Buy-to-let restriction in Rotterdam: stimulating households or bullying investors?

The first study about the effect of the buy-to-let restriction in Rotterdam

Pieter Reitsma, July 17th 2022.

Master Thesis

Abstract:

The buy-to-let restriction is a recent phenomenon in the Netherlands. This regulation gives municipalities the power to prohibit buy-to-let practices. It is a drastic limitation on property rights which should provide first-time buyers and young households a higher chance to buy affordable homes. Rotterdam is the first municipality to introduce the buy-to-let regulation in selected neighborhoods. This study researches the effects of the new policy on home prices and the trading liquidity of homes in Rotterdam using a difference in difference model.

Keywords: Buy-to-let, First-time-buyers, Property rights, Rotterdam.

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Preface

Writing this thesis was the last task for me in order to finalize the master real estate studies in Groningen. I greatly enjoyed the master, which offered a wide variety of courses about real estate. This wide perspective on real estate helped me to write the master thesis. In the beginning I had difficulties with finding a suitable subject. However, in the end I came up with a topic that suited me well. Investigating the buy-to-let restriction was perfectly complementary to my job as a valuer of buy-to-let properties. In this way I was able to use my knowledge immediately in my work. It also taught me something about the real estate market in Rotterdam. In this preface I want to thank dr. Xiaolong Liu for his guidance in writing the thesis. Additionally, I hope my thesis inspires other students or researchers to investigate the buy-to-let restriction even further as the regulation has only just started in the Netherlands.

Introduction

The housing market in the Netherlands has been booming in recent years. As a result, house prices have surged to all time high levels; the average purchase price for a house has increased from €230.000 in 2015 to €387.000 in 2021 (CBS, 2021). From the home price dip in 2013, prices increased by 93,6 percent until March 2022. Supply of homes is too low to support the excessive demand. In March 2022 supply decreased 37 percent compared to March 2021 (CBS, 2022).

A consequence of the increased home prices is that first-time-buyers and middle income households are less and less able to obtain a home. One of the causes of the high home prices is the involvement of the buy-to-let sector into the housing market. First-time-buyers and buy-to-let investors are mostly interested in the same neighborhoods (Vastgoedmarkt, 2022). As a result the buy-to-let sector competes with households who would like to buy a home to live in it. Most of the times an investor wins this competition because the investor is able to bid more on a home than the household who is more constrained in their purchasing power (NOS, 2021; Sprigings, 2008).

The national government of the Netherlands made it possible for municipalities to introduce a new regulation concerning buy-to-let investments. This regulation is called the buy-to-let restriction (Dutch: opkoopbescherming). On the 10th of march 2021 the house of representatives of the Netherlands voted for an amendment of the housing law. (Tweede kamer, 2021). On the 6th of July 2021 the senate accepted the amendment (Eerste kamer, 2021). This amendment made it legally possible for municipalities in the Netherlands to implement the buy-to-let restriction from the 1st of January 2022 onwards. With this buy-to-let restriction, municipalities are legally able to prohibit buying a home in order to rent it out. As a consequence, property rights of the buyers of homes become restricted (BNR, 2021). The buy-to-let market must be discouraged in this way. This should result in households, in particular first-time-buyers and middle income households, having a better chance to purchase a home by only having to compete with other households with the same liquidity.

Rotterdam is the first major municipality in the Netherlands who chose to make use of the buy-to-let restriction law. The municipality choose to implement the restriction in certain neighborhoods on mid-priced homes. Another goal of the restriction is to keep aggressive investors from the market. These aggressive investors purchase homes and try to rent it out for a rent as high as possible by making use of the excessive demand because of the housing crisis. Critics of the regulation argue that the buy-to-let restriction is not a solution for the housing crisis because the housing crisis has a lot of causes and this rigorous regulation covers only a small portion of the problem. A more specific critique is that by implementing the buy-to-let restriction, the home prices might go down resulting in more affordable housing, but on the other hand, private rent prices will go up even further because there will be less homes available for the private renting market and demand for rental homes stays the same. These critics say that the private renting market might become distorted as a consequence of the restriction (BNR, 2021).

Real estate ownership represents private property rights. These rights involve a stream of benefits to the owner of the property. The benefits include the right to use the asset, the right to the produce of the asset, and the freedom to transfer the asset to others (Segal & Whinston, 2010). In other words, a property owner is free to occupy, rent, and sell the property. By implementing the buy-to-let restriction, clearly property rights will become restricted (Lee & Ooi, 2018). In this study, the economic effect of restricting the property right to rent a property is examined.

Restricting the right to rent a property mostly affects the buy-to-let investors. The buy to let market can simply be defined as one that 'comprises private investors who purchase residential property using mortgages in order to rent out accommodations to tenants' (Ball, 2006). The role of buy-to-let in the housing market is disputed. Promoters see it 'stimulating private rental and promoting the consumption of riskier sites for regeneration activity. Opponents cite damage to communities where buy-to-let stock remains empty, bringing environmental decline, or inflating prices and excluding first time buyers from ownership' (Sprigings, 2008).

Bø (2022) explored the relation of buy-to-let investments into the housing market. He found that buy-to-let investors buy more in periods of house price growths and increased rental demand induces more buy-to-let investors to enter the market, which adds extra demand to the housing market. This drives up housing prices, both because buyers are willing to pay more to avoid paying the high rents and because additional investors compete for the same housing. Bø also mentioned that policies to regulate the investment market can have negative additional effects for the welfare of non-owners who lose the possibility to rent.

The Dutch real estate market consists of a vivid buy-to-let share. The Dutch bureau of statistics reports that in 2019 218.595 homes were sold, 17,3% of these homes were bought by buy-to-let investors. Major urban regions are more popular by buy-to-let investors. Data on the real estate market by kadaster shows that in 28% of the neighborhoods in these urban regions the buy-to-let share is more than 30% (Vastgoedmarkt, 2021). This is in line with the information provided by De Nederlandsche Bank (2018) who stated in their report that the overall investor share in Rotterdam and Amsterdam is 25% in 2017. The buy-to-let market in the major urban areas grows faster than outside of these regions. Between 2009 and 2020 their market share doubled. Remarkable is that the demand of first-time-buyers and buyers under 30 years of age for those regions is also numerous. Young households and investors are both interested in cheaper housing, as a result, young households compete with the investors for the same housing in the same neighborhoods (Vastgoedmarkt, 2022).

Excessive buy-to-let practices can lead to undesirable market outcomes for first-time-buyers (Sprigings, 2008). 'When a market outcome is deemed undesirable, governments or municipalities can decide to regulate' (Arcadis, 2008). This is what happened with the implementation of the buy-to-let restriction. The aim of this research is to give insight into the buy-to-let restriction. It does so by assessing what the effect of the buy-to-let restriction is on home prices. However, according to (Krainer, 2001) 'the fundamental value of a property is not solely transmitted through market prices,

but trough market liquidity as well'. For this reason this study also assesses the effect of the new policy on the market liquidity measured in days a property has been listed on the market.
Property right restrictions can result in full or partial liquidity constraints by decreasing the pool of potential buyers (Lee & Ooi, 2018, Kluger & Miller, 1990). Days on market is an important measurement for liquidity. The expectation is that days on the market will increase as a result of the by-to-let restriction.
The results of this study can be used by municipalities to evaluate whether the buy-to-let restriction has the desired outcome. Municipalities who consider using the buy-to-let restriction can use the results to decide if, and in that case how the policy should be used. For example by choosing to take the whole municipality subject to the buy-to-let restriction or only a couple of neighborhoods as in Rotterdam. The results of the research on market liquidity can be used by homeowners in the neighborhoods where the buy-to-let restriction applies. These homeowners or their brokers can consider the effect of the policy on days on the market to establish their selling strategy. Because homeowners or brokers base their selling strategy on the expected days on the market (Galbraith, 2021).

Regulations concerning buy-to-let to stimulate affordability of housing are for example; rent-control policies, rent-freezes (Deschermeier et al., 2016), subsidies (Lee & Reed, 2014) and price controls for newly developed properties (Kim & Kim, 2000). Remarkable is that the field of knowledge about a buy-to-let restriction policy is limited. However, Lee and Ooi (2018) did study a similar policy in Singapore where owners' right to transfer and rent their property was restricted for 10 years. This resulted in a price decrease of those properties. The housing purchase restriction (HPR) policy in China is another example of restriction similar to the buy-to-let restriction. But there is no consensus in the literature whether this HPR has an effect on house price escalation (Zhang et al., 2021).
The buy-to-let restriction in Rotterdam is a rather new policy with similarities to the restrictions in Singapore and China, however there are differences. A major difference is that the policy in Singapore applies only to new construction while the buy-to-let restriction in Rotterdam applies to already existing homes. Another difference is that the time span of the policy in Singapore was known beforehand, while the time span of the buy-to-let restriction in Rotterdam is not known. Also the restriction in Rotterdam can expand to other neighborhoods and possibly to the whole municipality (Municipality of Rotterdam, 2022). These differences show that the amount of uncertainty regarding the policy in Rotterdam is bigger than in Singapore, which could indicate a different effect on home prices. The HPR in China is also similar to the policy in Rotterdam however a difference in the policies lies in the fact that in Rotterdam it is still possible to buy a home to let vacant and profit from house price appreciation while in China this is not possible. This could result in different outcomes. Another remarkable difference is that papers studying these restriction outside China and Singapore

could not be found. To the best of my knowledge this is the first study that shows the effect of the buy-to-let restriction on home prices and market liquidity in the Dutch context.
Earlier literature on policy science calls to 'evaluate spatial policies while paying attention to the diversity of territorial contexts in which these spatial policies, objectives and strategies are applied' (Sykses, 2008). Hajer, (2002) also states that contextualism is important to consider when analyzing policies. The importance of contextualism for the analysis of policy processes has also been increasingly emphasized by work from the 'deliberative' school of policy analysis and spatial planning research (Lee & Albrechts, 2005). Additionally, Arnott (1995) advised to perform evaluations on a case-by-case basis because the institutional frameworks and the different types of policy mechanisms vary to a great extent among countries and different types of controls will have different impacts on the market. Considering the differences with the previous policies in China and Singapore and the importance of contextualism (Lee & Albrechts, 2005), this study aims to analyze the effects of the buy-to-let restriction in Rotterdam. While doing so, the study adheres to the aforementioned calls of how to evaluate a new policy. It does so by making use of a case study (Arnott, 1995) while considering the contextualism of that case study (Hajer, 2002; Sykes, 2008).
Additionally, this study contributes to the literature on property rights. The literature on property rights has generally focused on the role of property rights in transitioning a society towards economic growth and market efficiency (Coase 1960; Demsertz 1967; Libecap; 1989; North 1990; Mahoney 2005). In the context of real estate ownership, most prior studies have focused on the effects of restricting owners' rights to use property (McMillen and McDonald 1993; Cannaday 1994; Hughes and Turnbull 1996; Munneke and Slawson 1999; Netusil 2005; Sirmans et al. 2006; Rogers 2006; Lin, Allen, and Carter 2013; Meltzer & Cheung 2014).
The research problem statements focuses on the implications of the buy-to-let regulation. It aims to find out whether the policy has the desired economic outcome in terms of more affordable housing and if it affects the days on the market. To capture the abovementioned effects the study is based on a main question which will be answered by using three sub questions.

Main research question: What is the effect of the buy-to-let regulation on home prices and residential real estate liquidity in Rotterdam?

Sub question 1: What does the literate say about buy-to-let restrictions in relation to the housing market?

This sub question will be answered based on the literature about existing buy-to-let market regulation and the corresponding consequences of these regulations. Finding concerning the effect of the housing purchase restriction (HPR) policy in China will be discussed as well as the transfer restriction in Singapore and the ban on construction for second homes in Switzerland.

Sub question 2: What is the effect of the buy-to-let restriction on home prices in Rotterdam?

Sub question 2 can be answered by quantitative analysis. A method to measure externalities is the standard difference in difference method (Imbens & Woolbridge, 2009). The difference in difference approach will be used, whereby the target group receives 'treatment', in this case the treatment consists of transactions subject to the buy-to-let restriction. The control group, consisting of all adjacent neighborhoods to the treatment neighborhoods do not receive this treatment. With this approach, home prices between neighborhoods with and without buy-to-let restriction can be analyzed as well as home prices before and after the implementation of the restriction.

Sub question 3: What is the effect of the buy-to-let restriction on the liquidity of transactions in Rotterdam?

The last sub question will be answered by assessing the effect of the buy-to-let restriction on the liquidity of transactions. This will be measured in the amount of days a property has been listed on the real estate market (Zhu et al., 2016). In order to answer this question the same standard difference in difference method will be used (Imbens & Woolbridge, 2009) as for research question 2. However different control variables will be used based on the literature.

The remainder of the study is organized as follows. Section 2 provides the literature review. Section 3 discusses the specifics of the restriction in Rotterdam, Section 4 shows the methods. Section 4 provides data description, section 5 shows the empirical results, section 6 discusses these results and section 7 provides a conclusion, limitations and future research.

Literature review

To analyze the effect of the buy-to-let restriction on home prices as well as real estate market liquidity in Rotterdam, these two concepts are important to understand. That is why the previous literature about property right restrictions and market liquidity is reviewed in this chapter. At the end of this chapter hypothesis are established based on the literature and the corresponding conceptual model is shown.

Lee and Ooi (2018) did study a policy in Singapore where owners' right to transfer and rent their property was restricted for 10 years. The Singaporean government introduced the so-called executive condominiums (ECs). These ECs were meant to provide affordable housing to middle class citizens. To reach this goal, specific restrictions applied to the ECs. EC units were subject to a 5 year minimum occupation period. After this period ECs could be sold or rented but only to Singapore citizens or permanent residents. After 10 year, the property became fully privatized and restrictions were lifted. The restrictions resulted in ECs valued 21% lower than similar properties without restrictions.
A lot of literature has investigated the purchase restriction in China. This policy is called the housing purchase restriction (HPR) policy. The HPR policy 'prohibits resident households from buying more than two homes and non-resident households from buying more than one home' (Du & Zhang, 2015). The HPR policy is a non-mandatory policy, local governments can decide whether to implement HPR it and for how long (Zou et al., 2022). The policy has been adopted by many cities and is one of the most important tools to regulate the real estate market and suppress house price growth. In the literature a lot of cities have been studied regarding the HPR. These studies show contradictions in their findings. Zhang and Wang (2016) found that 'the HPR policy can limit demand from investors, but that the HPR has difficulties with reducing housing prices, especially in cities with high housing prices'. Chen et al. (2019) found that the HPR policy 'could restrain the price of new construction in the short term, but it could not control the rise of second-hand housing prices'. Additionally Wang and Huang (2013) found that 'HPR policy could reduce housing prices, but it had a limited impact'. Li et al. (2020) used a suburb of Beijing and found no significant reduction in prices of the second-hand homes in their study area. On the contrary, other studies found that the HPR policy can significantly reduce the home prices. According to Sun et al. (2017) the HPR policy in Beijing caused the sale price of housing to drop between 17 and 24 percent. Additionally, Li (2016) argues that the HPR policy can efficiently be used to reduce home prices.
Further literature on buyers restrictions outside of China is scarce. However, the previously discussed Lee and Ooi (2018) studied a transfer ban on new construction in Singapore and Switzerland had restrictions on that banned construction of second homes in some Swiss municipalities. Hilber and Schoni (2016) found that this restriction resulted in an increase in the price of second homes because

of less supply but the restriction lowered the prices of primary homes in those municipalities by 12 percent.

Wood and Wood (1985) define liquidity as 'the inverse of the amount of time that elapses between the decision to sell a security and the receipt of the full market value by the seller'. Days on the market is an important measurement for market liquidity (Zhu et al., 2016). Days on the market provides information about the real estate market, it can also be crucial information to identify housing bubbles (Galbraith, 2021). Days on the market is a special concern for investors because the real estate market is highly cash flow dependent and it shows the risk associated with real estate investments. Additionally it is a useful indicator for potential buyers to consider the popularity of the property (Taylor, 1999). Sellers use the average days on the market for comparative homes as a benchmark for pricing their properties (Galbraith, 2021). Sellers set thresholds values of days on the market for their properties after which they consider reducing the list price of this property. Sellers will maximize the net present value from selling by choosing the list price, a stopping rule (Haurin, 1988) and whether to use a real estate broker or not. These choices will depend on the characteristics of the property itself and the characteristics of the seller as well as the pool of potential buyers and competing sellers (Lippman & McCall, 1986).To circumvent part of the information asymmetry in the real estate market, buyers can use days on the market as a measurement to determine the quality of the property. A large value of days on the market indicates that the home is in a bad condition (Kamara et al. 2020). However, while sellers know that a large value of days on the market can be interpreted as a bad sign by buyers, they can influence the days on the market by relisting, or by setting a list price above market value so potential buyers will attribute the large days on the market to the fact that the list price is above market value (Tucker, 2013).
Measuring the causes of days on the market can thus be of valuable insight to the real estate industry and can make the information asymmetry in the real estate market less present. However it is difficult to measure the causes of the days on the market, because it is dependent on different factors, such as price, location and the year of completion. Some literature for example found that actual sale prices are positively related to days on the market (Trippi, 1977, Kalra, 1997), while other studies did not find a significant relationship between the two (Benefield & Hardin, 2013). Additionally the study of Zhu (2016) did find that the price per square meter of homes had limited contribution to days on the market because properties within the same urban district have similar square meter prices. On the contrary, a positive effect between list prices and days on the market was found by Miller (1978). Also, the difference between list price and selling price had a positive effect in the paper of Belkin (1976). Asabere (1993) confirmed that listing prices and above market pricing effect days on the market. Additionally, Haurin (1988) showed that days on the market is positively related to the atypicality of a property, more unusual homes require more days on the market before the home will be sold.

The buy-to-let restriction is a property right restriction. Due to this restriction there is no incentive for buy-to-let investors to buy new properties. As a consequence households will experience less competition and overbidding by buy-to-let-investors will diminish (NOS, 2021; Ball, 2006). The expectation is that home prices will decrease as a consequence of the buy-to-let restriction. The corresponding conceptual model is shown in figure 1.

H1: *The implementation of the buy-to-let restriction leads to a decrease in home prices.*

After implementation of the buy-to-let restriction, buy-to-let investors are forced out of the market in the neighborhoods subject to the buy-to-let restriction because the possibility to rent is restricted. As a result, competition for homes subject to the restriction will become less. This means that demand decreases, as a consequence the expectation is that the time a property will be available on the market measured in days will increase after the buy-to-let restriction.

H2: *The implementation of the buy-to-let restriction leads to an increase the days a property has been listed on the market.*

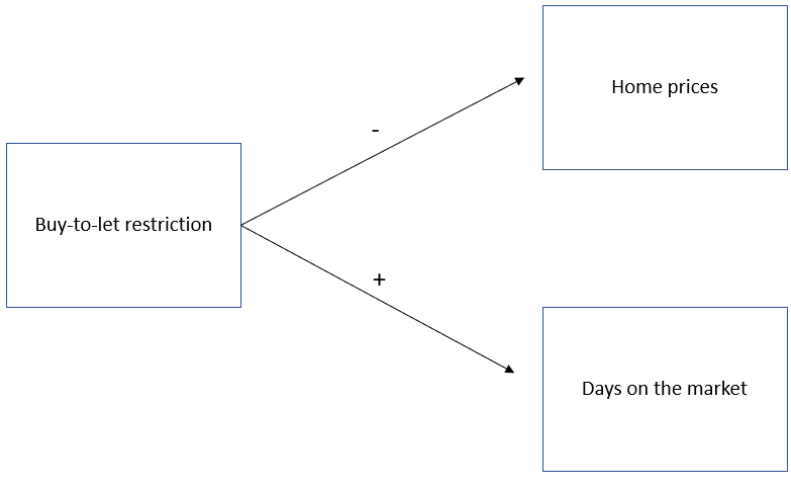

Figure 1: *Conceptual model*

Background

The municipality of Rotterdam is selected to research the effect of the new policy on the real estate market. This municipality is the first major municipality in the Netherlands who chose to make use of the buy-to-let restriction immediately when it was legally possible to do so. Other municipalities will later follow such as the municipality of Amsterdam and Eindhoven. Rotterdam is chosen because of abundant data availability compared to other municipalities. Because Rotterdam is a large municipality with a big housing stock, sufficient transactions are available in the short period of time that the buy-to-let restriction has been active. Another benefit of using Rotterdam as a case study is that in Rotterdam the buy-to-let restriction is only in place in specific neighborhoods. This creates the possibility to perform a difference in difference analysis with a target and control group.
In figure 2 is visible in which neighborhoods the regulation exists as of the 1st of January of 2022 the corresponding names of those neighborhoods are listed in table 1. In addition, a sold home in those neighborhoods should have a WOZ-value (valuation of real estate by the government for tax purposes) lower than €335.000 to qualify for the regulation (Municipality of Rotterdam, 2022).
The transfer date, which is the day on which the property is registered in the public registers is important. This is the reference date which determines if the buy-to-let restriction applies. This date is easily confused with the transaction date, the date on which the contract of sale is signed by a buyer and seller. The transfer date often takes place after the transaction date.
Additionally the status of the property is important, the property should on the transfer date be free of rent and use or in a rented condition for a period of less than six months, or was rented with a rental license under the buy-to-let restriction. This rental license can be possessed by an owner if the owner wants to rent the property to relatives. However this license automatically expires when the property is transferred to another owner. An overview of all conditions is shown in table 2.

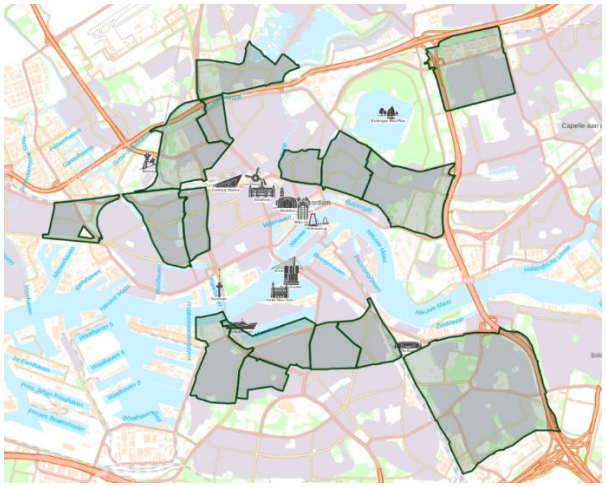

Figure 2: *Neighborhoods where the buy-up restriction is in place in Rotterdam. (Source: website municipality of Rotterdam)*

Table 1: *Neighborhoods subject to buy-to-let restriction in Rotterdam (Source: website municipality of Rotterdam)*

Neighborhoods in Rotterdam subject to the buy-to-let restriction
Bergpolder
Blijdorp
Bloemhof
Carnisse
Groot-IJsselmonde
Hillegersberg-Zuid
Hillesluis
Kralingen-Oost
Kralingen-West
Het Lage Land
Middelland
Nieuwe Westen
Oud-Charlois
Oud-Mathenesse
Rubroek
Tarwewijk

Table 2: *Conditions a transaction has to meet in order to qualify for the buy-up restriction.*

Transaction date	*If the property is transferred after 31-12-2021.*
WOZ-waarde	*If the property has a WOZ-waarde < €335.000.*
Location	*If the property is located in one of the neighborhoods mentioned in table 1.*
Status of the property	*If the property is; free of rent and use, in a rented condition for a period of less than six months, or was rented with a rental license under the buy-to-let restriction.*

Methodology

In this research the standard difference in difference model will be used, whereby outcomes are observed in one of two groups, in one of two time periods. Only observations in one of the two groups, in the second time period, are exposed to a treatment, in this case the buy-to-let restriction. Both groups are not exposed to the treatment in the first period. The control group is exposed to the treatment. The average gain over time in the non-exposed (control) group is subtracted from the gain over time in the exposed (treatment) group. This double differencing removes biases in second period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of time trends unrelated to the treatment (Imbens & Wooldridge, 2009).

Regression specification:

$$LnTRP = B_0 + B_1 TarArea + B_2 After + B_3 TarArea * After + B_4 Time + B_5 Char + B_6 Loc + e$$

$$LnDOM = B_0 + B_1 TarArea + B_2 After + B_3 TarArea * After + B_4 Time + B_5 SaleList + B_6 Loc + e$$

To measure the effect of the buy-to-let restriction on transaction prices and days on the market, two regressions are performed. LnTRP is the natural logarithm of the transaction price of a home and LnDOM is the natural logarithm of the days a property has been listed on the market. TarArea is a dummy which shows if the home falls in the target area. After is a dummy variable which indicates if the transactions's transfer date is on 1-1-2022 or later and. By multiplying the aforementioned variables the policy effect is captured by TarArea*After. SaleList represents the sales/listprice ratio. Char represents the relevant characteristics of the home, Loc is a variable controlling for location fixed effects and Time is a dummy variable which accounts for monthly fixed effects to allow for market influences (Turnbull & van der Vlist, 2022). At last, the error term is projected by e.

Data

The data comes from a database which covers all transactions made on www.funda.nl. This is the most popular website in the Netherlands for residential real estate market participants such as real estate brokers to offer their real estate. Because it is important to know which addresses are subject to the buy-to-let restriction, the database is with an automatic tool enriched with the corresponding neighborhood per transaction address as well as the corresponding WOZ-value per transaction address. In this way, the dataset is suitable for this research. WOZ-values are publicly available on www.wozwaardeloket.nl. Secondly, the corresponding neighborhood is publicly available on https://allecijfers.nl/adressen/rotterdam/. Each of the WOZ-values and neighborhoods are checked by hand. Based on these added information, dummy variables can be made to know if the transaction is subject to the buy-to-let restriction.

The time span of the transactions in the database is between 1-8-2021 and 15-5-2022 (n= 4400). List prices are available in the dataset as well as the actual transaction prices. Also, housing characteristics are part of the data. By making use of this database, relevant transactions which are subject to the buy-to-let restriction are available to analyze as well as transactions before the implementation of the buy-to-let restriction. The database provides information on when the contract for the transaction is signed as well as the transfer date of the property. The data also shows how many days a property has been listed on the market. Additionally the data provides information on characteristics of the properties such as, square meters, cubic meters, building year, number of (bed)rooms, type of home and energy label. Functional characteristics such as proximity to train stations, schools, etc. are also included as well as neighborhood characteristics such as the percentage of owner occupiers, average income per resident and the housing stock in the neighborhood.

Out of the enriched dataset with WOZ-values and neighborhood per address, variables were created in order to be able to perform as standard difference in difference analysis. The measurements of interest for this study are the transaction price and the days on the market. The natural logarithm was taken from the transaction prices as well as the natural logarithm of the days on the market to make the dependent variables normally distributed. In order to identify if the corresponding neighborhood of a transaction address is subject to the restriction, a dummy was created, which shows a 1 when the neighborhood falls in table 1 and a 0 otherwise. Another dummy was made which shows a 1 if the transfer date of the property was after the implementation of the restriction and a 0 if the transfer date was before the implementation. The interaction with the two aforementioned variables is the variable which shows if the property is subject to the buy-to-let restriction (1) or not (0). For each month a time dummy variable was created which indicates a 1 if the transaction date falls in this month and a 0 if this was not the case. Transaction dates occurred between august 2021 and May 2022, this results in 10 dummies. Other dummy variables were made in the same way for the type of housing and year of construction. According to the study of Ermolin (2016) the sale list price ratio can significantly affect

the time a property has been active on the market. That is why this ratio will be used in this research as well, by dividing the transaction price by the list price.

The data has been cleaned in order to make the available data suitable for this research. First of all, properties with a WOZ-value over €334.000 are dropped, the policy applies only to properties with a WOZ-value under €335.000. The policy only applies to existing homes. As the dataset contains some new construction, these observations are all dropped. If the transaction had no corresponding neighborhood name the observations were dropped. The actual transaction prices have been winsorized at the 1st and 99th percentage level. This means that all transaction prices under €170.000 and above €515.000 are dropped. In order to make the target and control group comparable only adjacent neighborhoods are included in the control group. This is why all non-adjacent neighborhoods are dropped. The control group only consists of properties with a WOZ-value above €144.000 and the properties in the target group also consist of WOZ-value under €144.000. To make the groups more comparable, all properties with a WOZ-value under €144.000 are dropped. For the days on the market variable, all observations under 8 days are dropped because any accuracy within one week would be considered unreasonable due to seasonality and weather effects in the real estate market (Ermolin, 2016). For example, on a hot or rainy days a home for sale would generate less traffic. The days on the market variable is at the upper side winsorized at the 99th percentage level, which means that any value above 125 days is dropped.

Table 3 shows descriptive statistics for the target and control group combined, table 4 shows the descriptive statistics of the target and control group separately. The average WOZ-value differs with €22.983 however due to the difference in square meters between the target and control group, the WOZ-value per square meter differs only with €86. The WOZ-value is established by the government and is mostly determined under the market value and has the function of collecting taxes on the property. Also some WOZ-values in the dataset are still from 2020 instead of 2021, because no WOZ-value with reference date 2021 has been established yet by the government, the municipality of Rotterdam uses the most recent WOZ-value for the policy. Given the aforementioned facts, the WOZ-values do not qualify to conclude that the target and control group are comparable.

The transaction prices differ by €19.330. The transaction price per square meter is almost identical (€3847). This means that the buyers in the target and control group value the properties as identical per square meter. While actual transaction prices show the market value of a property, transaction prices per square meter are comparable enough to perform a difference in difference analysis.

Another remarkable difference is that the target group consists of 90 percent apartments and 10 percent single family homes, while the control group consists of 72 percent apartments and 28 percent single family homes. However this is not considered as a problem because buy-to-let investors can buy both type of homes for investment purposes. In figure 3 and figure 4 development over time of the average transaction price and the average transaction price per square meter is pictured for the target and control group. In figure 5 is the average days on the market over time visible. The time axis

indicates the month and corresponding year in which the property was or will be transferred. Remarkable is that august 2021 indicates a large gap between the average transaction price, average transaction price per square meter and average days on the market. This is due to the fact that for this month few observations were included in the dataset. Transaction from august 2021 onwards are in the dataset and the transfer date usually takes place after the transaction date, most transfer dates for the properties sold in august 2021 took place in September 2021. This results in outliers in the figures for the month August. The blue line in December 2021 indicates that the buy-to-let restriction was implemented after this month.

Table 3: *Descriptive statistics for the whole area containing 567 observations*

Variable	Mean	S.D.
WOZ-value	241682.50	51208.04
WOZ-value per m2	3115.68	818.88
Transactionprice	298507.20	60040.07
Transactionprice per m2	3847.09	970.11
Days on the market	33.6	20.9
Characteristics	.	.
Square meters	80.95	21.26
Volume	268.02	77.06
Number of rooms	3.5	1.08
Owner occupiers in %	34.7	12.6
Type of real estate (1=yes)	.	.
Appartment	.81	.39
Single family home	.19	.39

Table 4: *Descriptive statistics for the target group with 300 observations and control group with 267 observations*

	Target group		Control group	
Variable	Mean	S.D.	Mean	S.D.
WOZ-value	230860.00	51597.36	253842.70	48027.15
WOZ-value per m2	3075.30	846.34	3161.04	785.99
Transactionprice	289404.70	60136.33	308734.80	58368.78
Transactionprice per m2	3846.84	991.13	3847.39	947.79
Days on the market	32.5	21.0	34.7	20.7
Characteristics	.	.	.	.
Square meters	78.44	20.76	83.76	21.49
Volume	263.83	76.10	272.74	77.99
Number of rooms	3.5	1.0	3.6	1.1
Owner occupiers in %	36.1	12.6	33.0	12.4
Type of real estate (1=yes)	.	.	.	.
Apartment	.90	.30	.72	.45
Single family home	.10	.30	.28	.45

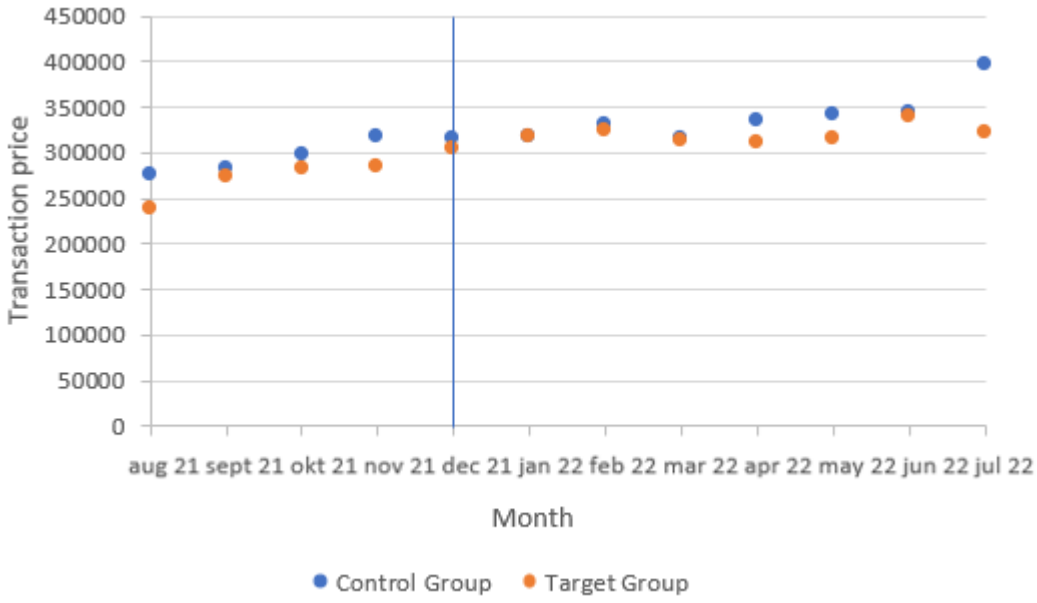

Figure 3: *Average price per month in €*

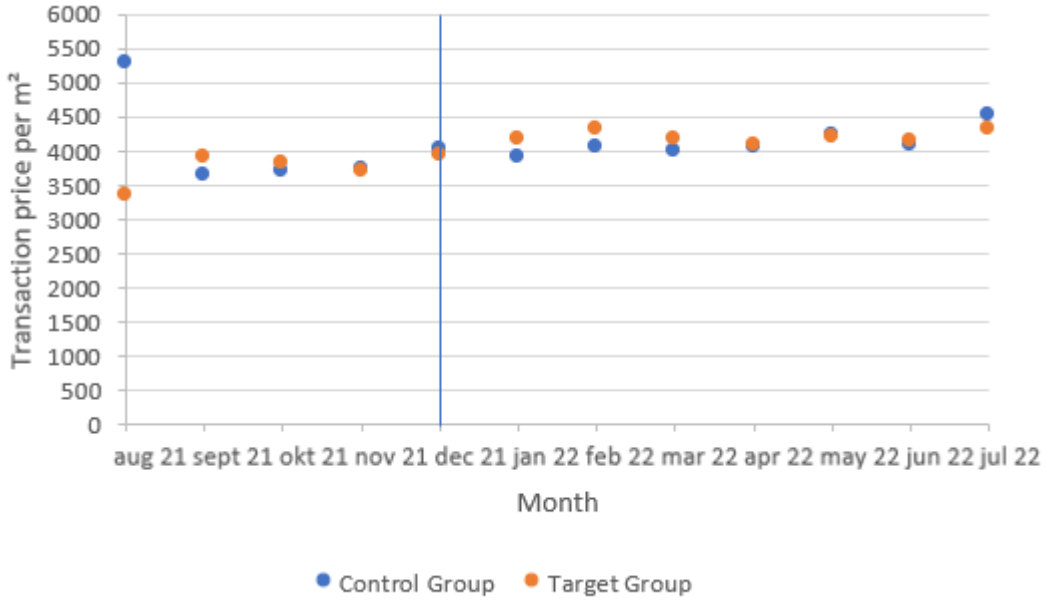

Figure 4: *Average price per square meter per month in €*

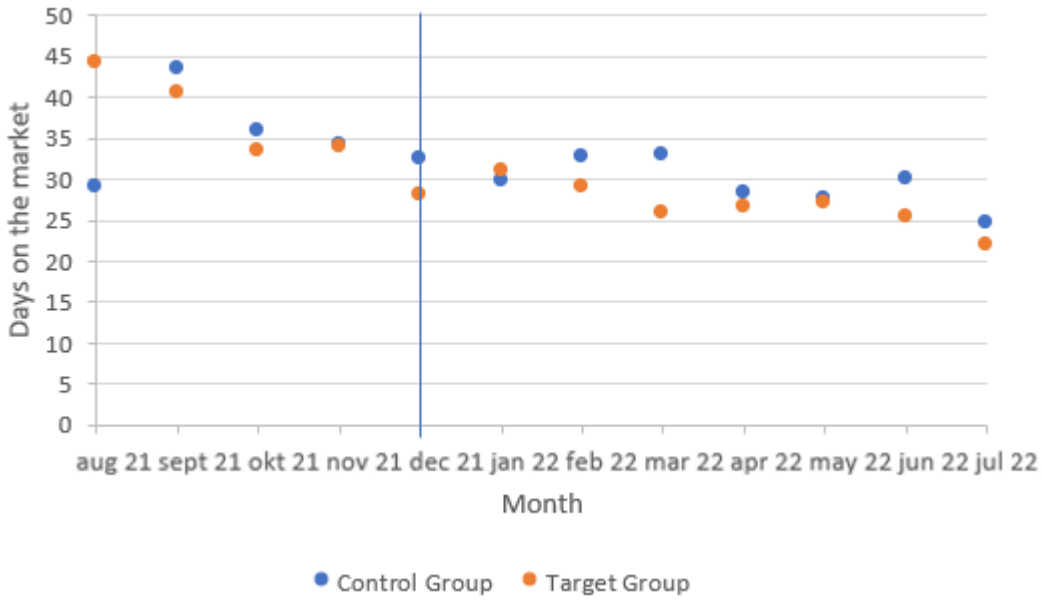

Figure 5: *Average days on the market per month*

Empirical Results

This chapter presents the results of the two difference in difference regressions specified in the methods section. The models aims to capture the price changes after the implementation of the buy-to-let restriction in the target and control group. The neighborhoods in the target group are shown in table 1 and figure 2. The control group consists of the neighborhoods adjacent to the target group shown in table 7 and figure 8 in appendix A . First, the results of the baseline model (1) are described. Followed by model 2, 3 and 4. Whereby each model increasingly uses control variables. The OLS assumptions are addressed in appendix C.

Table 6 shows the coefficients and the standard errors for the difference in difference analysis whereby the natural logarithm of the transaction prices are used as dependent variable. The table consists of 4 different columns. Each column represents a model. The baseline model includes only the variables which are used to capture the policy effect. In the baseline model the R-squared is 5,8%, which means that the model explains 5,8% of the variation. In model 2 monthly fixed effects are added to the baseline model by including a dummy variable for each month with August as the reference month. This increases the R-squared to 7,6%. Model 3 adds characteristics of the property such as square meters and energy label as variables compared to model 2. This increases the R-squared further to 45,7%. By adding location fixed effects in the final model the R-squared increases to 66,1%. The F statistic for model 4 is 0.0000, this is significant at the 1% significance level which means that the null hypothesis that the R-squared is equal to 0 can be rejected, that is why the model has explanatory power. The total number of observations between model 1 and 2 (N=1438) and model 3 and 4 (N=1390) differ because the energy label variable had 48 omitted observations.

The coefficients of all variables for all models are presented in appendix D. In all models except the baseline model, the month dummies September 2021, October 2021, March 2022 and April 2022 show a significant increase in home prices compared to August 2021.

The square meter variable shows a significant increase in the transaction price by 0,5% per square meter in the last model. Energy label is included as a dummy with energy label A as reference group. In model 4, the results show that energy labels D, E, F and G significantly lower the price of a home by 4,8%, 8,0%, 10,1% and 8,1% respectively compared to energy label A. While an energy label of A++ significantly increases the price of a home with 6%. This is very straightforward because the energy label A++ is the best and energy label G is the worst.

The type of housing dummy shows that a penthouse compared to a semi-detached house increases the price (+30,2%) while a terraces house decreases the price (-19,3%) significantly.

Construction between 1930-44, 1960-69, 1970-79 and 1980-1989 significantly lowers the transaction prices compared to construction between 2010 – 2022, this could be due to a difference in building styles or difference in quality as a result of the building period. Location characteristics show that

distance to train station, distance to daycare and distance to school significantly decreases the price at. This is in line with the paper of Miller (1982) about locational characteristics of a property. Neighborhood characteristics such as average income per resident in thousand euros (+2,0%) and labor participation in percentages (-0,4%) significantly influence the price.

The main variables used to assess home prices are TarArea, After and TarArea*After. First, the results of the baseline model will be discussed.

If the property is located in the target area (TarArea), transaction prices significantly decreased by 6,5%. In contrast, if the transfer date of the property was after 2021 (after) transaction prices significantly increased by 7,8%. If the buy-to-let restriction applied to the transaction (TarArea*After), this shows an increase in the transaction prices of 1,9%, however this result is not significant.

Looking at model 4, if the property is located in the target area transaction prices decreased with 1,6%, however, in contrast to the other models this result is not significant. If the transfer date of a property was after 2021 transaction prices significantly increased with 5,0%. This coefficient shows the price increase between homes transferred before and after 2021 (Imbens & Wooldridge, 2009) it is in line with the market price trend in Rotterdam over this period (NVM, 2022).

Also in the 4th model the restriction is not significant and shows an increase of 1,6%.

In all models, the policy dummy show in increase in transaction prices, but these results are in none of the models significantly different from zero. These findings are in line with the findings of Zhang and Wang (2016), Chen et al. (2019) and Li et al. (2020) who could also not find a significant reduction in house prices which could be assigned to the HPR policy in China. On the contrary, the results conflict with the findings of Lee & Ooi (2018), Sun et al. (2017) and Zhang et al. (2015) who all found that the property right restrictions they investigated can significantly reduce home prices. The reason for this could be the difference in the studied real estate markets and also in the strictness of the policy. Sun et al. (2017) and Zhang et al. (2015) studied Beijing and Shanghai. These are first-tier cities with high investment demand and a strict HPR policy compared to smaller cities where the HPR have been relaxed. It could therefore be that HPR policy significantly reduces prices in first-tier cities however not in third-tier cities because of the differences in the real estate market (Li et al., 2020). As a consequence Rotterdam's real estate market might be too small for the buy-to-let restriction to have a significant influence on home prices.

Using the TarArea, After and TarArea*After variables as subsets for the Chow F-test for subsets (Gerking & Weirick, 1983), the F statistic shows a value of 9.18 and a P value of 0.0000, in conclusion, the subset is significant at the 1% significance level (0.0000<0.01) the results are also shown in appendix D. This means that the null hypothesis that the subset is not significantly different from zero can be rejected. The subset has explanatory power.

Table 5: *Estimation results with ln transaction prices as dependent variable*

Variables	(1)	(2)	(3)	(4)
TarArea	-0.067***	-0.064***	-0.058***	-0.016
	(0.017)	(0.017)	(0.015)	(0.013)
After	0.075***	0.090***	0.062***	0.049***
	(0.015)	(0.021)	(0.016)	(0.014)
TarArea*After	0.019	0.014	0.025	0.016
	(0.022)	(0.022)	(0.018)	(0.015)
Constant	12.622***	12.573***	12.403***	12.315***
	(0.012)	(0.017)	(0.056)	(0.077)
Observations	1,438	1,438	1,390	1,390
R-squared	0.058	0.076	0.457	0.661
Time FE		YES	YES	YES
Characteristics			YES	YES
Location FE				YES

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

Table 6 shows the coefficients and the standard deviations for the difference in difference analysis where the natural logarithm of days on the market is used as a dependent variable. In this case, also 4 models are used with model 1 as the baseline model. Model 1 shows a R-squared of 2,8%. By adding the corresponding control variables model 2,3 and 4 show an R-squared of 4,3%, 11,9% and 12,3% respectively. The R-squared for the final model is lower than in the previous regression which means that less of the variance in the independent variable is explained. The F statistic for model 4 is 0.0000, this is significant at the 1% significance level which means that the null hypothesis that the R-squared is equal to 0 can be rejected, that is why the model has explanatory power.

The total number of observations between model 1 and 2 (N=1438) and model 3 and 4 (N=1390) differ because the energy label variable had 48 omitted observations. The coefficients of all variables for all models are presented in appendix D. The month dummies show that January 2022 significantly increased the days on the market compared to the reference month august.

Model 3 includes the characteristics of the property such as energy label, type of housing and the salelistepice ratio, the energy label A++ increases the days on the market significantly compared to the reference group (Label A). The type of housing dummies show that a semi-detached and down-and upstairs apartment significantly increase the days on the market compared to the reference group. These homes both consist of less than 1% the total homes in the dataset. This result is in line with Haurin (1988) who stated that the days on the market is positively related to the atypicality of a property. The sale listprice ratio significantly decreased the days on the market with 77,5%. This is in line with the paper of Ermolin (2016). It means that when the list price has been set lower compared to the actual selling price, the days on the market decreases. In final model 4 the location fixed effects are

added, the distance to school variable shows that a 0.1 km increase in distance to supermarket significantly decreases the days on the market.

The same main variables are used as previously for the difference in difference model, these are TarArea, After and TarArea*After. In the baseline model, if the property was located in the target area, this showed a significant decrease in days on the market of 8,3%. When the transfer date of the property was after 2021 it resulted in a significant decrease in days on the market of 14,4%. If the policy applied to the transaction, the results show an increase in days on the market of 0,6%, however this result is not significant. Looking at model 4, a property located in the target area resulted in a decline in days on the market of 5,2%. However contrary to model 1 this is not significantly different from 0. A transfer date after 2021 resulted in a significant decrease in days on the market of 13,1%.

Also in the 4th model the policy is not significant and shows an increase in days on the market of 0,8%. The results are contrary to the statements Lee and Ooi (2018) make in their paper. They state in their paper that by implementing a purchase restriction, the property becomes fully illiquid when no one is allowed to purchase, partially illiquid when only a certain amount of the population is allowed to purchase or fully liquid when the property is can be freely transferred to anyone. However by using days on the market as measurement for liquidity the difference in difference results do not show a decrease in liquidity as a result of the restriction.

Using the treatment area, after and policyeffect variables as subsets for the Chow F-test on subsets (Gerking & Weirick, 1983), the F statistic shows a value of 4.12 and a P value of 0.0046, in conclusion, the subset is significant at the 1% significance level (0.0046<0.01). These results are also shown in appendix D. This means that the null hypothesis that the subset is not significantly different from zero can be rejected. The subset has explanatory power.

Table 6: *Estimation results with ln days on the market as dependent variable*

Variables	(1)	(2)	(3)	(4)
TarArea	-0.087*	-0.083*	-0.058	-0.053
	(0.045)	(0.045)	(0.046)	(0.047)
After	-0.156***	-0.164***	-0.140***	-0.140***
	(0.039)	(0.052)	(0.053)	(0.053)
TarArea*After	0.006	0.001	0.005	0.008
	(0.055)	(0.055)	(0.055)	(0.055)
Constant	3.407***	3.371***	4.865***	4.796***
	(0.031)	(0.044)	(0.288)	(0.310)
Observations	1,438	1,438	1,390	1,390
R-squared	0.028	0.043	0.119	0.123
Time FE		YES	YES	YES
Characteristics			YES	YES
Location FE				YES

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

Discussion

The aim of the buy-to-let restriction is providing more opportunities for first-time-buyers as well as middle income households to buy affordable housing (Municipality of Rotterdam, 2022). This study tests if housing indeed became more affordable by assessing the effect of the buy-to-let restriction on the transaction prices of homes as well as the days the property was listed on the market. In this section, the results will be discussed. The difference in difference analysis in section 4 are used to assess the effect of the new policy.

The results of this study shows that the policy does not have a significant effect on the transaction prices. The buy-to-let restriction does not lead to a causal difference in home prices or days on the market. It seems that the housing shortage on the Dutch real estate market (NOS, 2021) and the desire to live in the city causes excessive demand. This will still lead to rising home prices. Having said that, it does not necessarily mean that the policy is a failure. The aim of the municipality: 'providing more opportunities for first-time-buyers as well as middle income households to buy affordable housing' (Municipality of Rotterdam, 2022) can be partly achieved. Buy-to-let investors are blocked from the market, consequently households have a bigger chance of purchasing the home due to not having to compete with the buy-to-let investor. However the affordability of the home did not improve due to the buy-to-let restriction.

When a property is located in the treatment area, the transaction prices decrease compared to the control group in the models. This could be due to the difference in average square meters between the two groups (table 4). Another reason could be that the target group consists of homes of lower quality, assuming that house prices are a proxy for quality (Rosen, 1974). It could also be the result of unobserved differences between the groups which lay outside of the scope of the used database.

If the transfer date of the property was after the implementation of the policy, the transaction prices show an increase of 5,0%. This increase is in line with transaction data from the Dutch Association of Real Estate Agents and Appraisers, in the region Groot-Rijnmond. Rotterdam is part of the region Groot-Rijnmond. The report shows an increase of transaction prices of 1,2% between the first quarter of 2022 and the last quarter of 2021. Additionally the report shows an increase in transaction prices of 14,9% between the first quarter of 2022 and the first quarter of 2021 (NVM, 2022). Considering that this study uses data between august 2021 and may 2022 we can assume that the transaction prices on the real estate market increased with a percentage between 1,2%-14,9%. This is in line with the results.

As house prices are associated with the days a property has been listed on the market (Miller, 1978) and the policy did not have effect on these house prices, it is not a surprise that the policy does also not show significant results on the days a property was listed. The target area did also not show a significant effect, which is remarkable because the target area did show a significant effect on house prices. This could be due to the fact that days on the market are not only explained by house prices.

The amount of days on the market can also be a consequence of the quality of the home, the listing strategy and the type of real estate agency (Tucker, 2013). When a property has been transferred after the implementation of the policy, the days on the market decreased with 13,1%. This is a logical result because of the transaction price increase discussed in the previous paragraph.

Conclusion

The main research question of this study is: *What is the effect of the buy-to-let regulation on home prices and residential real estate liquidity in Rotterdam?* Results from the difference in difference analysis show that the null hypothesis that the policy effect on home prices and days on the market is not significantly different from zero cannot be rejected. This means that it cannot be concluded that the buy-to-let restriction reduced housing prices or increased the days on the market. The answer to the main research question is therefore that from this study no conclusive effects could be established by the buy-to-let restriction on home prices and market liquidity.

Limitations

Rotterdam is the first municipality in the Netherlands who implemented the buy-to-let restriction. This leads to the first limitation of this research which is the availability of data. The policy started on 1-1-2022 and the analysis had to be done in the months May and June 2022. As a consequence, transactions who fall under the restriction are limited. That is why a similar study after the buy-to-let restriction has been in place for several years might provide more conclusive results.
Another limitation in this study is the possibility of investors to move to other neighborhoods in Rotterdam, where the buy-to-let restriction is not in place. This is the so-called ‘waterbed effect’. Zhang et al. (2021) calls this effect a ripple effect and found that the HPR policy in China caused a significant ripple effect. As it is difficult to assess this effect, the possibility of a waterbed or ripple effect is outside the scope of this research. But it is an interesting topic for a qualitative analysis. Whereby investors can be interviewed regarding choices for investments in buy-to-let properties.
Other municipalities in the Netherlands such as Amsterdam and Eindhoven will follow the example of Rotterdam by implementing the same policy, this opens the possibility to assess the effect of the policy in those municipalities as well and to compare the outcomes to see if there are remarkable differences between the case studies.

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Appendix A – Tables and figures

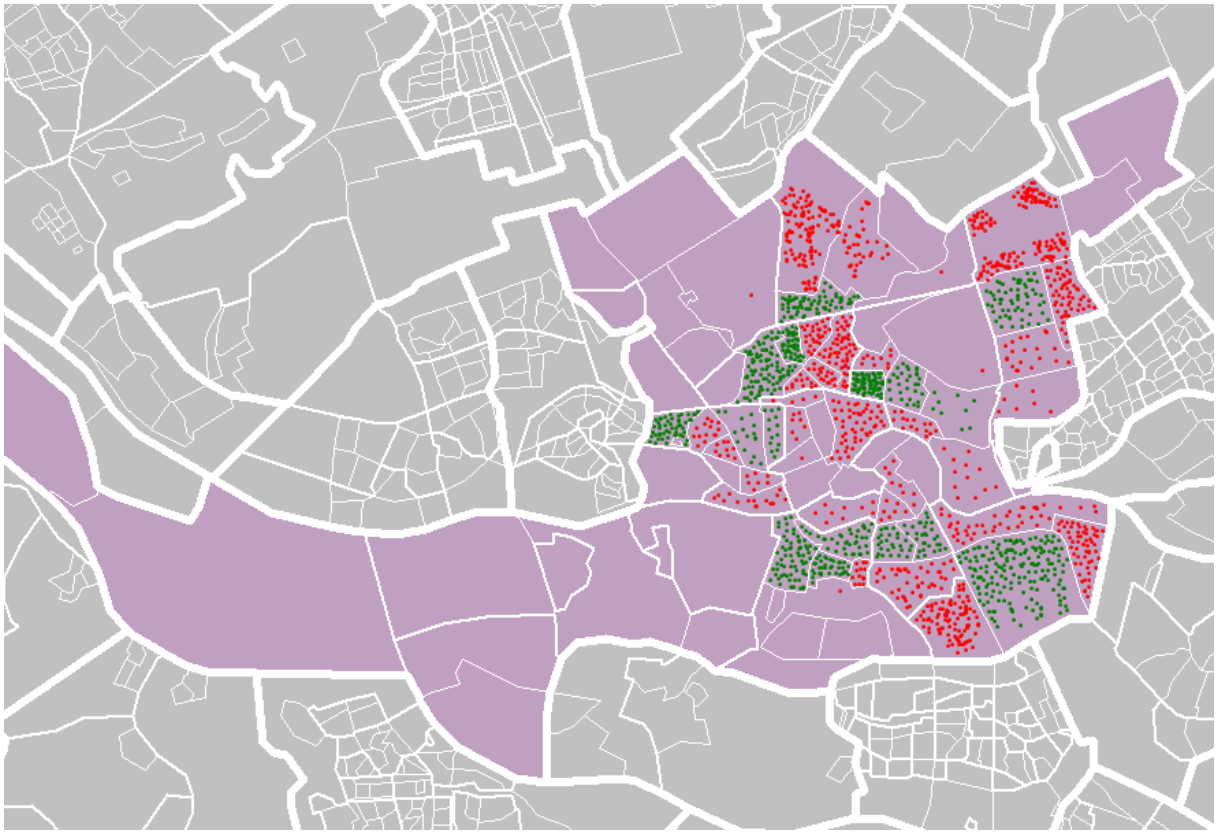

Figure 6: *Transactions in the target and control group*

Table 7: *Neighborhoods in the control group*

Neighborhoods in Rotterdam adjacent to the target group
's-Gravenland
Afrikaanderwijk
Agniesebuurt
Beverwaard
Cs Kwartier
De Esch
Delfshaven
Dijkzigt
Hillegersberg Noord
Katendrecht
Kop van Zuid - Entrepot
Kralingse Bos
Liskwartier
Lombardijen
Ommoord
Oosterflank
Oud Crooswijk
Oud IJsselmonde
Oude Noorden
Oude Westen
Prinsenland
Provenierswijk
Schiebroek
Schiemond
Spangen
Stadsdriehoek
Struisenburg
Terbregge
Tussendijken
Vreewijk
Zestienhoven
Zuiderpark
Zuidplein

Appendix B – Stata commands

```
cd "C:\Users\Pieter Reitsma \Documenten\School\Master Thesis\Opkoopbescherming\STATA"

import excel "C:\Users\Pieter Reitsma\Documenten\Master Thesis\Opkoopbescherming\Data\Data
Master Thesis Pieter.xlsx", sheet("Blad1") fi
> rstrow

//Cleaning the dataset

destring huidige_woz_waarde, gen(WOZ)

destring Transactieprijshuur, gen(Transactionprice)

drop if WOZ >= 335000

replace Transactionprice = round(Transactionprice, 1.0)

drop if Koopconditie == "Vrij op naam"

gen neighPolicy = 0

drop if Neighborhoodname == ""

replace neighPolicy = 1 if Neighborhoodname == "Bergpolder"

replace neighPolicy = 1 if Neighborhoodname == "Blijdorp"

replace neighPolicy = 1 if Neighborhoodname == "Bloemhof"

replace neighPolicy = 1 if Neighborhoodname == "Carnisse"

replace neighPolicy = 1 if Neighborhoodname == "Groot IJsselmonde"

replace neighPolicy = 1 if Neighborhoodname == "Hillegersberg Zuid"

replace neighPolicy = 1 if Neighborhoodname == "Hillesluis"

replace neighPolicy = 1 if Neighborhoodname == "Kralingen Oost"

replace neighPolicy = 1 if Neighborhoodname == "Kralingen West"

replace neighPolicy = 1 if Neighborhoodname == "Het Lage Land"

replace neighPolicy = 1 if Neighborhoodname == "Middelland"

replace neighPolicy = 1 if Neighborhoodname == "Nieuwe Westen"

replace neighPolicy = 1 if Neighborhoodname == "Oud Charlois"
```

```
replace neighPolicy = 1 if Neighborhoodname == "Oud Mathenesse"

replace neighPolicy = 1 if Neighborhoodname == "Rubroek"

replace neighPolicy = 1 if Neighborhoodname == "Tarwewijk"


format %tdDD/NN/CCYY Transportdatum

gen year =year(Transportdatum)

gen after = 1 if year == 2022

replace after = 1 if year == 2023

replace after = 0 if year == 2021

format %tdDD/NN/CCYY Transactiedatum

gen transactionmonth = month(Transactiedatum)

gen transactionmonthDUM = 0

gen transactionyear = year(Transactiedatum)

replace transactionmonthDUM = 1 if (transactionmonth==8 & transactionyear==2021)

replace transactionmonthDUM = 2 if (transactionmonth==9 & transactionyear==2021)

replace transactionmonthDUM = 3 if (transactionmonth==10 & transactionyear==2021)

replace transactionmonthDUM = 4 if (transactionmonth==11 & transactionyear==2021)

replace transactionmonthDUM = 5 if (transactionmonth==12 & transactionyear==2021)

replace transactionmonthDUM = 6 if (transactionmonth==1 & transactionyear==2022)

replace transactionmonthDUM = 7 if (transactionmonth==2 & transactionyear==2022)

replace transactionmonthDUM = 8 if (transactionmonth==3 & transactionyear==2022)

replace transactionmonthDUM = 9 if (transactionmonth==4 & transactionyear==2022)

replace transactionmonthDUM = 10 if (transactionmonth==5 & transactionyear==2022)

gen policyeffect = neighPolicy*after

rename Dagenopdemarkt daysonMarket

rename Woonoppervlakte SQmeters

rename Inhoudwoning volume
```

```
rename Aantalkamers NumberofRooms

rename SoortOG typeofRE

//Dropping neighborhoods which are not adjacent to the target group

drop if Neighborhoodname == "Bospolder"

drop if Neighborhoodname == "Cool"

drop if Neighborhoodname == "Feijenoord"

drop if Neighborhoodname == "Heijplaat"

drop if Neighborhoodname == "Molenlaankwartier"

drop if Neighborhoodname == "Kleinpolder"

drop if Neighborhoodname == "Overschie"

drop if Neighborhoodname == "Noordereiland"

drop if Neighborhoodname == "Kralingseveer"

drop if Neighborhoodname == "Nesselande"

drop if Neighborhoodname == "Nieuw Crooswijk"

drop if Neighborhoodname == "Nieuwe Werk"

drop if Neighborhoodname == "Pendrecht"

drop if Neighborhoodname == "Zevenkamp"

drop if Neighborhoodname == "Zuidwijk"

//Cleaning of the data

gen TP = Transactionprice

drop if TP < 170000

drop if TP > 515000

drop if daysonmarket < 8

drop if daysonmarket > 125

gen LnDOM = ln(daysonmarket)

gen LNtransactionprice = ln(transactionprice)

gen saleslistprice = transactionprice/Huidigeprijs

gen TPsqm = TP/SQmeters
```

```
drop if WOZ < 144000

sum WOZ WOZpSQM TP TPsqm daysonMarket SQmeters volume NumberofRooms
Percentageowneroccupiedneigh appartement woonhuis  if after == 0 & neighPolicy == 1

sum WOZ WOZpSQM TP TPsqm daysonMarket SQmeters volume NumberofRooms
Percentageowneroccupiedneigh appartement woonhuis  if after == 0 & neighPolicy == 0

sum WOZ WOZpSQM TP TPsqm daysonMarket SQmeters volume NumberofRooms
Percentageowneroccupiedneigh appartement woonhuis  if after == 0


//Regressions

reg LNtransactionprice neighPolicy after policyeffect i.transactionmonthDUM SQmeters
NumberofRooms i.EnergLabel i.TypeHousing construction_before_1901 construction_1901_1929
construction_1930_1944 construction_1945_1959 construction_1960_1969
construction_1970_1979 construction_1980_1989 construction_1990_1999
construction_2000_2009 Distancesupermarketkm Distancehighwayprovincialroad
Distancetrainstationkm Distancedaycarekm Distanceschoolkm Averageincomeperresidentnei
Laborparticipationneighborhooregcheck

reg LNtransactionprice neighPolicy after policyeffect

regcheck

reg TRprice neighPolicy after policyeffect, robust

outreg2 using klaar66, replace word dec (3)

shellout using `"klaar66.rtf"'

reg LNtransactionprice neighPolicy after policyeffect i.transactionmonthDUM, robust

outreg2 using klaar66, append word dec (3)

shellout using `"klaar66.rtf"'

reg LNtransactionprice neighPolicy after policyeffect i.transactionmonthDUM SQmeters
NumberofRooms i.EnergLabel i.TypeHousing construction_before_1901 construction_1901_1929
construction_1930_1944 construction_1945_1959 construction_1960_1969
construction_1970_1979 construction_1980_1989 construction_1990_1999
construction_2000_2009, robust

outreg2 using klaar66, append word dec (3)

shellout using `"klaar66.rtf"'

reg LNtransactionprice neighPolicy after policyeffect i.transactionmonthDUM SQmeters
NumberofRooms i.EnergLabel i.TypeHousing construction_before_1901 construction_1901_1929
construction_1930_1944 construction_1945_1959 construction_1960_1969
construction_1970_1979 construction_1980_1989 construction_1990_1999
construction_2000_2009 Distancesupermarketkm Distancehighwayprovincialroad
Distancetrainstationkm Distancedaycarekm Distanceschoolkm Averageincomeperresidentnei
Laborparticipationneighborhooregcheck, robust
```

outreg2 using klaar66, append word dec (3)

shellout using `"klaar66.rtf"'

reg lnDOM neighPolicy after policyeffect i.transactionmonthDUM salelistprice i.EnergLabel i.TypeHousing Distancesupermarketkm Distancehighwayprovincialroad Distancetrainstationkm Distancedaycarekm Distanceschoolkm

regcheck

reg LNdaysonthemarket neighPolicy after policyeffect, robust

outreg2 using DOM66, replace word dec (3)

shellout using `"DOM66.rtf"'

reg LNdaysonthemarket neighPolicy after policyeffect i.transactionmonthDUM, robust

outreg2 using DOM66, append word dec (3)

shellout using `"DOM66.rtf"'

reg lnDOM neighPolicy after policyeffect i.transactionmonthDUM salelistprice i.EnergLabel i.TypeHousing, robust

outreg2 using DOM66, append word dec (3)

reg lnDOM neighPolicy after policyeffect i.transactionmonthDUM salelistprice i.EnergLabel i.TypeHousing Distancesupermarketkm Distancehighwayprovincialroad Distancetrainstationkm Distancedaycarekm Distanceschoolkm, robust

outreg2 using DOM66, append word dec (3)

shellout using `"DOM66.rtf"'

//Chow F-test

reg lnDOM neighPolicy after policyeffect i.transactionmonthDUM salelistprice i.EnergLabel i.TypeHousing Distancesupermarketkm Distancehighwayprovincialroad Distancetrainstationkm Distancedaycarekm Distanceschoolkm, robust

test neighPolicy after policyeffect

reg LNtransactionprice neighPolicy after policyeffect i.transactionmonthDUM SQmeters NumberofRooms i.EnergLabel i.TypeHousing construction_before_1901 construction_1901_1929 construction_1930_1944 construction_1945_1959 construction_1960_1969 construction_1970_1979 construction_1980_1989 construction_1990_1999 construction_2000_2009 Distancesupermarketkm Distancehighwayprovincialroad Distancetrainstationkm Distancedaycarekm Distanceschoolkm Averageincomeperresidentnei Laborparticipationneighborhooregcheck, robust

test neighPolicy after policyeffect

Appendix C – OLS assumptions

1. The error term has a conditional mean of zero

In order to adhere to the first assumption a constant is added in the difference in difference regressions. In this way the non-zero mean will be absorbed by the constant term.

2. No heteroskedasticity in the error term

This assumption demands that the error term should have an equal variance. This has been tested with the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity. The test shows that the dependent variable ln transaction price showed no sign of heteroskedasticity because the P-value is higher than 0.05. However for the ln days on the market heteroskedasticity has been detected because the P-value is above 0.05. To deal with this heteroskedasticity robust standard errors are used in the models.

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of LNtransactionprice

H0: Constant variance

    chi2(1) =   1.56
Prob > chi2 = 0.2114
```

Figure 7: *Heteroskedasticity test for ln transaction prices*

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of lnDOM

H0: Constant variance

    chi2(1) =  26.80
Prob > chi2 = 0.0000
```

Figure 8: *Heteroskedasticity test for ln days on the market*

3. No autocorrelation

In order to have no autocorrelation in the error term time fixed effects are added as control variables, since the data on transactions can contain trends over time.

4. Multicollinearity

Multicollinearity can be determined when the variance of inflation factor has a value above 5. After each regression the VIF has been checked with a command. No signs of multicollinearity were detected in the regressions.

5. The error term is normally distributed

The Shapiro-Wilk W normality test showed that the error term of the ln transaction price variable were normally distributed as the P-value is higher than 0.01. For the ln days on the market, this was not the case. The P-value is lower than 0.01 which means that the residuals are not normally distributed. However by using a large dataset (N>30) the data set is large enough to assume that the violation for this variable does not influence the results.

Appendix D – Complete regression results and Chow F-test results

Table 8: *Estimation results including all coefficients with ln transaction prices as dependent variable*

VARIABLES	(1) LNtransactionprice	(2) LNtransactionprice	(3) LNtransactionprice	(4) LNtransactionprice
neighPolicy	-0.067***	-0.064***	-0.058***	-0.016
	(0.017)	(0.017)	(0.015)	(0.013)
after	0.075***	0.090***	0.062***	0.049***
	(0.015)	(0.021)	(0.016)	(0.014)
policyeffect	0.019	0.014	0.025	0.016
	(0.022)	(0.022)	(0.018)	(0.015)
Sep 2021		0.069***	0.053***	0.032**
		(0.022)	(0.018)	(0.014)
Okt 2021		0.080***	0.063***	0.033**
		(0.021)	(0.018)	(0.014)
Nov 2021		0.038*	0.025	0.016
		(0.023)	(0.019)	(0.014)
Dec 2021		0.006	0.005	0.002
		(0.025)	(0.020)	(0.016)
Jan 2022		0.012	0.018	0.012
		(0.031)	(0.024)	(0.019)
Feb 2022		0.021	0.027	0.025
		(0.029)	(0.023)	(0.017)
Mar 2022		0.057**	0.066***	0.057***
		(0.027)	(0.021)	(0.017)
Apr 2022		0.067**	0.086***	0.073***
		(0.032)	(0.026)	(0.021)
May 2022		0.075*	0.057	0.027
		(0.043)	(0.045)	(0.034)
SQmeters			0.004***	0.005***
			(0.000)	(0.000)
NumberofRooms			0.003	0.014**
			(0.007)	(0.006)
EnergLabel A+			-0.036	-0.003
			(0.023)	(0.026)
EnergLabel A++			0.038	0.058**
			(0.026)	(0.026)
EnergLabel B			-0.023	-0.040**
			(0.018)	(0.016)
EnergLabel C			-0.044**	-0.038**
			(0.017)	(0.015)
EnergLabel D			-0.058***	-0.049***
			(0.020)	(0.017)
EnergLabel E			-0.100***	-0.083***
			(0.021)	(0.018)
EnergLabel F			-0.140***	-0.107***
			(0.024)	(0.020)
EnergLabel G			-0.117***	-0.084***

	(0.026)	(0.021)
TypeHousing Eindwoning	-0.157**	-0.159**
	(0.062)	(0.069)
TypeHousing Geschakelde woning	-0.172***	-0.215***
	(0.051)	(0.059)
TypeHousing Halfvrijstaande woning	-0.196***	-0.142**
	(0.051)	(0.063)
TypeHousing Hoekwoning	-0.046	-0.050
	(0.048)	(0.058)
TypeHousing Tussenwoning	-0.038	-0.067
	(0.046)	(0.056)
TypeHousing Vrijstaande woning	0.142	0.063
	(0.133)	(0.059)
TypeHousing beneden + bovenwoning	-0.052	-0.106
	(0.072)	(0.067)
TypeHousing benedenwoning	0.012	-0.056
	(0.048)	(0.057)
TypeHousing bovenwoning	0.036	-0.074
	(0.046)	(0.057)
TypeHousing dubbel benedenhuis	-0.025	-0.055
	(0.060)	(0.062)
TypeHousing galerijflat	-0.057	-0.107*
	(0.047)	(0.057)
TypeHousing maisonnette	-0.052	-0.101*
	(0.051)	(0.059)
TypeHousing penthouse	0.528***	0.264***
	(0.051)	(0.060)
TypeHousing portiekflat	-0.063	-0.108*
	(0.047)	(0.057)
TypeHousing portiekwoning	0.037	-0.057
	(0.049)	(0.058)
TypeHousing tussenverdieping	-0.022	-0.051
	(0.053)	(0.059)
construction_before_1901	-0.047	-0.042
	(0.046)	(0.043)
construction_1901_1929	-0.042	-0.058**
	(0.028)	(0.023)
construction_1930_1944	-0.040*	-0.062***
	(0.023)	(0.020)
construction_1945_1959	-0.043*	-0.052**
	(0.025)	(0.021)
construction_1960_1969	-0.170***	-0.143***
	(0.024)	(0.020)
construction_1970_1979	-0.111***	-0.113***

			(0.025)	(0.021)
construction_1980_1989			-0.098***	-0.063***
			(0.023)	(0.020)
construction_1990_1999			-0.002	0.020
			(0.024)	(0.021)
construction_2000_2009			0.004	0.031
			(0.021)	(0.021)
Distancesupermarketkm				0.058**
				(0.027)
Distancehighwayprovincialroad				-0.000
				(0.006)
Distancetrainstationkm				-0.040***
				(0.005)
Distancedaycarekm				-0.178***
				(0.055)
Distanceschoolkm				-0.200***
				(0.045)
Averageincomeperresidentnei				0.020***
				(0.001)
Laborparticipationneighborhoo				-0.004***
				(0.001)
Constant	12.622***	12.573***	12.403***	12.315***
	(0.012)	(0.017)	(0.056)	(0.077)
Observations	1,438	1,438	1,390	1,390
R-squared	0.058	0.076	0.457	0.661

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

```
( 1)  neighPolicy = 0
( 2)  after = 0
( 3)  policyeffect = 0

       F(  3,  1334) =    9.18
            Prob > F =    0.0000
```

Figure 9: *Chow F-test for subsets*

Table 9: *Estimation results including all coefficients with ln days on the market as dependent variable*

VARIABLES	(1) lnDOM	(2) lnDOM	(3) lnDOM	(4) lnDOM
neighPolicy	-0.087*	-0.083*	-0.058	-0.053
	(0.045)	(0.045)	(0.046)	(0.047)
after	-0.156***	-0.164***	-0.140***	-0.140***
	(0.039)	(0.052)	(0.053)	(0.053)
policyeffect	0.006	0.001	0.005	0.008
	(0.055)	(0.055)	(0.055)	(0.055)
Sep 2021		0.056	0.084	0.086
		(0.057)	(0.057)	(0.057)
Okt 2021		0.063	0.074	0.078
		(0.052)	(0.054)	(0.054)
Nov 2021		0.003	-0.007	-0.010
		(0.061)	(0.064)	(0.064)
Dec 2021		0.002	-0.022	-0.021
		(0.063)	(0.066)	(0.067)
Jan 2022		0.237***	0.163**	0.159**
		(0.074)	(0.077)	(0.077)
Feb 2022		0.013	0.005	0.002
		(0.070)	(0.071)	(0.072)
Mar 2022		-0.005	-0.010	-0.011
		(0.066)	(0.069)	(0.069)
Apr 2022		0.075	0.084	0.082
		(0.079)	(0.082)	(0.082)
May 2022		0.175	0.154	0.158
		(0.114)	(0.120)	(0.120)
salelistprice			-1.518***	-1.492***
			(0.200)	(0.203)
EnergLabel A+			0.174	0.165
			(0.198)	(0.199)
EnergLabel A++			0.913***	0.871***
			(0.075)	(0.089)
EnergLabel B			-0.052	-0.050
			(0.059)	(0.060)
EnergLabel C			-0.021	-0.018
			(0.049)	(0.049)

EnergLabel D	-0.055	-0.051
	(0.053)	(0.053)
EnergLabel E	-0.053	-0.051
	(0.057)	(0.058)
EnergLabel F	-0.043	-0.048
	(0.071)	(0.071)
EnergLabel G	0.022	0.026
	(0.068)	(0.068)
TypeHousing Eindwoning	0.149	0.146
	(0.266)	(0.270)
TypeHousing Geschakelde woning	-0.158	-0.189
	(0.176)	(0.177)
TypeHousing Halfvrijstaande woning	1.221***	1.193***
	(0.178)	(0.186)
TypeHousing Hoekwoning	0.333*	0.325*
	(0.180)	(0.180)
TypeHousing Tussenwoning	0.148	0.145
	(0.170)	(0.169)
TypeHousing Vrijstaande woning	0.964	1.067
	(0.610)	(0.665)
TypeHousing beneden + bovenwoning	0.498**	0.507**
	(0.204)	(0.202)
TypeHousing benedenwoning	0.140	0.154
	(0.170)	(0.170)
TypeHousing bovenwoning	0.188	0.201
	(0.169)	(0.169)
TypeHousing dubbel benedenhuis	0.151	0.142
	(0.192)	(0.190)
TypeHousing galerijflat	0.172	0.170
	(0.170)	(0.169)
TypeHousing maisonnette	0.258	0.261
	(0.177)	(0.177)
TypeHousing penthouse	-0.405**	-0.364**
	(0.177)	(0.179)
TypeHousing portiekflat	0.181	0.190
	(0.168)	(0.167)
TypeHousing portiekwoning	0.178	0.187
	(0.173)	(0.173)
TypeHousing tussenverdieping	0.256	0.262
	(0.182)	(0.181)
Distancesupermarketkm		0.096
		(0.098)
Distancehighwayprovincialroad		0.018
		(0.019)
Distancetrainstationkm		0.002
		(0.017)
Distancedaycarekm		0.248
		(0.204)
Distanceschoolkm		-0.308*
		(0.185)

Constant	3.407***	3.371***	4.865***	4.796***
	(0.031)	(0.044)	(0.288)	(0.310)
Observations	1,438	1,438	1,390	1,390
R-squared	0.028	0.043	0.119	0.123

```
( 1)  neighPolicy = 0
( 2)  after = 0
( 3)  policyeffect = 0

      F(  3,  1347) =    4.12
           Prob > F =    0.0064
```

Figure 10: *Chow F-test for subsets*