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Rotterdam's rising housing prices: A panel study on the effects of gentrification on the ethnic makeup of the city's neighborhoods

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Abstract

In recent years, the municipality of Rotterdam has focused on gentrification policies aiming to improve the living standard in the city, as a result of which, housing prices have gone up even more so compared to the rest of The Netherlands. These rising housing prices are changing the socioeconomic composition of the city, attracting more outside investors and high income groups to previously undesirable neighborhoods. This research conducts a panel study on a neighborhood level in Rotterdam to study the effects of these rising housing prices on the ethnic composition of neighborhoods, more specifically on the displacement of people from a non-western migrant background. Several regression models are used in the empirical analysis to find a significant negative effect on the proportion of people from a non-western migrant background with rising housing prices, controlled by variables on income and labor participation, as well as a lagged independent variable.

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1 - Introduction

The housing market in The Netherlands and the shortage of affordable housing are some of the biggest issues the country's policymakers are faced with today. After decades of municipal strategies aimed at gentrification and urban renewal, in recent years, the Dutch housing market has exploded and is at risk of overheating. Measured by indices such as rent-to-income, which indicates the affordability of housing options, and the price-to-rent ratio, which indicates the balance between rental properties and home ownership, these measures all indicate the tightening of the housing market in all major Dutch cities, with housing prices in many cities having soared by up to 15% per year in major cities like Rotterdam since the last economic crisis in 2008. (Nijskens et al., 2019). While the social sector of housing still constitutes about 40% of the market, the mid-level of regulated housing has shrunk to about 10% of the total, leaving many people who do not qualify for fully subsidized housing struggling to find suitable, affordable options and leaving the people dependent on these housing facilities at disproportionate risk of displacement.

The municipality of Rotterdam recently attracted global attention with its housing policies and the consequences these have on the city's inhabitants in terms of displacement, more specifically due to the demolition of affordable housing in the Tweebosbuurt neighborhood. 535 social housing units are to be demolished and replaced by upscale rental properties by housing corporation Vestia, which has been dealing with financial problems in recent times. The move has been criticized by the United Nations due to the fact that it is in violation of the human right to adequate housing, as current residents are not being offered suitable solutions. Furthermore, the letter criticized the housing policies employed by the Dutch government in recent years, stating they lead to displacement and homelessness of the socioeconomically disadvantaged, disproportionately affecting people with a migrant background. (Rajagopal et al., 2021)

The policies criticized by the UN, leading to housing shortages and the subsequent displacement of people from disadvantaged socioeconomic backgrounds have far-reaching societal implications and are contributing to social inequality and political instability (Boelhouwer, 2020). As also mentioned in the report by Rajagopal et al. (2021), some demographic groups are affected more by rising housing prices than others: In particular low-middle income groups. Considering the fact that due to discrimination and ethnic penalties, people with a non-western migrant background still obtain lower educational and labor market outcomes on average (Witteveen & Alba, 2018), it is not unlikely that people with a migrant

background are an example of a group that has been greatly affected by the shortage of affordable housing. With Rotterdam being one of the most ethnically diverse cities in the world, with over 50% of its population having a non-Dutch background, the topic of the displacement of people with a migrant background is highly relevant in this context. (Onderzoek010 – Bevolking, 2021).

Taking into account the rising housing prices in the Netherlands, the disadvantages people with a migrant background face in both the labor and housing market and the ethnic makeup of the city of Rotterdam, all the above leads to the following research question:

Do changes in housing prices in Rotterdam have an effect on the ethnic makeup of the city's neighborhoods?

2 - Literature review

2.1 - The history of gentrification

The concept of gentrification has been around for the past 50 years or so and stems from the influx of 'gentry' - affluent and educated people - into some of London's traditionally working class neighborhoods in the 1960's. The term was coined by British sociologist Ruth Glass, who describes a process of gradual displacement of neighborhoods' original inhabitants, as housing prices start to rise due to continued investments and the purchase and renewal of properties. This process is completed once the area has been transformed into an upscale residential area, along with a shift from rental to owner occupation. (Shaw, 2008).

The way through which the process of gentrification was spurred in each city has differed over time, as ideas about urban development strategies have changed. For example, in The United States during the 1970's, a wave of gentrification through private investment and purchasing of run-down buildings swept across cities such as New York. This process was presented as an attempt to 'recapture the true value' of prime geographical locations in the city center by individual investors (without significant policy interventions at the root), when these areas had become undesirable housing locations for the middle class after the post-war white flight from these same areas. (Zukin, 1993)

These areas were reframed from dangerous, poverty-stricken urban cores to important cultural and historical hubs over a short period of time, drawing white middle class 'urban pioneers', raising housing prices significantly and changing the socioeconomic makeup of these neighborhoods. For example, the area of Harlem, a historically black, working class neighborhood in New York, experienced an overall decline in living standards during the 1970's due to below-average wage growth. However, when looking at only West-Harlem, it can be seen that this area experienced an above average increase in both wages and rental prices . The juxtaposition between the decay of Harlem overall, while West-Harlem experienced a period of economic growth thus provides some evidence for gentrification in the area. The housing stock in this area consisted of more single-family, structurally sound housing, unlike East-Harlem, which included mostly derelict high-rise buildings. (Schaffer & Smith, 1986). West-Harlem thus attracted more investors and underwent the process of gentrification as described by Glass (1964), when white, middle-class individuals started moving into the area and changed the character of West-Harlem significantly.

From the late 1970's onwards, the process of gentrification has shifted from individual investors and 'urban pioneers', to a centralized process that is often stimulated by public administrators, including institutional incentives for the renewal and upscaling of urban working-class neighborhoods (Hackworth & Smith, 2001). Gentrification since the 1970's has become visible in smaller cities across the world, while before this period, it was mainly concentrated in big cities on the east coast of the U.S. and major European cities. One of the underlying causes of the increased centralization of gentrification is the fact that in the major cities, neighborhoods more attractive to individual investors (good location, historical features etc.) had largely been gentrified at that point and public incentives had become necessary to decrease the risk of investing in neighborhoods with less apparent potential. (Hackworth & Smith, 2001)

Furthermore, across the world, gentrification has been reframed from having many negative effects such as displacement of locals, to a strategy that can increase the attractiveness of a city to outside investors and spur economic growth and currently, urban renewal strategies are a major policy objective for many municipalities (Harris, 2008). The idea that transforming working-class neighborhoods into upscale residential areas attracts more capital and boosts the local economy has become widespread and has since become part of the development strategy of many cities. The idea of gentrification has a positive connotation in policy-making these days, while common negative effects, such as the displacement of the original residents, are often downplayed (Lees & Ley, 2008).

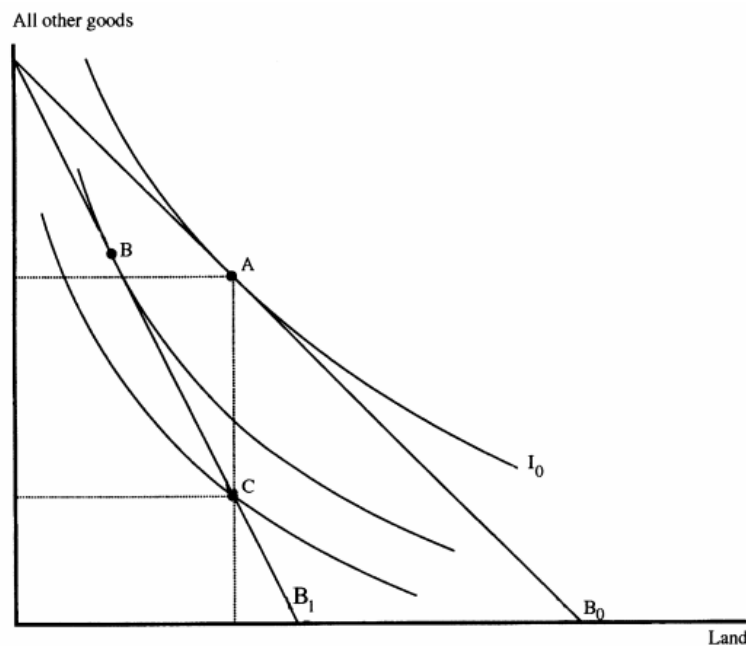
2.2 - The consequences of gentrification

One of the main possible negative societal consequences of the gentrification of working-class neighborhoods is the displacement of these neighborhoods' original inhabitants, who are most often either dependent on social housing or renting in the private market and thus vulnerable in cases of urban renewal practices. When rental prices start to go up as an area becomes more attractive to investors, vulnerable residents from low socioeconomic backgrounds are often hit hard and forced to move from areas many families have lived in for generations (Zuk & al., 2015).

The preferences of low-income groups being affected by gentrification and the subsequent changes in utility can be depicted in a relatively simple model, as shown in figure 1. These effects depend on the costliness of moving, with the budget constraint rotating inwards as the price of land increases relative to

other goods. Renters' initial situation is depicted in point A and if moving to a different neighborhood is costless, they will relocate to a neighborhood where they can obtain the same level of utility, remaining at point A in terms of consumption. If it is too costly to move between neighborhoods but moving within the neighborhood is costless, renters will end up at point B, experiencing a slight decrease in utility. Lastly, with high costs involved in moving anywhere, renters will remain at their previous level of land consumption, but due to the relative increase in price, will be able to consume significantly less of all other goods, ending up at point C. This model shows a significant decrease in utility for the displaced in any case of significant moving costs, which in reality, have been shown to exist in most cases of the displacement of low socioeconomic groups. (Vigdor et al., 2002)

Figure 1: A model of the preferences of the displaced under gentrification



Vigdor, J. L., Massey, D. S., & Rivlin, A. M. (2002). Does gentrification harm the poor?[with Comments]. Brookings-Wharton papers on urban affairs, 133-182.

Furthermore, as rental prices across cities go up, higher income groups are forced to consider neighborhoods that have traditionally been considered working class due to decreasing affordability, putting further strain on the housing stock in these areas. This can lead to a loss of socioeconomic diversity as working class residents are forced out of some neighborhoods and put intense psychological strain on the part of the population being displaced, as they are forced out of their original residential

area (Atkinson, 2009). Other consequences of spatial displacement and segregation can include a spatial mismatch between labor skills and opportunities, for low-skilled workers in particular. As these workers are driven further from city centers, often hubs of economic activity, transportation and information barriers prevent them from having effective access to job opportunities. Businesses may then struggle to find adequate low-skilled workers, which can then interfere with overall economic growth. (Atkinson, 2000).

Moreover, residential segregation can perpetuate other educational and labor market outcome disparities that exist between people from a high and low socioeconomic background. A high degree of metropolitan spatial segregation on a socioeconomic level has been shown to correlate with lower educational attainment, higher dropout rates and eventually, lower employment rates for residents living in areas with a high proportion of people with a low socioeconomic status. These effects are even more significant for minority groups, which are overrepresented in lower socioeconomic categories. (Turner, 2009). The effects of this process of segregation follow a cyclical pattern: Poor labor and educational opportunities in a neighborhood cause a local brain-drain, where people that have the ability to move out of the deprived neighborhood choose to do so, perpetuating the pattern of segregation.

The forced moves of low-income groups that follow as a result of gentrification have been shown to exacerbate socioeconomic spatial division and polarization across cities, with neighborhoods with residents from differing socioeconomic backgrounds becoming less common in the case of gentrification. Wei & Knox (2014) analyze the changes in demographics in terms of ethnicity and income on a neighborhood level in cities across the United States over time and observe that the makeup of neighborhoods has been relatively stable in recent years, i.e. people move less often, on average. The most common reason for household mobility is currently a change in economic status, for example by choosing to move to a more affluent area or by forced displacement, as in the case of gentrification. Both of these types of mobility promote the spatial segregation of different socioeconomic groups, deepening inequalities within cities across the United States. (Zuk et al., 2015).

Additionally, studies have shown that the level of income and employing income redistribution policies can have an effect on the ethnic makeup of a neighborhood. A case study by Taeuber (1968) on the city of Cleveland finds that a rise in income due to redistributive policies diminished residential segregation in

areas previously predominantly black. The reverse then also holds, i.e. a decrease in income that puts residents below the poverty line will increase spatial segregation by racial criteria.

Similar effects of increasing income decreasing racial segregation per neighborhood were found in a case study on Brazil, South Africa and The USA (Gradin, 2014), showing that increased wages offered opportunities for disadvantaged socioeconomic groups to move to different neighborhoods, again decreasing residential segregation.

In summary, both income and labor market participation can be considered as additional factors that affect the ethnic makeup of a neighborhood, in addition to the affordability of housing and the prices prevailing in the local housing market.

In the context of European cities, there is a similar pattern of increasing economic segregation on an urban level. Wealth inequalities across Europe have been increasing since the 1970's, after declining for around 30 years in the post-war years, currently being close to the level of the late 19th century (Piketty & Zucman, 2014). Furthermore, the degree of socioeconomic segregation has been found to be greater at the extremes of the spectrum, i.e. in the highest and lowest socioeconomic classes, with the level of segregation being highest for wealthy socioeconomic groups in the United States. (Duncan & Duncan, 1955). Moreover, a similar pattern of segregation as established by Duncan & Duncan (1955), of extreme segregation at the highest and lowest ends of the socioeconomic spectrum, was confirmed for the 1970's in both western, capitalist countries and countries in Eastern Europe behind The Iron Curtain (Morgan, 1975; Dangschat, 1987). These findings combined suggest that as wealth inequalities increase across Europe, so does segregation on an urban level.

A comparative study on a pan-European level, examining residential segregation on a socioeconomic level by Van Ham & al. (2015) shows deepening neighborhood disparities in all twelve cities studied, albeit in varying degrees. The cities were assigned points based on structural and institutional characteristics that have been shown to exacerbate inequalities. Firstly, global connectedness, as cities that function as a global hub attract high salaried employees, which in turn raises demand for housing in the high-end private sector. Secondly, the presence of a strong welfare state has been shown to reduce spatial inequalities, as access to social housing reduces the risk low-income groups face of being excluded from an area if rents start to rise. Lastly, following from the welfare state related to housing markets, the extent of regulation on the housing market - including the provision of social housing by government-funded housing corporations - was also considered to be an important determinant, with

speculative housing and an unregulated housing market being known to increase the link between wealth inequalities and segregation. (Van Ham et al., 2015)

Along with segregation by socioeconomic characteristics, gentrification has been shown to contribute to ethnic homogenization through the displacement of ethnically diverse neighborhood populations. As gentrification in European cities is often characterized by the influx of white, middle class people into ethnically diverse, working-class neighborhoods, initially the ethnic mix is slightly diversified. As the process of gentrification continues and housing prices start to rise, the original ethnically diverse population is no longer able to afford housing in their original residential area and this population is dispersed. What then remains in the neighborhood is an ethnically homogeneous, white middle class population. (Van Gent & Hochstenbach, 2020)

2.2 - Gentrification in Rotterdam

Focusing on the city of Rotterdam, urban renewal is an idea that has been part of a municipal development strategy for some years now. The city is currently economically oriented around the Port of Rotterdam, which provides jobs (directly and indirectly) to 385.000 people, with many of these workers falling in the category of low-educated people. (*Feiten en cijfers haven Rotterdam*, 2021).

From the late 19th century onwards, the port attracted migrant workers from other parts of The Netherlands and in the post-war years, guest workers and their families from former colonies, Morocco and Turkey, with these migrations over the years resulting in impoverished, working class neighborhoods constituting large parts of the city. With the advent of deindustrialization in the late 1970's, many of these migrant workers lost their jobs and the city as a whole experienced a decline due to previous overreliance on heavy industry and manufacturing. (Doucet et al., 2011)

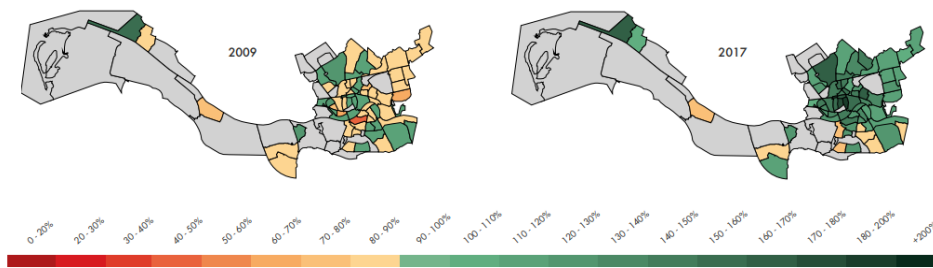
From the late 1980's onwards and shortly after the build of the Erasmus bridge, the municipal government focused its efforts on a waterfront regeneration program with a flagship development project around the Kop van Zuid area, developing distinct high-rises and luxury housing options that have since become emblematic for the city. (McCarthy, 1998). The city's aim was to attract people to the city from higher socioeconomic backgrounds, stimulating private investment and promoting job creation, subsequently making the city less reliant on industrial activities surrounding the port. Furthermore, the

area would contribute to changes in the image of the city, making the city more attractive to visitors, thus stimulating the hospitality industry in the city, while lastly, the idea was that the influx of investments, tourists and high-income residents would trickle down to the original inhabitants, increasing welfare overall. (Doucet et al., 2011)

The strategy employed by the municipal government of Rotterdam in the early 2000's can be characterized as so-called 'urban revanchism': An attempt to reconquer the city for capital and the middle class with a Dutch background (Uitermark & Duyvendak, 2008). In line with the city's vision to attract investors and tourists, these policies were an attempt to 'sanitize' the city from its previous image of being a crime-ridden, working-class city full of people with a migrant background and make it more attractive to the prospective target groups. This strategy was partially fueled by predictions that by the year 2017, more than half of Rotterdam's population would consist of people with a migrant background (a prediction that has since come true). Ethnic minorities, already hit disproportionately hard by the deindustrialization of the late 20th century, had now become the targets of housing policies of defunding social housing and the construction of high-end residential buildings, aimed at dispersing migrant communities with significant numbers of people subsequently being displaced. (Uitermark & Duyvendak, 2008)

As a consequence of the city's strategy of urban renewal, real estate prices in the city of Rotterdam have soared up in recent years. As a city that is seeing an increase in its number of inhabitants and constantly growing, Rotterdam is facing a pressing housing shortage, with a large number of housing developments being built in the high-end private sector. The housing market in Rotterdam is more and more characterized by private investors purchasing properties to sell them on with a margin of profit, once again driving up housing prices. (Nijskens et al., 2019) . The current average valuation of a property in the city of Rotterdam is €310.904, up by €21.816 compared to 2020, or +7.1%. (*Huizenmarkt Rotterdam*, 2021). Figure 2 below graphically shows the changes in housing prices per neighborhood, compared to the baseline level of 2008.

Figure 2: Changes in housing prices per neighborhood relative to 2008



Van Haaren, J., & Braun, E. (2019). *Economische verkenning Rotterdam*. Rotterdam; Erasmus UPT. Edited by EUR

Combining the data on the development of housing prices with the literature on the displacement of disadvantaged socioeconomic groups and the overrepresentation of people with a non-western migrant background in this category, this leads to the following hypothesis, which will be tested empirically using data on the median housing price and ethnic composition on a neighborhood level:

Hypothesis 1:

Neighborhoods with rising housing prices are experiencing a decline in the proportion of people with a non-western migrant background.

3 - Data

3.1 - CBS neighborhood data

The data used in this research has been drawn from the CBS open source database of Statline, more specifically the publication of 'Kerncijfers Wijken en Buurten' - an overview of general statistics throughout The Netherlands on a neighborhood level. The data considered here has been limited to the municipality of Rotterdam, filtering the municipal data by demographic characteristics like ethnicity, as well as the average housing price per neighborhood from 2008 to 2018.

3.2 - Defining the variables

Panel data was constructed by combining the information from CBS on the median selling prices of housing with demographic data on the ethnic composition per neighborhood for each year. This data was selected for the span of 11 years, starting from 2008 up and until 2018 and was available in the original dataset in absolute numbers per neighborhood per year. The categorical division of the data is bound by the 14 neighborhoods in Rotterdam, as defined by the CBS and the municipality of Rotterdam and the division of ethnicity in this dataset is, as defined by CBS, by Dutch, Western migrant background and non-Western migrant background, with individuals with a migrant background being defined as having at least 1 parent born outside of The Netherlands.

To fit the scope of the research and in order to be able to observe the changes in ethnic composition per neighborhood over the selected time period, the data was modified to be displayed in terms of proportion of the total inhabitants of a neighborhood, instead of the original absolute values that were given for each ethnic group. This led to the creation of the variables *Proportion Dutch*, *Proportion Western* and *Proportion non-Western*. As the main hypothesis tested in this research focuses on the displacement of people with a non-western migrant background, the variable *Proportion non-Western* is used as a dependent variable in the following analyses.

To examine the development of housing prices in the city of Rotterdam, the median selling price of residential properties in Euros (€) per neighborhood was used. This data was selected over the same time period as the variables on ethnicity (2008-2018 and was once again divided per neighborhood. The data on the median selling price of housing was used in the analysis as an independent variable (*House price*).

Next to the *House price* variable, in 2 of the regression models tested, a 1 year lag of the explanatory variable was used to test for the best fitting model, through the use of the variable *House price lagged*.

Originally, the dataset contained values on all 14 neighborhoods of Rotterdam, including the areas of Rozenburg and Hoek van Holland. However, due to the fact that Rozenburg was not part of the administrative area of the municipality of Rotterdam from the start of the observational period (it was added to the municipality in 2010), this neighborhood was excluded from the analysis. The neighborhood of Hoek van Holland had missing observations for the average housing price per year and was thus also dropped from the analysis.

Additional control variables of average income per neighborhood, measured in euros, and rate of labor participation as a percentage of the neighborhood population were added, to help control for some of the omitted variable bias and strengthen the regression models. This data was again retrieved from the *Kerncijfers wijken en buurten* series by CBS, but was only available for the years 2014 up and until 2018, and thus the regressions with control variables are run with fewer observations.

This process of data cleansing brought the total dataset down to 132 observations per variable in total for the regressions without control variables, while the control variables contain 60 observations. House Price is measured in Euros (€), the variables Dutch, Western and Non Western are measured in terms of the absolute value of residents per neighborhood, while the variables Proportion Dutch, Proportion Western and Proportion Non Western are measured as the proportion of total inhabitants in a neighborhood. Lastly, the rate of labor participation is measured as a proportion of the neighborhood population, while average income is again measured in Euros. Descriptive statistics on these variables can be found below in table 1.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
House Price	132	172107.58	54786.915	83500	390000
Dutch	132	24920.098	13978.335	3934	64302
Western	132	5734.765	2870.263	326	11517
Non Western	132	18885.947	13259.619	394	43909
Total	132	49540.811	24318.779	4737	95406
Proportion Dutch	132	0.546	0.159	0.284	0.848
Proportion Western	132	0.114	0.027	0.069	0.179
Proportion Non Western	132	0.341	0.147	0.083	0.602
Labor market participation	60	0.606	0.050	0.490	0.711
Average income	60	23508.17	4202.131	17250.22	32549.5

3.3 - Descriptive graphs

In addition to the descriptive statistics, depicted below in figures 3 and 4 are descriptive graphs showing the development of both housing prices and the proportion of individuals with a non-western migrant background. Figure 1 shows an overall upward trend of the median selling price per neighborhood for all neighborhoods considered, albeit in varying amounts. Figure 4 shows a mostly stable proportion of individuals with a non-western migrant background per neighborhood. Notably, the area of Delfshaven, a neighborhood that is often used as an example for gentrification in Rotterdam, is showing a downward trend in the proportion of people with a non-western migrant background.

Figure 3: The development of residential property prices per neighborhood

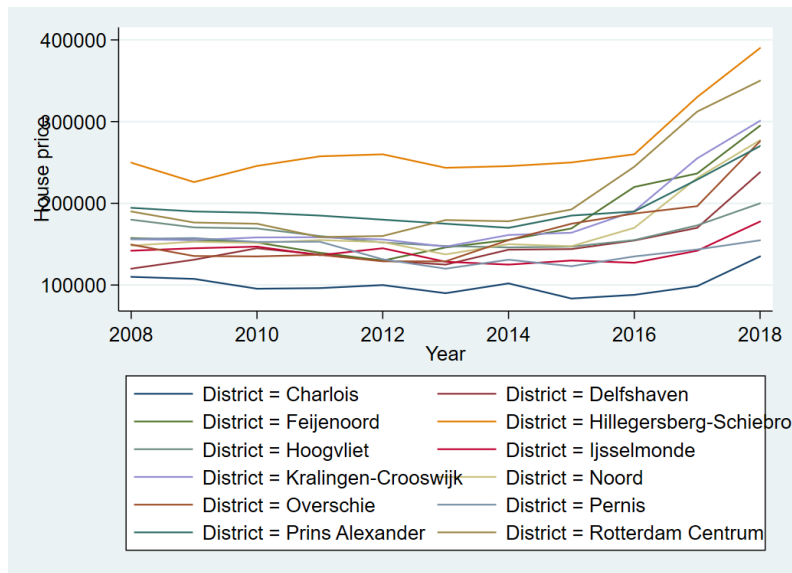
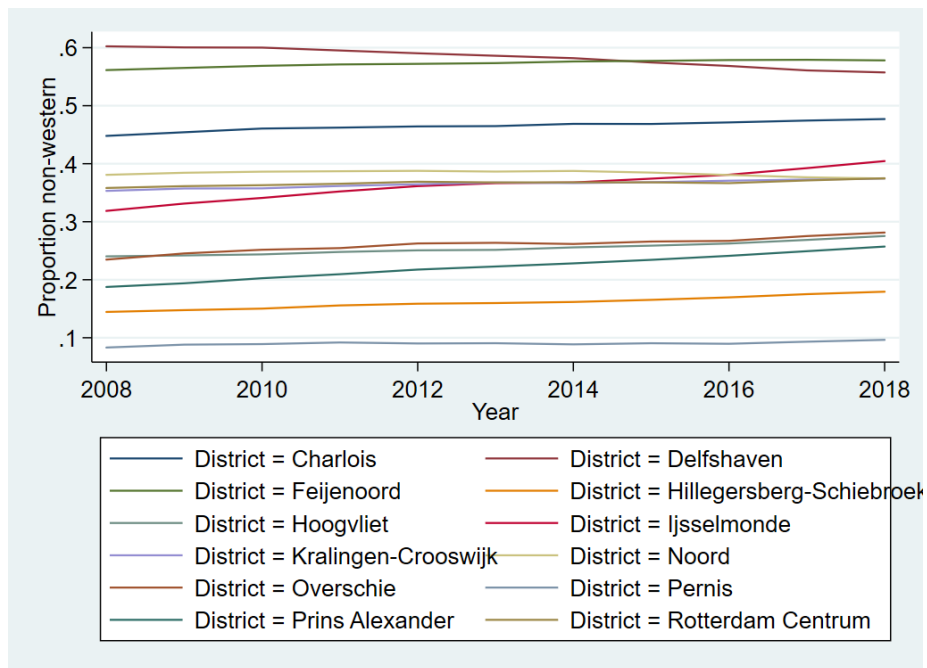


Figure 4: The proportion of people with a non-western migrant background over time



4 - Methods

In this research, econometric analysis methods for panel data are used to examine the relationship between the ethnic makeup of Rotterdam's neighborhoods and the housing prices over the years. These analyses are conducted using STATA, with different models being tested to choose the best fit for analyzing this particular set of panel data, the first one being pooled OLS regression.

In the first step of the analysis, a pooled OLS regression is run, as well as a regression with random effects and a regression with fixed effects, after which a Hausman test is performed to determine whether the regression with fixed or random effects is most suitable for this dataset. This test has a H_0 of random effects being the preferred model, with fixed effects being chosen if the null hypothesis is rejected at a significance level of 0.05. The benefit of a regression model with fixed effects lies in the fact that with this model, it is possible to control somewhat more for omitted variable bias, while a model with random effects is preferred if the omitted variables are uncorrelated with the explanatory variable, which is the housing prices in this case. Next, a regression with the control variables of average income and labor market participation rate is run for increased explanatory power and lastly, a regression is run with a 1 year lag in X. Intuitively, an increase in housing prices this year may only have an effect on the population due to residents moving in the next year, due to the way rental contracts work among other reasons.

The regression models that are tested in this research are thus set up as follows:

OLS regression:

$$Y_i = \beta_0 + \beta_1 * X_i + e_i$$

Fixed effects regression:

$$Y_{it} = \beta_0 + \beta_1 * X_{it} + \alpha_i + v_{it} + u_{it}$$

Regression with a 1 year lag:

$$Y_{it} = \beta_0 + \beta_1 * X_{t-1} + \alpha_i + v_{it} + u_i$$

Regression with control variables:

$$Y_{it} = \beta_0 + \beta_1 * X_{1t} + \beta_2 * X_{2t} + \beta_3 * X_{3t} + \alpha_i + v_{it} + u_{it}$$

In these models, i denotes the neighborhood (defined as *District* in the dataset), while t denotes the year in which the variables are measured. The dependent variable Y used in both regressions is the proportion of people with a non-western migrant background per neighborhood, while β_0 is the constant in both regression models. β_1 is the regression coefficient for the median selling price of a house, denoting the change in the dependent variable per unit change in X , while e_i is the error term for the random effects regression. In the 2nd regression equation, α_i denotes the time-invariant characteristics in the form of neighborhood fixed effects, while v_{it} captures the error term from neighborhood specific effects. Lastly, the measurement error from fixed effects is shown in the form of u_{it} . Regression number 3 contains the 1 year lag in X variable X_{t-1} , while the last equation (number 4) contains the regression coefficients for the control variables β_2 and β_3 , respectively the coefficients for the labor market participation rate and average income.

5 - Results

The Hausman test was employed to test the fit of the random effects models compared to the fixed effects models with all regression equations used, with the null hypothesis being the difference in coefficients is rejected at 0.05, and with this hypothesis being rejected if the fixed effects model proves to be a better fit. Table 2 below shows the results of the Hausman tests, showing that the null hypothesis cannot be rejected for the base regression (1) and the regression with a 1 year lag in X (2) - i.e. the regressions without control variables, hence the random effects model is preferred in these cases. However, in the models that include the control variables (3 and 4), the null hypotheses are rejected and the fixed effects model is preferred when control variables are included.

Table 2: Hausman test results

	Test statistic	P-value
(1) Base regression	1.487	0.2226
(2) 1 year lag in X_t	1.984	0.159
(3) Control variables	25.537	0.000
(4) 1 year lag in X_t and control variables	23.699	0.000

In the next step, the suitability of a random effects model compared to a pooled OLS regression is tested through a Breusch-Pagan Lagrangian multiplier test for random effects, with the null hypothesis meaning the pooled OLS regression is the best option for the model tested, the results of which are displayed below in table 3. The results of these tests reject the null hypothesis of OLS regression being the most suitable level at a significance level of 0.00, hence making the random effects regression model the best fit for the regressions without control variables.

Table 3: Breusch-Pagan Lagrangian multiplier test results

	Test statistic	P-value
(1) Base regression	600.81	0.000
(2) 1 year lag in X_t	487.81	0.000

After adding the control variables to the regression model, the variance inflation factors (VIF) are computed for the explanatory variables, to check for multicollinearity, the results of which are displayed below in table 4. Since the VIF of each variable is below 5, this indicates that the correlation between the variables is moderate and does not require further consideration.

Table 4: VIF values of explanatory variables

	VIF
House price	2.27
Labor market participation	1.78
Average income	3.39

In table 5 below, the results of the various regression models are displayed, with column 1 and 2 respectively depicting the results of regressions with random effects of the base regression and the regression model using a 1 year lag in X_t , as determined per the previously run Hausman tests. Column 3 shows the regression results of the model including the control variables *Labor market participation* and *Average income*, while the 4th column includes both the control variables and the 1 year lag in X_t . In the next section, the results will be discussed in the context of the theoretical framework, as well as mentioning the limitations of this research.

Table 5: Regression results

Variable	Proportion non-western migrants			
	(1)	(2)	(3)	(4)
House price	$-7.27 \cdot 10^{-8**}$		$-3.45 \cdot 10^{-8**}$	
House price lagged		$-4.68 \cdot 10^{-8**}$		$-4.06 \cdot 10^{-8**}$
Labor market participation			-0.029	-0.115
Average income			$-7.26 \cdot 10^{-7}$	$-8.00 \cdot 10^{-7}$
Constant	0.328**	0.334***	0.345***	0.289***
# Observations	132	132	60	60
Overall R^2	0.0565	0.1087	0.0716	0.3551

Note: $P < 0.1^*$, $P < 0.05^{**}$, $P < 0.01^{***}$

6 - Discussion and limitations

6.1 - Discussion of the results

The main research question in this paper on the effects of rising housing prices and the displacement of ethnic minorities, has been shown to be a negative one, considering the results of the empirical analysis. From the limited scope of this analysis, it can be seen that as housing prices rise with one unit (1 euro), the proportion of people with a non-western ethnic background per neighborhood declines on average, the amount varying depending on the regression model considered. Comparing the 4 regressions, model 4 (including control variables and a lag in X), shows the greatest explanatory power. Furthermore, the coefficient for *House price lagged* is significant at 0.05, showing a negative relationship between housing prices and the proportion of people from a non-western migrant background. Lastly, since models 3 and 4 are run with fixed effects, this allows for heterogeneity and removes some of the omitted variable bias in the coefficients, providing a more accurate estimate of the model. In summary, the effects measured in the 4 models, of which model 4 is the preferred one, along with the presented supported literature indicate that there is indeed a concern for housing security for minority groups living in areas undergoing the process of gentrification.

The small numbers for the independent variables' coefficients can partially be explained by the units used in the analysis, intuitively, if housing prices go up by 1 euro in a neighborhood, this will hardly affect residents' decision or ability to remain in the neighborhood. Similarly, when an individual's income changes by a euro, this will not impact their choice of housing. However, in order for a change in either housing prices or income to significantly affect the ethnic composition of a neighborhood (by 1 percent or more), according to this model, this would have to be in the order of millions of euros. The coefficient for the effect of labor market participation is of a bigger size, but not significant and thus cannot lead to any meaningful conclusions. In summary, if conclusions are to be drawn from this analysis, it can be said that a monetary change in euros hardly affects individuals' housing choice and this thus largely depends on other factors.

6.2 - Limitations and suggestions for future research

Although the results in section 5 confirm both the prevailing literature on the topic and the hypothesis of increasing housing prices in a neighborhood decreasing the proportion of ethnically non-western people, there are several limitations to these results.

Firstly, due to the incompleteness of the model, the coefficients most likely still suffer from omitted variable bias, since the proportion of people with a non-western migrant background cannot be explained only by a change in housing prices, income and labor market participation. Including the control variables for *Labor market participation* and *Income* improved the model slightly, however there are still other factors of influence. Including other control variables in the model would help to increase the explanatory power of the model and reduce the bias, but due to the lack of availability of data for this specific case, constructing a more complete model was not possible in the scope of this research. Other factors that influence the proportion of people with a non-western migrant background living in a given neighborhood, such as educational level, could be added to the model as control variables, helping to improve the model.

Secondly, the data available for the area of Rotterdam on a neighborhood level is not very extensive and specific, leading to a low number of observations in the dataset, as well as a general division of people with a migrant background by western and non-western, instead of by specific ethnicity or country of origin. Furthermore, an important aspect of gentrification includes displacement, which is only measured indirectly here through the ethnic makeup of Rotterdam's neighborhoods. To accurately track whether people with a non-western migrant background are actually displaced or the proportions in a neighborhood are changing due to other factors, such as differing birth rates for example, a more specific case study could be necessary, tracking individual residents and where they live over the course of several years, then linking it to housing prices.

Moreover, the regressions were conducted with the median selling price of a house, while a more robust regression result could be obtained by using individual transactions of properties over the years, due to the higher number of observations. Overall, datasets with more observations and information could help in determining more accurate effects and displacement as a result of gentrification.

Lastly, in this regression model there is the problem of reverse causality, as the dependent variable (the proportion of people with a non-western migrant background) affects the change in housing prices (the independent variable), as well as the other way around. This bias could be overcome by employing an instrumental variable that would isolate the effect of the independent variable on the dependent one. An example of such an instrumental variable could be to add a measure of a fiscal policy aimed at house owners, like a change in mortgage interest rate deduction. Since such policies are not aimed specifically at people with a non-western migrant background and the measures are country-wide, this should theoretically have no impact on the ethnic makeup of a neighborhood. However, again due to the lack of availability of data, employing this method was not possible within the scope of this research.

6.2 - Conclusion

In conclusion, this research has built upon existing literature that has shown minority groups are vulnerable to displacement when gentrification occurs in an area, but most studies on this problem have focused on the United States, a country characterized by an entirely different housing market than The Netherlands. The analysis conducted here has contributed to proving that a similar process is happening in the area of Rotterdam and policymakers should be aware of the potential implications of the displacement of ethnic minorities.

Due to the scope of the research as a bachelor thesis and the limited availability of data, the results of this analysis should be interpreted as exploratory research that indicates there is an underlying problem. Future research using more extensive data and methods should focus on isolating the exact effects of rising housing prices on Rotterdam's migrant population, in order for policymakers to be able to consider this when constructing housing policies, to keep the city affordable and the right to adequate housing intact for all of its inhabitants, since after all, diversity is one of Rotterdam's greatest strengths and it would be a shame if we lose it to progress as a result of gentrification.

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