Tackling affordability and sustainability using rent control: the Dutch case

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S3740684

Thesis MSc Economics & MSc Finance

June 7, 2023

Abstract

This paper studies the effect of the announcement to expand and modernize rent control in the Netherlands on the buying segment of its housing market. A hedonic style difference-in-differences regression is used to estimate a significant average decrease of 22,458 euros in the price of middle-segment houses following the announcement, ceteris paribus. This estimated effect significantly differs across houses with different energy labels. More specifically, the negative effect for houses with an energy label of E or worse and D (-41,562 and -31,158, respectively) is more than twice the size of the negative effect for houses with an energy label C and B (-13,714 and -10,249, respectively). I conclude that the expected value of future rents decreased for middle-segment houses upon the announcement of the plans to expand rent control, which decreases the value of these houses for investors and thereby decreases the price of these houses. Furthermore, I conclude that the modernization of rent control makes the price cap more stringent for houses with a worse energy label, which decreases the price of these houses more.

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JEL classification — G14, R31, R38

Keywords— Rent control, Energy label, Announcement effect, Difference-in-Differences

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1 Introduction

Rising housing rents brought the issue of affordable housing to the forefront of the policy debate. In the Netherlands, this led to the idea of expanding rent control. Besides, climate change remains one of the greatest challenges of the coming years and is top on the list of political priorities worldwide. Buildings account for 40% of EU's final energy use (Tsemekidi-Tzeiranaki et al., 2020) and much of the energy currently used in buildings is wasted due to the use of inefficient systems or appliances (Martinopoulos et al., 2018). Therefore, the improvement of houses' energy efficiency is of the utmost importance. Recently, the Dutch housing minister sent letters to parliament to inform about his plan to expand and modernize rent control. Part of the modernization is a bigger role for the energy performance certification in determining maximum rent prices to stimulate energy efficiency improvements. This implies that besides informing, a good energy label leads to direct financial benefit in the form of a higher maximum rent. I aim to study the effects of the expansion and modernization of rent control in the Netherlands. More specifically, I estimate the effect of the announcement to expand and modernize rent control on the price to purchase a house. Furthermore, I investigate whether this effect differs across houses with different energy labels.

As I discuss in the literature review, the literature on whether rent control is efficient and how it affects the size of the rental market is extensive. On the other hand, the literature on the linkage between the rental segment and the purchase segment is thin. This study fills this gap in the literature and thereby improves the understanding of the linkages between the different segments within a housing market. This study further investigates the effectiveness of rent control by exploring another channel, the price to purchase a house, through which rent control affects affordability. It is also interesting to see that the housing prices already respond to the announcement of plans before they are even adopted or implemented. Besides, this study explores whether using the energy label in policies creates an additional incentive for people to improve their house's energy efficiency by creating value differences based on the energy label.

1.1 Economic and regulatory context

In the past decade, mortgage rates were historically low and housing prices have surged all over Europe. In 2022 the economic situation changed drastically with a sharp increase in interest rates. When interest rates increase, people can often borrow less and thus offer less for a house. This can also be seen in the housing prices of the Netherlands from the NVM. The average housing price in the final quarter of 2022 is 6.4% lower than that of the year before, the first yearly decrease in nine years. Besides, since the invasion of Ukraine by Russia, energy prices in Europe surged. Although energy prices declined since the end of 2022, they remain higher than before the invasion.

Currently, the Dutch residential housing markets mainly consist of three segments: owner-occupied housing, social rental housing, and private rental housing. In the social rental sector, the maximum rent is determined by the 'Woningswaarderingsstelsel'

(WWS), which is a compulsory housing valuation system, which awards points for certain characteristics. The more points a house receives, the higher the maximum rent. The Netherlands has a housing shortage. Demand exceeded supply by 279.000 houses in mid-2021 and especially the private sector rents increased (Stuart-Fox et al., 2022). The high rents in the private sector lead to affordability problems, especially for people in the middle-income segment. To protect these people, the government aims to extend the price cap in the social sector to cover part of the private rental sector as well. On 14 October 2022, a letter to parliament was sent that contained the first sketches of the regulation of part of the Dutch private rental market. This was followed by a letter on 9 December containing more details on this regulation. Next to information about the specifics of the price cap, the letters also contained information about modernizing the compulsory housing valuation system. An important part of this modernization is the stimulation of sustainability. More specifically, houses with good energy labels receive additional points, while points are subtracted from houses with bad energy labels.

Next to this price cap, several other policies were recently introduced that affected the position of investors in the Dutch rental market. Bijlsma et al. (2023) provide an overview of these measures and analyzed the impact of these policies on the present value and IRR of 30 example houses. Another influential policy is the differentiation of the 'overdrachtsbelasting'. As of 1 January 2021, buyers who will not live in the purchased house have to pay a tax of 8% of the transaction price. This tax increased to 10.4% as of 1 January 2023. While households younger than 35 years, who will live in a house that they purchase for less than a threshold price (400,000 in 2021 and 2022) do not have to pay this tax. For other buyers, the tax remains 2%. Furthermore, since 2022 municipalities can prohibit renting out low- and middle-segment houses that are bought in certain areas. Additionally, the government changes the tax system in 'box 3' such that investors in real estate have to pay more taxes as of 2023. Besides these measures that affect the position of investors in real estate, there have also been developments that may influence the importance of energy labels. On 1 June 2022, plans to prohibit renting out houses with energy labels E, F, or G as of 2030 were announced. Also, the Dutch government introduced a price ceiling that applies in the year 2023 and offered discounts against energy costs in the months of November and December 2022 to protect consumers.

The paper proceeds as follows. Section 2 provides a brief literature overview of the effects of rent control and the implementation and effects of an energy label. Section 3 details the empirical method, the hypotheses, the data employed, and the assumptions. Section 4 reports and discusses the main empirical findings. Section 5 discusses some limitations. Finally, Section 6 concludes.

2 Literature review

One of the cornerstones of neoclassical finance is the efficient market hypothesis (Fama, 1965). If the efficient market hypothesis holds, all publicly available information is immediately incorporated into security prices and the price of a security equals its fundamental value. The fundamental value is the present value of all future expected cash flows. Similarly, if housing markets are efficient, new information will be capitalized into prices immediately. In line with this, Hahn et al. (2023) theoretically show that forward-looking owners might exit the rental market even upon the announcement of a rent control policy.

The literature distinguishes between first- and second-generation rent control. First-generation rent control implies a 'hard' control in which rents are frozen at a certain level, while second-generation rent control is more 'soft' regulation in which a set of regulations govern rents and rent increases, but usually, a 'reasonable' rate of return is ensured to landlords (Kettunen and Ruonavaara, 2021). The economic literature does not support the use of first-generation rent control, although it may be beneficial for existing tenants (Arnott, 1995). The consensus is that it reduces both the quantity and quality of housing available. On the other hand, second-generation rent control is so different that it should be judged largely independently of the experience with first-generation controls (Arnott, 1995). A recent example of first-generation rent control is the rent freeze in Berlin (Mietendeckel). Besides a significant drop in rents, Hahn et al. (2023) find a significant drop in the number of advertised properties for rent, a share of which appears to be permanently lost for the rental sector. Other studies also find that rent control shifts units away from the rental sector (Diamond et al., 2019; Sims, 2007). Besides the reduction in rental supply, Glaeser and Luttmer (2003) argue that rent control eliminates the ability of the price mechanism to allocate goods efficiently across consumers and that the resulting misallocation can lead to sizable social losses. Mense et al. (2019) agree that rent control causes misallocation and find that it increases rents in the free segment. Additionally, Autor et al. (2014) find that the end of the Massachutes rent control led to an increase in the assessed value and transaction prices. They argue that this is due to increased rental revenue, additional maintenance and improvements made at these locations, and potentially positive spillovers from improved maintenance and changes in resident composition at nearby units. Despite these disadvantages, Haffner et al. (2012) argue based on welfare economics that housing market inefficiency, uneven income distribution, or social segregation might justify rent regulation policy if disadvantages for tenants take center stage in housing policy.

The success of policies to improve the energy efficiency of the housing stock critically depends on the ability of homeowners, developers, and commercial real estate investors to identify efficiency opportunities and their willingness to invest in energy efficiency retrofits (Aydin et al., 2020). Gillingham et al. (2009) mention that information asymmetry as in Akerlof (1970) "lemons" model is a potential barrier that may lead to under-investment in energy efficiency. EU member states have been required since 2009 to implement energy performance certification (EPC) to combat this barrier.

Several authors empirically studied the effect of the energy efficiency of a property on its value. Brounen and Kok (2011) are the first to study the market adoption and economic implications of energy performance certificates implemented by the European Union. They find that consumers pay a four percent premium for homes labeled as "efficient" (energy label A, B, or C) in the Netherlands. This study is actualized by researchers from the University of Tilburg and Maastricht in 2021, who studied the period between January 2018 and July 2021. They find a 'green premium' (A/B label) that varies between 3% and 6% of the sale price of one-family homes and a 'red discount' (F/G label) of 6% on average. Chegut et al. (2016) specifically focus on the social segment in the Netherlands, which has strong rental protection. They argue that Dutch affordable housing suppliers recoup sustainability investment by selling dwellings. They find that energy-efficient affordable dwellings sell at a premium. More specifically, A-labeled dwellings are 6.3% (9,300 euros) more valuable than C-labeled ones. On the other hand, Buijs and Buijtendijk (2023) do not find evidence for a 'green premium' or 'red discount' in the private rental segment.

Since houses are heterogeneous, the housing market is viewed as a differentiated market. Often hedonic models are used to identify the marginal willingness to pay for each house characteristic and the value of a house is the realization of these attributes (Rosen, 1974). Indeed, both the papers studying rent control and the papers studying the effect of an energy label use hedonic methods. To estimate the effect of rent control, several studies use a difference-in-differences (DiD) approach applied to the hedonic method (Sims, 2007; Autor et al., 2014; Mense et al., 2019). These studies compare price trajectories of houses inside and outside the scope of the rent control. Besides this approach, Mense et al. (2019) also use a discontinuity in time approach, and Diamond et al. (2019) use the quasi-random variation in the assignment of rent control.

3 Methodology

3.1 Empirical method

To estimate the effect of the announcement to expand and modernize rent control on the price to purchase a house, I use a DiD approach applied to the hedonic method. The DiD approach is a quasi-experimental approach that compares the difference in outcomes before and after the treatment for the treatment group with that difference for the control group. I use 14 October 2022, the day that the letter containing the first sketches on the regulation was sent to parliament, as the announcement date. I compare the prices before and after this announcement/treatment. To determine the treatment group and the control group, I estimate the number of WWS points of a house to determine to which segment it belongs. The main components of the number of WWS points are the living area, the 'WOZ' value (a valuation of the property by the government), and the energy label. A house receives one point for each square meter of the living room, bedrooms, kitchen, and bathroom. For the remaining areas of living space, a house receives 0.75 points for each square meter. I assume that 15% of the living spaces is a 'remaining area', which implies that the weighted average is 0.9625 points for each square meter. I have data on the WOZ value in 2020 and will therefore use the calculation based on the value of 2020. It is specified that a house receives 1 point for every 10,289 euros of this value and 1 point for every 160 euros of the factor $woz/(m2)$. Additionally, a house receives points for the energy label. For these points, I use the number of points for each label for one-family homes that are bigger than 40m^2 as specified in the letter to parliament on 9 December, which contains more details on the new regulation. The numbers of points are 62, 57, 52, 47, 40, 32, 22, 14, -1, -5, and -10 for energy labels A++++, A+++, A++, A+, A, B, C, D, E, F, G, respectively. Finally, a house receives points for several characteristics (e.g. a toilet and the size of the countertop). This is only a small part of the total and is estimated to be 22 for an average 3-room house. An additional rule is that the share of points coming from the WOZ value can not exceed 33% of the total. I do not take this additional rule into account since I can not estimate the points for several characteristics as mentioned before, which may be the reason that the WOZ value is more than 33% of the total. Furthermore, not taking this into account simplifies the estimation. When taking this rule into account, only a small number of houses (¡1%) were allocated differently and it did not significantly change the results, which will be discussed in the following section. To conclude, the number of WWS points is estimated by:

$$wwsP = 0.9625 \times m2 + woz/10,289 + woz/(m2 \times 160) + wwsE + 22 \quad (1)$$

where $wwsP$ denotes the estimated number of WWS points for a house. $m2$ denotes the amount of living space in square meters and woz denotes the WOZ value in 2020. Finally, $wwsE$ denotes the number of points a house receives for the energy label.

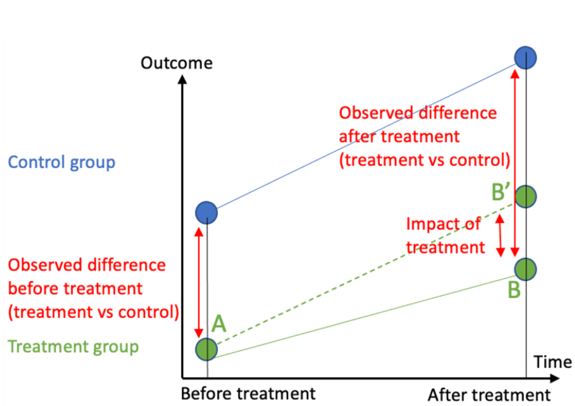

Figure 1: DiD framework

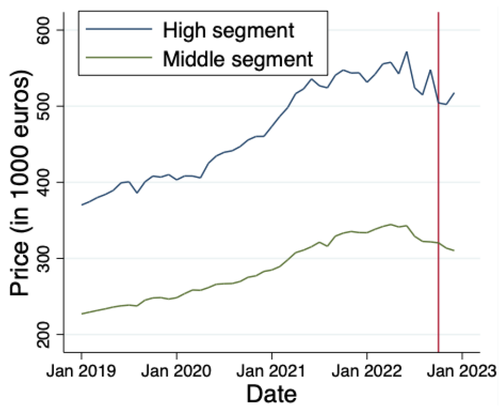

Figure 2: Average transaction price for the middle and high segment

The current price cap applies to the social segment, which consists of houses with less than 142 WWS points. The plan is to extend this price cap to houses with 186

WWS points or less. A free segment that includes houses with 187 WWS points or more remains. Therefore, a house is classified as being part of the social segment ($WWSpoints < 142$), the private middle segment ($142 \leq WWSpoints \leq 186$), or the private high segment ($WWSpoints > 186$). Note that I analyze all houses that are sold, which include both rental and owner-occupied houses. Thus, the classification is based on the segment of the house if it would be rented. The middle segment is the treatment group because houses in this segment are currently not subject to the price cap and will be subject to this if the plans are implemented. The high segment is the control group because houses in this segment are not and will not be subject to the price cap. Therefore, I expect that this group will be a good representation of what would have happened to houses in the middle segment if there were no plans to expand and modernize the price cap. Although the social segment is also affected by the plans through modernization and additional enforceability, this segment will not be the focus of my research. Furthermore, the social segment is not similar to the middle segment and thus not a good control group because it is already under regulation, subsidized, and supplied by corporations instead of market parties. Therefore, I exclude transactions in the social segment from the analysis. Figure 1 analytically shows the reasoning of the DiD framework. In line with my data, the control group has a higher outcome than the treatment group before the treatment. The key assumption of the DiD is the parallel trends assumption, which assumes that, in the absence of the treatment, the treatment group and the control group would have followed the same trend over time. In terms of Figure 1, it is expected that in the absence of treatment, the treatment group would have ended up at B′. Therefore, the effect of the treatment is estimated by the difference between B′ and B. Figure 2 shows that the average transaction prices of the middle and the high segment indeed follow a similar trend over time. Furthermore, there is already a slight divergence from the trend after the announcement to extend rent control (the red line). To estimate the effect of the announcement to expand and modernize rent control on the price to purchase a house, I use the following econometric model:

$$p_i = \beta_0 + \beta_1 Middle_i + \beta_2 PostA_i + \beta_3 Middle_i \times PostA_i + \sum_{n=1}^{3} (\theta_n t_n) + \xi' X_i + \epsilon_i \quad (2)$$

where p_i denotes the transaction price of house transaction i. The dummy variable $Middle_i$ equals one if the house falls in the middle segment according to the estimation of the WWS points, and zero otherwise. The dummy $PostA_i$ equals one if the unit was sold after the announcement to expand the rent control, and zero otherwise. Observe the interaction term, where β_3 estimates the effect of the regulation on the transaction price. $\sum_{j=1}^{3} (\theta_j t_j)$ represents the adjusted year dummies, which include a dummy for houses transacted in 2020, a dummy for houses transacted from 1 January 2021 until 24 February 2022, and a dummy for houses transacted from 24 February 2022 until 10 October 2022. I adjusted the year dummies to capture the effect of the invasion of

Ukraine, which started on 24 February 2022. The invasion may affect the value of the energy label through the prices for energy. Note that the reference group consists of houses transacted in 2019 and that transacted houses after 10 October 2022 are captured by the dummy $PostA_i$. X_i denotes a matrix containing various hedonic characteristics with associated parameter vector ξ. These characteristics include the living area in square meters, the number of rooms, dummies for the energy label, dummies for the period of construction, dummies for the house type, and dummies for the province. Finally, ϵ_i is a normally and independently distributed error term.

The new rent control awards houses with good energy labels with additional WWS points, which implies a higher maximum rent, and punishes houses with bad energy labels with a deduction in WWS points, which implies a lower maximum rent. Therefore, I extend the first econometric model by replacing the interaction term $Middle_i \times PostA_i$ with the interaction terms $\sum_{j=1}^{5}(\delta_j Middle_i \times postA_i \times Label_j)$. These interaction terms estimate the effect of the announcement to expand and modernize rent control for houses distinguished by the energy label. The second econometric model is specified as:

$$p_i = \beta_0 + \beta_1 Middle_i + \beta_2 PostA_i + \sum_{j=1}^{4}(\gamma_j Label_j) + \sum_{j=1}^{5}(\delta_j Middle_i \times postA_i \times Label_j) + \sum_{n=1}^{3}(\theta_n t_n) + \zeta' Z_i + \epsilon_i \quad (3)$$

where the denotation of p_i, $Middle_i$, and $PostA_i$ remains unchanged. $\sum_{j=1}^{4}(\gamma_j Label_j)$ represent the dummies for the energy label of a house. The dummies are $LabelA(+)_i$, $LabelB_i$, $LabelD_i$, and $LabelE, F, G_i$ for houses with energy label A or higher, B, D, and E, F, or G, respectively. The reference group consists of houses with energy label C. Note that these dummies were captured by $\xi' X_i$ in the first regression and are now explicitly mentioned. $\sum_{j=1}^{5}(\delta_j Middle_i \times postA_i \times Label_j)$ represent the interaction terms to estimate the effect of the announcement to expand and modernize rent control for houses distinguished by the energy label. The interaction terms are $Middle_i \times PostA_i \times labelA(+)_i$, $Middle_i \times PostA_i \times labelB_i$, $Middle_i \times PostA_i \times labelC_i$, $Middle_i \times PostA_i \times labelD_i$, and $Middle_i \times PostA_i \times labelE, F, G_i$. Note that this term includes five dummies whereas there are four energy label dummies. An interaction term for houses with energy label C is also included because the DiD estimate can be estimated for each energy label without the issue of the dummy trap. Z_i denotes a matrix containing the same hedonic characteristics as X_i excluding the energy label dummies and has associated parameter vector ζ. Finally, ϵ_i is a normally and independently distributed error term.

3.2 Hypotheses

I expect that the announcement to expand rent control to include the middle segment will decrease the price of middle-segment houses in the purchase market. The reason is that rent control leads to decreased rental revenue in the middle segment assuming that the cap is set below the market rent. This will decrease the value of these houses for investors. This implies that investors are both less likely to buy a middle-segment house and more likely to sell a middle-segment house. While the increased supply from investors may take some time, the decreased demand is likely to occur immediately. Both have a negative impact on the transaction price of a house. From a statistical viewpoint, I expect the following alternative hypothesis to be true in terms of the parameters in the first econometric model specified in equation 2:

Hypothesis 1

H_a: $\beta_3 < 0$

The modernization of rent control results in additional points and thus a higher price cap for houses with good energy labels. At the same time, points are subtracted for houses with bad energy labels. Before this modernization, there was no evidence of a difference in rents in the private rental segment (Buijs and Buijtendijk, 2023). Therefore, I expect that the rent control will be more stringent for houses with a worse energy label. This will decrease rental revenue more for middle-segment houses with a bad energy label than for middle-segment houses with a good label. Therefore, I expect that the value of middle-segment houses with a bad energy label will decrease more than the value of middle-segment houses with a good energy label. From a statistical viewpoint, I expect the following alternative hypothesis to be true in terms of the parameters in the second econometric model specified in equation 3:

Hypothesis 2

H_a**:** $0 > \delta_1 > \delta_2 > \delta_3 > \delta_4 > \delta_5$

where δ_1 is the coefficient for the interaction term for houses with label A or higher, δ_2 for houses with label B, δ_3 for houses with label C, δ_4 for houses with label D, and δ_5 for houses with label E, F or G.

3.3 Data

I employ data of 289,995 housing transactions in the Netherlands over the period 2019-2022. To obtain information on housing transactions, I use the database of the Dutch Association of Realtors (NVM), which includes information on the house's address, the characteristics of the transaction, and quality characteristics for each transacted dwelling. The members of the NVM collectively cover approximately 70 percent of all housing transactions in the Netherlands. The 'Rijksdienst voor Ondernemend Nederland (RVO)', an agency of the Dutch Ministry of Economic Affairs, exerts quality control and maintains the registration of energy performance certificates in the Netherlands. I accessed their database to obtain information on the energy label of the houses. From the Central Bureau of Statistics (CBS), I collected information on the WOZ value. This information is available at the zip code level. The NVM data is merged with the RVO data based on the address. This dataset is then merged with the CBS data based on the 'verblijfsobject identificatienummer', which is a unique identifaction number each houses. Table A1 in the Appendix provides some descriptive statistics of the variables that are used in the hedonic price regressions.

When including only transactions for which the transaction price and date are known, the dwelling does not have house number 0, and the transaction is 'good' (according to the NVM filter), the data consists of 457,464 transactions. I removed outliers in terms of the number of rooms and living space (<1% of the data). Also, to make a proper merge based on the address, I included only addresses with simple additions to the house number (which removed 4.2% of the data). After the merge with the RVO data, 334,922 housing transactions with an energy label remained (which implies that another 22.6% is removed). Then, this dataset was merged with the CBS data and I deleted observations with a missing WOZ value. This resulted in 328.578 housing transactions remaining (which implies that another 1.4% is removed). Finally, I noticed that the date of the transaction of some observations was outside the time interval that it was supposed to be in (1 January 2019 - 1 January 2023). Since these observations may be mistakes, I also removed these (<1% of the data). From the 327,980 remaining observations, 37,985 are in the social segment, 94,662 are in the middle segment, and 195,333 are in the high segment. For my analysis, I eventually use the 289,995 transactions in the middle and high segments.

3.4 Assumptions

For the econometric models, some assumptions need to be considered. For OLS to be the Best Linear Unbiased Estimator (BLUE) in the class of linear unbiased estimators, the regression model needs to satisfy the Gauss-Markov assumptions. Additionally, a normality assumption is needed to obtain valid t- and F-statistics. These assumptions can be summarized in algebra by:

1. $E\{\epsilon_i\} = 0, i = 1, ..., N$ (the expected value of the error term is zero)
2. $E\{\epsilon_i|X\} = 0$ (exogeneity)
3. $V\{\epsilon_i|X\} = \sigma^2, i = 1, ..., N$ (homoskedasticity)
4. $Cov\{\epsilon_i, \epsilon_{jt}|X\} = 0, i, j = 1, ..., N, i \neq j$ (no autocorrelation)
5. $\epsilon \sim N(0, \sigma^2)$ (normality)

The first assumption is satisfied, because the models in equation 2 and 3 both include an intercept.

The second assumption is the strict exogeneity (no endogeneity) assumption. It implies that the expectation of the error term, conditional on the set of regressors must be equal to zero. Violating this assumption will result in biased and inconsistent parameter estimates. There are several cases in which the strict exogeneity assumption is not satisfied: relevant omitted variables, measurement error and reverse causality. It is notoriously difficult to make sure that a model is free of endogeneity. When a variable is omitted that affects the dependent variable and is correlated with an independent variable, there is an omitted variable bias. As mentioned earlier, lots of changes took place in both the economic and regulatory context. Therefore, it is definitely not possible to simply compare the price of middle-segment houses before and after the announcement to expand and modernize rent control and claim that this difference is caused by the announcement. To deal with this problem, I use the DiD approach. This uses the fact that this announced regulation has an effect on the middle segment, while it does not have an effect on the high segment. Before the announcement, I observe the difference between the prices of houses in the middle segment and high segment, which takes into account all measured and unmeasured attributes. Assuming that these attributes do not change over time, these attributes are filtered away by comparing the difference over time. Furthermore, assuming that the economic and regulatory changes are the same for each group, these effects are also filtered away such that the effect of the announcement of the regulation remains. Thus, I need to assume that differences across groups that are not related to the treatment are constant over time. Essentially this implies that in the absence of the treatment, the treatment group and the control group would have followed the same trend over time. Of course, it is not observable what would have happened in the absence of treatment. However, Figure 2, shows that in the past the average price of both groups followed a similar trend. However, this does not guarantee that it would have continued to follow this trend without the treatment and it may be that these differences are not constant over time. It could be that e.g. the interest rate or the tax change affects middle-segment and high-segment houses in a different way, which would bias the results. The data falls subject to multicollinearity when explicitly controlling for these issues. However, I did include time dummies, which should capture part of these effects. Besides, there is always the risk of missing certain relevant variables. There is a low chance of measurement errors since the data is collected by reputable and reliable institutions. Furthermore, measurement error will only cause endogeneity problems when the error is substantial. Reverse causality is also not an issue since the announcement precedes any potential effects.

To check whether the third assumption holds, I performed the White (1980) test and the Breusch and Pagan (1979) / Cook and Weisberg (1983) test on the residuals of both models. All tests reject the null hypothesis of constant variance. Thus, I conclude that there is heteroskedasticity and the third assumption does not hold. The results of these tests are shown in Table A3. In the presence of heteroskedasticity, the OLS estimation is still unbiased, but the standard errors could be inappropriate. Therefore, I use White's heteroskedasticity consistent standard errors to solve this problem.

The fourth assumption is implied by random sampling. On one hand, this is likely to hold since the members of the NVM collectively cover approximately 70 percent of all housing transactions in the Netherlands. In general, it seems reasonable that there is no systematic reason why a particular type of person will sell their property at the same time. However, it could be that especially investors who rent out a house sold houses recently following the regulation, which affects the sample since it only includes transactions.

The fifth assumption is that all error terms follow a normal distribution. The central limit theorem suggests that a random variable converges to a normal distribution when the sample size is large enough. I consider my sample of 289.995 observations to be large enough. Therefore, I think it is reasonable to assume that the normality assumption holds.

Another issue that could cause estimation problems is multicollinearity, which occurs when the explanatory variables are very highly correlated with each other. To check for multicollinearity, I investigate the Variance Inflation Factor (VIF) of the independent variables in the regression, which are reported in Table A4. The VIF values are all well below the threshold value of 10. Therefore, I conclude that multicollinearity does not impose a problem.

4 Results

I use Ordinary Least Squares estimation with White's heteroskedasticity consistent standard errors to estimate the econometric models in equations 2 and 3. Table 1 shows the results of these regressions. The first difference in the DiD approach is the difference between houses in the middle segment (treatment group) and houses in the high segment (control group). This difference is represented by the coefficient of $Middle_i$ and shows that houses in the middle segment have a significantly lower transaction price than houses in the high segment, ceteris paribus. The second difference is the difference over time. This is represented by the coefficient of $PostA_i$, which shows that houses that transacted in the post-announcement period (10 October 2022 - 1 January 2023) have a higher transaction price than houses that transacted in 2019. While these coefficients are not the focus of my research question, they do demonstrate plausible and expected relationships in both models.

The DiD estimate in model 1 is the coefficient of $Middle_i \times PostA_i$, which is -22,458 and is significant at the 1% level. This interaction term estimates the effect of the announcement to expand and modernize rent control on the price of middle-segment houses. Therefore, my first hypothesis that the announcement will decrease the price of middle-segment houses in the purchase market is supported. If my assumptions in section 3.4 are valid, the coefficient means that the announcement to expand and modernize rent control causes prices of middle-segment houses to fall by 22,458 euros on average, ceteris paribus. This implies a drop of 5.6% of the average transaction price during the studied time period.

Table 1: Results of the OLS estimation of the econometric models specified in equation 2 (Model 1) and equation 3 (Model 2). The robust standard errors are in parentheses and the significance is represented by *** p<0.01, ** p<0.05, * p<0.1.

Variables	(1) p_i	(2) p_i
$Middle_i$	-34,063.13***	-34,141.86***
	(923.91)	(924.49)
$PostA_i$	114,766.16***	114,785.38***
	(1,964.76)	(1,964.75)
$LabelA(+)_i$	2,603.03**	2,665.26**
	(1,050.61)	(1,055.23)
$LabelB_i$	408.21	379.79
	(760.23)	(766.52)
$LabelD_i$	-2,390.61***	-2,036.89**
	(853.00)	(865.10)
$LabelE,F,G_i$	-3,380.15***	-2,814.75**
	(1,215.00)	(1,230.44)
$Middle_i \times PostA_i$	-22,458.40***	
	(2,316.14)	
$Middle_i \times PostA_i \times labelA(+)_i$		-20,022.00***
		(3,863.73)
$Middle_i \times PostA_i \times labelB_i$		-10,248.74***
		(3,506.60)
$Middle_i \times PostA_i \times labelC_i$		-13,713.76***
		(2,689.41)
$Middle_i \times PostA_i \times labelD_i$		-31,157.61***
		(3,494.58)
$Middle_i \times PostA_i \times labelE,F,G_i$		-41,562.42***
		(4,084.73)
Observations	289,995	289,995
Adjusted R-squared	0.63	0.63

Continued in appendix (Table A2)

In Model 2, I investigate whether the DiD estimate differs for houses with different energy labels. The coefficient of $Middle_i \times PostA_i \times labelA(+)_i$ is -20,022 and is significant at the 1% level. This is the DiD estimate for houses with energy label A or higher. Thus, it estimates the effect of the announcement to expand and modernize rent control on the price of middle-segment houses with energy label A or higher. Similarly, the coefficient of the interaction terms $Middle_i \times PostA_i \times labelB_i$, $Middle_i \times PostA_i \times labelC_i$, $Middle_i \times PostA_i \times labelD_i$, and $Middle_i \times PostA_i \times labelE, F, G_i$ represent the DiD estimates for houses with label B, C, D, and E, F, or G, respectively. Note that all coefficients are significantly below 0 at the 1% significance level. Thus, for houses in the middle segment with each energy label, the announcement to expand and modernize rent control is associated with a significant decrease in the price. The regression results in Table 1 also show that the coefficients of the interaction terms in model 2 differ. To test whether the coefficients are significantly different from each other, I performed F-tests which are displayed in Table A5. The F-tests show that the coefficients of the interaction terms are all significantly different from each other at the 1% significance level. Thus, the effect of the announcement significantly differs for houses with different energy labels. I find that the coefficient of $Middle_i \times PostA_i \times labelE, F, G_i$ displays the largest decrease. The estimated coefficient suggests that the announcement to expand and modernize rent control causes an average decrease of 41,562 euros in the transaction prices of middle-segment houses with energy label E, F, or G, ceteris paribus. This is followed by middle-segment houses with energy label D, which experienced a decrease of -31,158 euros on average, ceteris paribus. The effect on middle-segment houses with energy label C is comparatively smaller, with an average decrease of 13,714 euros, less than half the magnitude of the effect observed for houses with energy label D. Similarly, middle-segment houses with energy label B experience a decrease of 10,249, ceteris paribus. Therefore, my second hypothesis that rent control will be more stringent for houses with a worse energy label due to the modernization of rent control, which leads to a larger negative effect on the price is supported for houses with these energy labels. However, contrary to my initial expectation I find evidence that suggests that the announcement leads to a larger average decrease for middle-segment houses with label A than for middle-segment houses with label B or C. A potential reason could be that middle-segment houses with label A or higher have certain characteristics that are not included in the model that result in a higher market value and thus more stringency of the price cap.

Besides, the regression results show a significant effect of the energy label on the price of houses. Although this relationship has been previously investigated in the literature (Brounen and Kok, 2011), it is still noteworthy to observe this effect in our study. The findings are consistent with prior research, suggesting that a house with a better energy label is associated with a significantly higher transaction price, ceteris paribus.

5 Limitations

This study has some limitations that should be considered when interpreting the results. Firstly, this study assumes that differences across groups that are not related to the treatment are constant over time. While I observe a similar historical trend in the average price of both segments, this does not guarantee that the trend would have continued without the treatment. Although I used time dummies to control for changes in the environment, it may be that some factors such as changes in interest rates or other regulations affect middle and high-segment houses differently, potentially introducing bias into the results. For example, the plans to prohibit renting out houses with energy labels E, F, or G as of 2030 may have led to an overestimation of the effect for middle-segment houses with these labels.

Another limitation is that this study focuses on the effects of the expansion and modernization of rent control in the Netherlands. As such, the findings may be specific to the Netherlands and may not be directly generalizable to other countries with different housing markets and regulations.

Besides, this study only covers a short time period following the announcement to expand and modernize rent control. This does not capture any long-term effects or effects from the actual implementation. Additionally, there may still be uncertainty on whether the regulation will eventually be implemented. Future research could elaborate on this.

6 Conclusion and discussion

The announced expansion of rent control in the Netherlands aims to tackle the affordability problems in the private sector, especially for middle-income households. Furthermore, by also modernizing the rent control the government aims to value houses more properly and to create incentives for investing in housing energy efficiency. Besides the effect on the rental segment, this also influences the buying segment of the housing market. I use a DiD approach and estimate that the announcement to expand and modernize rent control causes the prices of middle-segment houses to fall on average by 22,458.40 euros, ceteris paribus. I conclude that the expected value of future rents decreased for middle-segment houses upon the announcement of the plans to expand the rent control, which decreases the value of these houses for investors and thereby decreases the price of these houses.

The effect of the announcement differs across houses with different energy labels. For houses with energy labels B, C, D, and E, F, or G, a worse energy label is associated with a significantly larger average adverse effect of the announcement to expand and modernize rent control. More specifically, the significant negative effect of respectively 41,562 and 31,158 for E, F, or G label houses and D label houses is more than twice the size of the effect for C and B label houses, which is 13,714 and 10,249, respectively. Houses with energy label A or higher are the only exception to the rule that a worse energy label is associated with a larger adverse effect because the average adverse effect for houses with energy label A or higher is -20,022 and thus smaller than for houses with energy label B and C. I believe that middle-segment houses with the label A or higher are often modern and well-equipped, especially since it is very difficult and costly for older houses to move from a lower energy label to A or higher. Furthermore, I believe that although the modernization of rent control makes the price cap less stringent for houses with energy label A or higher, the adverse effect is higher for these houses because they have a higher market value due to unobserved characteristics which makes the price cap more stringent. I conclude that the modernization of rent control makes the price cap more stringent for houses with a worse energy label, which decreases the price of these houses more.

These conclusions have several implications. Firstly, the expansion of rent control not only decreases rents but also decreases the price to buy houses. Secondly, the announcement of plans to impose regulation on the rental market already affects the buying market before the plans are adopted or implemented which is evidence in favour of an efficient housing market. Finally, the use of the energy label in rent control increases value differences based on the energy label, which increases the incentive for people to improve their house's energy efficiency. I recommend using the energy label in Future research should explore the effects of these incentives on households' willingness to invest in the improvement of the energy efficiency of their house.

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7 Appendix

Table A1: Descriptive statistics

Variables	Mean	Std. Dev.
Transaction price (euro's)	403093.7	203155.2
Time on market (days)	54.97	127.35
Segment (percent)		
Middle	32.64%	46.89%
High	67.36%	46.89%
Period of transaction (percent)		
$PostA_i$ (10 October 2022 - 1 January 2023)	3.87%	19.28%
24 February 2022 - 10 October 2022	11.11%	31.42%
1 January 2021 - 24 February 2022	27.24%	44.52%
2020	31.64%	46.51%
2019	26.15%	43.94%
Energy label (percent)		
A (++++)	26.90%	44.34%
B	17.64%	38.12%
C	30.38%	45.99%
D	11.70%	32.15%
E, F, or G	13.38%	34.04%
Interaction terms (percent)		
$Middle_i \times PostA_i$	1.33%	11.46%
$Middle_i \times PostA_i \times LabelA(+)_i$	0.15%	3.90%
$Middle_i \times PostA_i \times LabelB_i$	0.19%	4.30%
$Middle_i \times PostA_i \times LabelC_i$	0.50%	7.04%
$Middle_i \times PostA_i \times LabelD_i$	0.24%	4.87%
$Middle_i \times PostA_i \times LabelE, F, G_i$	0.26%	5.07%
WOZ value	316467.8	160508.2
WWS points estimate	214.87	55.41
Living space (in square meters)	126.87	43.05
Number of rooms	4.93	1.37
Period of construction (percent)		
Before 1960	3.15%	17.47%

Continued on next page

Table A1: continued from previous page

Variables	Mean	Std. Dev.
1906-1930	7.24%	25.91%
1931-1944	5.39%	22.57%
1945-1959	5.55%	22.89%
1960-1970	11.90%	32.38%
1971-1980	16.48%	37.10%
1981-1990	13.95%	34.65%
1991-2000	14.58%	35.29%
2001-2010	14.63%	35.34%
After 2010	7.13%	25.73%
House type (percent)		
Terraced	32.95%	47.00%
Sem-detached	2.96%	16.96%
Corner	13.72%	34.41%
Duplex	17.57%	38.05%
Detached	15.53%	36.22%
Apartment	17.27%	37.80%
Province (percent)		
Groningen	3.13%	17.41%
Friesland	3.23%	17.67%
Drenthe	3.49%	18.36%
Overijssel	6.24%	24.19%
Gelderland	13.76%	34.45%
Utrecht	9.43%	29.22%
Noord-Holland	16.44%	37.07%
Zuid-Holland	18.96%	39.20%
Zeeland	1.49%	12.12%
Noord-Brabant	16.30%	36.93%
Limburg	4.01%	19.62%
Flevoland	3.53%	18.45%

Table A2: Additional results of Table 1

Variables	(1) p_i	(2) p_i
Period of transaction		
2020	32,240.16***	32,240.52***

Continued on next page

Table A2: continued from previous page

Variables	(1) p_i	(2) p_i
	(528.59)	(528.62)
1 January 2021 - 24 February 2022	103,057.38***	103,060.18***
	(632.81)	(632.84)
24 February 2022 - 10 October 2022	133,265.73***	133,278.66***
	(850.98)	(851.01)
Living area (in square meters)	2,722.60***	2,722.17***
	(26.12)	(26.12)
Number of rooms	-3,111.88***	-3,122.03***
	(382.38)	(382.37)
Period of construction		
1906-1930	-2,608.77	-2,585.15
	(2,914.10)	(2,914.37)
1931-1944	4,514.42	4,511.97
	(2,853.72)	(2,853.95)
1945-1959	-19,293.08***	-19,205.66***
	(2,732.81)	(2,733.07)
1960-1970	-67,040.84***	-66,977.71***
	(2,606.36)	(2,606.68)
1971-1980	-95,527.23***	-95,439.30***
	(2,652.70)	(2,653.23)
1981-1990	-64,160.18***	-64,075.93***
	(2,646.69)	(2,647.26)
1991-2000	-52,275.80***	-52,135.56***
	(2,764.36)	(2,765.17)
2001-2010	-41,709.29***	-41,562.12***
	(2,939.92)	(2,940.74)
After 2010	-6,473.09**	-6,337.56**
	(3,018.21)	(3,018.95)
House type		
Semi-detached	40,499.01***	40,525.52***
	(1,424.45)	(1,424.34)
Corner	15,913.98***	15,927.88***
	(602.45)	(602.34)
Duplex	43,712.71***	43,739.63***
	(715.64)	(715.59)
Detached	98,515.57***	98,547.93***

Continued on next page

Table A2: continued from previous page

Variables	(1) p_i	(2) p_i
	(1,361.63)	(1,361.71)
Apartment	46,862.06***	46,773.27***
	(759.61)	(759.96)
Province		
Friesland	-4,252.19**	-4,247.99**
	(1,678.80)	(1,678.77)
Drenthe	1,518.33	1,513.10
	(1,675.30)	(1,675.26)
Overijssel	37,693.22***	37,720.59***
	(1,501.46)	(1,501.45)
Gelderland	86,594.09***	86,614.67***
	(1,436.40)	(1,436.50)
Utrecht	194,977.14***	194,999.42***
	(1,551.10)	(1,551.16)
Noord-Holland	216,079.23***	216,111.96***
	(1,633.78)	(1,633.80)
Zuid-Holland	145,536.83***	145,574.89***
	(1,456.07)	(1,456.14)
Zeeland	35,985.12***	36,007.05***
	(2,051.58)	(2,051.79)
Noord-Brabant	90,068.46***	90,098.30***
	(1,426.53)	(1,426.64)
Limburg	447.71	489.38
	(1,695.90)	(1,696.01)
Flevoland	79,083.45***	79,099.97***
	(1,536.68)	(1,536.55)
Constant	-73,385.60***	-73,502.08***
	(3,902.98)	(3,903.49)
Observations	289,995	289,995
Adjusted R-squared	0.63	0.63

Table A3: Results of the White (1980) test and the Breusch and Pagan (1979) / Cook and Weisberg (1983) test. The test statistic and p-value are shown to test the null hypothesis of homoskedasticity. The tests were performed on model 1 specified in equation 2 and on model 2 specified in equation 3.

	chi2	p-value
Model 1		
White's test	36903	0.000
Breusch-Pagan / Cook-Weisberg test	434889	0.000
Model 2		
White's test	36910	0.000
Breusch-Pagan / Cook-Weisberg test	435061	0.000

Table A4: The VIF values of the independent variables in both models to test for multicollinearity.

Variables	VIF model 1	VIF model 2
Building period 2001-2010	6.71	6.71
Building period 1991-2000	6.03	6.03
Province Zuid-Holland	5.90	5.90
Building period 1971-1980	5.77	5.77
Building period 1981-1990	5.44	5.44
Province Noord-Holland	5.37	5.37
Province Noord-Brabant	5.27	5.27
Province Gelderland	4.69	4.69
Building period 1960-1970	4.47	4.47
Building period after 2010	4.21	4.21
Energy label A(++++)	3.46	3.49
Building period 1906-1970	3.09	3.09
Province Overijssel	2.83	2.83
Living space (in square meters)	2.77	2.77
Building period 1945-1959	2.69	2.69
Building period 1931-1944	2.60	2.60
Number of rooms	2.28	2.28
Province Limburg	2.23	2.23
Province Flevoland	2.10	2.10
Province Drenthe	2.05	2.05
Province Friesland	1.97	1.97
Energy label E, F or G	1.89	1.92
Middle segment	1.81	1.81
Detached house	1.78	1.78

Continued on next page

Table A4: continued from previous page

Variables	VIF model 1	VIF model 2
Energy label is B	1.75	1.77
Transaction in post-announcement period	1.63	1.63
Apartment	1.63	1.63
$Middle_i \times PostA_i$	1.57	
$Middle_i \times PostA_i \times labelC$		1.22
$Middle_i \times PostA_i \times labelE, F, G$		1.13
$Middle_i \times PostA_i \times labelD$		1.12
$Middle_i \times PostA_i \times labelB$		1.09
$Middle_i \times PostA_i \times labelA(+)$		1.07
Transaction in 2020	1.51	1.51
Transaction between 1 january 2021 and invasion Ukraine	1.49	1.49
Province Zeeland	1.46	1.46
Energy label is D	1.42	1.44
Duplex house	1.41	1.41
Transaction between invasion Ukraine and announcement	1.27	1.27
Corner house	1.24	1.24
Semi-detached house	1.09	1.09
Mean VIF	2.93	2.75

Table A5: Results of the two-sided F-tests to test Hypothesis 2 from section 3.2. The p-value of the test is indicated and the test statistic is shown between brackets.

Coefficient	δ_1	δ_2	δ_3	δ_4
δ_2	0.000 (14.49)			
δ_3	0.000 (19.30)	0.000 (13.36)		
δ_4	0.000 (43.74)	0.000 (39.75)	0.000 (41.10)	
δ_5	0.000 (56.08)	0.000 (51.80)	0.000 (53.36)	0.000 (73.16)