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Industrial agglomeration and housing prices: The case for the Port of Rotterdam.

Tim van Venrooij
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Colophon

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Author	**Tim van Venrooij**
Student number	**S4948793**
E-mail	**t.p.m.van.venrooij@student.rug.nl**
Supervisor	**Dr. X. Liu**

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Image title page **Botlek en Vondelingenplaat by Port of Rotterdam, 2022**

Abstract

The housing prices in the Netherlands has increased in the last couple of years. It leads to more issues for starters who cannot buy a house and there are no new houses build to get more stock in the market. The industrial sides seem to grow in the Netherlands as more and more industrial and logistic parks are build. In this paper a case study for the province of Zuid-Holland is done, whereby the Port of Rotterdam is seen as the biggest industrial agglomeration. This paper aims to investigate the effect of distance from an agglomeration of industrial real estate on the housing transaction prices in a 15 kilometre range from the biggest industrial agglomeration in the province of Zuid-Holland. Other studies have focussed on markets in China, logistic agglomeration, and office agglomeration. Multiple regression was preformed to examine this relationship, using a large dataset from Walterliving. The dataset consists of transaction prices and housing characteristics. The results indicate a significant effect of distance to industrial agglomeration and housing transaction prices; however, this relationship does not imply that transaction prices are higher when closer to industrial agglomeration. Regressions show a positive coefficient with distance further away from the industrial agglomeration. Transaction prices seem to rise with 1,2 percent when located further away from the Botlek, after 15 kilometres this becomes 8,6 percent.

Keywords: Industrial agglomeration, Transaction prices, Distance, Zuid-Holland

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1.Introduction

Agglomeration of economies are the benefits that occur when firms and people locate near on another, this happens in cities and industrial clusters (Gleaser, 2010). Gleaser (2010) found rising of wages, population and housing prices in New York and London in the 1970s. Another study by Dumais, Ellison & Gleaser (2002) showed a small decrease in industrial agglomeration between 1970 and 2000, while transportation cost was low. This showed there is still the urge to agglomeration of economies. The Dutch government still aims till 2040 for so-called 'mainports' in Rotterdam, Eindhoven, and Amsterdam (Schiphol), it also wants to have more of these 'mainports' in the Netherlands (Ministry of Infrastructure & Environment, 2012).

There are several studies conducted that incorporate the effect agglomerations of economies has on the prices of industrial real estate. A study by Francke et al. (2021) shows that agglomerations of economic activity result in higher rent for user. The study also found the effect of agglomerations of economic activity on capitalization rates for investors. Hu et al. (2021) also looked at agglomeration of economies but more detailed to offices. This study investigated the effect relocation has on housing prices. They study investigated districts up to 15 miles from the relocation area. Chen, & Li (2016) conducted research on the effect of housing prices on agglomeration of economies. This research showed higher housing prices negatively affected the manufacturing agglomerations in China. This study focused on the East of China with relatively high agglomerations of cheap labour manufacturing. Pan & Yang (2020) conducted research on agglomeration of human capital and housing prices in China. This study focussed on 31 Chinese provinces between 1999 and 2015. Another research conducted by Lin & Ben (2009) also investigated a relationship between agglomeration and land prices. This research looked at industrial land prices and industrial agglomeration in Taiwan.

This leaves room for research on different agglomeration of economies. The industrial agglomeration is not used in multiple studies and does not include recent data. Furthermore, the studies mentioned above do research housing prices effects but only in China and Taiwan. This leaves room for the investigation of the Dutch residential real estate market; this market has a fast raise in the last ten years. The mentioned studies also looked at rent prices, capitalization rates, land prices and human capital. This leaves room for investigating distance to industrial agglomeration and housing prices in the Netherlands.

The average housing prices in the Netherlands rose from 220.000 euros to 360.000 euros between 2013 and 2021 (CBS, 2021). This is a relatively high rise in such a short time span. This has led to problems on the housing market for starters in the cities as well as in the provinces (Calcasa, 2020). On the other hand, the Dutch government also aims for more agglomeration of economies, especially industrial and logistic agglomerations (Ministry of Infrastructure & Environment, 2012). This will probably lead to more population density in certain areas (Dumais, Ellison & Gleaser, 2002). The high housing prices in the Netherlands are a reason to investigate if industrial agglomeration has effect on this phenomenon, whereby starters on the residential market are having a hard time finding houses.

This raises questions on whether this agglomeration of industrial economies will affect housing prices in certain parts of the Netherlands. The literature mentioned in the introduction shows a relationship between agglomeration and housing or land prices. This is in principle based on the Bid Rent Theory (Alonso, 1960). This paper contributes to the understanding of industrial agglomeration and the link to housing prices in the region. In this paper the following research question will be answered:

“How does industrial agglomeration effect Housing Prices in a 15-kilometer range in the province Zuid-Holland?”

To answer this question and test the relationship between industrial agglomeration in the port of Rotterdam and housing prices in the surrounding urban areas, the following subjects need to be taken in to account: Which areas of the port of Rotterdam have the most agglomeration of industries, to what extent is distance a factor in higher of lower housing prices and what relationship is there between housing prices and industrial agglomeration.

The plan of the paper is as follows. In section 2, the theoretical framework is explained. This provides all relevant research on this topic. Section 3 will present the data on housing prices and the determination of the agglomeration. Section 4 focusses on the outcomes of the multiple linear regression. The conclusion will follow the results and focusses on the outcomes of housing prices and distance to industrial agglomeration.

2.Theoretical Framework

The agglomeration of economies is defined by Glaeser (2010) as a place that is doing well, and thereby attracts people from other areas to this place. Glaeser (2010) also takes real estate prices into account in these regions with agglomeration economies. The research Gleaser (2010) conducted showed a relationship between housing prices and agglomeration of economies, this because of price growth in cities. Glaerser conducted multiple studies on the topic of agglomeration economies and spatial equilibrium. A study from Edward, Gleaser, & Gottlieb (2009) showed service orientated agglomerations move closer to the city, while manufacturing agglomeration do not necessarily locate in urban areas. The study showed transportation cost are low, because of good infrastructure in most countries. In both cases, Glaeser (2009; 2010) used data from the United States to support his claims. With regression statistics the relationship between housing prices and agglomeration of economies could be defined. It also showed productivity in a city and the size of a city. A study conducted by Pan, & Yang (2020) seek to find a relationship between agglomeration of human capital, regional economic development, and housing prices in China. Whereby they made use of the existing knowledge and definition of agglomeration of economies. The research consisted of 31 Chinese provinces from 1999 to 2015. Hereby the researchers only focused on agglomeration of human capital and less on the different types of industries. Pan & Yang (2020) used a regression method. This study showed a relationship between human capital and real estate prices in two ways. A positive relationship was shown on long term, whereby human capital mostly effected regional development. Whereby regional development had a strong relationship with housing prices. There was also a negative relationship found in short-term, whereby high housing prices effected human capital in certain cities.

Another Chinese study conducted by Chen & Li (2016) showed the effect of housing price on industrial agglomeration in China. This study used panel-data on 268 Chinese cities from 2001-2007. This research also used regression to show a relationship between the variables. The research shows housing prices have a negative impact on the manufacturing agglomeration, which was mostly due to major policy changes in the eastern region of China in 2003. This study mostly focused on how housing prices effect industrial agglomeration instead of the other way around. The study from Pan & Yang (2020) focussed more on human capital instead of the impact housing prices has on agglomeration or the other way around. A study by Lin & Ben (2009) also showed a relationship between industrial land prices and industrial agglomeration in Taiwan. Hereby the focus was mostly on the impact the government had on these land prices.

This study showed industrial parks with a stronger agglomeration have higher land value. This study did not investigate the prices of land of urban areas nearby. A study from Mori & Nishikimi (2001) stated that industrial agglomeration appears in association with major traffic. This means near cities where there are key junctions of highway networks and railroad stations. Around the three largest ports of the 1980s, there was unprecedented growth in cities and agglomeration. These ports were in Hong Kong, Singapore, and Kaohsiung. Mori & Fujita (1995) already showed the role of ports in the making of major cities. This research showed how ports lead to agglomeration of economies and eventually in major cities. The researchers used a model that forms a counterpart of the new trade theory.

Francke et al. (2021) showed agglomeration of economies, especially offices, result in higher rents for users. By using transaction data from 1996 till 2011 from offices in the Netherlands, agglomerate on economies result in lower capitalization rates. This study looked only at the rent-to-price ratio in CBDs and outside CBDs (Francke et al., 2021). On the office agglomeration the relocation of headquarters is also important (Hu et al. 2021). This research looked at the effect corporate relocation has a housing price. The research showed the impact of headquarters relocation on the local housing market is high. Relocation into a district led to 10% higher housing prices in the district. This research documented the effect on housing prices one year before relocation and two years after relocation. The study also investigated nearby districts up to 15 miles from the relocation area. Hu et al. (2021) also showed agglomeration economies have a greater effect on the corporate relocation and housing market.

The literature mentioned in the theoretical framework focusses on different countries with different real estate markets than the Netherlands. The study from Franke et al. (2012) focusses on the Netherlands, but before the housing market rise. Furthermore, this study focussed on the agglomeration of offices and the rent price. Hu et al. (2021) investigated housing markets up to 15 miles from agglomeration of economies but investigated corporate relocation and not the industrial agglomeration. Mori & Fujita (1995) investigated ports and the effect those have on major cities. This is not something this paper wants to explain, this research wants to know the effect a port has on housing prices.

This research will investigate the effect the industrial agglomeration in the port of Rotterdam has house prices in areas within 15 kilometres. Hereby the distance to the Port of Rotterdam will be seen as the X variable, also known as the independent variable. The housing prices in

the areas will be seen as the Y variable, also known as the dependent variable. These variables will be used in a regression-model as many of the studies on this subject have done so. Furthermore, this research will investigate traffic noise, living environment regarding industrial agglomeration, population density and the total jobs per address in the area.

2.1 Conceptual Model

The theory of Gleaser (2010) shows a relationship between housing prices and agglomeration of economies. Chen & Li (2016) see the same thing in their research, whereby industrial agglomeration has a positive effect on housing prices. This means that there is a connection between agglomeration and housing prices. The conceptual model shows this in figure 1. This figure also shows that the theory of Gleaser (2010) can be stretched from agglomeration of economies to industrial agglomeration. Mori & Nishikimi (2001) shows the theory of Gleaser (2010) can also be linked to ports. This research also shows a connection the other way around and to the research of Chen & Li (2016) whereby industrial agglomeration, including ports, have a positive effect on housing prices. Hu et al. (2021) investigated housing prices and distance towards an agglomeration. This can also be directly linked to all the other literature from this paper. This research connects distance to housing prices in case of an agglomeration of economies. All these outcomes will lead to the regression models and variables in this research paper. Figure 1 shows a graphic model of how all variables can relate to each other through existing literature as mentioned in the theoretical framework and introduction.

In figure 1 the agglomeration of economics in the theory of Gleaser (2010) states an agglomeration arises when people and firms locate near each other. This also counts for industrial companies and employees. This means agglomeration of economies leads to industrial agglomeration. The industrial agglomeration is a variable in the regression in this model. The theory of Gleaser (2010) also shows a relationship between housing prices and agglomeration of economies, therefore these variables can also be linked to each other. Chen & Li (2016) use housing prices and industrial agglomeration in their study, this means there is a link between these variables in the literature. Hu et al. (2021) uses distance in the equation to determine the effect of agglomeration of economies on housing prices. This means there is a clear link between distance, agglomeration of economies and housing prices.

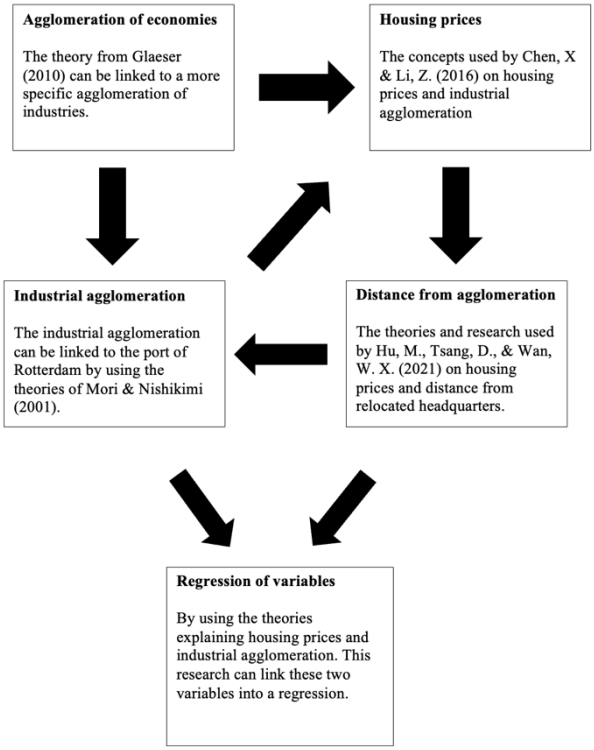


Figure 1 Conceptual model

2.2 Hypotheses

Based on the theoretical framework, a null hypothesis if formed:

Hypothesis 0: There is no effect on the housing prices in an area up to 15 kilometres from the port of Rotterdam, due to industrial agglomeration.

3. Data & Methodology

For this research, a quantitative approach has been used. This research is supported by two sets of data which have been used to run a multilinear regression. The first dataset consists of industrial agglomeration in the province of Zuid-Holland and surrounding villages and towns in a radius of 15 kilometres. The second dataset consists of 3.305 property transactions from 2021 & 2022. This data is collected by WalterLiving, a program that uses transaction prices from the land register (Kadaster).

3.1 Research method

For this research a multilinear regression has been chosen as the most appropriate method, as this regression analysis has been designed to explain the relationship between the dependent variable and multiple independent variables. These independent variables can also include dummy variables. This research looks at distance to the equation of housing prices, using the multilinear regression. In this research it is important to define two central concepts for the understanding of the results. These are house prices and agglomeration in Zuid-Holland. For the house prices, these are defined as transaction prices from the WalterLiving data, which are given in euros. Log of transaction prices have been used as dependent variable in the regressions. Agglomeration distance is the distance in kilometres between a house and the Botlek.

3.2 Research area

This paper presents a case study on the Port of Rotterdam and the province of Zuid-Holland. Zuid-Holland consists of a population of around 3.7 million inhabitants (CBS, 2022). The study area of this research consists of the port of Rotterdam up to 15 kilometres from the port. Figure 2 shows the determination of the biggest agglomeration in the Rotterdam Port Area (National Geo register, 2018). By laying these maps over each other, darker spots on the map seem to appear. The largest dark blue area in the middle of the map is the Port of Rotterdam.

The grey spots on the map in figure 2 show the different industrial sites in the province of Zuid-Holland. The purple and dark blue spots show the clustering of companies inside the industrial sites. As seen on the map the Port of Rotterdam is completely dark blue, this implies the most clustering takes place in that area. The Botlek is situated in the middle and a somewhat darker blue than the rest of the harbour. Therefore, the Botlek in the port of Rotterdam is selected as starting point because it has the most industrial agglomeration.

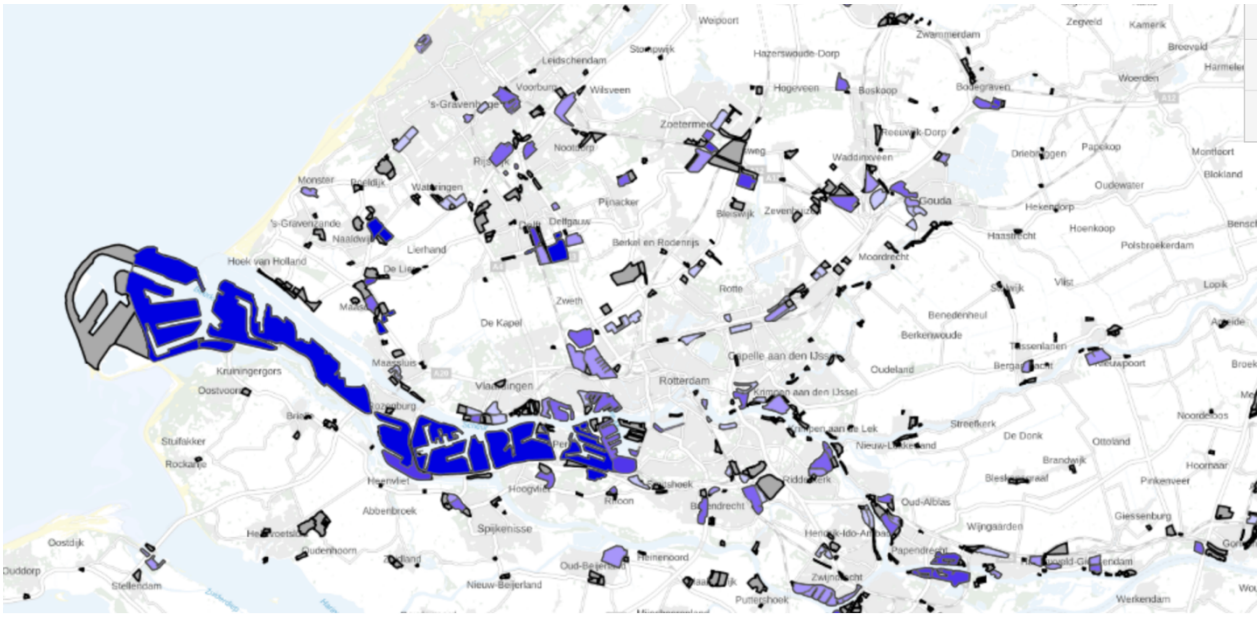


Figure 2 Industrial agglomeration (black spots) and clustering of industrial agglomeration in Zuid-Holland (blue spots – the darker the blue, the more clustering) (source: NGR, 2018).

Figure 3 shows the 15-kilometre radius which is set from the Botlek to all directions in Zuid-Holland. Appendix A shows the cities which fall within 5 kilometres, 10 kilometres and 15 kilometres in separate maps.

Figure 3 15-kilometres range from the Botlek (red dot) (source: gps-coördinaten.nl, 2022)

After drawing the research area for this thesis, a selection of three urban areas per 5 kilometres was selected. By selecting a 5-kilometre range for the selection of villages, towns, and cities the regression can support the suspicion of higher housing prices in less distance from the

industrial agglomeration, as shown in other research by Glaser (2010), Chen & Li (2016), and Hu et al. (2021). Appendix A shows what cities were selected at which distance.

3.3 Housing data

The second dataset consists of quantitative data from WalterLiving, which includes 3.305 property transactions in the selected cities within a 15-kilometre range from the Botlek during the period of 2021 and 2022. A large variety of data is included in this dataset. This most important for this research are transaction price, transaction year, living area in m2, year of construction and the type of residence (see table 1).

The data from WalterLiving and the data on agglomeration in Zuid-Holland has been used to calculate the distance range between properties and the agglomeration. For the selection of WalterLiving data a 5-kilometre range was used to select urban areas within that range. This resulted in 3.305 addresses in the province of Zuid-Holland that could be used. Approximately 35% of the data has been removed during this process either due to duplicates in the database or low transaction prices and small houses. The database allows only for searching one address at the time, it gives per address around 50 to 100 comparable houses. This could be on transaction price, transaction date, construction year, living area in m2 or nearby located. Some comparable transaction could overlap with different addresses, therefore filtering out duplicates was necessary and led to almost all removed cases. In the dataset there were a few outliners regarding transaction price, a few houses had a transaction price that would be ten times lower than the property on the lowest edge of the dataset.

The data has been analysed using Excel and SPSS to remove outliners and unrealistic values to prepare the data for statistical analysis. The variable for distance has been set to 15-kilomteres. Otherwise, the city of Rotterdam would have been considered, which could let to outliners and invalidity. Table 1 presents the descriptive statistics for the housing data and the distance measurements. The data cleaning procedure has resulted in a dataset of 2.044 transactions, which are used for the multilinear regressions.

Table 1 Descriptive statistics

Descriptive statistics	N	Minimum	Maximum	Mean	Std. Deviation
Transaction price	2044	110000	1100000	336097.75	116960.930
LN_transactionprice	2044	11.61	13.91	12.6732	.31428
Distance_agglomeration_km	2044	1.00	3.00	2.2828	.62520
Distance_5km_Dummy	2044	.00	1.00	.0939	.29181
Distance_10km_Dummy	2044	.00	1.00	.5294	.49926
Distance_15km_Dummy	2044	.00	1.00	.3767	.48468
Apartment_Dummy	2044	.00	1.00	.3659	.48181
Row_House_Dummy	2044	.00	1.00	.3958	.48914
Corner_House_Dummy	2044	.00	1.00	.1566	.36347
Semi_Detached_House_Dummy	2044	.00	1.00	.1566	.23236
Detached_House_Dummy	2044	.00	1.00	.0245	.15452
Transaction_year_2011	2044	.00	1.00	.9168	.27621
Transaction_year_2011	2044	.00	1.00	.0832	.27621
Dummy_1500_1900	2044	.00	1.00	.0386	.19281
Dummy_1901_1920	2044	.00	1.00	.0396	.19513
Dummy_1921_1940	2044	.00	1.00	.1248	.33052
Dummy_1941_1960	2044	.00	1.00	.1150	.31906
Dummy_1961_1970	2044	.00	1.00	.1536	.36067
Dummy_1971_1980	2044	.00	1.00	.1614	.36803
Dummy_1981_1990	2044	.00	1.00	.1561	.36301
Dummy_1991_2000	2044	.00	1.00	.0964	.29518
Dummy_2001_2010	2044	.00	1.00	.0709	.25679
Dummy_2011_2022	2044	.00	1.00	.0435	.20412
Valid N (listwise)	2044				

3.4 Variables & Regression

This study propose distance to the agglomeration of the Botlek has a significant impact on the housing prices in the nearby area. To examine and quantify the economic effect of distance to industrial agglomeration on local housing prices by estimating the following model:

$$\log Y_t = \alpha + b1 \text{ Distance}_t + b2 \text{ Type of house}_t + b3 \text{ Transaction year}_t + e_{it}$$

The dependent variable, Y, measures natural logarithm of housing prices up to 15 kilometres from the agglomeration.

In preparation of the multilinear regression, variables needed to be transformed into different formats, this also includes the creating of dummy variables for the data. The dependent variable ‘transaction price’ has been transformed into a log variable, called ‘LN transaction price’ since it is a natural logarithm. The distance to agglomeration is transformed from meters into

kilometres, this is for better interpretation of the results. Living area is defined by different ranges from below 50 square meters to above 150 square meters. For transaction year, type of residence and construction period a dummy variable has been created. Parameters α and b indicate the linear independence of the dependent εi variable from the independent variable. The factor b of the independent variable is the regression coefficient; when the distance to industrial agglomeration changes by 1, how much is the housing price changing. The regression error, defined by εi explains the difference between the predicted value and the actual value of the average income per resident.

Research shows that the impact of air and noise pollution is generally limited to 100 meters from the road where it originates from (Tillema et al., 2012). Traffic noise, especially from highways will fade away within almost 300 meters from the highway or agglomeration (Nelson, 1982). According to Eliasson et al. (2002) finds that short distances to roads and train stations have negative impact on housing prices, however this seems to reduce quite fast with distance increasing. However, they also argue that the assumptions made could not be realistic for developed countries, were infrastructure in general sufficient. Therefore, this research does not reckon with variables as noise pollution and air quality. The distance to the closest area of housing prices from the Botlek agglomeration is at least one kilometre. Based on the literature there would be no noise pollution. The distance to agglomeration is enough to not decrease the housing prices.

For the distance there are three categories created. By creating categories, it is easier to see from the regression what areas are more influenced by agglomeration than others. It can also show if the theory holds or only holds on certain parts. The first category is 5 kilometres from agglomeration Botlek. The second variable was created at 10 kilometres from the agglomeration. The third variable for distance is at 15 kilometres from the agglomeration.

4. Results

In this paragraph multiple linear regressions are set up, per model extra variables are added. In this way, the impact per addition of characteristics on transaction price can be measured. Both regressions consist of the prepared housing transaction and distance to agglomeration data, which includes 2.044 cases (N=2.044). For the transaction price a natural log variable has been used.

Table 2 presents the results of the multiple linear regression, whereby the total distance is used as one variable. Table 3 presents a similar regression, however, this time using categories for distance measurement. Both regressions make use of control variables for properties, to control for the differences between properties. For the year of construction dummy variables are included and should be compared to the construction year 1961-1971. This year is the most dominant in the dataset. The transaction year has a dummy for 2022, whereby compared to 2021. The remaining variable is the type of residence, there are also dummy variables for this variable. These results should be compared to apartments. In the dataset the apartments have the highest number of cases.

Table 2 shows the coefficient on distance to Boltek is positive and significant at the five percent level, implying that there is a relationship between distance to industrial agglomeration and housing prices in the province of Zuid-Holland. In other words, for every kilometre the housing price rises with 1,2%. Housing prices increase when industrial agglomeration arises within 15 kilometres of that agglomeration. The type of house also has an impact on the housing prices. As presented in table 2, the detached house has a big role. For every extra detached house, the average housing price rises with 8,1 percent. This coefficient is also significant at the five percent level. Table 2 shows one variable which has a negative coefficients and is significant, this is the year of construction between 1941 and 1960. This show housing prices drop for transactions in this year of construction period.

As shown in table 2 the multilinear regression has a significance level of <0,001 and R square of 0,555. The ANOVA has a significance level of 0,000. This indicates that the means of two or more independent variables are not equal. The variable distance between agglomeration Botlek and the properties has a significance level of <0,001 and a standard coefficient of 0,002.

Table 2 Regression 1: Multilinear regression results for all distance measurements

Model	β	Coefficients std. Error	T	Sig.
Constant	12.253	0.23	542.849	.000
Distance from Botlek to house in meters	.012	.002	7.856	<.001
Dummy_2022	.007	.017	.422	.673
Row_House_Dummy	.254	.012	21.995	<.001
Corner_House_Dummy	.325	.015	22.139	<.001
Semi_Detached_House_Dummy	.549	.021	25.754	<.001
Detached_House_Dummy	.813	.031	26.190	<.001
Dummy_1500_1900	.015	.027	.552	.581
Dummy_1901_1920	.014	.026	.545	.586
Dummy_1921_1940	.024	.018	1.316	.188
Dummy_1941_1960	-.072	.018	-3.963	<.001
Dummy_1971_1980	.036	.017	2.147	.032
Dummy_1981_1990	.032	.017	1.873	.061
Dummy_1991_2000	.243	.019	12.533	<.001
Dummy_2000_2010	.396	.021	18.665	<.001
Dummy_2011-2022	.403	.026	15.782	<.001

Note: References categories: Dummy_2021 (transaction year), Dummy_1961-1970 (construction period), Apartment_Dummy (type of residence).

This regression suggests that a closer distance to the Botlek does not result in higher housing prices. The regression shows a different outcome than literature has shown. Gleaser (2010), Franke et al. (2012) and Hu et al. (2021) stated that housing prices were higher in areas closer to agglomeration of economies. This regression shows this is not the case for Zuid-Holland.

There may be a concern, the variable 'Distance from the Botlek to house in meters' does not specify the outcome that much. Close to the Botlek is the city of Rotterdam. This is a major city in the Netherlands and a major agglomeration of economies. There might be influence of this city to the selected cities in this research. Therefore, another regression has been done, whereby distance is categorized by a range to 5 kilometres, 10 kilometres and 15 kilometres. Table 3 shows the results of the second model. The dependent variable is again the logged transaction price, the control variables are the same as used in the regression from table 2.

In order to check if there is a relationship between the variables an analysis of variance (ANOVA) is used. The significance is lower than 0.05, this implies that there is a relationship between the housing transaction price and the distance in kilometre to the Botlek.

When looking at the regression outcome of table 3, the 'Dummy_10km' has a negative coefficient and an insignificance level at the five percent level. This implies that on average houses at 10 kilometres from the agglomeration do not have lower housing prices than at other distances. At 15 kilometres there is a significant and positive coefficient. This implies that every kilometre a house is located further away from the agglomeration the housing prices rises with 8,6 percent.

Table 3 Regression 2: Multilinear regression results including dummy variables for distance

Model	**β**	**Coefficients std. Error**	**T**	**Sig.**
Constant	12.316	0.19	639.173	.000
Distance_10km_Dummy	-.008	.017	-.485	.627
Distance_15km_Dummy	.086	.018	4.879	<.001
Dummy_2022	.004	.017	.256	.798
Row_House_Dummy	.255	.012	22.130	<.001
Corner_House_Dummy	.327	.015	22.398	<.001
Semi_Detached_House_Dummy	.552	.021	26.016	<.001
Detached_House_Dummy	.812	.031	26.271	<.001
Dummy_1500_1900	.021	.027	.799	.424
Dummy_1901_1920	.009	.026	.324	.746
Dummy_1921_1940	.025	.018	1.377	.169
Dummy_1941_1960	-.064	.018	-3.504	<.001
Dummy_1971_1980	.044	.017	2.628	.009
Dummy_1981_1990	.045	.017	2.580	.010
Dummy_1991_2000	.249	.019	12.891	<.001
Dummy_2000_2010	.399	.021	18.909	<.001
Dummy_2011-2022	.399	.025	15.687	<.001

Note: References categories: Dummy_2021 (transaction year), Dummy_1961-1970 (construction period), Apartment_Dummy (type of residence), Dummy_5km (Distance)

As shown in table 3, the model has a significance of 0,000 and an R square of 0,560. The ANOVA has a significance of 0,000. The regressions still show a different outcome than literature has already shown. The model shows that distance is positively related to housing prices but shows the further away from the agglomeration of the Botlek, the higher the housing prices will be. For every kilometre added after the 15-kilometre range, housing prices will increase with 8,6 percent.

5. Conclusion & Discussion

Agglomeration of economies is a place that is doing well, and thereby attract people from other areas to this place. This does not only count for cities, but it also counts for logistic parcs & ports. A lot of research has been done about the effects of this phenomena worldwide. However, there is only limited research on the relation between distance from industrial agglomeration and housing transaction prices. Especially research about ports and their effect on housing prices is limited. This research investigated the effect distance to the Botlek, the biggest cluster in the Port of Rotterdam, has on housing prices in a range of 15 kilometres. The following research question has been formulated: ""How does industrial agglomeration effect Housing Prices in a 15-kilometer range in the province Zuid-Holland?". In this case especially the industrial agglomeration in the Port of Rotterdam.

In this paper, a multiple regression is used the measure the effect. A dataset with 2044 housing transactions in 2021 and 2022 was used for the statistical analysis. The dependent variable is the housing transaction price. This variable is log-transformed in the regression. The independent variable is the distance to the agglomeration in kilometres. The control variables are transaction year, housing type and construction year. From the results of the multiple regression, it can be concluded that there is a significant effect between the variables distance and housing price. The regression model reports a highly significant result. When looking at the distance to the Botlek, this resulted in a significant standard coefficient of 0.012. This means that moving one kilometre away from the industrial agglomeration, the transaction prices are raised with 1,2%. The second regression split up the distance in to three different ranges. These results showed that at 10 kilometres there is no significance between distance to agglomeration and housing prices. For 15 kilometres this was the case, hereby can be stated that for every kilometre added after 15 kilometres the transaction price will increase with 8,6 percent.

This founded relationship is in line with the findings of Gleaser (2010), Francke et al. (2012), Hu et al. (2021) and Chen & Li (2016). Only the findings with regarding to what type of effect the distance has on transaction prices are not in line with the findings of the mentioned literature. Gleaser (2010) found that housing prices would increase once agglomeration of economies arises. This outcome is also supported by Chen & Li (2016). Francke et al. (2012) and Hu et al. (2021) focused more on agglomeration of offices in cities. This study does not align with Hu et al. (2021) were there would be a negative coefficient expected from the regressions.

One limitation of the dataset used in the research is the information about transaction year. The database only showed transactions from 2021 and 2022. There were no earlier transactions of the same house, this means it is not clear if the price has risen in the last couple of years and if this is due to the agglomeration of industry in the Port of Rotterdam. Furthermore, the city of Rotterdam could also have influence on the housing prices of the houses in the dataset. This factor is not considered. The model shows a significant result but could not give an explanation of why this is the case.

It could be argued that housing prices can be explained by the distance to industrial agglomeration in the province of Zuid-Holland. This study investigated the effect distance to agglomeration has on housing prices. For future research also the city of Rotterdam needs be taken in to account and could be researched by itself. The effect agglomeration has on housing prices could be used by planners in the future. There are a lot of places in the Netherlands that are not vital villages or towns but have the ability to attract industrial or logistical companies. This could lead to more vital cities at other provinces than the Randstad.

References

Alonso, W. (1960). A theory of the urban land market. *Papers and proceedings of the regional science association,* 6 (1960), pp. 149-157

Ben, T., & Lin, S. (2009). Impact of government and industrial agglomeration on industrial land prices: A Taiwanese case study. *Habitat International,* 33 (2009), 412-418.

Calcasa (2020). *The WOX Quarterly Q1 2021*. Retrieved on March 3, 2022, from https://www.calcasa.nl/nieuws/2021-q1-wox-kwartaalbericht-vergroening-nederlandse-woningmarkt-heeft-nog-lange-weg-te-gaan

CBS (2021). *Bestaande koopwoningen: verkoopprijzen; regio; prijsindex 2015=100*. Retrieved on March 3, 2022, from https://opendata.cbs.nl/#/CBS/nl/dataset/83906NED/table

CBS (2022). *Regionale Kerncijfers Nederland: Zuid-Holland.* Retrieved on May 15, 2022, from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/70072NED/table?fromstatweb

Chen, X. & Li, Z. (2016). The effect of housing price on industrial agglomeration in China. *Modern Economy,* 7 (12), 1505-1516.

Dumais, G., Ellison, G., & Glaeser, E. L. (2002). Geographic Concentration as a Dynamic Process. *The Review of Economics and Statistics*, 84 (2), 193-204.

Eliasson, J., Lindqvist Dillen, J., & Widell, J. (2002). Measuring intrusion valuations through stated preference and hedonic prices: a comparative study. In *Proceedings of European Transport Conference*, pp. 9-11.

Francke, M, K., Schoenmaker, D. A. J., & Vlist A. J. van der, (2021). Agglomeration Economies and Capitalization Rates: Evidence from the Dutch Real Estate Office Market. *The Journal of Real Estate Finance and Economics.*

Fujita, M., & Mori, T. (1995). The role of ports in the making of major cities: Self-agglomeration and hub-effect. *Journal of Development Economics,* 49 (1996), 93-120.

Gleaser, E, L. (2010). *Agglomeration Economics.* 1st edition. National Bureau of Economic Research: London.

Gottlieb, J. D., & Glaeser, E. L. (2009). Wealth of Cities: Agglomeration economies and Spatial Equilibrium in the United States. *Journal of economic literature,* 47 (4), 983-1028.

Gps-coördinaten.nl (2022). *15 km coronaregels.* Retrieved on March 15, 2022, from https://www.gps-coordinaten.nl/15-km-coronaregels

Hu, M., Tsang, D., & Wan, W. X. (2021). Corporate Relocation and Housing Market Spillover. DOI: http://dx.doi.org/10.2139/ssrn.3683630

Ministry of Infrastructure & Environment. (2012). *Structuurvisie infrastructuur en ruimte.* Retrieved on March 2, 2022, from https://www.rijksoverheid.nl/onderwerpen/ruimtelijke-ordening-en-gebiedsontwikkeling/documenten/rapporten/2012/03/13/structuurvisie-infrastructuur-en-ruimte

Mori, T., & Nishikimi, K. (1999). Economics of transport density and industrial agglomeration. *Regional Science and Urban Economics,* 32 (2002), 167-200.

National Geo Register (2018). *Map of industrial agglomeration and clustering.* Retrieved on March 12, 2022, from https://nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search;jsessionid=C1B3EB216F2AB4C5C01B3D03388A5D26#/map

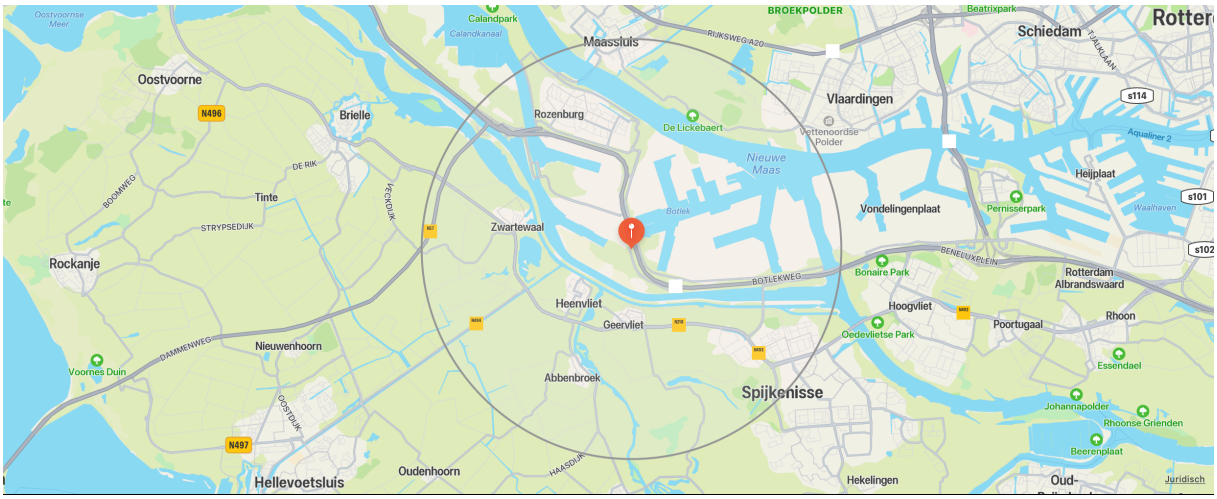
Nelson, J. P. (1982). Highway noise and property values: a survey of recent evidence. *Journal of transport economics and policy*, 16(2), pp. 117-138.

Pan, Y., & Yang, Z. (2020). Human Capital, Housing prices, and regional economic development: Will “vying for talent” through policy succeed? *Cities 98.* DOI: https://doi.org/10.1016/j.cities.2019.102577

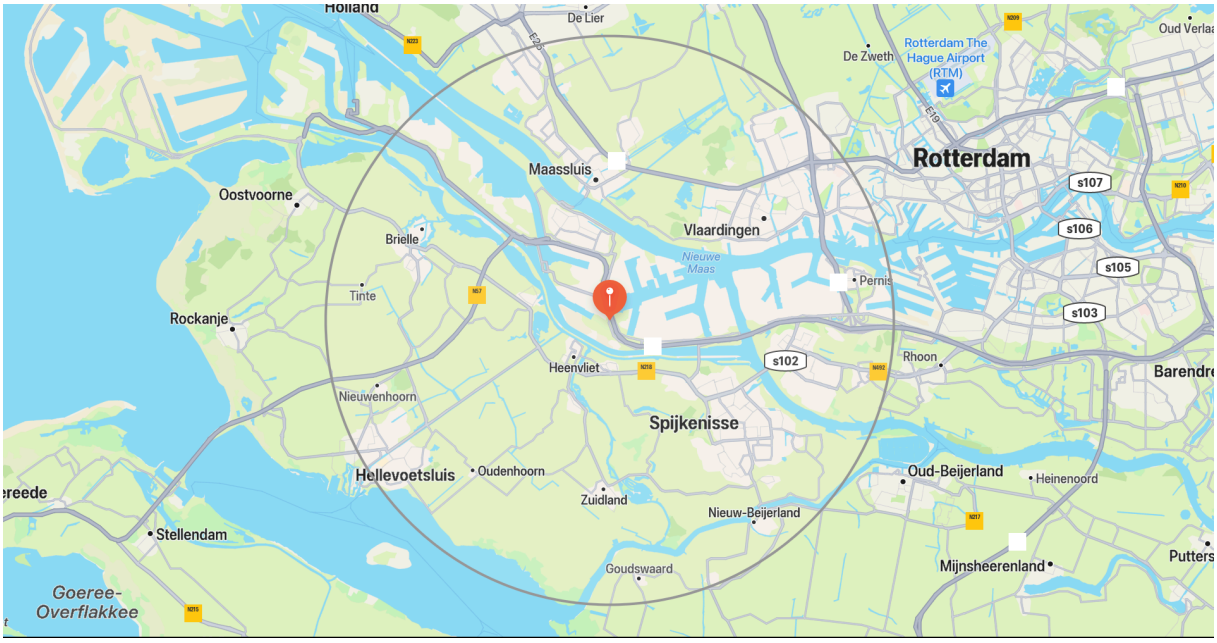
Tillema, T., Hamersma, M., Sussman, J. M., & Arts, J. (2012). Extending the scope of highway planning: accessibility, negative externalities and the residential context. *Transport Reviews*, 32(6), pp. 745-759.

WalterLiving. (2022). *WalterLiving database.* Retrieved on April 7, 2022 from: https://walterliving.com

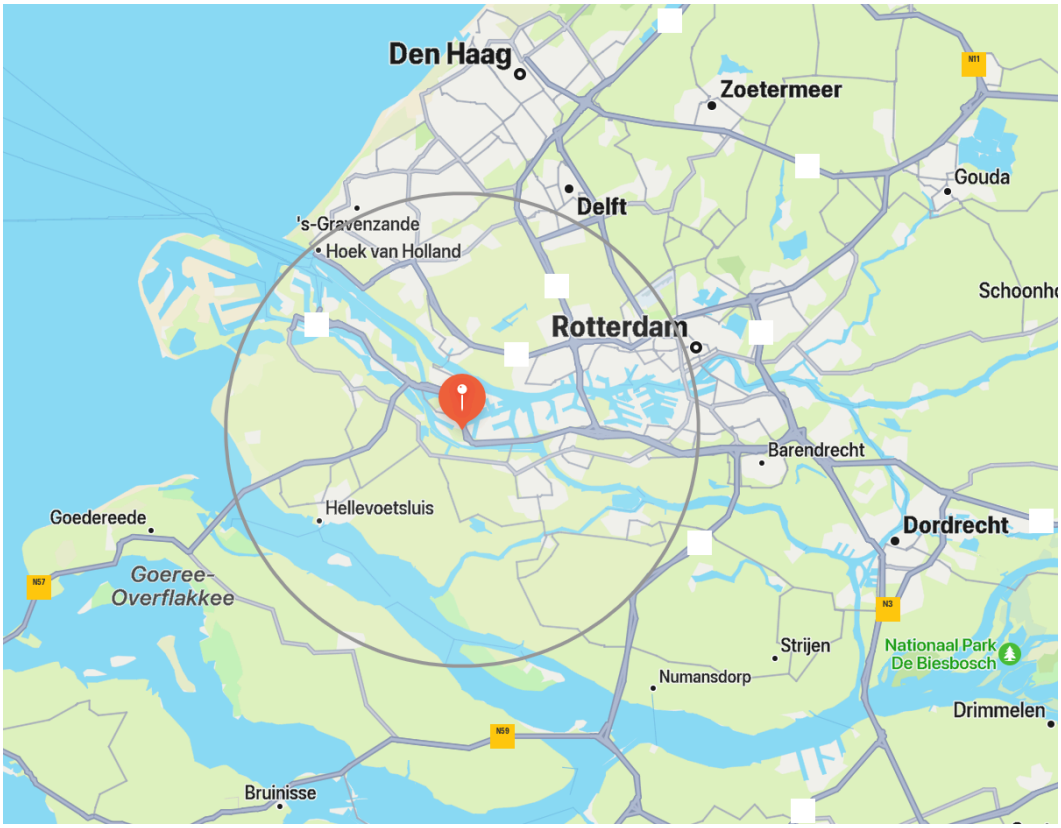
Appendix A – Distance from agglomeration Botlek



Cities 5km
Rozenburg
Maassluis
Zwartewaal



Cities 10km
Spijkenisse
Vlaardingen
Hellevoetsluis



Cities 15km
Schiedam
Naaldwijk
Oud-Beijerland