigate systematic risk during upswings and creating cushions that are able to limit the downfall after a boom. Measures aimed at borrowers such as caps on loan-to-value or debt-to-income ratios are able to limit credit growth and rising real estate prices as well as reducing household leverage. On the banking side, countercyclical buffers such as reserve requirements and limits on profit distribution are capable to soothe escalations in bank leverage and assets.

### 2.2.1 Loan-to-Value caps

Loan-to-Value (LTV) cap is a macroprudential tool used by regulators to try and limit housing bubbles, where the borrower is limited to a certain percentage of the value of an asset he can borrow. Crowe et al (2011) explain the purpose of the LTV cap and how it is used to limit vulnerabilities on the borrower side. By restraining leverage

buildup of individuals, they are able to limit his risk of default when housing prices decline and putting him in negative equity on the asset. Lim et al. (2011) provide a thorough study on the effectiveness of macroprudential instruments thus far, using data from 49 countries. They find that countries often use the LTV cap and debt-to-income (DTI) together to restrict credit growth and asset price inflation in the real estate market, but do need to be adjusted regularly in regards to the business cycle to work efficiently. Furthermore, credit growth and asset price inflation have been proven to decline after introducing the LTV and DTI caps in more than half the countries in the sample. The LTV and DTI caps complement each other in reducing the cyclicality of collateralized lending, LTV addressing the wealth aspect and DTI the income aspect of the same risk factor.

Igan et al. (2009) state that in advanced economies the housing price cycle has proven to lead credit and business cycles, thus suggesting that housing prices can sometimes be the sources of shocks like in the financial crisis of 2008 in the US. Crowe et al. (2011) find that the narrower focus of LTV caps reduces their costs and appears to have the best chance to prevent booms of all the macroprudential tools. Because of the narrow focus of the LTV ratio, it sometimes creates the chance of circumventing it. In the US prior to the global crisis in 2008, borrowers would combine two or more loans to avoid the required mortgage insurance which kicked in when the LTV ratio exceeded 80%. Morgan et al. (2015) look into how effective LTV ratio is at moderating mortgage loan creation using a large sample of banks in Asian economies, a region where LTV cap has been a very popular regulatory instrument. They find that there is a strong economic effect of those LTV policies applied. Comparing countries that have LTV policies in place to those that don't, the countries with the cap have an 8.1% lower growth rate differential of economies and 5.1% of that reduction points a direct effect of the LTV policies.

Real estate macroprudential instruments have been used quite intensively in Asia compared to other regions of the world. Zhang & Zoli (2016) find that LTV narrowing episodes have taken place more than twice as much as in Europe and North America and that the tightening occurrences have been far more common loosenings. Their analysis suggests that in most countries credit growth has been bolstered by many capital flows instruments, but in Asia only housing-related macroprudential tools have proven effective. Wong et al. (2014) use a dataset from the Hong Kong market where policymakers have often utilized an LTV policy to battle high real estate prices and credit growth. They identify that the LTV cap tightening since the global financial crisis of 2008 has reduced the borrowers´ credit growth and overall leverage, as well as strengthening banks´ perseverance to housing price shocks. Secondly, they find that the LTV policy has a more significant impact on the loan supply than on the demand for loans. Furthermore, they observe that there is little effect of the LTV policy on the housing demand in Hong Kong. Their findings suggest that an LTV is primarily effective to target household leverage and that there are certain limitations when using the LTV cap to balance credit growth and real estate price.

## 2.3 Banking Regulation and Peer-to-Peer lending

To date, most of the existing literature on marketplace lending has focused on how investors invest based on borrower characteristics. There haven't been many papers that have investigated P2P lending in relation to banking lending, which this paper will contribute to. When applying for a loan, borrowers usually tend to look towards their bank and if their application is declined they often turn to alternative financing options. When a bank experiences a credit supply shock and will have less credit to lend out, more borrowers should be turned down. Alfaro et al. (2019) check how those credit supply shocks affect the economy and find that it affects both investment and output for firms in Spain. Amiti & Weinstein (2013) also look into how supply sided financial shocks affect firm investment and find that investment for publicly

listed companies in Japan is affected by credit supply shocks, surprisingly as those large firms are generally believed to always have access to equity markets.

Ferrarini (2017) states that digital lending platforms don´t create any stability risks to the economy like large banks and investment firms do and therefore are not required to adhere to capital requirements and other regulations like the traditional financial institutions. It is believed that if the P2P lending platforms started lending themselves instead of only acting as intermediaries they would have to adhere to the same regulations as the traditional financial institutions. Plantin (2014) states that when capital requirements are tightened it may lead to an increase in shadow-banking lending. Jiang et al. (2019) use a hand-collected dataset to examine how government affiliation in China influences the development of marketplace lending platforms in the country where P2P lending has thrived in recent years. They find that the government-affiliated marketplaces tend to attract more investors, have a higher trading volume, offer lower interest rates, as well as having a higher persistence to market bubbles. However, they don't find any significant difference in profitability between the state-affiliated platforms and those with no government ties.

The relationship between banks and the P2P marketplace platforms is a very interesting subject and many researchers have looked into that from different perspectives. Wolfe & Yoo (2019) find that small banks lose some lending volume and tend to take on riskier borrowers to counter peer-to-peer lending encroachment in the credit market. Furthermore, larger banks appear to be unaffected by the emergence of P2P lending, which means that the already slightly vulnerable small commercial banks are the ones losing market share to P2P credit platforms. The main takeaway from their research is how regulators will have to carefully consider how to regulate the P2P credit industry going forward. Buchak et al. (2018) analyse the rise of fintech from 2007 to 2015, they find that shadow banks and P2P platforms gained a significant market share in the credit market during this time, especially among borrowers with a lower credit

rating. Shadow banks gained the largest market share in areas where banks faced the most regulatory burdens and tightening capital constraints. The fintech lenders' use of technology and its ease of use allows them to charge an interest rate premium. They also find that the regulatory burden of the traditional banks accounts for 55% of the rise in shadow banks and 35% due to technological advances. Fuster et al. (2018) state that the market share of P2P credit platforms in the U.S. mortgage market increased from 2% to 8% from 2010 to 2016. They find that the P2P platforms process the loan applications faster, but with the cost of higher defaults than the traditional finance institutions. The fintech lenders are able to adjust their supply of credit quicker than banks and thus not sitting on capital and struggling to find ways to earn the required return on capital.

Tang (2019) studies whether P2P lending platforms serve as substitutes or complements to the traditional financial institutions. She uses an exogenous shock to a bank's credit supply to address these questions and finds that for sub-par borrowers P2P platforms act as a substitute and for small loans it complements banks by supplying small loans. Roure et al. (2019) also test what kind of borrowers P2P platforms attract in relation to banks and use a credit supply shock in Germany to do so. They use data from Germany and find that P2P lending volume increases as total bank lending declines when they are faced with these capital requirement restrictions. Furthermore, the P2P platforms charge a higher interest rate than banks, the borrowers at the platforms are riskier and less profitable. These implications lead them to the conclusion that P2P lenders are bottom fishing when attracting customers from traditional banks. Braggion et al. (2019) study to what extent borrowers are able to use P2P credit platforms to circumvent LTV caps using data from the Chinese market. They find that in cities in China where the LTV cap was tightened there was an increase in P2P lending relative to the cities where it wasn´t, which suggests their hypotheses that borrowers are using the P2P market to circumvent the altered down payment requirement.

## 2.4 LTV cap tightening in Finland

Topi & Vauhkonen (2017) report on the introduction on the LTV cap in Finland, where on July 1st, 2016 the Financial Supervisory Authority entered into force a Loan-to-Value cap (LTV) where home-buyers are limited to a maximum of 90% loan to the value of the asset, with the exception of first time home-buyers who can borrow up to 95% of the value of the asset. Topi & Vauhkonen (2017) discuss that prior to this regulation change there was no LTV cap in Finland and home-buyers could borrow up to 100% of the assets value if they qualified for their bank´s debt-to-income ratio, which the bank would generally set themselves. By introducing this cap on LTV ratio the Finnish government intended to prevent extreme volatility in housing prices, limit the rising household leverage in the country and try to prevent the value of those household's wealth wouldn't fall below the value of the asset if house prices were to fall dramatically.

Putkuri & Vauhkonen (2012) explore how the macroprudential environment was before the LTV cap tightening and how the Finnish Financial Supervisory Authority was only able to set a non-obligatory LTV cap recommendation of 90% to the banks, but the banks continued to exceed the cap and proving this recommendation inefficient. Vauhkonen (2016) states that the procedure for calculating the LTV ratio in Finland is very lenient. A wide collection of other collateral can be taken into account when calculating the maximum LTV ratio, which in some cases may cause the borrower to have a lower equity stake in the asset than is generally required and sometimes the LTV ratio even exceeds the value of the asset. As a result of this, some may question the LTV caps effect, however the Financial Supervisory Authority is authorized to confine the extent of collateral when calculating the borrower´s LTV ratio.

## 2.5 Research question and hypotheses

Based on the aforementioned literature I developed the following hypotheses based on the data gathered to test the impact of the LTV cap. As I test a similar shock as Braggion et al. (2019), but in a different setting the hypotheses and methodology are based to some extent on their research. I came up with the first hypothesis to directly test the effects the LTV cap has on the P2P borrowers, are they borrowing larger amounts to circumvent the regulation?

**Hypothesis 1**: *With the tightening of the LTV cap, borrowers will turn to P2P lending platforms and borrow larger amounts than before the shock.*

The second hypothesis is developed to test what kind of borrowers are circumventing the cap and if the quality of borrowers changes in any way after the tightening of the LTV cap. Because the banks will require a higher down-payment on each mortgage they approve after the LTV cap tightening, this means that families that are more financially constrained will receive a lower credit evaluation and thus may not be able to buy the more desired home. In this case, they would turn to the P2P lending platform to be able to buy the house they want, this in turn would drive lower rated borrowers to the platform and the influx of relatively low rated borrowers would decrease the average rating of borrowers from the treated area on the platform.

**Hypothesis 2**: *The overall quality of borrowers on the P2P lending platform decreases in Finland after the tightening of the LTV cap.*

Because more financially constrained borrowers will turn to the platform to be able to buy the house they want, they will borrow the amount they lack on the down-payment from a P2P platform. By doing so these individuals will be more financially stretched and have a higher chance of defaulting on the loan. This will lead to an overall of more borrowers in the treated area to default on their loans relative to the control group than before the LTV cap tightening.

**Hypothesis 3**: *After the tightening of the LTV cap, more borrowers will default on their loans.*

Because there will likely be an influx of new borrowers after the introduction of the new LTV cap and these borrowers requiring higher loans than before, Bondora will have to increase their verification of the information provided by borrowers. As it might give investors more assurances when they lend money to lower rated borrowers when it is verified that the information they provided is truthful, the platform would want to verify more borrowers than before to increase the chances of those loans being invested in. The platform´s motivation comes from the fact that more loans would lead to higher revenues for them.

**Hypothesis 4:** *Bondora will react to the tightening of the LTV cap by verifying more borrowers.*

To offset the changed composition of the borrowers on the P2P platform, is the platform and its investors changing the design of the loans to deal with that? With the likelihood of higher default rates and lower rated borrowers, they will shorten each new loan´s maturity on those loans to react to the predictions in the previous hypotheses.

**Hypothesis 5**: *The average time to maturity on each loan is shorter than before the shock.*

# 3. Data & Methodology

## 3.1 Data

The main sample in this study is gathered from the P2P lending platform Bondora, a platform that has been operating since 2009. Bondora is one of the leading online non-bank lenders in Europe, offering unsecured consumer loans in Finland, Spain and Estonia. Their loans range from around €500 to €10,000 and payment terms from 3 to 60 months. Bondora aims to target the euro area countries that have not yet developed competitive credit markets due to their size (Finland and Estonia), or certain macro vulnerable markets (Spain). These markets have lower consumer debt to GDP ratios than other countries in the region, making them viable to operate in.[3]

The dataset contains 21,124 loans across the 3 countries (Finland, Spain and Estonia). The sample period starts on 1st July 2015 and ends on 1st July 2017, 12 months before and after the LTV cap tightening was put in place in Finland on July 1st 2016. All the loan data is retrieved from the public reports at Bondora.com, who provide very detailed data on each borrower. In their public reports, Bondora doesn´t provide data on their investors and on unfunded loans, therefore the research is limited to the borrower's side. The only cleaning for errors in the dataset was to delete observations where the borrowers were under the age of 18, as according to Bondora´s terms borrowers have to be over the age of 18 to be eligible for loans on the platform. All country specific controls are retrieved from the datastream database, such as GDP, population growth, house price index and unemployment rate. These controls are included because the study uses three different countries that have different characteristics and therefore controls are needed to minimize the effect of these characteristics. In order to test whether individuals are circumventing the LTV cap and the effect it has on the P2P lending market there is an exogenous shock needed. The

[3] Background information from Bondora.com

shock used in this study is when Finland lowered their LTV ratio from 100% to 90% and 95% for first time home-buyers on July 1st 2016. They did so to try and mitigate the growing household leverage in the country and increasing real estate prices.

## 3.2 Variables

The dependent variables in this paper are the amount in each loan, borrowers' rating, whether the borrowers are verified by the platform, loan default and the maturity of each loan. To eliminate heteroscedasticity the logarithm is taken of the amount. To test if the rating of the borrowers' changes after the shock, a dummy variable is created where AA, A and B are equal to 1, and other ratings equal to 0. Verification is a dummy variable equal to 1 if the platform has verified the information provided by the borrower and 0 if otherwise. Default is a dummy variable equal to 1 if the borrower defaults on the loan over the loan period and equal to 0 if not. The last dependent variable is how many months to maturity are for each loan.

The main independent variables are treated, post and treated x post. Each observation gets a dummy variable equal to 1 if the loan originates within the treated area (Finland) and 0 if it originates in the control group (Spain and Estonia). Post is also a dummy variable equal to 1 if the loan is given out after the LTV cap tightening and 0 if it happens before. Treated x post is equal to 1 if both treated and post are equal to 1, basically if the loan happens after the shock and in Finland and 0 if otherwise. Important control variables are country specific characteristics (GDP per capita, house price index, unemployment rate and population growth), this is done so the differences between each country's economy don't drive the result. The country controls are all on a yearly basis. Other control variables are mainly borrower specific characteristics so that the variation between each borrower does not overly affect the results. The dataset is very detailed for borrower characteristics, but because many of those are optional and therefore can't all be included.

## 3.3 Descriptive Statistics

Table 1 shows the summary statistics for the dataset over the period July 1st 2015 to July 1st 2017, reporting the mean, standard deviation, median, minimum and maximum of all the variables used in the research. In panel A the loan characteristics are summarized. The maximum amount lent out by the platform is €10,630 and the average amount is €2,614. This shows that most of the loans on the platform are a relatively low amount. The verification variable is a dummy equal to 1 if the borrower is verified, its average is 0.612 which shows that the majority of borrowers in the dataset are verified. The rating variable is a dummy equal to 1 if the borrowers had a rating of AA, A and B, and 0 if they had a lower rating. The average of the rating dummy variable is 0.174, which suggests that the quality of the borrowers is relatively low on the platform and high rated borrowers are scarce. However, the investors on the platform generally make the highest return on lower rated loans and therefore the higher quality borrowers may be less desirable by the investors.[4] The average of the default variable is 0.546, which means that over half of the borrowers default on their loan at some point. This is worrying for potential investors, but Bondora had a recovery rate of around 40% for the years in question.[5]

In table 1.B, the characteristics of the average borrower are reported. The average borrower is 38.5 years old and has a monthly income of €1,419. The majority of the borrowers have a college degree and about half are homeowners. The debt to income percentage of the average borrower is 33.4% and the max is 75.61%, this is in line with the general practice as the borrower´s shouldn't exceed 43% or he will run into trouble managing his monthly payments.[6]

[4] See https://www.bondora.com/en/public-statistics
[5] Statistic retrieved from https://www.bondora.com/blog/june-2019-recoveries-data/
[6] Recommendation by the Consumer Financial Protection Bureau

**Table 1**

| | Mean | St. dev. | Min | Median | Max | N |
|---|---|---|---|---|---|---|
| A. Loan characteristics | | | | | | |
| Amount (€) | 2614.395 | 2083.632 | 115 | 2125 | 10630 | 21124 |
| Maturity | 45.37579 | 17.31158 | 3 | 49.2 | 62.06667 | 21124 |
| Verification (Y/N) | 0.6121947 | 0.4872613 | 0 | 1 | 1 | 21124 |
| Rating (0/1) | 0.1742568 | 0.3793391 | 0 | 0 | 1 | 21124 |
| Default (0/1) | 0.5459667 | 0.4978944 | 0 | 1 | 1 | 21124 |
| B. Borrower characteristics | | | | | | |
| Income | 1419.185 | 2391.901 | 260 | 1200 | 228550 | 21124 |
| Age | 38.58952 | 11.45996 | 20 | 37 | 70 | 21124 |
| College Degree (0/1) | 0.6466578 | 0.4780191 | 0 | 1 | 1 | 21124 |
| Married (0/1) | 0.272865 | 0.4454426 | 0 | 0 | 1 | 21124 |
| Home owner (0/1) | 0.4839046 | 0.4997527 | 0 | 0 | 1 | 21124 |
| Debt to income (%) | 33.40222 | 20.70151 | 0 | 31.78 | 75.61 | 21124 |

Table 1 displays the summary statistics from Bondora´s loan characteristics (Panel A) and borrower characteristics (Panel B) for all funded loans. A definition for all variables is given in the Appendix.

Table 2 shows the yearly control data for each country for the years included in the study. Finland has a significantly higher GDP per capita than the other countries, but a lower GDP growth. Spain has a very high unemployment rate which they have been battling since the 2008 financial crisis and is decreasing over the time period. Spain has always had a relatively large amount of unreported workers especially in the tourism industry, which might influence Spain's GDP per capita and unemployment rate. Estonia is a high growing developed economy, which shows in their GDP growth and increasing GDP per capita. Housing prices are growing in all the countries in the sample, with Estonia experiencing very high house price growth over the time period and Spain and Finland a relatively stable growth.

**Table 2**

| | Population | GDP per capita (%) | GDP growth (%) | Unemployment rate | House price index | House price growth (%) |
|---|---|---|---|---|---|---|
| A. Finland | | | | | | |
| 2015 | 5,479,531 | 38,309 | 0.18 | 9.375 | 100.0002 | 0 |
| 2016 | 5,495,303 | 39,320 | 2.48 | 8.8 | 100.4425 | 0.44 |
| 2017 | 5,508,214 | 40,652 | 2.82 | 8.625 | 102.0135 | 1.56 |
| B. Spain | | | | | | |
| 2015 | 46,444,832 | 23,296 | 3.73 | 22.06 | 100 | 1.07 |
| 2016 | 46,483,569 | 24,085 | 3.09 | 19.64 | 104.6684 | 1.86 |
| 2017 | 46,593,236 | 25,064 | 2.74 | 17.23 | 109.3792 | 2.41 |
| C. Estonia | | | | | | |
| 2015 | 1,314,608 | 15,725 | 1.83 | 6.175 | 100 | 6.9 |
| 2016 | 1,315,790 | 16,477 | 3.46 | 6.775 | 104.756 | 4.7 |
| 2017 | 1,317,384 | 17,950 | 4.73 | 8.775 | 110.5125 | 5.5 |

Table 2 displays yearly statistics for each country in the sample.

## 3.4 Empirical approach

Using the variables mentioned above, the regression model used in this paper is a difference-in-differences model. This model allows me to extract the effect the tightened LTV cap has on the P2P lending market in Finland relative to the control group and if borrowers are circumventing the regulation through this market. The

treated group (Finland) has 3,765 observations and the control group (Estonia and Spain) has 17,359 observations. Using the P2P lending data from Bondora at the borrower level I do a similar analysis to Braggioni et al. (2019) who also investigated the effect on P2P lending after a tightening on the LTV cap in China. To identify the effects of this shock on P2P lending, I capitalize on the fact that there was only an LTV cap tightening in a part of the sample (treated group) and use the unaffected section of the sample as a control group. The difference-in-differences regression equation is specified as follows:

$$y_{c,t} = \beta\ Treated_c \times Post_t + Controls_{c,t} + \Upsilon_c + \sigma_t + \varepsilon_{c,t}$$

Where c identifies the countries and t identifies the year. $Treated_c$ is a dummy variable equal to 1 if the loan originates from the treated area and set to 0 if not. $Post_t$ is a dummy variable set equal to 1 if the loan is issued after the LTV cap tightening in Finland and equal to 0 if it is issued before the tightening. Combining those two variables the $Treated_c \times Post_t$ dummy variable is created and is equal to 1 if the loan is issued both after the shock and in the treated area, 0 if otherwise. $\Upsilon_c$ represents country fixed effects and $\sigma_t$ represents time fixed effects, which are employed in all specifications of the formula. $Controls_{c,t}$ represents all the control variables used, such as country characteristics of country c and period t. The standard errors used in all regression specifications are robust standard errors and are demonstrated in the equation by $\varepsilon_{c,t}$ term. In most difference-in-differences regressions clustered standard errors are employed, but as this dataset only includes three countries it wasn't an option.

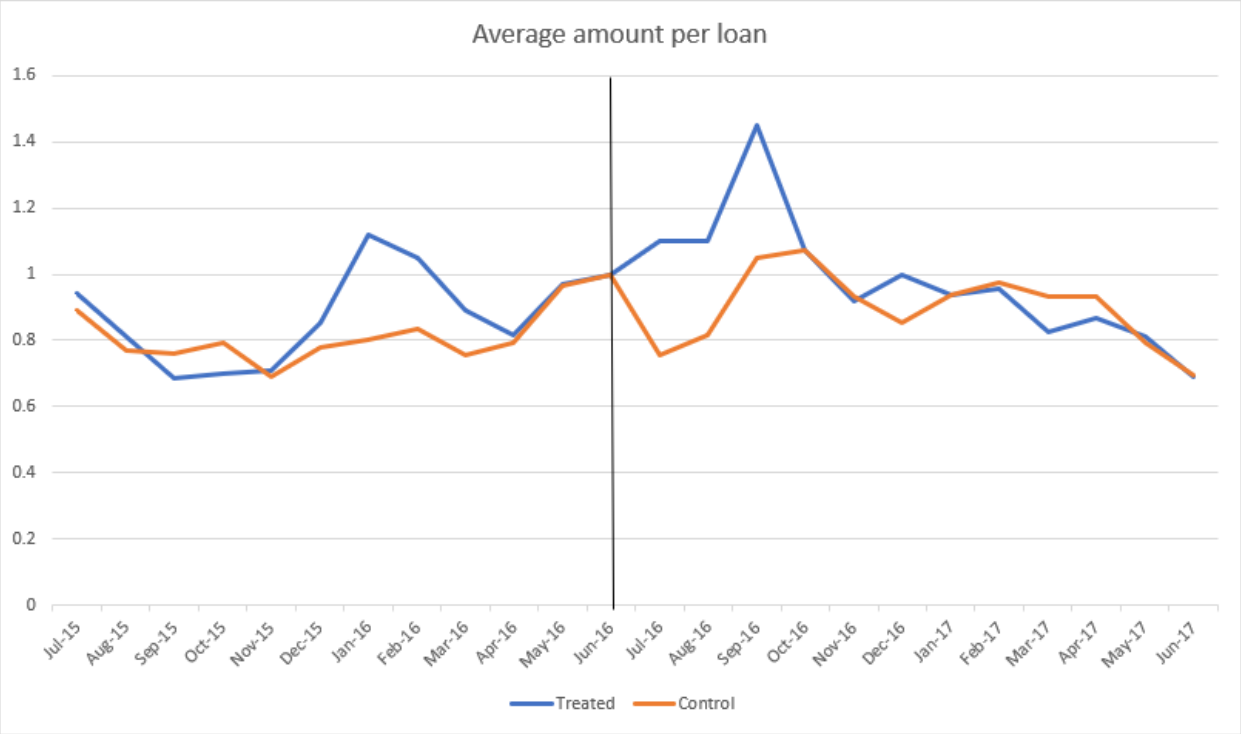
The dependent variables in the regressions are variables that describe the P2P lending where the only things altered for each specification of the regression formula are the dependent variables. In the first two specifications, the dependent variable is the logarithm of the amount of each loan, in the first the amount is regressed on the whole dataset and in the second the dataset is separated if the borrower is a homeowner and if he is married. In the latter two specifications, the dependent variables are related to

the characteristics of the loans, such as the borrower ratings, Bondora´s verification, default rates and each loan's time to maturity. To examine if the quality of the borrowers changes after the LTV cap changes, a dummy variable is constructed because the borrower rating is an alphabetical variable in the dataset and used as the dependent variable. The dummy is equal to 1 if the borrower´s rating is AA, A or B and set equal to 0 if it is lower. For the last specification, dummy variables are constructed to see if Bondora verifies more borrowers after the shock and to examine if more borrowers are defaulting on their loans, a variable is also constructed for a loan´s time to maturity and the natural logarithm of it used to see if the design of each loan altered to offset the potential changes after the shock.

# 4. Results

Figure 1 shows a visual check that there is a relatively parallel trend in P2P lending in the treated group and the control group. Before the LTV cap tightening the groups follow a similar trend, but after the tightening there is an observable increase in average amount per loan in the treated area relative to the control group for the first few months, reaching its highest point in September of 2016. In October of 2016 the difference is back to normal and the groups follow a similar trend from then on. This visual check validates the difference-in-differences setting for the LTV cap tightening in Finland.

**Figure 1**




This graph plots the P2P average amount per loan per month in the treated area and the control area around the increase in required down-payment requirements in Finland. The vertical y-axis reports the total sum of all loans in the given month in the treated/control group divided by the number of loans. The graph is normalized to equal 1 at the time of the regulation change to represent the relative change in amounts per loan compared to that period.

The results of the first set of regression on country-level data are shown in table 3. The results are in line with the first hypothesis that when an LTV cap is tightened, borrowers turn to P2P lending platforms and borrow higher amounts than before to circumvent the altered LTV cap. In column (1) the model is run without any controls, column (2) is run with country growth controls, column (3) with all country controls and column (4) with all previous controls plus borrower specific controls. All specifications show an increase in the amount borrowed per loan and all at a significant level, these results are in line with the visual check in figure 1 showing an increase in borrowed amount per loan in the treated group relative to the control group after the LTV cap tightening. Over the sample period, the housing prices in Finland experienced the slowest growth, see table 2. This suggests that at least one of the goals of regulators to limit the growth of housing prices with the increased down-payment requirement was somewhat successful. Specification (4) where all country and borrower controls are implemented shows the greatest increase of all the specifications or a 10.2% increase in the amount on each loan in Finland relative to the control group after the introduction of the LTV cap, which appears like an economically significant impact of the regulation change.

In table 4 the same hypothesis is tested and the same model is used as in the previous regression, but the sample is separated into two groups to check if any of these groups is driving the results more than the others. In column (1) the borrowers who are homeowners are only included in the regression and in column (2) only the borrowers are included who aren't homeowners. In column (3) the borrowers who are married are only included in the regression and in column (4) borrowers who aren't married are included in the regression. All columns include year and country fixed effects as well as all controls used in the previous regression. Close to half of the dataset are homeowners and just above half of them aren't homeowners. Both borrowers that are homeowners in and borrowers that aren't homeowners are borrowing significantly more in the treated country than their counterparts in the control group. The

increase for the homeowners in Finland is 10.1% more after the shock relative to the control area and 8.3% for non-homeowners. This means that both homeowners and non-homeowners are driving the increase in the P2P lending in Finland after the shock. Braggioni et al. (2017) found that the increase was driven by loans to homeowners, but the difference is that the LTV cap tightening in China only affected second home buyers whereas in Finland the LTV cap was decreased for all home-buyers. Next, I look at if borrowers are married or not and if either of those groups is driving the increase in the size of loans on the platform more than the other. Only a quarter of the sample are married and about 75% are not married. The married borrowers in Finland are borrowing significantly more than before the altered LTV cap or about 15.7% more and the unmarried borrowers are borrowing insignificantly less than before relative to the control group or about 3.2% less than before. The average age to get married and to buy a first home are both around the age of thirty, most young people that aren't homeowners are living in rent based housing.[7] This supports the old custom in Finland that most people buy their first home after getting married, as well as married people would change their housing more often than others thus driving the increase in the amount borrowed more than the unmarried people.

[7] Statistics from Finland statistics
http://www.tilastokeskus.fi/til/asas/2016/01/asas_2016_01_2017-10-11_tie_002_en.html

**Table 3**

| VARIABLES | (1) log(amount) | (2) log(amount) | (3) log(amount) | (4) log(amount) |
|---|---|---|---|---|
| Treated x Post | 0.084*** | 0.042* | 0.090*** | 0.102*** |
| | (0.021) | (0.024) | (0.027) | (0.027) |
| GDP growth | | 0.021** | 0.205*** | 0.203*** |
| | | (0.010) | (0.026) | (0.026) |
| House price growth | | 0.034*** | 0.059*** | 0.058*** |
| | | (0.011) | (0.013) | (0.013) |
| log (GDP per capita) | | | 1.151*** | 1.140*** |
| | | | (0.094) | (0.094) |
| log (population) | | | 0.270*** | 0.265*** |
| | | | (0.052) | (0.052) |
| House price index | | | 0.052*** | 0.053*** |
| | | | (0.008) | (0.008) |
| Unemployment rate | | | -0.112*** | -0.111*** |
| | | | (0.014) | (0.014) |
| College Degree | | | | 0.072*** |
| | | | | (0.011) |
| Total Income | | | | 0.000* |
| | | | | (0.000) |
| Year FE | Y | Y | Y | Y |
| Country FE | Y | Y | Y | Y |
| Observations | 21,124 | 21,124 | 21,124 | 21,124 |
| R-squared | 0.083 | 0.084 | 0.085 | 0.094 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 reports the effects of the LTV cap tightening on P2P loan amounts as estimated from the following regression:

$$y_{c,t} = \beta \text{ Treated}_c \text{ x Post}_t + \text{Controls}_{c,t} + \Upsilon_c + \sigma_t + \varepsilon_{c,t}$$

Each observation equates to a given country c on a given period t. The dependent variable is the log-loan amount per loan. Treated is an indicator equal to 1 if the loan originates in Finland. Post is an indicator equal to 1 if the loan occurred after the LTV cap tightening. Treated x Post an indicator if the loan originated in Finland and occurred after the shock. Other controls are defined in the Appendix. Year and country fixed effects (FE) are included in all regressions. In specification (1) there are no controls, in specification (2) country growth statistics are included as controls, in specification (3) all country controls are included and in specification (4) borrower controls are added to the previous controls.

**Table 4**

| VARIABLES | (1) log (amount) | (2) log (amount) | (3) log (amount) | (4) log (amount) |
|---|---|---|---|---|
| | Home owner | | Married | |
| | Yes | No | Yes | No |
| Treated x Post | 0.101** | 0.083** | 0.157*** | -0.032 |
| | (0.045) | (0.036) | (0.047) | (0.034) |
| GDP growth | 0.262*** | 0.172*** | 0.311*** | 0.139*** |
| | (0.043) | (0.033) | (0.046) | (0.031) |
| House price growth | 0.073*** | 0.038** | 0.068*** | -0.012 |
| | (0.019) | (0.019) | (0.024) | (0.015) |
| log (GDP per capita) | 1.135*** | 1.066*** | 1.147*** | 0.710*** |
| | (0.143) | (0.131) | (0.171) | (0.109) |
| log (population) | 0.395*** | 0.203*** | 0.507*** | 0.098 |
| | (0.088) | (0.066) | (0.095) | (0.060) |
| House price index | 0.077*** | 0.038*** | 0.084*** | 0.018* |
| | (0.014) | (0.010) | (0.015) | (0.009) |
| Unemployment rate | -0.143*** | -0.095*** | -0.178*** | -0.076*** |
| | (0.024) | (0.018) | (0.026) | (0.016) |
| College degree | 0.073*** | 0.047*** | 0.066*** | 0.081*** |
| | (0.019) | (0.015) | (0.021) | (0.013) |
| Total income | 0.000** | 0.000 | 0.000 | 0.000* |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Year FE | Y | Y | Y | Y |
| Country FE | Y | Y | Y | Y |
| Observations | 10,222 | 10,902 | 5,764 | 15,360 |
| R-squared | 0.070 | 0.116 | 0.098 | 0.162 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 reports the estimates of regressions of identical specifications as in Table 3, but estimated over alternative subsamples using the following regression:

$$y_{c,t} = \beta\ \text{Treated}_c \times \text{Post}_t + \text{Controls}_{c,t} + \Upsilon_c + \sigma_t + \varepsilon_{c,t}$$

Each observation equates to a given country c on a given period t. The dependent variable is the log-loan amount per loan. Treated is an indicator equal to 1 if the loan originates in Finland. Post is an indicator equal to 1 if the loan occurred after the LTV cap tightening. Treated x Post an indicator if the loan originated in Finland and occurred after the shock. Other controls are defined in the Appendix. Year and country fixed effects (FE) are included in all regressions. Specifications (1)-(2) focus on whether the borrower is a homeowner (Yes/No) and specifications (3)-(4) focus on whether the borrower is married (Yes/No). All specifications include all country and borrower controls.

In table 5 the second hypothesis is tested to see if the quality of the borrowers at the platform changes after the LTV cap is tightened. As previously done in the first regression, in column (1) the model is run without any controls, column (2) is run with country growth controls, column (3) with all country controls, column (4) with all previous controls plus borrower specific controls and all columns include both country and year fixed effects. Since Bondora operates in Estonia, Finland and Spain and there is no common credit agency between those countries, Bondora has to rely on its own rating system. Bondora operates an alphabetic rating system which limits the methods available to test changes in the quality of borrowers, for this reason a dummy is created equal to 1 if the borrower´s rating was AA, A or B (called “good rating” in this analysis) and 0 if it was lower. In column (1) where there are no controls used, there is a significant decrease of “good ratings” in Finland relative to the control group, this significant decrease is also the case in column (2) where GDP growth and House Price Growth are added as controls. The decrease disappears in column (3) where all country controls are included and there is no change in the amount of “good ratings” for borrowers in Finland relative to the control group after the shock. It is interesting to see that in column (4) the results flip from column (1) and (2) and there is an increase in the quantity of “good ratings” for borrowers in Finland relative to those in Spain and Estonia when borrower controls are added to those already in place. THis change is likely due to the fact that Bondora establishes the loan rating for each borrower based on their borrower characteristics, these results could mean that borrower characteristics weigh more in Finland than in the control group when determining their rating. This means that the results are partly in line with my hypotheses that the overall quality of borrowers on the platform in Finland will decrease after the tightening of the LTV cap.

## Table 5

| VARIABLES | (1) Rating | (2) Rating | (3) Rating | (4) Rating |
|---|---|---|---|---|
| Treated x Post | -0.032*** | -0.079*** | -0.000 | 0.010* |
| | (0.006) | (0.007) | (0.005) | (0.006) |
| GDP growth | | 0.041*** | 0.021*** | 0.020*** |
| | | (0.003) | (0.006) | (0.006) |
| House price growth | | 0.027*** | 0.053*** | 0.052*** |
| | | (0.005) | (0.006) | (0.006) |
| log (GDP per capita) | | | 0.280*** | 0.304*** |
| | | | (0.037) | (0.037) |
| log (population) | | | -0.109*** | -0.113*** |
| | | | (0.011) | (0.012) |
| House price index | | | 0.021*** | 0.021*** |
| | | | (0.002) | (0.002) |
| Unemployment rate | | | 0.017*** | 0.017*** |
| | | | (0.003) | (0.003) |
| College degree | | | | 0.118*** |
| | | | | (0.004) |
| Total Income | | | | 0.000* |
| | | | | (0.000) |
| Year FE | Y | Y | Y | Y |
| Country FE | Y | Y | Y | Y |
| Observations | 21,124 | 21,124 | 21,124 | 21,124 |
| R-squared | 0.151 | 0.154 | 0.158 | 0.212 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 reports the effects of the LTV cap tightening on the rating of borrowers on the Bondora platform as estimated from the following regression:

$$y_{c,t} = \beta\ \text{Treated}_c \times \text{Post}_t + \text{Controls}_{c,t} + \Upsilon_c + \sigma_t + \varepsilon_{c,t}$$

Each observation equates to a given country c on a given period t. The dependent variable is a dummy variable equal to 1 if the borrower had a rating of AA, A or B and 0 if it was lower. Treated is an indicator equal to 1 if the loan originates in Finland. Post is an indicator equal to 1 if the loan occurred after the LTV cap tightening. Treated x Post an indicator if the loan originated in Finland and occurred after the shock. Other controls are defined in the Appendix. Year and country fixed effects (FE) are included in all regressions. In specification (1) there are no controls, in specification (2) country growth statistics are included as controls, in specification (3) all country controls are included and in specification (4) borrower controls are added to the previous controls.

In Table 6 the last three hypotheses are tested, all columns include all country and borrower controls as well as year and country fixed effects. In column (1) it is tested whether Bondora is verifying more borrowers in Finland than before the shock relative to the control group. Contrary to my expectations that Bondora would perform more verifications to respond to the larger loans, the results show that the amount of verified borrowers in Finland decreases significantly after the LTV cap tightening relative to Spain and Estonia. Among the reasons for this decrease could be that Bondora is having to sacrifice how many verifications they can do in order to meet the increased demand for P2P lending in Finland after the shock. Column (2) tests whether there is an increase or decrease in the amount of borrowers defaulting on their loans after the tightening of the LTV cap in Finland. The initial thinking regarding defaults was that more borrowers would default on their loans after the tightening, because lower rated borrowers would turn to P2P platforms in order to circumvent the altered cap and be able to buy the desired real estate without meeting the LTV requirements. The results from the regression show that there is almost no change (a very small insignificant increase) for the number of borrowers defaulting on their loans in Finland relative to the control group. This suggests that despite fewer borrowers being verified and the average rating for borrowers decreasing after the shock, that the loans from those borrowers are performing slightly worse than the loans before the altering of the LTV cap. These results also indicate that with the overall rating of borrowers decreasing in Finland that the investors can censor out the riskiest investors to some extent.

Column (3) examines whether or not maturity is affected by the tightened LTV cap. Similar to the results on verification, there is a significant decrease in the months to maturity when the loan is issued after the shock than before in Finland relative to Spain and Estonia. Each loan is on average about 31.8% shorter in Finland after the introduction of the LTV cap than in the control group. Those results mean that lenders are possibly reacting to the fact that there are more lower quality borrowers on the platform after the shock, but they are still willing to invest if they get paid back quicker.

Further, lenders might be willing to meet the demand for an increased amount per loan if the maturity is decreased and they make their return over a shorter period. It could be said that Bondora is making up for the fact that they are verifying fewer borrowers by shortening the loan period, subsequently decreasing the risk of the investor slightly. A shorter loan duration means that from the lender's perspective there is less chance of something going wrong during the loan period.

**Table 6**

| VARIABLES | (1) verification | (2) default | (3) ln maturity |
|---|---|---|---|
| Treated x Post | -0.074*** | 0.011 | -0.318*** |
| | (0.021) | (0.022) | (0.023) |
| GDP growth | 0.153*** | -0.028 | -0.053*** |
| | (0.019) | (0.019) | (0.020) |
| House price growth | 0.054*** | -0.017** | 0.001 |
| | (0.009) | (0.008) | (0.010) |
| log (GDP per capita) | 0.680*** | 0.041 | 0.266*** |
| | (0.063) | (0.063) | (0.069) |
| log (population) | 0.172*** | 0.053 | -0.243*** |
| | (0.039) | (0.037) | (0.040) |
| House price index | 0.028*** | -0.001 | -0.046*** |
| | (0.006) | (0.006) | (0.005) |
| Unemployment rate | -0.049*** | 0.006 | 0.052*** |
| | (0.011) | (0.010) | (0.011) |
| College degree | -0.025*** | -0.101*** | -0.046*** |
| | (0.007) | (0.007) | (0.008) |
| Total Income | -0.000 | -0.000 | -0.000 |
| | (0.000) | (0.000) | (0.000) |
| Year FE | Y | Y | Y |
| Country FE | Y | Y | Y |
| Observations | 21,124 | 21,124 | 21,124 |
| R-squared | 0.026 | 0.116 | 0.044 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 reports the effects of the LTV cap tightening on verification of borrowers, default rates and maturity as estimated using the following regression:

$$y_{c,t} = \beta\ \text{Treated}_c \times \text{Post}_t + \text{Controls}_{c,t} + \Upsilon_c + \sigma_t + \varepsilon_{c,t}$$

Each observation equates to a given country c on a given period t. The dependent variable is verifications in specification (1), default rate in specification (2) and the natural logarithm of the duration of the loan in specification (3). Treated is an indicator equal to 1 if the loan originates in Finland. Post is an indicator equal to 1 if the loan occurred after the LTV cap tightening. Treated x Post an indicator if the loan originated in Finland and occurred after the shock. Other controls are defined in the Appendix. Year and country fixed effects (FE) are included in all regressions.

# 5. Conclusion

This thesis aimed to examine to what extent P2P credit platforms are able to disempower LTV regulation in the real estate market in Europe. Using P2P loan data from the online lending intermediary Bondora and using an exogenous shock in the form of an LTV cap tightening in Finland in 2017 I was able to run a difference-in-differences model to see whether consumers in Finland were circumventing this regulation change and increasing the demand for P2P lending relative to the control countries, Estonia and Spain. P2P markets are very loosely monitored and are subject to very little regulation, which is what makes them a viable option for consumers to bypass the regulation and an excellent setting for this research. Most of the research on LTV regulation and P2P credit platforms had previously been done in Asia and North America, therefore this LTV cap tightening in Finland proved to be a good scenario to examine this in a European environment. In line with my beliefs on the subject and the key findings of this thesis, home-buyers in Finland use the P2P platform to circumvent the increased down-payment requirements on mortgages by borrowing more on average in each loan relative to the control area.

To validate further ideas about the impact of this macroprudential regulation change on P2P lending, many different aspects regarding the performance and the design of the loans are examined. The overall rating of borrowers decreases in two specifications, which might be a result of the influx of new borrowers on the platform are those getting denied by the banks for mortgages on the basis of not having the required equity for their desired asset and borrowing on the platform trying to circumvent these circumstances. With regards to loan performances, default rates stay relatively close to zero with only a very slight increase suggesting that investors in Finland are somewhat able to censor out the riskiest borrowers on the platform. To explore how Bondora reacts to the altered environment, the verification of the information provided by the borrowers and the duration of the loans were examined. Contrary to my beliefs, verifications by Bondora decrease in Finland after the shock, but as durations of the

loans also decrease it makes sense that Bondora is making up for the decrease in verifications by shortening the maturity of the loans to try and reduce the investors' risk. The results from this study show that consumers can use the P2P lending platforms to circumvent the altered LTV regulation, confirming that there is a lot of need for regulation covering P2P lending platforms.

As the P2P lending industry is rather young there is a lot of room for further research in the field, especially considering how fast it has been growing over the last couple of years. Future research into how P2P credit can undermine macroprudential regulation should focus on the robustness of these and the results from previous papers covering this by using different datasets from different countries. More research into this area would hopefully give policymakers a better idea of whether there is a need for regulating the market further and if so, how they could add to the little regulation there is today. The main limitation of this study is that Bondora doesn´t publish its data for unfunded loans and therefore it is hard to say for sure how much the demand for P2P credit increases. Also, the LTV cap tightening in Finland was rather small (from 100% to 90%), as well as other collateral could be taken into account when valuing the borrower's LTV ratio, making it questionable how much of an effect the regulation change actually had on home-buyers.

# References

Alfaro, L., Garcia-Santana, M. & Moral-Benito, E. (2019). On the direct and indirect real effects of credit supply shocks. *National Bureau of Economic Research Working Paper No. 25458*

Amtiti, M. & Weinstein, D.E. (2013). How Much do Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data. *CEPR Discussion Paper No. DP 9400.*

Aveni, T., Qu, C., Hsu, K., Zhang, A., Lei, X., & Hemrika, L. (2015). New Insights Into An Evolving P2P Lending Industry: how shifts in roles and risk are shaping the industry. *Positive Planet Report*, 1, 28

Balyuk, T. & Davydenko, S. (2019). Reintermediation in FinTech: Evidence from online lending, Working paper, *University of Toronto*

Belleflamme, P., Lambert, T. & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing 29 (2014) 585-609.*

Braggion F., Manconi A. & Zhu H. (2019). Can technology undermine macroprudential regulation?

Buchak, G., Matvos, G., Piskorski, t. & Seru, A. (2018). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics 130, 453-483.*

Claessens, S., Ghosh, S.R. & Mihet, R. (2013) Macro-prudential policies to mitigate financial system vulnerabilities. *Journal of International Money and Finance 39 (2013) 153-185.*

Claessens, S. (2015). An Overview of Macroprudential Policy Tools. *Annual Review of Financial Economics, 397-422.*

Crowe, C., Dell'Ariccia, G., Igan, D., & Rabanal, P. (2011). Policies for macrofinancial stability: options to deal with real estate booms. *International Monetary Fund staff discussion note.*

De Roure, C., Pelizzon, L. & Thakor, A. (2019). P2P Lenders Versus Banks: Cream Skimming or Bottom Fishing? *SAFE Working Paper 206.*

Dell'Ariccia, G., Igan, D., Laeven, L., Tong, H., Bakker, B. & Vandenbussche, J. (2012). Policies for Macrofinancial Stability: How to Deal with Credit Booms. *IMF Staff Discussion Note 12/06*.

Ferrarini, G. (2017). Regulating Fintech: Crowdfunding and Beyond. *European Economy: Banks, Regulation, and the Real Sector 2017.2*

Freedman, S.M. & Jin, G.Z. (2011). Learning by doing with asymmetric information: Evidence from Prosper.com. *National Bureau of Economic Research. Working Paper.*

Fuster, A., Plosser, M., Schnabl, P. & Vickery, J. (2018). The role of technology in mortgage lending. *Working Paper, National Bureau of Economic Research.*

Galati, G. & Moessner, R. (2013). Macroprudential Policy - A Literature Review. *Journal of Economic surveys.*

Greiner, M. E. & H. Wang (2009). The role of social capital in people-to-people lending marketplaces. *ICIS 2009 Proceedings*

Igan, D., A. N. Kabundi, F. Nadal-De Simone, M. Pinheiro, and N. T. Tamirisa. (2009). Three Cycles: Housing, Credit, and Real Activity. *IMF Working Paper No. 09/231*

Jiang, J., Liao, L., Wang, Z. & Zhang, X. (2019). Government Affiliation and Fintech Industry: The Peer-to-Peer Lending Platform in China.

Landau, J.P. (2009). Bubbles and macroprudential supervision. *Remarks by Mr Jean-Pierre Landau, Deputy Governor of the Bank of France1 , at the Joint conference on "The Future of Financial Regulation", organised by the Bank of France and the Toulouse School of Economics (TSE), Paris, 28 January 2009.*

Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., . . . Wu, X. (2011). Macroprudential policy: what instruments and how to use them? Lessons from country experience. *IMF Working Paper*

Luo, C., Xiong, W., Guo, Y. & Deng, G. (2011). Enhancing Investment Decisions in P2P Lending: An Investor Composition Perspective. *KDD´11: Proceedings of the 17th*

*ACM SIGKDD international conference on Knowledge discovery and data mining (2011) 292-300*

Morgan, P., Regis, P.J. & Salike, N. (2015). Loan-to-Value Policy as a Macroprudential Tool: The case of Residential Mortgage Loans in Asia. *ABDI Working Paper 528. Tokyo: Asian Development Bank Institute.*

Morse, A. (2015). Peer-to-Peer Crowdfunding: Information and the potential for disruption in consumer lending. *National Bureau of Economic Research. Working paper.*

Plantin, G. (2014). Shadow Banking and Capital Regulation. *Review of Financial Studies 28, 146-175.*

Putkuri, H. & Vauhkonen, J. (2012). Kotitalouksien velkaantumiseen ja asuntomarkkinoiden kehitykseen vaikuttaminen: makrovakaustyökalut. *Bank of Finland Articles on the Economy.*

Ryan, S.G. & Zhu, C. (2018). FinTech Isn't So Different from Traditional Banking: Trading off Aggregation of Soft Information for Transaction Processing Efficiency. *New York University*.

Segal, M. (2016). What is alternative finance?. *U.S. Small Business Administration Office of Advocacy.*

Tang, H. (2019). Peer-to-Peer Lenders versus Banks: Substitutes or Complements? *The Review of Financial Studies, Volume 32, Issue 5, May 2019, P. 1900-1938.*

Topi, J. & Vauhkonen, J. (2017). How can we dampen the build-up of housing price bubbles? *Bank of Finland Articles on the Economy.*

Vallee, B. & Zeng, Y. (2019). Marketplace Lending: A New Banking Paradigm? *Review of Financial Studies*

Vauhkonen, J. (2016). Finland's neighbours rein in lending for house purchase. *Bank of Finland Articles on the Economy.*

Wardrop, R., Zhang, B., Rau, R., & Gray, M. (2015). Moving Mainstream. *The European Alternative Finance Benchmarking Report, 1, 43*

Wolfe, B. & Yoo, W. (2019). Crowding out Banks: Credit Substitution by Peer-to-Peer Lending. *Working Paper.*

Wong, E., Tsang, A. & Kong, S. (2014). How Does Loan-To-Value Policy Strengthen Banks´ Resilience to Property Price Shocks - Evidence from Hong Kong. *Hong Kong Institute For Monetary Research Working Paper.*

Zhang, L. & Zoli, E. (2016). Leaning Against the Wind: Macroprudential Policy in Asia. *Journal of Asian Economics 42, February 2016, p 33-52*

# Appendix A

| Variable | Definition |
|---|---|
| **A. Loan Characteristics** | |
| Amount (€) | The loan´s amount in €. |
| Maturity | The loan's maturity, reported as the number of months from loan date to its final payment. |
| Verification (0/1) | An indicator variable equal to 1 if an employee from Bondora verified the information presented by the borrower on the platform was accurate. |
| Rating (0/1) | An indicator variable equal to 1 if the borrower´s rating was AA, A or B and 0 if his rating was below that threshold. |
| Default (0/1) | An indicator variable equal to 1 if the borrower defaults on the loan over the loan period and 0 if he doesn´t |
| **B. Borrower Characteristics** | |
| Income (monthly in €) | The borrower's monthly total income, reported in € at the start of the loan. |
| Age | The borrower's age at the start of the loan. |
| College Degree (0/1) | An indicator variable equal to 1 if the borrower has a college degree. |
| Married (0/1) | An indicator variable equal to 1 if the borrower is married. |
| Home Owner (0/1) | An indicator variable equal to 1 if the borrower is a homeowner. |

| | |
|---|---|
| Debt to Income (%) | The percentage of the borrower's monthly income that is required to pay off debts. |

**C. Macroeconomic variables**

| | |
|---|---|
| Country Population | The country's total population where the loan originated, retrieved from the Datastream database. |
| Country GDP per Capita (€) | GDP per capita of the country where the borrower is located, retrieved from the Datastream database. |
| Country GDP Growth (%) | The annual growth of the country's GDP where the loan originated, retrieved from the Datastream database. |
| Country Unemployment Rate (%) | The number of unemployed workers in the country where the loan originated is divided by the country's total labor force, retrieved from the Datastream database. |
| Country House Price Index | Average house price in the country where the loan originated is divided by the country´s household consumption, retrieved from the Datastream database. |
| Country House Price Growth (%) | Average annual growth of house prices in the country where the loan originated, retrieved from the Datastream database. |