The Chicken Game

Site development under conditions of market power on the Dutch land market

Matthijs Ham
Bachelor Thesis Geography, Planning and Environment (GPE)
Radboud University, June 2021
Nijmegen School of Management

kadaster

The Chicken Game

Site development under conditions of market power on the Dutch land market

Matthijs Ham (s1003904)
Bachelor Thesis Geography, Planning and Environment (GPE)
Supervisor: Francisco E. M. Filho
Internship supervisor: Marc van Geene
Radboud University, June 2021
Nijmegen School of Management
Word count: 18.530

Abstract

The Netherlands currently suffer from a housing shortage. As a consequence this also entails that the prices for residential real estate are skyrocketing. To tackle this problem the national government has set a commitment to build 900.000 houses until 2030 (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021a). To meet this commitment, this means that the rate at which houses are constructed has to be accelerated. This does not go easily, however, as the supply side of the real estate market reacts rather inelastic to an increase in demand (Renes, Thissen & Segeren, 2006; Michielsen, Groot, & Maarsseveen, 2017). Within this context, planning authorities often get accused by market actors of facilitating too little land for residential development (White, 1985). This is countered though, with observation of *stalled sites* (McAllister, Street, & Wyatt, 2016). These are sites that are completely ready to be developed, nevertheless they remain undeveloped. This is detrimental to the speed at which new houses are brought onto the market. The problem of stalled sites can also be observed in the Netherlands. A rough estimation made by Buitelaar and Van Schie (2018) suggested that 100.000 residences are currently not being developed. McAllister et al. (2016) looked further into what might be the reason for these stalled sites. They pointed at planning issues, viability issues, site specific issues, and owner issues. The latter encompasses the strategic behaviour of landowners. However, a study by Geuting, Ham and De Leve (2021) suggested that speculation was not that pertinent in most cases. According to research in the field of real options theory, *market power* might be an important factor that is conducive to stalling sites (Ott, Hughen, & Read, 2011; Read, 1997; Sommerville, 1999; Wang & Zhou, 2006). Should a certain landowner possess a substantial proportion of the available land supply for residential development, then they have the ability the set prices for their real estate that are higher than the market prices that result in equilibrium (Buitelaar & Pouls, 2009). Studies by Priemus and Louw (2003) and Buitelaar and Pouls (2009) argued that certain market actors in the Dutch land market have excessive amounts of market power. When a landowner possesses great market power, it becomes strategic for them to stall the development of their sites. This ensures a stable flow of income through phased development and keeps the supply artificially low which will result in higher revenues (Ott et al., 2011).

This research aims to tackle the problem of stalled sites and, on a bigger scale, the housing crisis in the Netherlands. It does so by a more in-depth study of the question about the role that market power plays in residential developments and the occurrence of stalled sites. In doing so, this research will add to the body of literature on stalled sites and delay in developments by providing an empirical analysis on this phenomenon. This is investigated for the plans in the province of Noord-Holland that ought to finish somewhere in 2018, both time and place demarcations are due to the reason of data availability. A logistic regression is performed to assess the relationship between the occurrence of stalled sites and market power. The dependent variable is categorical; each plan is categorised as either ‘not stalled’ or ‘stalled’. This is done through assessing whether the time the development is taking has surpassed the average lead time. This is the time between the moment the developer obtains the building permit and the finalisation of the plan (Centraal Bureau voor de Statistiek, 2018). In theory, the development then has had enough time to be fully completed. If the plan is still not completed after this time, then it is considered to be stalled. Out of the 131 plans in the study, 32 plans are considered to be stalled (Figure 7). The logistic regression model predicts in which category a plan will most likely belong on the bases of several independent variables. The main independent variable is market power. This is measured through calculating the *Herfindahl-Hirschman Index* (HHI), which is an indicator for *market concentration*. Market concentration refers to the way the supply is distributed over all of the sellers present in a market. If a market is strongly concentrated, this indicates that a substantial part of the total supply is controlled by only a few actors. Therefore, a concentrated market is an indication that certain suppliers possess market power. The HHI ranges from 0 to 1, where a score above 0.18 suggests

a strongly concentrated market. The HHI is calculated by summing al of the squared shares of each of the landowners. The ownership situation on January 2018 is known through the database of the Kadaster, allowing the HHI to be calculated for the land market of every municipality. On average, the HHI of each of the municipalities in the province of Noord-Holland is 0.32 (Figure 8); thus indeed signalling that the market is highly concentrated and indicating that there are certain actors that possess a high amount of market power. The model also included variables on the location, demand volatility, and plan size. To check for any influence of the location, the distance to the nearest big city was calculated for each of the plans. It is expected that plans closer to the Central Business District (CBD) were more likely to become stalled, due to the extra revenues landowners could capture (Davy, 2012). Next, the population growth for every municipality between 2017 and 2018 was included in order to control for demand volatility. As found in the literature, the more volatile housing demand is, the more inclined landowners are to postpone the development of their sites (Ott et al., 2011). For in the near future demand could be even higher, resulting in bigger profits. Finally, the gross plan capacity (i.e., the number of houses in the plan) was added as a variable for plan size. Bigger plans should encourage phasing, thus stalling certain plans to keep supply low (Markusen & Scheffman, 1987).

The model is a statistically significant improvement over the baseline model without any predictors; for χ^2 (4) = 11,696; $p < 0.05$. The model was able to correctly classify 12,5% of all the observed stalled sites as stalled. It is suggested that there is a negative relationship between the HHI and the occurrence of stalled sites; for every 0.1 increase in HHI, the likelihood of a plan becoming stalled decreased with 9,0%. This is in contradiction with the hypothesis of this research. Moreover, it pointed towards a small positive effect of gross plan capacity on the occurrence of stalled sites; for every extra house added to the plan it becomes 0,2% more likely to be stalled. The remaining variables were found to have no significant effect on the likelihood of a plan becoming stalled. Different models in regard to this matter have not been found, this should therefore serve as an invitation to create a model that is able to more accurately predict whether a plan will be stalled or not.

The main findings of this research are that the land market of the province of Noord-Holland is strongly concentrated, adhering to earlier findings of Priemus and Louw (2003) and of Buitelaar and Pouls (2009). It also supports the findings of Geuting et al. (2021) that about two-fifths of all the residential developments are stalled. This again illustrates the severity of the problem of stalled sites. The negative relationship between the HHI and the occurrence of stalled sites should be stated with precaution. If a pure monopoly remains absent, a high HHI indicates that a couple market actors have a strong degree of market power, but that there are also other landowners present in the market that own only a small fraction of the total supply. These landowners can benefit from the other stalled sites in the market by quickly developing their sites. This way, they bring real estate into a market where demand for residences is high which will increase their profit. This research could not account for this effect. The plans of the landowners with low market power will most likely be quite small, as otherwise the landowners would have had more market power. Future research on this matter should demonstrate whether this holds up. Should this be the case, then the rate at which residential real estate is developed might be accelerated if municipalities were to create smaller plans. This is already suggested by the small positive effect of plan size the model pointed towards. For there seems to be a positive feedback loop where the currently dominant market actors will only strengthen their positions, because they can outbid others due to their higher profits. After they gain possession of the land, these actors will stall their sites again. As a policy recommendation municipalities should think about creating smaller plans. This would ensure more competition on the land market and also on the contractor market. Construction costs would become higher, however, due to less cost reduction as a result of economies of scale. Nevertheless, this can be negated if unprofitable developments subsidised by the government. Also, by being aware of the results of the now prevalent practice of stalling sites, municipalities can respond by deploying instruments that prevent stalling and ultimately combat the housing crisis.

Preface

This thesis concludes my bachelor's programme of Human Geography, Spatial Planning and Environment and Society Studies. At the start of this year, I imagined my last year of this programme to be different than it has turned out to be. Even though there were some roadblocks in the beginning and some towards the middle of this thesis, I am still quite satisfied with the finished result you are about to read.

During this whole process I have had people advising and helping me. I would like to thank Francisco E. M. Filho for supervising me during the process of writing my thesis; Erwin van der Krabben for pointing me towards a research theme that I still find very intriguing; Huub Ploegmakers for advising me about my research strategy and helping me to get access to part of the data that I used; Babak Firoozi Fooladi for providing usable spatial data and assisting me in handling this data; and lastly Marc van Geene for supervising my research internship at the Kadaster and for sparring with me on the difficulties in the research.

I hope that the outcomes of this thesis provides some insights that are helpful to the joint research project of Aalto University and Radboud University, as well as to the Kadaster. I expect that the Kadaster will continue to be involved in the afore mentioned research project in order to bring that to a successful end too. Lastly, I am grateful for my internship at the Kadaster. I learned a lot in my time there and I wish the team the best of luck in all of their future endeavours.

Table of contents

1. Introduction

The Netherlands face a serious housing shortage. The central government has estimated that another 900.000 houses need to be built before 2030. This is, according to the Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (BZK) (2021a), 150.000 dwellings more than the commitment made in the 'Nationale Woonagenda 2018-2021'. To realize this commitment, the rate at which houses are constructed needs to be accelerated. However, the housing supply is still lagging behind the demand (Buitelaar, 2019). In the following paragraph, the problems of housing shortage and the acceleration of the housing construction will be elaborated on.

1.1 Problem definition

The most basic explanation for the housing shortage can be found in the imbalance between housing supply and demand. Simply put, a housing shortage is present when the demand for housing is higher than the supply. Therefore, (part of) the explanation for this deficit can be found by looking at the demand as well as at the supply side of the Dutch real estate market. The rise in demand is caused by the growing number of households in the Netherlands. This has its origin in natural population growth, a positive migration surplus and household dilution (ABF Research, 2020; Ministerie van BZK, 2020a). Furthermore, the increase of households, and thus the demand for housing, is not the same throughout the Netherlands. Figure 1 shows the future development of households until 2035 specified per region. It is estimated that the Randstad area will have the biggest increase in households and that in some areas in the corners of the country there will not be any growth at all, but rather a decline.

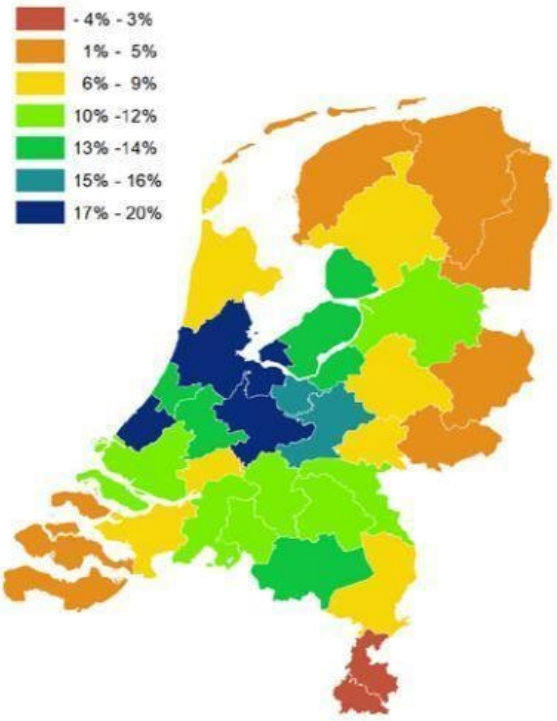

Figure 1: Household growth per real estate market area 2020 to 2035 (ABF Research, 2020a, p.10)

This rise in housing demand needs to be accommodated. However, this proves to be easier said than done, as it has been suggested by a myriad of inquiries that the supply elasticity of the Dutch real estate market is nearly inelastic (Swank, Kakes & Tieman, 2002; Renes, Thissen & Segeren, 2006;

Michielsen, Groot & Maarsseveen, 2017; Öztürk, Van Dijk & Van Hoenselaar, 2018). This means that a rise in housing prices does not lead to an increase in housing supply, as would be the case in 'normal' (i.e., elastic) markets. It has even been pointed out by Michielsen et al. (2018) that the housing supply reacts asymmetrically to housing prices; there is little effect when housing prices increase, but whenever housing prices drop so too does the housing supply. Furthermore, it has been suggested that the construction sector still suffers from longer lasting effects of the financial crisis of 2008 (Ministerie van BZK, 2018; Buitelaar, 2019).

In addition to troubles in the construction sector, a study by Buitelaar and Van Schie (2018) showed that in the Netherlands quite a number of sites remain undeveloped, despite being 'shovel ready'. It is roughly estimated these sites hold a capacity of 100.000 residences, which makes up for eleven percent of the number of total residences the government has committed to build before 2030. This phenomenon is also pertinent in England and has been called stalled sites by McAllister, Street and Wyatt (2016). Or in their words, a site is stalled when "an abnormal time period has lapsed since the grant of planning consent and the commencement of development activity on-site" (McAllister et al., 2016, p.134). It is obvious to state that these sites are neither beneficial to the housing shortage nor to the acceleration of the housing construction.

Historically speaking, blame for this phenomenon is often placed on large developers and landowners (Markusen & Scheffman, 1978; White, 1985). They are accused of "restricting development and raising prices for their own gain" (Markusen & Scheffman, 1978, p.519). One of the reasons an investor can stall development is to strengthen her/his position within the local land market. In other words, they want to increase their market power. Multiple studies provided a theoretical foundation for the restriction of development due to market power (Markusen & Scheffman, 1985; Cotteleer, Gardebroek & Luijt, 2008; Wang & Zhou, 2006; Ott, Hughen & Read, 2011). These studies suggested that development is postponed because, in the case of developers and landowners who own a large share of the available supply of the land market, it is rational to do so. Demand is very high, thus by restricting development of their sites they can keep land supply low in the market, so that they have the ability to raise prices. A study by Buitelaar and Pouls (2009) has suggested that landowners on the Dutch land market, and especially in the Randstad, indeed have a high degree of market power. Therefore, this might be (one of) the reason(s) sites are stalled.

1.2 Research aim and questions

In this study, the effect of market power on land and real estate markets will be further explored. It does so by studying the province of Noord-Holland. This is mainly due to the reason of data availability. By zooming in on the province of Noord-Holland the complexity of its land and real estate markets will be displayed even further. Getting insight into this complexity will help to tackle some of the problems that exist within these markets, specifically the occurrence of stalled sites. Hopefully, this can ultimately contribute to solving the problem of the current housing shortage in the Netherlands. Also, it could, to a bigger extent, help the public sector and land and real estate markets on a global scale to prevent and solve the problem of stalled sites, when their excessive presence in the urban fabric is disadvantageous to society. To do so, the main research question is the following:

"What role does market power play in the development process and the stalling of sites?"

In order to answer this question adequately, the following sub-questions need to be answered:

1. How can stalled sites and market power be defined?
2. What is the state of the development process of the developable sites in the Noord-Holland province?

3. What is the state of market power in the land market in the Noord-Holland province?
4. What is the relationship between market power and the development progress of housing sites?
5. What other factors can influence the development process and how?

1.3 Societal relevance

At the current time, the housing crisis is one of the most prominent problems in the Netherlands, as the biggest building commitment has been made by the government ever since World War II and the 'babyboom' that followed (Ministerie van BZK, November 2018). This time, however, the qualitative side of the housing crisis is highlighted more. The country does not just need more housing, it is in need of affordable housing, sustainable housing, life-cycle proof housing and fair housing. Furthermore, there is very a slow paced, or no, advancement in the real estate market (Das & Van Daalen, 2012; Knipp, 2018). The issue of stalled sites contributes to an increase in prices, as supply is 'artificially' kept low. Because of the latest two issues, entry into the real estate market is made more difficult, which puts more pressure on the market for social housing.

Due to the complexity and interweaving of multiple aspects within the spatial domain, governments are able to, and thus aim to, tackle and partly solve other problems through planning processes and housing development (Spit & Zoete, 2016). This includes sustainability issues such as climate adaptation, generating renewable energy, and circular economy. But also more social matters such as integration, polarisation and the extramuralisation of health care. Because these problems are part of broader systems and processes, the practice of site development has shifted to an integral approach as well (Spit & Zoete, 2016). By ultimately solving the problem of stalled sites, this research therefore might aid in the progression of several other issues.

1.4 Scientific relevance

Literature on stalled sites is limited. Stalled sites are a relatively new problem, as the term was first coined in 2016 by McAllister et al. However, they point out that even though there is little academic literature focused specifically on stalled sites, there is a substantial body of literature about vacant sites (for example Farris, 2001; Markusen & Scheffman, 1978; Titman, 1985; Ott et al., 2011; Wang & Zhou, 2006). It should be noted that vacant sites can also be stalled sites (however, they do not have to be). It will prove to be very difficult, however, to investigate which of these inquiries has in fact dealt with stalled sites. This does not mean that the explanations, solutions, and lessons drawn from this existing body of research cannot be applied to the cases of stalled sites. Nevertheless, these should be carefully evaluated before one does so. This research attempts to add to the small body of literature on stalled sites and more specifically to the Dutch context thereof.

Furthermore, not much (urban) literature can be found about the existence and possible effects of market power on land markets. According to Markusen and Scheffman (1978), this is because most assume that competitive conditions in (land) markets prevail. Market power and concentration have been brought in relation to site development by some (for example Bulan, Mayer & Somerville, 2009; Cunningham, 2006; Grenadier, 1996; Markusen & Scheffman, 1978; Ott et al., 2011; Somerville, 1999; Williams, 1993). Most of the discourse has been established through theoretical (economic) models and research. Empirical studies on this relationship are scarce (Priemus & Louw, 2003; Buitelaar & Pouls, 2009). This study will add to the literature of market power and of site development and will be specifically adding to the empirical literature on this phenomenon.

In a broader context, this research adds to the already extensive debate between planners and market actors on reoccurring housing shortages. White (1985) discussed the arguments of both sides. Market actors argue that the shortage is due to the planning authorities because through planning laws

and regulations, land supply for housing is limited and zoned at locations that might not be optimal (in terms of efficiency) for development. Planning authorities on the other hand accuse market actors of stalling development for speculation purposes and to be able to land bank (the latter purpose holds especially for large homebuilders, this is explained in paragraph 2.2.4). The existence of stalled sites might also be an argument in favour of planning authorities.

1.5 Reading guide

In the next chapter, a theoretical framework is created to grasp more in-depth the notions of stalled sites and market power. At the end of this elaboration, a hypothesis is put forward. In the third chapter, the methodological approach will be elaborated and it is explained how the hypothesis will be tested. After this, the results of this study are shown. In the following chapter, a conclusion is drawn from these results. Finally, a chapter that discusses these results and this research as a whole is put forward. This chapter will also discuss possible shortcomings of this study.

2. Theoretical Framework

In this chapter, a theoretical framework will be discussed in an attempt to fully understand the aspects of this research. First, stalled sites will be elaborated on; what are they and how does this fit in the Dutch planning context? Then, possible causes for stalled sites are searched in a scope of different disciplines. After this, market power will be discussed; what is it, how is it obtained, and how can it be measured? Lastly, a hypothesis will be put forward.

2.1 Stalled sites

2.1.1 What are stalled sites?

Site development is a complex process in which a myriad of actors, interests, laws and regulations, and power relations are involved (Healey, 1992). The steps a development process goes through can differ, depending on ownership distribution, planning regulations and landscape characteristics to name just a few. In a broader context, site development also influences and is influenced by social trends and macroeconomic conditions (McAllister et al., 2016). The interplay of all these processes, agents and contexts can result in uncertainty and delay. Therefore, not all development projects take place smoothly; some might not even take place at all. As a result, vacant sites can be observed, some of which are what McAllister et al. (2016) consider to be 'stalled sites'.

Stalled sites are sites that have obtained the grant of planning consent, however, since then no development activity has taken place on the site for an abnormal period of time (McAllister et al., 2016). Buitelaar and Van Schie (2018) also adhere to this definition, but they create a typology of three different forms of stalled sites. The first type are sites for which the building permit is granted, but where there has not been any development activity for a period of time which surpasses the average lead time; the time between the granting of the building permit and the formal moment of completion. Next, the second type is the situation where the zoning plan has been approved, but no request for a building permit is made. This is odd since most of the time, the zoning plan is only approved by the municipality when it is accompanied by a building plan so it is clear how the costs are allocated (Buitelaar et al., 2012). Lastly, the third type are those sites for which only partially a building permit has been requested or that have been underdeveloped. These sites have not (yet) been developed to their fullest potential. The typology of Buitelaar and Van Schie (2018) helps to identify in which step(s) of the process the delay is manifested. This helps to explain the stalling better and is useful when creating policy.

2.1.2 Stalled sites in the Dutch context

As for stalled sites in the Netherlands, Buitelaar and Van Schie (2018) estimated that the development of 100.000 houses is currently postponed. The Dutch government also views this as a problem that requires intervention. Recently, a motion was put forward in the House of Representatives to investigate the causes of stalled sites in the Netherlands (Ministerie van BZK, 2021b). The following research showed that about two-fifths of all the development plans that have been authorized by the municipality through a zoning plan ("*harde plannen"*) are delayed (Geuting, Ham & De Leve, 2021). The reason for the delay was almost always a combination of multiple factors, such as the financial viability and the reconsideration of the building programme. Many of the given explanations also reinforce one another. For example, once the development is not financially viable, the building program is likely to be reconsidered. Furthermore, it showed that speculation was not that much of an important factor in the stalling of sites (Geuting et al., 2021). However, this should be suggested carefully, since the research used a survey amongst municipalities; they do not know for sure whether a landowner is speculating on land, but made an educated guess. In addition, the landowner and developer issues brought forward by

McAllister et al. (2016) have not been looked at in full.

In the Netherlands, governments have several ways to prevent or act upon delay of site development. First of all, governments can account for postponement of development by simply creating more development capacity by authorizing more development to take place through zoning plans. This is what is referred to as '130% planning'. It is estimated that about 30% of the developments get stalled in one way or another, this way only 70% of developments are brought to completion. By adding 30% on top of the existing capacity, the central government aims to diminish the effects of delay (Ministerie van BZK, 2020b).

In case of land management via public law, the government can include a phasing schedule in the land exploitation plan ('*exploitatieplan*') it is required to ascertain. In the case of land management by means of private law, the government can include a building obligation in the anterior agreement ('*anterieure overeenkomst*') if this can be closed (Geuting et al., 2021). After a land exploitation plan or an anterior agreement has been closed, a posterior agreement ('*posterieure overeenkomst*')can also be made between the government and the developer. Through this agreement, some additional matters can be arranged, amongst which a schedule for the phasing of the development. In the case of a public-private partnership (PPP) for the intended development, the most common legal construction is the development claim ('bouwclaim'). This entails that the developers sell their lands to the government, in return the government takes care of the land exploitation and sells the sites back to the developers. In this claim, a development obligation can be included (Geuting et al., 2021). Furthermore, when the government owns the land, it has additional options. First, the government is able to select a developer. In the selection procedure, the government can make agreements about the development or include a building obligation. The government also has the option of including a fine on surpassing the term for development or the developer is forced to sell the land back to the government for the same or a lower price (Geuting et al., 2021).

From this can be gathered that the number of options to tackle delay pre-development seems quite extensive. Yet a study by Geuting et al. (2021) showed that in about 40% of the instances where delay occurs, no instruments are/were implemented by the government. This means that the planning authorities either are not aware of the problem of delay or that they do not have the knowledge or capacity to implement these clauses, however the exact reason remains unknown. In addition, the options of the government are limited if no such clauses are added in the agreements and development is postponed by the developer. Only by expropriating the land can the government gain back the control of the development. Land expropriation is, however, a very time-consuming and costly process which almost no planning authority makes use of (Geuting et al., 2021).

2.2 Factors influencing the progression of site development

As stated above, site development is a complex process that has interfaces with multiple disciplines. Therefore, causes for postponement or delay in site development can be found within a scope of different disciplines. This paragraph gives an overview of some reasons for this phenomenon relevant to the main research interest. However, this is by no means a complete overview.

2.2.1 (Neo)liberal explanations

From a (neo)liberal perspective, cost efficiency is the most important factor when explaining phenomena. In (neo)liberalism land is thought to be a production factor. Meaning that land has value, because people can derive utility from it. Developments at certain locations are assumed to be made in an attempt to maximize utility and reduce costs. Within this context, many scholars have tried to create a spatial model that explains the spatial structure of cities. One of the more well-known is the model of Von Thünen (Davy, 2012). It describes the relation between land rent, land uses and spatial structures,

i.e., the distance to the city centre. He imagines an isolated state wherein all farmers bring their produce to the city centre to sell. This brings about transportation costs. The transportation costs can vary per product, some are higher than others.

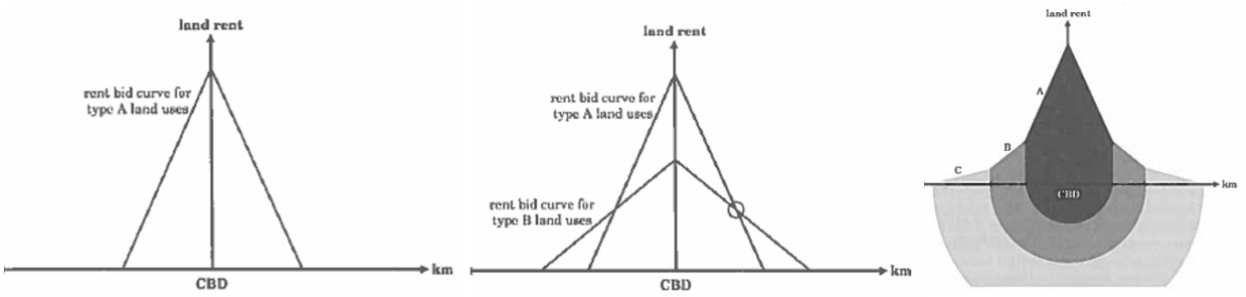

Figure 2: The Von Thünen model (Davy, 2012, p.41).

According to the Von Thünen model, land rent is the surplus of the total profit minus the total transportation costs. In figure 2, the Von Thünen model is presented. It starts with the bid rent curve of one single agricultural land use, where product A is produced. Then the bid rent curve for product B is added. The transportation costs for A and B differ, A's is higher than B's. At the intersection of A and B, one land use yields to another (Davy, 2012). This results in the final figure, where rings of different land uses are formed around the city centre. The model shows that land rents near the city centre are higher. This is the result of the prices at which the products of land use A can be sold at the market. A farmer, that he considers to be a homo oeconomicus, that produces product A does not want to move further away from the city centre, because otherwise the transportation costs would become too high. For farmers that produce product C, it is rational to move further away from the city centre, because otherwise their land rent is too high.

Alonso (1964) adopted a similar kind of model, but he differentiated between retail, industrial and residential land uses. His bid-rent model is still widely used (Davy, 2012). The bid-rent refers to the utility of a location as a function of the accessibility of that specific location. The farther away from the city centre, the more the accessibility decreases. The rate at which accessibility decreases depends on the land use. This also results in a ring-like structure around the Central Business District (CBD).

The theories are mainly criticised for two reasons. First, the imagined cities in both theories are monocentric, which means that they have only one city centre. However, due to mixed land uses and dispersed employment, (larger) cities have become polycentric (Gao, Wu, Chen & Chen, 2020). Scholars have found that in Chinese cities, the price gradient of housing prices and the influence of city centres on housing prices were much larger than in the traditional models with just one CBD (Wen & Tao, 2015; Lin, Allan, & Cui, 2015). Moreover, the bid-rent model has been challenged because "[…] both Western and Chinese cities have experienced the conversion of centrally located industrial land to residential properties in recent decades" (Gao et al., 2020). Thus, in urban redevelopment, neither location nor accessibility is the predominant motivation; rather it is the outcome of negotiations between stakeholders (Gao, Chen, & Liu, 2018). However a study by Gao et al. (2020) concluded that the distance to the CBD still remains an important factor in the spatial structure of cities.

2.2.2 Macroeconomic factors

Macroeconomics analyses site developments as part of a larger interconnected framework. Within this discipline, the interconnectivities between the real estate market and a number of different adjacent markets are subject of study. The most well-known model to do so, is the four quadrant model presented by DiPasquale and Wheaton (1992). They explain how the property market (space) and asset market (real estate) influence each other. The model is presented in figure 3. On the right side of the model the

property market is described and on the left the asset market. These markets explain how the rise in housing demand will, slowly, lead to the adjustment of the supply; i.e., gradual market clearing (Lisi, 2015).

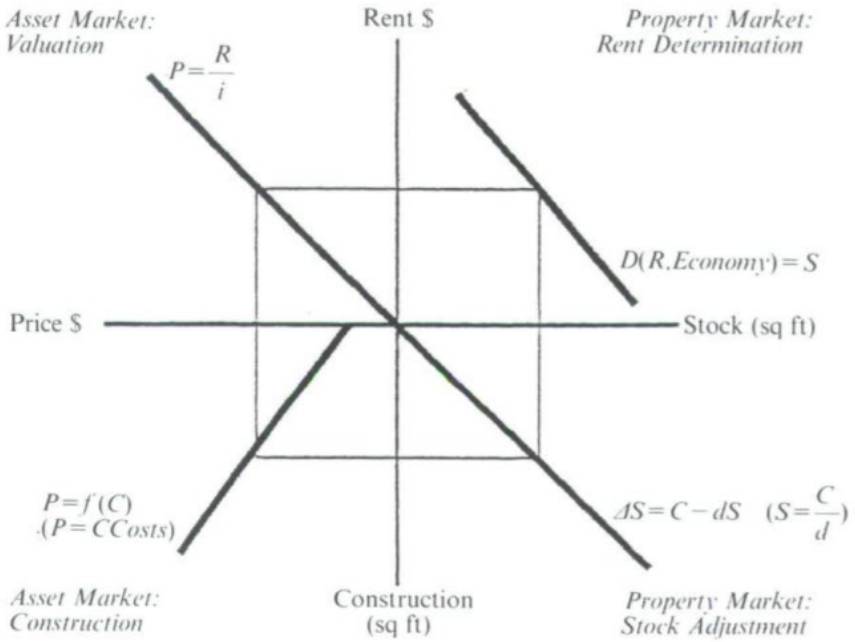

Figure 3: Four quadrant model (DiPasquale & Wheaton, 1992, p.188).

The model starts at the top right side. If the price for housing rises, the valuation of the real estate will rise (in the top left corner on the asset market). If real estate is more lucrative, investors will be inclined to invest more in the same type of real estate. If investors are willing to pay more for the real estate, then more real estate will be constructed (bottom left corner). Once more real estate is being constructed, the stock will slowly adjust to the demand (bottom right corner). Additions to the housing stock will, in case of a stable demand, lead to lower housing prices (DiPasquale & Wheaton, 1992). This, however, all starts with a rise in the demand for housing. Since the housing stock cannot be adjusted to the demand for housing that quickly, a rise in demand will lead to a rise in housing prices; this is what is meant by the inelasticity of the housing market (Swank, Kakes & Tieman, 2002; Renes, Thissen & Segeren, 2006; Michielsen, Groot & Maarsseveen, 2017; Öztürk, Van Dijk & Van Hoenselaar, 2018).

There are some points of critique to this model. The model offers a heavily generalised explanation of the stock and flow dynamics of land and real estate markets. First of all, Cowell (2002) pointed out that a number of other variables that influence the described dynamics are not included in the model. These included the long term supply, the capitalisation rate, the short-run adjustments, and the reservation demand that deals with the speculative demand and vacant land transactions made by landowners. Leung and Wang (2007) refer to other aspects that are not included, for example strategic interactions between real estate developers, bargaining, the political economy of housing supply, leverage effects, and monopoly power. Furthermore, the model does not account for the search-and-matching process, the discrepancies in this process will affect both housing prices and rental income (Lisi, 2015).

2.2.3 Causes found in real options theory

Even though stalled sites are presented as a new phenomenon, there are, of course, earlier instances of a comparable problem. Postponement of development has been given attention by several scholars,

particularly those interested in investment and assets. They explain the delay by means of real options theory (Bulan et al., 2009; Capozza & Helsley, 1990; Cunningham, 2006; Grenadier, 1996; Sommerville, 1999; Wang & Zhou, 2006; Williams, 1993). Through different economic models it becomes clear that in certain instances, the opportunity costs of developing in the future outweigh the costs of leaving the land undeveloped for a while, also known as holding costs (Ott et al., 2011). Research in this field also shows that depending, amongst other things, on the degree of pricing power (i.e., market power), development is more likely to take place in large or small phases (Ott et al., 2011; Read, 1997; Sommerville, 1999; Wang & Zhou, 2006).

Research by Ott et al. (2011) looked further into what factors influence the rate at which development takes place. The results explain under what market conditions it might prove to be rational to develop all sites at once, phase development or postpone development. They found that economies of scale discourage phasing, but when an adequate amount of market power is present, it encourages slow release of lots into the market. Furthermore, carrying costs were of influence. These are the costs of holding a developed site in inventory. These costs stimulate phasing of the development and discourage withholding developed plots from the market. Signalling effects also influence the rate of development and release into the market. Developers only sell a few lots to start with, so that they signal to the market about certain characteristics of the houses they have developed. By doing so, demand for that specific development rises and higher prices for the rest of the lots can be captured by the developer. Lastly, demand volatility was seen to encourage both phasing and withholding developed lots from the market. If market conditions can quickly change then the opportunity costs of holding off development increase. The conclusions are summarized in Table 1. In the case of no phasing and holding inventory the development can be postponed to maximize profit. In other words, the development can be stalled. The option of phased development and holding inventory can also be seen as stalled sites, namely the last category in the typology of Buitelaar and Van Schie (2018); a building permit has only been partially requested or the site is not developed to the fullest potential (yet). Another remark is that a necessary condition in the column of holding inventory is significant market power. This will be further elaborated in paragraph 2.3.

Table 1: Market characteristics influencing optimal phasing and inventory decisions (Ott et al., 2011, p.915).

	Holding inventory	**Immediate release into the market**
Phasing	- Low economies of scale - Low carrying costs - Significant pricing power - Volatile market demand - Strong signalling effects	- Low economies of scale - High carrying costs - Volatile market demand - Strong signalling effects - Positive or negative price momentum
No phasing	- High economies of scale - Low carrying costs - Significant pricing power - Volatile market demand - Strong signalling effects	- High economies of scale - High carrying costs - Minimal pricing power - Limited demand volatility - Weak signalling effects

2.2.4 Explanations in urban literature

Within the urban context, Markusen and Scheffman (1978) observed the phenomenon of leapfrog development as a result of speculation in the USA. This means that certain sites closer to the CBD of the city are not being developed, but the sites on the edges of the city are developed instead. The sites

near the CBD could then be considered stalled sites. At first glance this does not seem logical, as demand for residences near the CBD is higher most of the time; thus, a bigger profit could be acquired. This plays out differently, however, if the sites are owned by a single developer. The reason leapfrog development then occurs is that "withholding an acre of land inside the city raises the rent gradient more than the amount it is raised by withholding an acre at the edge of the city" (Markusen & Scheffman, 1978, p.522). The large landowner wants to keep demand high, for then the prices (s)he can charge will be higher. If the landowner develops the sites at the edges of the city in lower density, then demand will not drop as significantly as would be the case if the sites in the inner parts of the city with high density are developed (Markusen & Scheffman, 1978). Therefore, the market power of developers can result in an expansion of the city.

McAllister et al. (2016) gave four possible explanations for the phenomenon of stalled sites. First, there could still be unresolved planning issues that continue to block development. Even though the site is zoned for housing, the building permit still needs to be granted by the government. The site development can get stuck in negotiations between the government and the developer about certain planning obligations. For example, the government wants a certain percentage of the development to include social housing. The developer might not find this ideal and can try to persuade the government into deciding otherwise. Second, there can be issues surrounding the viability of the site development. In this situation, the developer is granted the planning permission, but the development cannot take place because the development is not (sufficiently) profitable. This problem may arise because market conditions change or the requirements set by the government reduce the profit. Third, there may be issues specific to that site that causes the development to be stalled. Examples of these kinds of issues are soil remediation, drainage, installation of services and infrastructure, or archaeological findings. Lastly, the development can be stalled by actions of the landowner and/or the developer. As a result of strategic behaviour, landowners decide to postpone development and sometimes even choose to completely abandon the development (McAllister et al., 2016). A form of strategic behaviour is land speculation; actors expect the value of the land or the development to increase due to better market conditions in the future. This may cause developments to be postponed to secure a bigger profit. Some private investors try to obtain and speculate on multiple lots, this is what is called land banking. Land banking is a step up from merely speculation. The investor also wants to have enough lots available for future development in order to ensure a stable flow of income. In some cases, land banking is also used to create a portfolio of assets. This is particularly pertinent with big construction companies (White, 1985).

2.3 Market power

2.3.1 What is market power?

In a market, the interplay between supply and demand results in an equilibrium. In this equilibrium, resources are allocated in the most optimal way, also known as Pareto optimal (Ledyard, 1989). A prerequisite for this are multiple buyers and sellers. There must be competition between sellers for the equilibrium to be optimal (Lerner, 1934). However, this does not always occur, for competition does not exist in every market. Without, or with a lower level of, competition, market actors can manipulate the market for their own gain (Hahn, 1984). Market concentration describes a market in which the sellers/providers do not hold equal shares of the available supply; certain producers hold a more substantial proportion of the supply (Feinberg, 1980). In the case of land and real estate markets this is called ownership concentration (Markusen & Scheffman, 1978). Certain actors then own a relatively large amount of the available land in comparison to other actors who own only a small portion of the total land supply. As a result, the large landowners have market power; the ability to charge land prices that are higher than they would have been able to in a competitive market (Glick & Campbell, 2007).

The bigger the portion of the supply they own, the more market power they possess. “A private party (or multiple parties working together) has market power if they can increase [land] prices above the [prices in] equilibrium, without the loss of sales (as a consequence of the increased prices) causing the profit to be lower than if it were to be sold against market price” (Buitelaar & Pouls, 2009, p.46).

The higher the market power, the higher the price a landowner can charge. Within the context of a local land market, a landowner can heighten her/his market power by obtaining a larger portion of the total land supply. However, once the landowner chooses to develop the land, their portion of the supply decreases and thus so does their market power. Meaning, if the landowner wishes to (at minimum) maintain her/his market power within a certain local land market, they need not develop their site(s) (Markusen & Scheffman, 1978). Should a landowner wish to increase her/his market power, then (s)he has two options. They either wait to develop their sites and hope that other landowners in the same market will develop their sites. This way their own share of the developable land supply increases in relative terms. The other option is to actively purchase more land to increase the owned share of the developable land supply in absolute as well as in relative terms (Buitelaar & Pouls, 2009).

Because market power is a result of ownership concentration, market power is highest when ownership concentration is too. The highest form of ownership concentration is a monopoly. In this case, there is only one landowner who owns all of the available land supply. Consequently, the monopolist can set prices and capture monopoly revenue; the greatest profit (s)he can make (Lerner, 1934). Even though a monopoly is an extreme and will not be the case for most markets (Markusen & Scheffman, 1978), market actors are still able to raise prices in markets with less ownership concentration (Cotteleer et al., 2008).

2.3.2 Market power on the Dutch land market

Over the last few years, a process of upscaling is taking place on the Dutch land and real estate market, as a result of the cost-reducing advantages of economies of scale (Priemus & Louw, 2003; Buitelaar & Pouls, 2009; Ott et al., 2012). The size of the developers increases and the number of developers is decreasing. This is also occurring within the area of project development. Furthermore, big traditional construction companies are becoming more active in the land and real estate market. For example, in 2004 BAM, Ballast Nedam, and Heijmans owned a shared supply of land which could have been developed into 66.000 residences (Buitelaar & Pouls, 2009, p.45); this is about the total annual Dutch production (Priemus, 2007). By taking an active role in the land market, developers can strengthen their market positions within the construction market. “Through their knowledge of the land market, their market position become greater as the size of the developers’ land transactions increases” (Priemus & Louw, 2003, p.373). This results in limited choices in selecting a contractor, as consumers “are confronted with a local monopoly, or at least a very imperfect competition of developers with building sites” (Priemus & Louw, 2003, p.373). From this, it becomes clear that there is enough suspicion of a highly concentrated land market. As stated above, market concentration gives large landowners market power.

2.3.3 Measuring market power

There are two types of market power: ‘potential’ and ‘exercised’ (Markusen & Scheffman, 1978), the latter is sometimes also referred to as market power ‘in force’ (Lerner, 1934; Glick & Campbell 2007). With the first type, large landowners have the potential of raising prices above the prices that would result in equilibrium, however they choose not do this (Feinberg, 1980). In the latter case, the landowner does raise prices above the equilibrium level, exerting their market power and thus capturing higher revenues (Lerner, 1934). The equilibrium level is the (theoretic) price level at which land is sold if the land supply and demand match perfectly. There are several methods for measuring market power. For potential market power the Herfindahl-Hirschman Index, or HHI, is most commonly used (Rhoades,

1993). It calculates the level of market concentration by squaring the share of the total market supply each seller holds, through the following formula:

$$HHI = \sum_{i=1}^{n} (MS_i)^2$$

In this formula, n is the number of all participants in the market and MS_i is the market share of landowner i. The result is a value between 0 (complete competitive market) and 1 (pure monopoly). In a monopoly one seller owns 100% of the land, so HHI = $(1)^2 = 1$. A value anywhere between 0.1 and 0.18 is an acceptable degree of market concentration; a market is strongly concentrated if the HHI is higher than 0.18 (Rhoades, 1993; Buitelaar & Pouls, 2009). In a highly concentrated market, certain market actors possess potential market power. Matsumoto, Merlone & Szidarovszky (2011) stress the importance of knowing which sellers cooperate with one another. If this is not accounted for, the index does not provide a realistic view of the market. Glick & Campbell (2007) pointed out that price elasticity of the demand side is an important factor in determining whether the potential market power can be exerted. If price elasticity is high, a rise in prices would result in consumers choosing to purchase a substitute. However, Buitelaar & Pouls (2009) noted that on the Dutch land market, there is a low level of substitutability. Thus, this problem can be omitted.

To measure exercised market power, the Lerner Index is most frequently used. This "measures a firm's ability to price above marginal cost in percentage terms" (Glick & Campbell, 2007, p.231). It is calculated the following way:

$$(P - MC)/P$$

In this formula, P is the price for which land is sold and MC are the marginal costs of selling one more unit of land. The higher the value, the more market power (Elzinga & Mills, 2011). The application of this index has been critiqued by some. The most important critique is that the index "does not recognize that some of the deviation of P from MC comes from either efficient use of scale or the need to cover fixed costs" (Lindenberg & Ross, 1981, p.28). Ascribing the difference between the price and the costs only to market power is simply too severe. Next, the index does not account for interdependencies between markets and the imperfections that occur between these markets. An example is monopsony power (i.e., the power of a single buyer in a market) in a factor market (Elzinga & Mills, 2011). Furthermore, the index does not encompass the effect of technological change, innovation, and learning-by-doing on the market (Pindyck, 1985). In addition, the index ignores instances of non-competitive behaviour and the pursuit of a 'quiet life' (Hicks, 1935). In Chamberlin (1954) the singular emphasis of the formula on price competition is questioned as well as "the important problems of competition and monopoly in the non-price area" (Chamberlin, 1954, p.266). Despite these limitations, the index is still a useful tool to scout for the possibility of the exertion of market power, however further investigation is still needed (Elzinga & Mills, 2011).

2.4 Hypothesis and conceptual model

When combining the notions of market power of developers on the Dutch land market and speculative behaviour, a possible new explanation for stalled sites might arise. Land speculation alone already has an impact on site development. If uncertainty exists over future market conditions, it might be wise to hold off development as a means to acquire a larger profit in the future (Titman, 1985). However, the study by Geuting et al., (2021) suggested that this is not the only explanation for the stalled sites on the

Dutch land market.

Literature on real options theory has given a theoretical foundation for the assumption that it is strategic for large landowners to postpone development in order to exert market power in the future. Other studies give an indication of a highly concentrated land market and thus market power on the Dutch land market (Priemus & Louw, 2003; Buitelaar & Pouls, 2009). Landowners do not necessarily exert their market power (yet). For now, they are waiting for others to develop their sites. By doing so, the market shares of the market actors that do develop their sites shrink, and the market shares of the actors that wait grow relatively. This way, even higher revenues can be captured by large landowners in the future. From the (neo)liberal literature it becomes clear that these revenues are even higher if the plan is closer to the city centre (Alonso, 1964; Davy, 2012). Stalled sites are therefore expected to be more present in areas closer to the CBD. Demand for housing in these areas will already be higher, but by postponing development this effect will be even greater. Furthermore, on a macroscale, demand volatility is found to influence the decisions of developers. The more volatile the housing demand, the greater the uncertainty of future market conditions. This is expected to result in more stalled sites, seeming as more uncertainty will lead to more phasing and inventory holding according to findings from real options theory (Ott et al., 2011). Lastly, according to the model of DiPasquale and Wheaton (1992), housing prices are influenced by adjustments in the housing stock. Housing prices drop as soon as the supply is better aligned with the demand. This means that bigger plans can influence housing prices. Therefore it is assumed that bigger plans will be stalled more often. A slow absorption of new houses into the market will keep profits higher.

Hence, the hypothesis of this research is that to maximize profit, landowners attempt to increase their market power by waiting for other landowners to develop their sites or by buying more land in the area. This leads to postponements of developments (i.e., stalled sites), as it keeps supply artificially low, which will relatively heighten the housing demand resulting in higher profits. Thus, it is expected that landowners with more market power will be more likely to postpone development than landowners with little or no market power. Developments closer to the CBD are expected to be stalled more often, as land prices are higher which will increase the aforementioned effect even more. A more volatile housing demand will also results in more stalled sites, because it is expected that the increased uncertainty about future market conditions will add to the revenues of the development in times of higher demand. Finally, the bigger the plan size, the more likely the plan becomes to be stalled by the developer. Bringing a high number of houses onto the market simultaneously, will causes prizes to drop. Developers are expected to prevent this by delaying the development progress of their sites. The hypothesis is illustrated in figure 4.

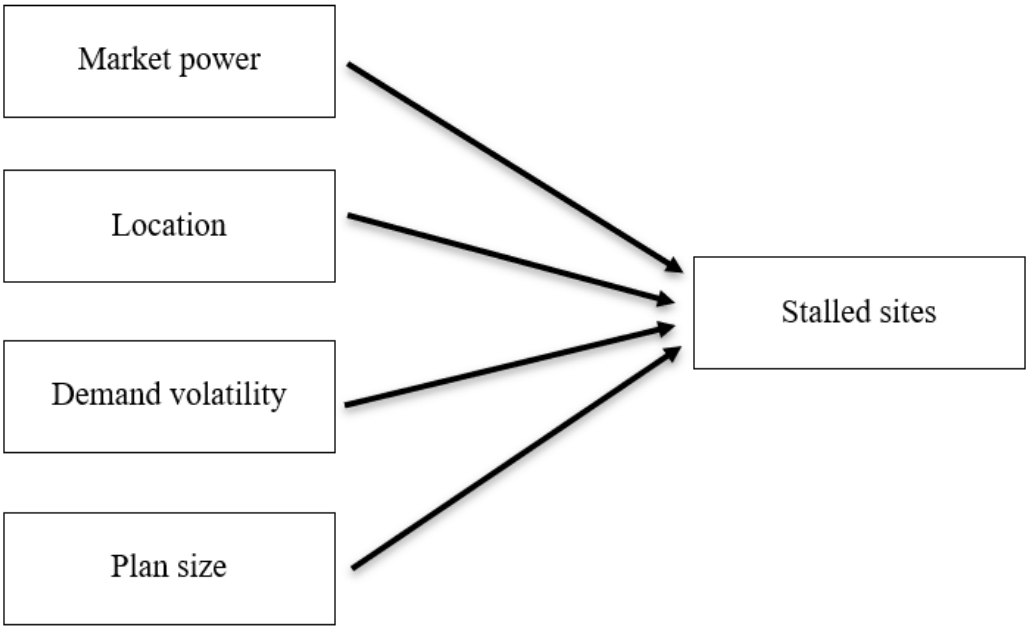

Figure 4: Conceptual model.

Furthermore, it is good to note that by zoning more land for development planning authorities can increase the land supply in an area, which might negate the market power through relative changes in the market shares. Planning authorities can also influence the relationship between market power and stalled sites by including building obligations or a phasing schedule in agreements closed with the developer. If this is the case, postponement is not an option for the developers. However, different instruments will yield different results. Therefore, the precise influence of planning authorities is hard to determine. These effects are not included in this inquiry (and therefore not included in the conceptual model), but their influence on site development is certainly present.

3. Methodology

This chapter explains how the hypothesis formulated in the previous chapter shall be tested. To begin with, the research strategy will be explained. Secondly, the scope of the research will be demarcated in both conceptual and geographical terms. In the following paragraphs, the concepts will be operationalised and the data will be elaborated on. Finally, the used regression model will be explained.

3.1 Research strategy

This research aims to study more in-depth the relationship between market power and site development, building on earlier, more explorative studies on delay of site development. The hypothesis will be tested by means of a quantitative study. To test the hypothesis best the analysis should ideally have a longitudinal approach. By following site development over a period of time, the possible influence of market power on the development progress can be shown more clearly. However, this is not possible in the set time frame of this thesis. Therefore, a logistic regression analysis shall be performed on a cross section of 2018. This should thus be considered as an invitation to perform an analysis akin to this one, but with the time component that longitudinal analysis includes.

3.2 Research demarcation

This research studies developable land, the progress of that development and what kind of actor possesses the land and what the effect is thereof and of other factors. It should be clear what the boundaries of this study are in both conceptual terms as well as in geographical terms.

3.2.1 The research subjects: housing sites

The question what is considered to be developable land arises first of all. In this research, only sites that are zoned for housing by means of an irrevocable zoning plan are incorporated in the final dataset. After a municipality establishes a zoning plan, it is available for vocation for a period of six weeks. After this period the plan comes into effect, only then can legal rights be derived from it. From this moment on the zoning plan is prevailing for the prescribed area. All types of housing are included in the analysis, apartments, terraced, (semi)detached etc.; as well as all types of plans, greenfield, brownfield, urban renewal, transformation etc.

3.2.2 Geographical demarcation

Data on residential development plans was available for the provinces of Noord-Holland and Limburg. Large parts of the province of Limburg deal with a population decline now or in the near future, as is shown in figure 5. In the darker blue areas, the '*krimpregio's',* the population is expected to decline at least 12,5% until 2040. The lighter blue areas, called the '*anticipeerregio's',* should be aware of a population decline in the (near) future. The entire province of Limburg (southwestern part of the Netherlands) is either a '*krimpregio*' or an '*anticipeerregio*'. Population decline affects site development processes in such a way that it becomes rational for developers to make different decisions as they would in conditions of increasing market pressure (Ott et al., 2011). Therefore, the province of Noord-Holland is preferred over the province of Limburg.

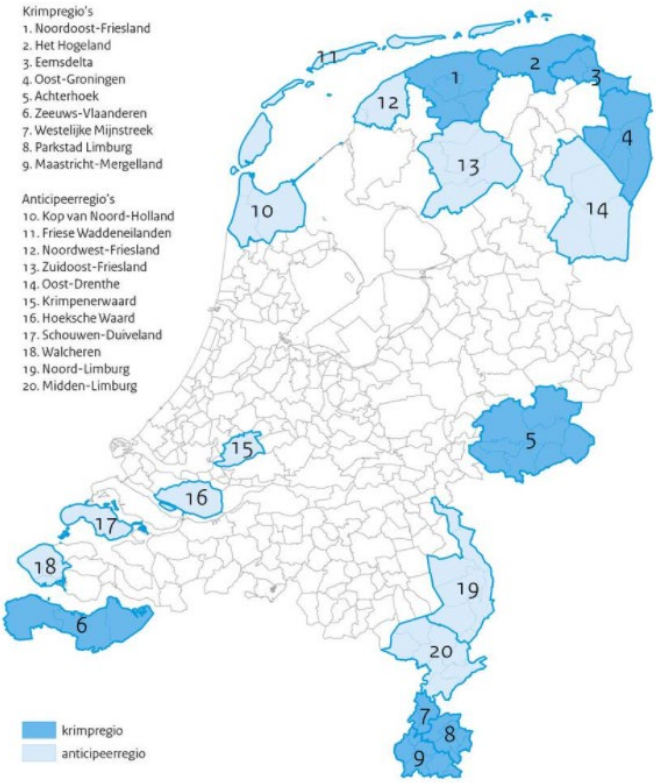

Figure 5: Areas with (anticipated) population decline (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, January 2018)

The more southern municipalities of the province of Noord-Holland are part of the Randstad area. This is a network of cities (including the biggest four cities of the Netherlands), which make up for (in Dutch terms) a big urban agglomeration. The Greater Haarlem, Greater Amsterdam, and Het Gooi and Vechtstreek areas all, to varying extent, contain municipalities that are considered to be part of the Randstad area. The northern part of the Kop van Noord-Holland area is marked as an "*anticipeerregio*" by the Ministerie van BZK (2018), which means that in this part the population might start to decline in the near future. This COROP region can be considered a more rural area. The Greater Alkmaar, IJmond, and Zaanstreek areas are more comparable to the rest of the Netherlands; they contain some urban centres as well as some more rural areas. The entire research area is shown in figure 6.

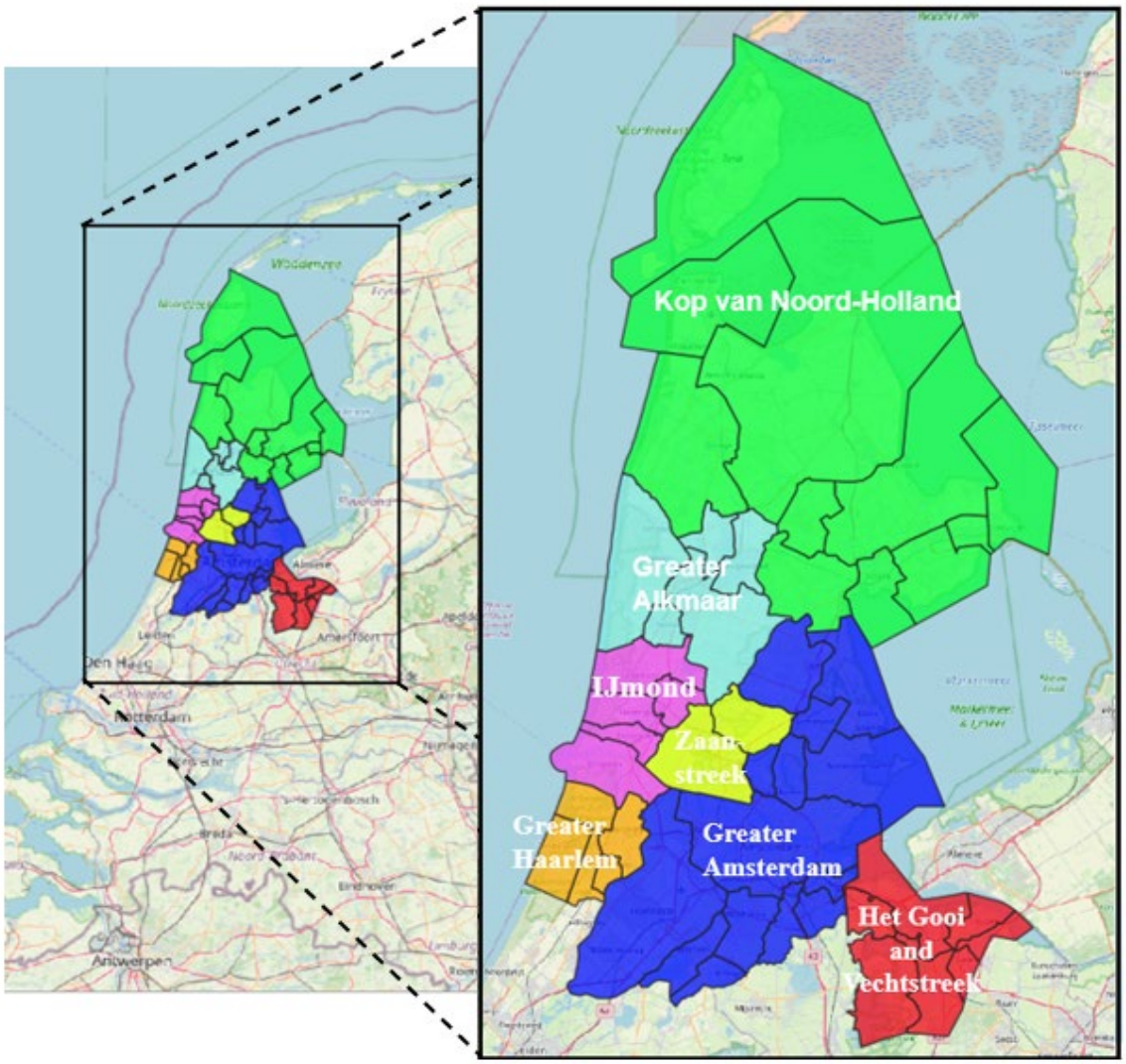

Figure 6: Research area.

3.3 Operationalisation

The theoretic concepts have to be operationalised before they can be accurately measured. This paragraph describes how this is done and discusses different options.

3.3.1 Operationalisation of the dependent variable

The dependent variable, the development progress of sites, is operationalised as either 'stalled' or 'not stalled'. This is determined, following McAllister et al. (2016), by looking at the average lead time. After the average lead time is surpassed, it is assumed in this research that the landowner actively chose to stall the site for strategic, i.e., utility maximising, reasons. Sites will be attributed the label 'stalled' if the average lead time is surpassed after the zoning plan of the site has become irrevocable and the development has not been fully completed. Two concepts in this operationalisation are important; the average lead time and the completion of the development.

The average lead time is measured as the number of months in between the moment that the building permit has been granted and the moment that the municipality has been noted that construction is completed or when the municipality has been noted that the building is being used, i.e. someone resides in the home. Unfortunately, this data is only available at the CBS between the years 2012 until 2016. For this reason, the mean of the average lead times from 2012 to 2016 is used to determine

whether a site is stalled or not. The data is reported on COROP region level and has multiple categories of plan size, these are shown in table 2. Each plan is ascribed its average lead time, based on the plan size category and its location. The plans are sorted into the plan size categories based on their gross plan capacity (at times of approval), because this is the number of houses that actually has to be constructed. Otherwise a plan of for example 1 house net capacity would have 14 to 19 months to be completed, when in fact the plan can prescribe that 99 houses have to be demolished first and 100 have to be constructed thereafter.

Table 2: Average lead time (months) corresponding with plan size category (number of houses) (CBS, 2018).

COROP	1 house	2-4 houses	5-9 houses	10-19 houses	20-49 houses	50-99 houses	100-199 houses*	200 or more houses*
Greater Alkmaar	14	20	20	19	22	21	26	28
Greater Amsterdam	20	23	23	25	24	25	26	28
Greater Haarlem	18	16	17	19	20	21**	26	28
Het Gooi and Vechtstreek	14	19	15	17	20	27	26	28
IJmond	14	23	23	19	19	19**	26	28
Kop van Noord-Holland	17	20	19	24	24	19	26	28
Zaanstreek	19	14	24	32	27	27	26	28

**The average lead times of the last two plan size categories is the average lead times of the all the COROP regions in the province of Noord-Holland, because there were too few plans of these sizes to have a representative number.*
***This is the average lead time of all but one of the years from 2012-2016, because for this plan size in the Greater Haarlem and IJmond area the average lead time of one specific year was too high, probably due to a lack of plans this size.*

In this time, the site should be fully developed, meaning that the total number of constructed houses is the same as the total capacity of the plan. This is checked by comparing the data of 2018 with the data of 2019. The year the plan is completed is the last year that data is recorded for that plan. This means that if a plan has been fully completed in 2018, it does not reoccur in the data set of 2019. The data set is elaborated on more in-depth in paragraph 3.4.

Through this operationalisation, all three types of stalled sites, according to the typology of Buitelaar and Van Schie (2018) are, mostly, incorporated in the analysis. First, for the sites for which the building permit has been approved but no progress has been made on the development (so type 1), this is clear: once the average lead time is surpassed it would have been possible for the landowner to develop their site, but the plan reoccurs in the data set of 2019 because it is not being developed. Every case of this type of stalled site is included. Next, the sites for which the zoning plan has been approved but no building permit has been requested (type 2) are also, for the most part, included. This is because most of the time, the zoning plan is only approved if it is accompanied by a building plan (Buitelaar et al., 2012). However, it is difficult to determine what share of these cases is included, because exact data on building permits are not available for this research. Lastly, the sites for which the building permit has only been partially requested or are not brought to their fullest potential (type 3) cannot be fully included in the analysis with the available data, for the same reason as the type 2 sites; data on granted building permits are not available. Sites that have not been brought to their fullest potential (yet), are included as these would reoccur in the data set of 2019.

Through this operationalisation the variable will be of nominal measurement level. For

performing standard regression analysis, the dependent variable has to be of either interval or ratio measurement level. Preferably, this would be the case and could be done by operationalising the development progress as the number of days/months the development took or is taking. However, this would require a clear starting point from which the time would start, which presents some issues. First, data on approved requests for building permits is not available, hence taking the approval date of the building permits as starting point does not work. A second logical starting point would be the date the zoning plan becomes irrevocable. The problem here lies in the fact that a plan can be part of multiple zoning plans or that the municipality decides to deviate from the zoning plan in a smaller area by using a '*postzegelbestemmingsplan*'. The same can also be done by incorporating the '*uitwerkingsplicht*' or '*wijzigingsbevoegheid*', two tools that are used by the municipality to create some leeway within the zoning plan. This way, the municipality can approve the zoning plan for the bigger area, but can still change certain rules about a smaller area within the already approved zoning plan. To avoid this complexity, the development progress is operationalised as explained above.

3.3.2 Operationalisation of the independent variables

Market power

The main independent variable, potential market power, is in need of operationalisation too. In the previous chapter it is explained that potential market power is derived from market concentration. After that some indicators of market concentration were discussed. The HHI can be used to calculate the market concentration, it can range from 0 to 1 with 0 indicating a perfectly competitive market and 1 would be a monopoly. A concentrated market indicates that there are landowners that possess potential market power, making it a viable indicator for potential market power. The HHI is calculated on municipality level by looking at the ownership situation on January 1st 2018. So, the ownership situation right before the theoretic date of completion. Again, it would be insightful to see how the HHI changes over time through phased market absorption, but that was not possible in this time frame. For the HHI, the squared shares of every landowner in the municipality are summed.

To determine the share each of the landowners hold, the area of the total land supply needs to be established. This is done by calculating the area of all the plans included in the study, for which the criteria are already elaborated in paragraph 3.2.1. It could be argued that not only land for approved plans should be included in the analysis, but also land for which plans are being prepared. However, these sites are not included, only developable land is included in this share. For only land with an irrevocable zoning plan can lead to the exertion of the potential market power. Despite the fact that land can be strategically bought in order to heighten market power in the future, no houses can be constructed on these sites, for no legal rights can be derived from a zoning plan that is not yet approved. So purchasing more land does not add to the market power of that actor in that exact moment.

After the total land supply is established, the shares of every landowner are calculated. This is simply done by a command in QGIS. Landowners are of course anonymised in the reporting. Here, only a distinction is made between different types of landowners. First there is public ownership, which includes municipalities, the province, the central government, *Rijkswaterstaat* (Department of Waterways and Public Works), *Staatsbosbeheer* (Forestry Commission) and other governmental bodies and organisations. Next, there is ownership by private parties, which entails private investors, project developers, building parties and other private companies. Then there is ownership of housing corporations and ownership of private individuals. And finally, other types of ownership. It should be noted that it is quite difficult to know exactly what the ownership situation is. Parties can work together and make certain arrangements about the ownership and (timing of) development. Should this be the case then the market concentration would only be higher, resulting in an increased HHI in the

municipality. It would be very hard, however, to get a complete insight into these informal and at times confidential agreements between all of the actors.

Location

Another independent variable included in the analysis is the location of the plan. This is operationalised as the distance of the plan to the nearest big city. QGIS can compute this using the distance to nearest hub command. For each plan, the centroids are determined, then QGIS calculates the linear distance to the nearest hub. This results in a variable with the ratio measurement level. For this analysis, only cities with more than 100.000 citizens are considered, which in the Noord-Holland province comes down to Amsterdam, Haarlem and Alkmaar. This number was chosen because research by Markusen and Scheffman (1978) showed that leapfrogging, i.e., leaving certain sites undeveloped, was a result of (amongst other things) the distance to the CBD in cities in northern America; which have higher populations and a strong central function within the region.

Demand volatility

Demand volatility, whether demand for housing can rapidly change, can depend on multiple factors. Therefore, operationalisation for this concept is quite difficult. In this case, it is operationalised as the population growth on municipality level. Demographical trends are of great influence on housing demand, as is shown in multiple studies (Belsky, 2009; Eichholtz & Lindenthal, 2014; Lauf, Haase, Seppelt & Schwarz, 2012). Other factors are of influence on the extent to which housing demand is volatile. However, for data availability and simplicity reasons, population growth is the only variable taken into accounted for measuring demand volatility.

Plan size

The last factor of influence on stalled sites looked at by this study is plan size. This is operationalised as the gross plan capacity. In other words, it is the number of houses that is allowed to be constructed according to the plan, without taking the number of houses that have to be demolished into account. Gross plan capacity is preferred over net plan capacity as an indicator of plan size. Subtracting demolitions from the gross plan capacity results in the net plan capacity. Gross plan capacity indicates how many houses are added to the market if the plan is completed. Even though the net plan capacity might be 50 houses, 100 houses might have to be actually constructed. Gross plan capacity is also preferred over the area of the plan. This is due to density restrictions set within the zoning plan and different types of housing that make the area of the plan a less precise indicator for measuring plan size.

3.4 Data

The data on approved plans and their capacity is provided by the province of Noord-Holland. It encompasses the planning list of 2018 and 2019 of the province, which is a list of all the approved and intended developments of the municipalities within the province. The data set contains the plan locations, legal status of the plan, the spatial function type, and the plan capacity. This data is filtered, as not all plans are incorporated in this study. Only the housing sites are interesting for this research, as well as only the plans that have been irrevocable for at least as long as the average lead time; otherwise they would not have a fair time to be completed. Additionally, only irrevocable plans prior to 2019 are included. This is because of a number of reasons. The first is that more recent data of 2020 and 2021 is currently not available. Also, the data set of 2019 is used to determine whether the plan is completely finished at the end of 2018. If the plan reoccurs in the data set of 2019, it is clear that the plan is still not entirely finished. Using this filtered data, the division between stalled and not stalled plans is made. This is a variable of a nominal level; sites can either be 0 meaning ‘not stalled’, or 1 indicating ‘stalled’.

A site receives a 1 if the plan surpasses the average lead time and the plans reoccurs in the data set of 2019. In all other cases, the plan is considered to be not stalled, earning it a 0.

The data on ownership is provided by the Kadaster. They register and keep track of landownership. Each time a land transaction is made, the Kadaster has to be up to date within 24 hours. The data used is a snapshot of the province of Noord-Holland on January 2018 which has been anonymised. Based on the plan locations of the first data set, this data set is filtered. Only the ownership situation of the sites within the included plans is used. Then the total area of the developable land in each municipality is calculated. Next, the share of the total area of land is calculated for each landowner that possesses land in the plans in that municipality. Then these shares are squared and finally summed. This results in the HHI for each of the municipalities. This is a variable of the ratio level. It would be even better to have calculated the share of the housing supply each owner possesses, however this is not possible since the data are at plan level and not on parcel level.

It is good to note that this data set contains spatial data, as the sites under study all have a location within geographical space. This holds some points of remark for the data analysis. There will be spatial dependence between the data. This can be explained by Tobler's first law: "[…] everything is related to everything else, but near thing are more related than distant things" (Tobler, 1970, p.236). Most of the time, a plan encompasses a group of sites which it will affect in similar ways. The consequence of a plan becoming stalled will be the same for all the sites within that plan; all sites in that plan will be stalled too. Market power has a spatial component as well. For if one owner possesses a bigger share of the land supply, other landowners will own a smaller share in relative terms. This means that there is a pattern in the intensity of the effect of market power on the development progress based on the location of the geographic entity, which is called spatial heterogeneity (Miller, 2004). However, this study will only perform non-spatial regression. For this reason, it is good to nuance the studied effect.

The data on population growth for each of the municipalities is obtained from the open database of the CBS. It is the total population of 2018 minus the total population of 2017. The numbers are taken from the population register of all the Dutch municipalities. All people who live within the municipality are included in this register. Certain types of residents do not have to register themselves in the population register, among which are diplomats and NAVO soldiers. Undocumented residents are also not included in the register.

3.5 Logistic regression analysis

This is a quantitative study into the relationship between market power and the appearance of stalled sites. This dictates that there will be at least two types of variables: dependent and independent (Vennix, 2016). The dependent variable is the development progress, operationalised as a dichotomy; the site being stalled or not. The independent variables are the HHI of every municipality, the distance to the nearest big city, the population growth of each municipality, and the number of houses in each plan. As explained in the previous paragraphs, this seemed to be the best way to measure these variables with the available data. A logistic regression will be used to assess the relationship between these variables. "Logistic regression analysis predicts the values on one dependent variable from one or more independent (predicting) variables when the dependent variable is dichotomous […]" (Foster, Barkus & Yavorsky, 2006, p.57). In other words, it calculates a model to assess the likelihood of a site becoming stalled, based on the all of the independent variables that are included in the model.

In other aspects it is quite similar to multiple regression analysis. However, logistic regression does not indicate the nature of the relationship between all of the different independent variables, for example any indirect or interaction effects. Furthermore, none of the variables have to be normally distributed, even though this does increase the validity of the analysis (Foster et al., 2006). Central

concepts within logistic regression are the odds and odds ratio. The first is the likelihood that a certain event occurs. The latter is the likelihood that a certain event will occur given a certain indicator (independent variable). In the case that the odds ratio is calculated with more than one independent variable, it is called the adjusted odds ratio (Peng, Lee & Ingersoll, 2002). In logistic regression, the logarithm of the odds, or logit, is used to produce the model. This is necessary because the relationship between the dependent and independent variables in not linear, but logarithmic (Field, 2013). The most simple model of a logistic regression will have the following form (Field, 2013, p.762):

$$P(Y) = \frac{1}{1 + e^{-(\alpha + \beta X)}}$$

In this formula, $P(Y)$ is the probability of the dependent variable Y occurring; e is the base of the natural logarithms. The bracketed part of the formula is akin to regular linear regression; X is the independent variable, α is the Y intercept and β is the regression coefficient (Peng et al., 2002). Should the model include more than one independent variable, as is the case in this research, then these are added much like in linear regression:

$$P(Y) = \frac{1}{1 + e^{-(\alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4)}}$$

The dependent variable in this case is the development progress. The main independent variable in the analysis is the potential market power of the landowners. The outcome of the formula above will be a value between 0 (no chance of Y occurring) and 1 (Y will most definitely occur). To assess to what extent the model fits the data, the likelihood, $P(Y)$, is compared to the real outcome, Y, by using the log-likelihood statistic; for which the following formula exists:

$$\textit{Log-likelihood} = \sum_{i=1}^{N} [Y_i \ln(P(Y_i)) + (1 - Y_i) \ln(1 - P(Y_i))]$$

This is an indicator of how much the model explains versus what it still does not (yet) explain. If the outcome is high then there are still a lot of unexplained observations. So, the higher the outcome, the worse the model fits the data (Field, 2013). However, it is more convenient to use the deviance instead of the log-likelihood, because the deviance has a chi-square distribution which can be used to calculate the significance of the model and compare them to other models (Field, 2013). The deviance is calculated through:

$$\textit{Deviance} = -2 \times \textit{log-likelihood}$$

Three of the most applied types of logistic regression are direct, sequential and exploratory. In the case of the direct logistic regression all of the independent variables are included in the analysis. This is mostly performed when one does not know the order of importance for explaining the dependent variable. The sequential logistic regression is used to estimate the predictive power of each of the independent variables, which results in an order of importance. Additionally, it also checks the predictive power of the model as a whole. Lastly, the exploratory, or stepwise, logistic regression checks to see whether the predictive power of each independent variable is statistically significant. The end result is a model in which only the statistically significant independent variables are included (Foster et al., 2006). In this inquiry, the direct method is used get an indication of the extent to which each of the

variables influences the development progress.

A logistic regression model is chosen as best fit in this case, for a model can be composed in which the dependent variable is categorical. In this case a binary logistic regression is used, because the dependent variable is dichotomous; i.e., not stalled or stalled. For a linear regression, the dependent variable has to be continuous, which is not preferable in this case as is explained in paragraph 3.3.2. In most other aspects linear and logistic regression are quite similar, which adds to the comprehensibility of this study. The independent variables in a logistic regression analysis can be of any measurement level, just like in normal linear regression. Should a variable be categorical then dummy variables should be created. However, this is not necessary since all of the predictors are continuous variables. A logistic regression model does not attain a causal relationship, but rather it calculates the likelihood of a subject to belong in either one of the two categories of the dependent variable based on the value(s) of the independent variable(s). A more incomprehensive body of research should be conducted before a causal relationship can be suggested. This research will therefore present a first step into a possible relationship between market power and site development in the Netherlands, rather than concluding with a definitive relationship between these two variables.

4. Results

In this chapter the logistic regression analysis is performed and the results are described. First, all of the different variables are described and some are illustrated by means of maps. Next the logistic regression analysis is performed and the output is elaborated.

4.1 Describing the data

4.1.1 Plans in study

First of all, the data of the province of Noord-Holland is filtered, leaving only the sites whose zoning plans are at January 1st 2019, irrevocable for the same or a longer period of time than the average lead time in that COROP region for a plan that size and hold a minimum gross plan capacity of one house (meaning that new houses have to be constructed). Furthermore, the plan should, theoretically, be completed somewhere in 2018 or the plan should reoccur in the data set of 2019 (meaning that it is still stalled at the end of 2018). Table 3 shows the result hereof. It is established whether or not these sites reoccur in the database of 2019. Should a site in fact reoccur, it is seen as stalled. About 24% of all the plans is marked as stalled, which is in line with the study performed by Geuting et al. (2021). Two plans are stalled the longest, since 2008 their zoning plans have turned irrevocable, however they are still not finished in 2018 as they reoccur in the data set of 2019. This percentage amounts to 32 plans that hold a net plan capacity of 4.143 houses, which is about 35% of the total net plan capacity of the province of Noord-Holland. This is quite a higher percentage than the 11% found by Buitelaar and Van Schie (2018), however that is over the Netherlands as a whole and not just this one province. The influence of Amsterdam on this number is now greater than it would be when the entirety of the Netherlands would be studied. All of the sites are mapped, which is illustrated in figure 7. The green dots represent sites that are not stalled and the red dots are considered to be stalled sites.

Table 3: Number of plans and total net capacity per COROP region.

COROP region	Number of plans	Stalled sites	Net plan capacity	Stalled net plan capacity
Greater Alkmaar	8	3 (37,5%)	888	791 (89,1%)
Greater Amsterdam	38	9 (23,7%)	8.862	2.885 (32,6%)
Greater Haarlem	32	5 (15,6%)	639	57 (8,9%)
Het Gooi and Vechtstreek	13	2 (15,4%)	215	14 (6,5%)
IJmond	19	2 (10,5%)	323	7 (2,2%)
Kop van Noord-Holland	19	11 (57,9%)	879	389 (44,2%)
Zaanstreek	2	0 (0,00%)	67	0 (0,0%)
Total	**131**	**32 (24,4%)**	**11.873**	**4.143 (34,9%)**

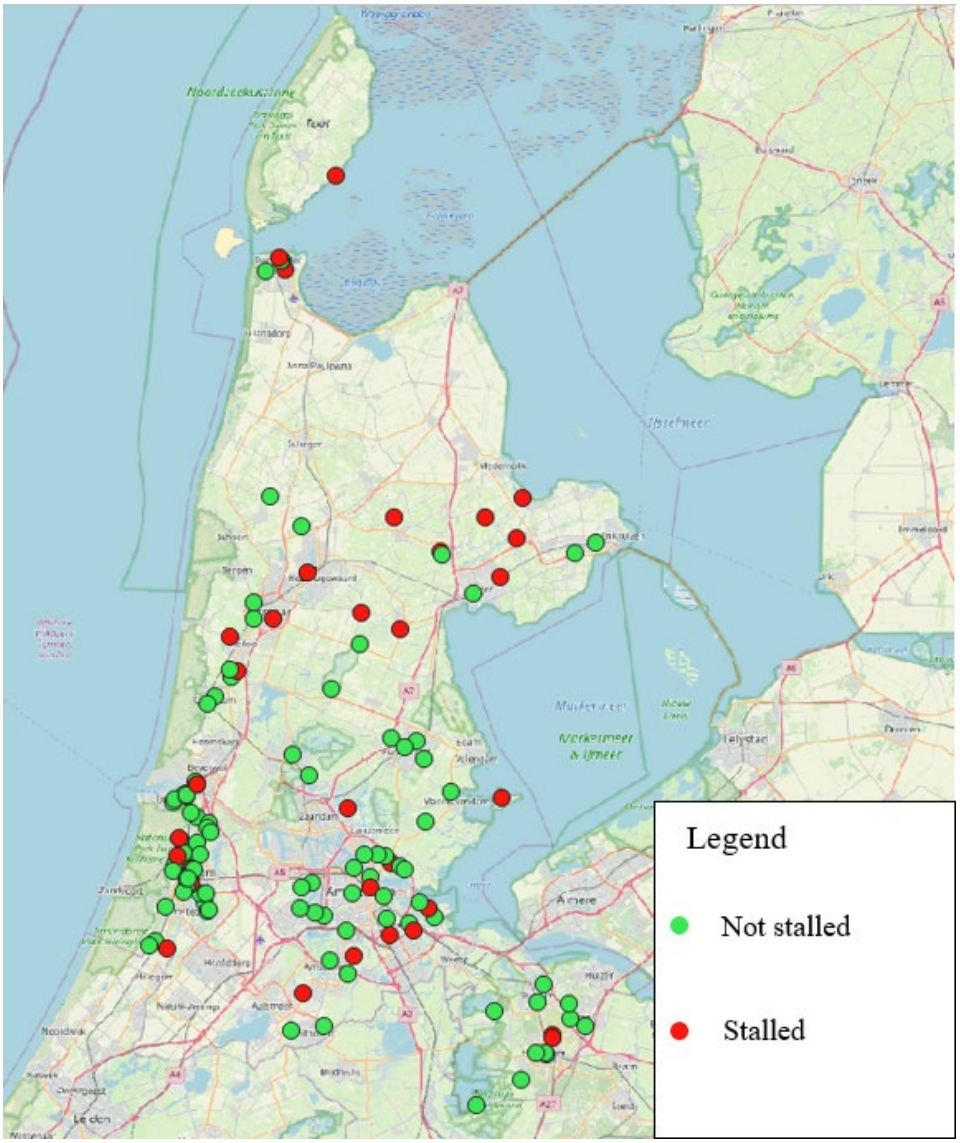

Figure 7: Stalled sites in the Noord-Holland province.

4.1.2 Market power

The database of the Kadaster is used to see who owns the lands, on parcel level, within these plans. With this information, the HHI of the municipalities can be construed. The total area of developable land in each municipality is calculated by summing all the areas of the parcels that make up for the plans included in the analysis, as is presented in table 4. Next, the share that each owner possesses is calculated, squared and then summed to determine the HHI for every municipality. Not every municipality had plans that met all the aforementioned criteria. The HHI that is calculated here, is the HHI of only those plans that meet the stated conditions. A more robust HHI could be calculated once changes in ownership situation over time can be accounted for; but that was not possible in the scope of this thesis. This does, however, give an indication of the ownership concentration of each of the municipalities included and thus of the potential market power of certain landowners within the market.

Table 4: HHI index of each municipality.

Municipality*	Total developable area in km²	Number of plans	HHI
Aalsmeer	0,251	1	0,101
Alkmaar	0,012	5	0,199
Amstelveen	0,012	3	0,259
Amsterdam	16,58	21	0,054
Beemster	0,008	1	0,413
Blaricum	0,012	1	0,348
Bloemendaal	5,639	10	0,386
Castricum	1,674	5	0,068
Den Helder	1,058	5	0,897
Diemen	1,440	2	0,601
Drechterland	0,010	1	0,530
Gooise Meren	0,667	2	0,710
Haarlem	0,162	22	0,215
Heerhugowaard	0,931	1	0,157
Heiloo	0,307	1	0,115
Hilversum	0,064	5	0,267
Hoorn	0,002	1	0,126
Koggenland	0,007	2	0,189
Langedijk	0,027	1	0,189
Laren	0,007	2	0,504
Medemblik	0,499	5	0,290
Oostzaan	0,010	1	0,104
Opmeer	0,011	1	0,418
Ouder-Amstel	0,292	1	0,830
Purmerend	0,017	3	0,460
Schagen	0,005	1	1,000
Stede Broec	0,173	2	0,708
Texel	0,001	1	1,000
Uithoorn	0,245	2	0,952
Velsen	0,681	14	0,276
Waterland	0,010	3	0,320
Wijdemeren	0,002	3	1,000
Zaanstad	0,014	2	0,465

**Only the municipalities are listed in which plans are located that are included in this study.*

Figure 8 shows the market power of the municipalities. A market is considered to be strongly concentrated if the HHI has a value higher than 0.18 (Rhoades, 1993; Buitelaar & Pouls, 2009); approximated here at 0.20. Interestingly, Amsterdam has a low HHI. This can be explained by the number of plans, which is greater than for most of the municipalities. Moreover, land will be worth more on average here, making it more desirable. This causes many actors to enter the land market, causing the battle for land not to be dominated by one single party but multiple. Aversely, in the municipalities where land is worth less on average, land will be less desirable. As a consequence, less actors will enter the market, making it easier for only a handful of parties to dominate the battle for land.

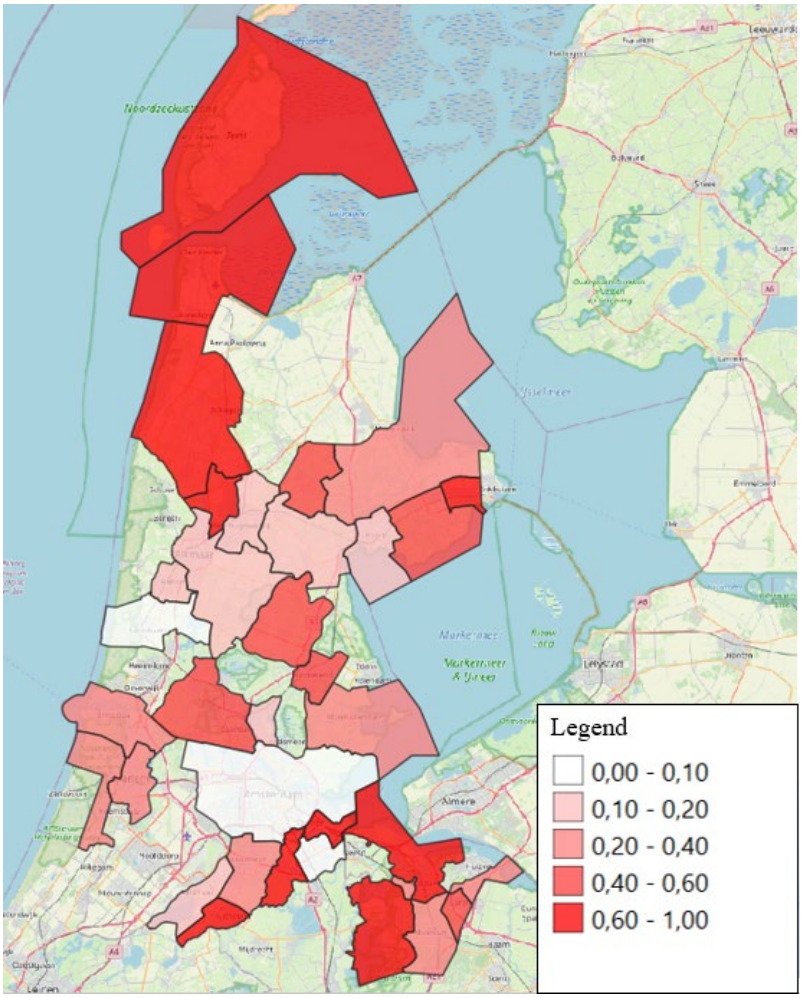

Figure 8: HHI index of municipalities.

In total, there are 3.626 different owners in the study, most of which are private individuals as is presented in table 5. It also happens that the ten owners with the biggest shares, possess about 42% of the total developable land area in the province. It is safe to say that a number of owners indeed have (potential) market power. Whether that power influences the development process remains to be seen.

Table 5: Total number of owners and total area owned per category.

Owner category	Number of owners in category	Total area owned in km²	% of total area owned
Housing corporation	22	1,23	4,0%
Private individual	3.365	18,41	59,7%
Private party	157	4,53	14,7%
Public organisation	37	2,59	8,4%
Other type	45	0,36	1,2%
Unknown*		3,73	12,1%
Total	**3.627**	**30,84**	**100%**

**Due to changes in the registration system, the owners of some parcels are unknown to the Kadaster. This can be traced back based on made transactions, however this was not possible in the scope of this thesis.*

4.1.3 Distance to nearest big city

A second independent variable is the distance to the nearest big city. For each plan QGIS analyses whether the plan is closest to Alkmaar, Amsterdam or Haarlem (the cities in Noord-Holland with 100.000 or more citizens) and the distance to that city. Table 6 summarises the results hereof.

Table 6: Nearest big city to plans.

Nearest big city	Number of plans	Number of stalled plans	Mean distance	Shortest distance	Longest distance
Alkmaar	33 (25,2%)	15 (11,5%)	18.476 m	898,1 m	45,6 km
Amsterdam	52 (39,7%)	11 (8,4%)	11.888 m	846,9 m	27,1 km
Haarlem	46 (35,1%)	6 (4,6%)	4.087 m	87,0 m	10,2 km
Total	131 (100%)	32 (24,4%)	10.808 m	87,0 m	45,6 km

Most plans, almost 40%, are within the vicinity of Amsterdam. Plans that are closest to Alkmaar are more widespread and more often stalled, which makes sense since Alkmaar is further removed from the other two cities. However, whether this is also statistically significant will be examined in paragraph 4.2.

4.1.4 Population growth

A third independent variable taken into account is the population growth in every municipality. This is the net population growth between the years 2017 and 2018. Figure 9 illustrates the population growth of each of the municipalities. The biggest population growth is found in Amsterdam and some of the adjacent municipalities. In the northern part of the province the population actually declined, which is in line with the classification as "*anticipeerregio*" by the Ministerie van BZK (2018).

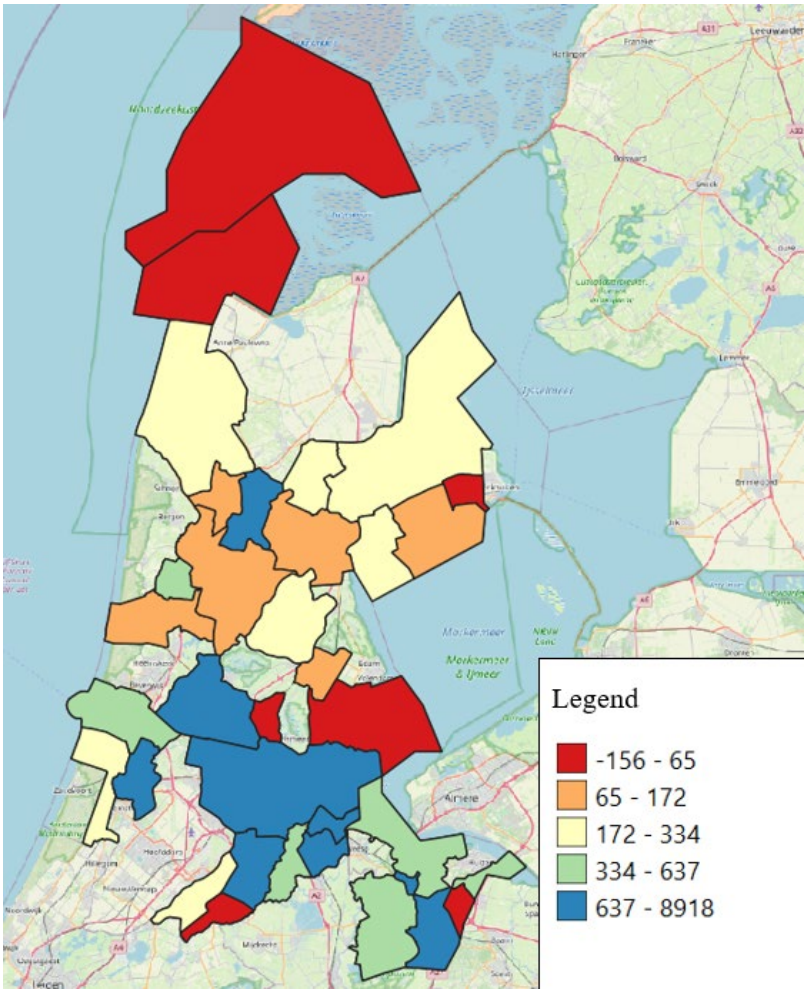

Figure 9: Population growth per municipality (CBS, 2018).

4.1.5 Gross plan capacity

The last independent variable that is added in the logistic regression is the gross plan capacity. This is the number of houses in each of the plans. The distribution hereof is shown in table 7.

Table 7: Net plan capacity per COROP region.

COROP region	Number of plans	Percentage of plans	Total gross plan capacity	Percentage of total net capacity
Greater Alkmaar	8	6,1%	892	6,8%
Greater Amsterdam	38	29,0%	9.814	75,4%
Greater Haarlem	32	24,4%	639	4,9%
Het Gooi and Vechtstreek	13	9,9%	277	2,1%
IJmond	19	14,5%	500	3,8%
Kop van Noord-Holland	19	14,5%	890	6,8%
Zaanstreek	2	1,5%	67	0,5%
Total	**131**	**100%**	**13.079**	**100%**

Almost three-quarters of the total plan capacity of plans that should end somewhere in 2018 is located in the Greater Amsterdam area, which is by far the biggest share. This is logical of course, since on average more people are looking for a place to live in or near Amsterdam than in some of the more northern regions. Among the remaining COROP regions, the gross plan capacity is more evenly spread.

4.1.6 Summary of descriptive statistics of all variables

Table 8 summarises the descriptive statistics of all of the variables that are included in the model. There are no missing values in the analysis. The lowest values of population growth is less than zero. This indicates that the population is decreasing, as is the case for three municipalities in the study; Den Helder, Uithoorn and Texel. The average HHI is pinpointed at 0.32, which indicates that most markets are rather strongly concentrated. This is in line with the HHI found by Buitelaar and Pouls (2009) of 0.31 for the Netherlands as a whole.

Table 8: Summary descriptive statistics.

Independent variable	Number of records	Minimum	Maximum	Mean	Standard deviation
HHI municipality	131	0,0537	1,000	0,3233	0,2572
Distance to nearest big city	131	87,004	45565,43	10808,47	1008,94
Population growth	131	-156	8918	1905,95	3118,91
Gross plan capacity	131	1	1914	99,84	245,82

4.2 Results of the logistic regression analysis

The logistic regression starts with assuming a "no-model" or baseline model to predict the outcomes of the dependent variable. In other words, it sees how well the two different outcomes, not stalled and stalled, can be predicted on the basis of chance alone and without the influence of any variables. This baseline model is mostly used as a reference point for the model with the predictors, the independent variables, in it. Then the predictor variables are included into the model. A variance inflation factor (VIF) test is run to determine that there is no multicollinearity between the different independent variables. A VIF value above 10 would indicate that there is in fact a high multicollinearity between two variables. This is not the case since all the VIF values 2,0 or lower; so multicollinearity is absent.

Furthermore, the assumption of linearity of the logit is tested for each of the variables. This is done by running the logistic regression with the interaction added of each predictor with the log of itself (Field, 2013). This checks if the log of the dependent variable is linearly related to each independent variable. All four interactions are not significant, which indicates that the assumption of linearity is not violated.

Next, the baseline model is calculated first to serve as a reference point. The Chi-square of the model checks whether the model with the predictors is significantly different from the baseline model. The model with all the predictor variables in it is a significant improvement from the baseline model, $\chi^2(4) = 11{,}696$; $p < 0.05$. This is summarised in table 9. This Chi-square value is the difference between the deviance (see paragraph 3.5) of the model with all the predictors and the deviance of the baseline model. It is, however, not significant on a $p < 0.001$ level.

Table 9: Chi-square of logistic regression model

	Chi-square	Degrees of freedom (df)	Significance
Model	11,696	4	0,020

In normal linear regression, the R^2 indicates how much of the observed variance is correctly explained through the proposed model. Or in other words, it measures the predictive power of the model. In the case of a logistic regression this R^2 indicator does not exist. There are, however, so-called pseudo R^2 indicators that attempt to embody the R^2 indicator of the linear regression. Three well known pseudo R^2 indicators are Cox and Snell R^2, Nagelkerke R^2, and McFadden R^2. The values of these indicators are listed in table 10@. For the R^2 of Nagelkerke and McFadden the perfect model would have a value of

1, the closer the value is to 1 the better. As can be seen in table 10 the Nagelkerke R^2 is 0.127. In the case of the R^2 in linear regression, one could say that 12,7% of the variance is now explained by the model. However, this does not go entirely for the pseudo R^2 that a logistic regression is dealing with. More often these pseudo R^2 are used to compare models on the same dependent variable with one another (Field, 2013). The model with the highest pseudo R^2 values are then considered to be more accurate. However, no earlier model is brought forward to predict the probability of sites becoming stalled. This should therefore be considered an invitation to any future research on this matter.

Table 10: Pseudo R-square values.

	Pseudo R^2
Cox and Snell	0,085
Nagelkerke	0,127
McFadden	0,080

Table 11 shows that with the model, 4 out of the 32 stalled sites were predicted correctly on the basis of the predictor variables in the model; this makes up for 12,5%, which is higher than the 0% of the baseline model. The model still misclassifies 28 out of the 32 stalled sites based on the predictor variables. For the sites that are not stalled, the model correctly predicts 96 out of the 99. Together, the model correctly classifies 76,3% of the sites as either stalled or not stalled.

Table 11: Classification table of the model.

Observed	**Predicted**		**Percentage correct**
	Not stalled	**Stalled**	
Not stalled	96	3	97,0%
Stalled	28	4	12,5%
Overall percentage			**76,3%**

The outcome for each of the independent variables and the intercept (constant) is presented in table 12. From this it can be gathered that both the distance to the nearest big city and the population growth are significant. The HHI of the municipality and the gross plan capacity are both only just not significant on a 0,05 level.

The values listed under B are replaced the β in the formula for a logistic regression model noted at paragraph 3.5. Here, B represents the change in the logit of the dependent variable (the natural logarithm of the odds that sites are stalled) that results from a one-unit change in the predictor variables. If B is higher than 0, a positive relationship between stalled sites and the variable can be established. Meaning that if the variable increases, so too does the likelihood of a site becoming stalled. If B is lower than 0, a negative relationship between stalled sites and the variable can be concluded. This means that as the variable increases, the likelihood of the site becoming stalled decreases. The regression coefficient of the HHI is -2,268; thus negative. This means there is a negative relationship between the likelihood of sites being stalled and market power. This does not comply with the hypothesis. For distance to the nearest big city and population growth, B=0.000. This indicates that the influence of these two variables on the likelihood of sites becoming stalled is not that high. There is a very small positive relationship between gross plan capacity and the likelihood of sites becoming stalled. This is in accordance with the hypothesis.

Table 12: Variables in the equation.

Variable	B	Standard Error	Wald statistic	Degrees of freedom	Significance	Exp(B)
HHI of municipality	-2,268	1,219	3,460	1	0,063	0,104
Distance to nearest big city	0,000	0,000	4,880	1	0,027	1,000
Population growth	0,000	0,000	3,982	1	0,046	1,000
Gross plan capacity	0,002	0,001	3,583	1	0,058	1,002
Constant	-0,912	0,456	4,004	1	0,045	0,402

The values listed under Exp(B) denote the odds ratio of that predictor variable, which can be calculated by e^B. According to this model, the odds of a site becoming stalled decrease with 0.104 (which in terms of percentages is a 89,6% decrease) for every one unit the HHI increases. However, this is not very useful, since the HHI can range from 0 to 1. Therefore, to see how the likelihood changes with a 0.1 increase of HHI, the odds for an HHI of 0.2 and 0.1 are calculated and then subtracted. This results in an decrease of 9,0% for every 0.1 unit of change in HHI, ceteris paribus.

For gross plan capacity, the odds of a site becoming stalled increases with 1,002 (or 0.2%) for every one unit increase. Or in other words, each time a house is added to the plan, the likelihood of the site becoming stalled increases with 0.2%. The distance to the nearest big city and the population growth both do not increase the likelihood of a site becoming stalled.

5. Conclusion

This thesis is an inquiry into the role market power plays in the occurrence of stalled sites in the context of the Dutch land and real estate market. The phenomenon of stalled sites were brought forward by McAllister et al. (2016) and later by Buitelaar and Van Schie (2018). Stalled sites are considered by both as sites for which the developments take an abnormal period of time. In this research, this is established by looking whether the development surpassed the average lead time. The phenomenon is also observed in the Netherlands; a number of sites that are zoned for residential development, remain fallow (Buitelaar & Van Schie, 2018). There are a number of different reasons for developments to take such an extended amount of time to fully complete. One of the possible causes found in the literature was the notion of market power (Buitelaar & Pouls, 2009; Markusen & Scheffman, 1978; Ott et al., 2011). Market power is described as the ability of suppliers to raise prices above the prices that would occur in equilibrium, due to the fact that they possess a substantial share of the available supply in a certain market. In order to obtain this power it is assumed that landowners stall their developments, so that once they deem their market power high enough they can choose to exert it and capture big revenues. Research prior to this has concluded that there is suspicion to believe that the Dutch land market is strongly concentrated (Priemus & Louw, 2003). Thus, as a result certain landowners have market power. This is investigated for the province of Noord-Holland.

To measure the state of market power the HHI is used. Market power is derived from market concentration. The HHI measures the extent to which the supply of a market is concentrated, by summing the squared shares that each landowner possesses. A value between 0 and 0.2 is considered an acceptable amount of market concentration, a value between 0.2 and 1,0 indicates a strongly concentrated market (Buitelaar & Pouls, 2009). In combination with data on all of the residential developments in the province of Noord-Holland, Kadaster data is used to calculate the HHI for every municipality in the province. The results (figure 8) showed that most of the municipalities have a strongly concentrated market (HHI > 0.2), with the mean HHI of the province being 0.32. This comes down to 10 out of a total of 3.626 different landowners, that together possess about 42% of all the land that is zoned for residential development in the Noord-Holland province. These findings are in line with the HHI value of 0.31 Buitelaar and Pouls (2009) found for the entire Netherlands. Along with this come two remarks. First, it is good to note that these HHI values do not include any subsidiaries that a private company may have. This will result in a more concentrated market. Moreover, it should be interesting for future research to study more in-depth any (confidential) agreements there might exist between market actors with regard to purchasing land and the rate at which it is developed. From the literature it becomes clear that these agreements are pertinent (Matsumoto, Merlone & Szidarovszky, 2011; Buitelaar & Pouls, 2009). Accounting for these agreements would also result in an even stronger concentrated market.

Research on the progress of residential developments in the Noord-Holland province was also conducted. This mainly focused around the extent to which stalled sites are present. Data on the approved residential plans was obtained through the province of Noord-Holland. The average lead time was used to indicate whether a plan is considered to be not stalled or stalled. All developments that surpassed the average lead time from the moment the plan turned irrevocable and reoccurred in the database of 2019, were classified as stalled. Those that did not reoccur in the database of 2019 were categorised as not stalled, for then the development would be completely finished. Plans that were not irrevocable for a longer period of time than the average lead time were not included in the analysis. Plans should also have a minimum gross plan capacity of 1 house. Otherwise no houses are constructed. The study only included plans that finish, according to the average lead time, somewhere in 2018 or plans that were stalled during 2018. If not included, the latter group of plans influences the ownership

situation over which the HHI for market power is calculated. In total, 131 residential plans met the criteria, of which 32 plans were marked as stalled (see figure 7); this comes down to 24,4%, which is in line with the findings of research by Geuting et al. (2021). Translated to the net plan capacity, this amounts to 34,9% of all intended houses to be stalled. This is quite a leap from the 11% found by Buitelaar and Van Schie (2018). However, they studied the Netherlands as a whole and looked at building permits, also by only looking at the province the influence of Amsterdam is more substantial. The sites are quite evenly dispersed throughout the province.

A logistic regression was performed to determine the nature of the relationship between market power and the occurrence of stalled sites and the intensity thereof. The model was significant for χ^2 (4) = 11,696; $p < 0.05$. Market power was found to have a negative relationship with the likelihood of a site becoming stalled. The relationship was only just not significant. For every 0.1 increase in HHI, the likelihood of a site becoming stalled dropped with 9,0%. This is in contrast to the hypothesis of this research. Two possible reasons are suspected to cause this found negative relationship between market power and the occurrence of stalled sites. First, it is possible that landowners have such great market power that they deem the added profits they can capture because of it high enough, which would lead them to choose to develop their sites. Or in other words, they do not have to wait anymore in order to obtain more market power. They already possess great amounts of market power, which gives them the ability to raise the prices for the houses they bring into the market. Stalling their sites would still lead to even greater market power, but it also comes with risk. The municipalities might approve more developments, as a consequence their market power would shrink which would result in a loss of profit. Market conditions might also change, causing them to lose profit. For future research it would be interesting to see whether landowners also exert their market power, i.e., charge higher prices for their real estate than landowners with no or low market power do. The second reason for the negative relationship between market power and the occurrence of stalled sites might lie in the landowners with no or small amounts of market power. As long as a monopoly is absent, landowners with low amounts of market power are present in the market. As found in real options literature, these landowners can maximize the utility of their sites (i.e., profit) by quickly developing their sites and benefitting from the high demand that is caused by the postponement of multiple and/or bigger plans (Wang & Zhou, 2006). This is not captured by the analysis of this research, because it is performed with data on plan level. To get around this issue, data on parcel level is needed. However, the problem here lies in data on plan capacity on parcel level. The municipality determines how many houses can be built within the established plan area. How these houses are distributed over the parcels within that plan area is determined in later stages of the development and is not included in the plans that are in the current data set. This should be included in order to know more precisely the impact of market power on the development progress. For future studies, it is recommended to be mindful for this particular problem.

The model also included several other predictors that, as gathered from theory, are supposed to influence the development progress. First, the model included the distance of the plan to the nearest big city. It was hypothesised that plans closer to the city centre would be stalled more often. Stalling these sites would increase the profits even further. However, the results of this effect were found to be absent by the model. Future research could pose an investigation into the effect of accessibility rather than just distance on the occurrence of stalled sites. Next, the effect of demand volatility on the occurrence of stalled sites was studied. It was assumed that the more volatile housing demand, the more likely a landowner would be to stall their sites. Demand volatility was measured as the population development of the municipality between the years 2017 and 2018. The logistic regression yielded the conclusion that this was not of significant influence on the occurrence of stalled sites. A more in-depth study into the effect of demand volatility is desirable, since many factors contribute to the extent to which demand is volatile. Lastly, the model included gross plan capacity as an indicator for the size of the plan. Plan size was expected to influence the occurrence of stalled sites in a positive way; the more houses are

allowed to be constructed, the bigger the likelihood of the site becoming stalled. The model found a very small positive correlation. For every 1 house extra added in the plan, the likelihood of a site becoming stalled increases by 0.2%. Future research might be able to determine this with more precision by analysing this effect on parcel level, as is mentioned before. Another point for future research would be to include the reason for delay for each of the plans. Not all stalled sites are stalled on purpose, during the development a number of issues, as McAllister et al. (2016) explained, can arise that slow the development process down. Only in the cases were sites are stalled on purpose by the landowners is market power of relevance. If no issues pop up unexpectedly (like archaeological findings or soil contamination) that might halt the development, then market power might be an important factor. In this research this could not be accounted for. The presence of market power might also yield other disadvantageous consequences for residential developments, such as the types of houses that are built (Buitelaar & Pouls, 2009).

The main research question of this thesis was: *What role does market power play in the development process and the stalling of sites?* This research showed that market power is indeed present on the Dutch land market. The logistic regression performed to ascertain the role it has in the development process suggested there be a negative relationship between market power and the occurrence of stalled sites. This should, however, be stated with care as this is concluded for the market as a whole. It might be possible that in a concentrated market were one landowner possesses a significant amount of market power that one landowner stalls their sites, as opposed to the other landowners that possess only a small fraction of the total supply for whom it is economically rational to develop their sites quickly in order to benefit from the heightened housing demand. This is subject for future research. So, the role that market power plays in the development process might depend on the dispersion of market power within the submarket. It should be critically reviewed whether the owners with great market power do in fact stall their sites more often than those with less market power. Should this be the case, than the smaller developments within a concentrated market do take place but the bigger plans will lay fallow. This would mean that those that do not possess market power develop their sites quickly, causing the market power of those that already possessed it to increase even further. This is supported to some extent already by the small positive relationship found between plan size and the occurrence of stalled sites. This is, however, negated somewhat by the entry of newly approved plans. Nevertheless, these dominant market actors have a bigger chance of acquiring control in these plans too, for they can capture bigger profits with their developments, thus they are able to outbid others. This seems to be a positive feedback loop, where the dominant market actors keep winning the battle for land, which can only be broken by government intervention. Therefore, a policy recommendation would be to consider creating more but smaller plans. This could lead to more competition on the land market as well as on the contractor market. This will, however, lead to an increase in construction costs due to less cost reduction as a consequence of economies of scale. If the government aims to accelerate the rate at which new houses enter the real estate market, however, they might consider subsidising any unprofitable developments; which due to the heightened competition, has less chance to be considered state aid. Future research can look further into the efficacy of such an intervention. In the context of the development progress, municipalities can, by knowing the state of market concentration and the distribution of market power as a result thereof, tread more carefully when zoning additional land for residential development and in the agreements they make with the developers. By preventing landowners to stall their sites for extended periods, more houses will be brought into the market faster which can ultimately lead to a better advancement in the real estate market that is so desperately needed in the Netherlands.

6. Discussion

Certain aspects involving this research were not optimal. This chapter explains these suboptimalities, elaborates what made them suboptimal, discusses their influence on the research outcomes, and makes recommendations on how to overcome these suboptimalities. Lastly, the validity and reliability of this thesis are examined.

6.1 Higher *N*

N is the number of subjects in the study, in this case the number of plans, which amounted to 131 plans. In quantitative research, this number is quite important. Ideally, the number of subjects is high enough that one more subject is not of influence on the outcome of the performed analysis (Field, 2013). This number is not the same for every statistical analysis. Some have suggested there be a minimum of 10 cases for the least frequent outcome for each of the independent variables. However, this goes for categorical independent variables, whereas this study only deals with continuous independent variables. Nevertheless, this study might benefit from including more plans into the analysis.

The data in this study, however, is quite difficult to obtain. Not many provinces possess this kind of elaborate data and not every province wants to share this either. Additionally, the number of subjects cannot be infinitely heightened in this case; there is a finite number of plans in every province. Even fewer plans meet all the criteria. It could be useful to extend the study to other provinces in the Netherlands, so that the effect of market power can be grasped more completely. The market conditions of those provinces need to be taken into consideration then. This will influence the final results of the study in that province. If extended to other countries, then the differences between those countries should be critically evaluated.

6.2 Longitudinal research design

A recommendation for further research is a longitudinal approach to study the influences of market power on the development progress. It was mentioned a few times within this thesis that a longitudinal research design would have been more insightful. Longitudinal research takes a time component into account. The subjects, plans, are being follow through time and at different points in time data for that plan is recorded (Vennix, 2016). This allows a very thorough analysis of the influence of certain factors on the development progress. If possible, the study can start with looking at the ownership situation before the plan is even being prepared. This way, plans enter the analysis right before any action is undertaken by the municipality. They exit the study once they are completely finished. This best mirrors the situation that is taking place in reality. Data on market power can be recorded every time a land transaction has been made. This is very helpful, because one land transaction not only influences the market power of the buyer, but also relatively influences the market power of all the other actors present in the market.

Another benefit of a longitudinal research design is that the development progress can be operationalised as the amount of time it takes to complete after the plan turns irrevocable. Because multiple records are made of the same plan at different times, a clearer starting point of irrevocability can be determined. When operationalising development progress as a dichotomy, as is done in this research, the plans that have surpassed the average lead time by one day are immediately considered as stalled. This affects the results of the influence market power has on the development progress.

6.3 Measuring market power

When measuring market power, the ownership situation is essential. In this research, the HHI is calculated by looking at the shares of each owner that is registered in the database of the Kadaster. An important point of attention is that this calculation is done with the assumption that no two parties work together. It is plausible to think that two landowners make agreements about what land they purchase, when they will start with the development of that land, and what the quantitative and qualitative characteristics of that development will be. For example, if two landowners both own large plots, but one builds apartments and the other builds only detached houses then they both satisfy, for the most part, different demands. This gives them more market power than is now reflected in the HHI. These agreements can be informal and even confidential and is not reflected in the data of the Kadaster. This goes for all the owner categories, as municipalities can work together too. Private companies can also have subsidiaries that also heighten the market power of the parent company. Therefore, another recommendation for further research is a qualitative study into the agreements of market actors. This is the only way of uncovering the effect these agreements have. This needs to be performed with care, because market actors might be hesitant in sharing this kind of information.

Another point of improvement would be to measure market power based on the number of houses each landowner can build. In this thesis, the shares of every landowner is determined by looking at the area of land each owner possesses. This was done because the data on plan capacity was only available on plan level and not at parcel level. Ideally, it is determined for each parcel in a plan what the total number of houses is that can be developed. This way, the HHI can be calculated by looking at the shares of the total plan capacity each owner possesses. The area of a plan can be quite small, but if density is high (for example with high rise apartments) then the landowner is able to influence the supply more than a landowner who possesses a large amount of land but for low density detached houses. When looking at the distribution of the number of houses in all the plans, density restrictions and housing types can be accounted for.

6.4 Validity and reliability

Validity mainly consists of two concepts; internal and external validity. Internal validity is about the way the research is performed, how the subjects of the study are chosen and the way the data has been recorded (Lakshmi & Mohideen, 2013). For this study, pre-existing databases were used. This means that the method of data collection could not be altered. The extent to which the Kadaster data set is internally valid is high. By law, land transactions have to be registered by the Kadaster. The database of all the plans from the province of Noord-Holland also is to quite a high extent internally valid. Every municipality has to give notice to the province about their intended spatial developments, both those in preparation and already approved. This has to be done in order for the province to align the developments on a higher scale. However, certain developments are confidential, especially greenfield developments. Otherwise other market parties swoop in to purchase land in that area, causing the municipalities to have less control over the development.

Internal validity is also about measuring what one intends to measure (Vennix, 2016). This is a study into the effect of potential market power on the occurrence of stalled sites. Plans were categorised as stalled or not stalled. The extent to which sites were stalled is measured accurately. Potential market power is measured through the HHI. This is an indicator for the extent to which a market is concentrated. As explained in chapter 2, market power is derived from market concentration. Market power is absent if there is no market concentration. Therefore, the HHI is also an accurate measurement to establish the presence of market power. It would be even more accurate, however, to measure potential market power on the owner level, as was originally intended. The problem with this can again be found in the scale at

which the plan data is recorded. If an analysis on parcel level could be possible, the internal validity would be higher.

Within the context of internal validity, reliability is also of great importance. This is about the research consistently concluding the same result (Vennix, 2016). This research will to a great extent yield the same results if performed again. This is because the used measurements are rather objective, like the average lead times, whether the plan is irrevocable, and the number of houses the plan contains. When calculating the HHI, however, the shapes of the plans are used to determine which parcels constitute the plan. This is done by means of a spatial join in QGIS, which can result in some parcels being added to the plan that are only for a really small fraction in the plan. This is tried to overcome by spatially joining the centroids of the parcels, instead of the entire parcel shapes, to the plan shapes. This might slightly influence the calculation of the HHI for the municipalities, but it heightens the reliability as it can be repeated and produce the same results more easily than it would by making a more objective selection.

External validity is about the generalisability of the research to a bigger population, or in this case area (Lakshmi & Mohideen, 2013). Extrapolating the conclusions made by this research to other areas in the Netherlands, the market conditions characteristic to that area should be taken into consideration. For example, the conclusions in the greater Amsterdam area will differ from what is happening in a more rural area. When comparing these results to the situation in other countries it should be done with even more care. As explained in chapter 2, the Netherlands are one of few countries where active land policy is allowed and often applied. Furthermore, other planning regulations can intervene in the development process, which might alter the effect of market power. Lastly, differences in market conditions will have an impact on the choices with regard to site development made by landowners.

Literature

ABF Research. (2020a, June). *Vooruitzichten bevolking, huishoudens en woningmarkt: Prognose en scenario's 2020-2035*. https://www.rijksoverheid.nl/documenten/rapporten/2020/06/12/vooruitzichten-bevolking-huishoudens-en-woningmarkt-prognose-en-scenarios-2020-2035

ABF Research. (2020b, November). *Inventarisatie plancapaciteit 2020*. https://www.rijksoverheid.nl/documenten/rapporten/2020/12/08/abf-rapportage-inventarisatie-plancapaciteit

Alonso, W. (1964). *Location and Land Use* (1ste ed.). Amsterdam University Press.

Belsky, E. (2009). Demographics, Markets, and the Future of Housing Demand. *Journal of Housing Research, 18*(2), 99–119. https://doi.org/10.1080/10835547.2009.12092006

Buitelaar, E. (2019). Versnelling van de woningbouw: van korte- naar langetermijnperspectief. *Real Estate Research Quarterly, 2019* (2), 6-11.

Buitelaar, E., Bregman, A., Van den Broek, L., Evers, D., Galle, M., Meijer, T., & Sorel, N. (2012, februari). *Ex-durante evaluatie Wet ruimtelijke ordening: tweede rapportage*. Den Haag, PBL. https://www.pbl.nl/publicaties/ex-durante-evaluatie-wet-ruimtelijke-ordening-tweede-rapportage

Buitelaar, E. & Pouls, G. (2009). Marktconcentratie en woningbouw: een empirisch onderzoek naar marktaandelen van woningaanbieders. *Real Estate Research Quarterly, 8*(1), 45-51.

Buitelaar, E. & Van Schie, M. (2018). Bouwen niet verboden: een onderzoek naar onbenutte plancapaciteit voor woningbouw. *Ruimte + Wonen (2)*.

Bulan, L., Mayer, C., & Somerville, C. T. (2009). Irreversible investment, real options, and competition: Evidence from real estate development. *Journal of Urban Economics, 65*(3), 237–251. https://doi.org/10.1016/j.jue.2008.03.003

Capozza, D. R., & Helsley, R. W. (1990). The stochastic city. *Journal of Urban Economics, 28*(2), 187–203. https://doi.org/10.1016/0094-1190(90)90050-w

Chamberlin, E. (1954). Measuring the Degree of Monopoly and Competition. In: Chamberlin, E.H. (eds). *Monopoly and Competition and Their Regulation*. Palgrave Macmillan, London. https://doi.org/10.1007/978-1-349-08434-0_13

Centraal Bureau voor de Statistiek (CBS) (2018, January 26). *CBS StatLine*. StatLine (consulted at 17-05-2021). https://opendata.cbs.nl/statline/#/CBS/nl/

Cotteleer, G., Gardebroek, C., & Luijt, J. (2008). Market Power in a GIS-Based Hedonic Price Model of Local Farmland Markets. *Land Economics, 84*(4), 573–592. https://doi.org/10.3368/le.84.4.573

Colwell, P. F. (2002). Tweaking the DiPasquale-Wheaton Model. *Journal of Housing Economics, 11*(1), 24–39. https://doi.org/10.1006/jhec.2001.0301

Cunningham, C. R. (2006). House price uncertainty, timing of development, and vacant land prices: Evidence for real options in Seattle. *Journal of Urban Economics, 59*(1), 1–31. https://doi.org/10.1016/j.jue.2005.08.003

Das, M., & Van Daalen, G. (2012, maart). *Dynamiek op de woningmarkt*. CBS, Den Haag. https://www.cbs.nl/nl-nl/publicatie/2012/13/dynamiek-op-de-woningmarkt

Davy, B. (2012). *Land Policy: A German perspective on planning and property*. Farnham, Surrey: Ashgate. 37-46.

DiPasquale, D., & Wheaton, W. C. (1992). The Markets for Real Estate Assets and Space: A Conceptual Framework. *Real Estate Economics, 20*(2), 181–198. https://doi.org/10.1111/1540-6229.00579

Eichholtz, P., & Lindenthal, T. (2014). Demographics, human capital, and the demand for housing. *Journal of Housing Economics, 26*, 19–32. https://doi.org/10.1016/j.jhe.2014.06.002

Elzinga, K. G., & Mills, D. E. (2011). The Lerner Index of Monopoly Power: Origins and Uses. *American Economic Review, 101*(3), 558–564. https://doi.org/10.1257/aer.101.3.558

Farris, J. T. (2001). The barriers to using urban infill development to achieve smart growth. *Housing Policy Debate, 12*(1), 1–30. https://doi.org/10.1080/10511482.2001.9521395

Feinberg, R. M. (1980). The Lerner Index, Concentration, and the Measurement of Market Power. *Southern Economic Journal, 46*(4), 1180. https://doi.org/10.2307/1057252

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. SAGE Publications.

Foster, J. J., Barkus, E., & Yavorsky, C. (2006). *Understanding and Using Advanced Statistics*. SAGE Publications.

Gao, J., Chen, W., & Liu, Y. (2018). Spatial restructuring and the logic of industrial land redevelopment in urban China: II. A case study of the redevelopment of a local state-owned enterprise in Nanjing. *Land Use Policy, 72*, 372–380. https://doi.org/10.1016/j.landusepol.2018.01.006

Gao, J., Wu, Z., Chen, J., & Chen, W. (2020). Beyond the bid-rent: Two tales of land use transition in contemporary China. *Growth and Change, 51*(3), 1336–1356. https://doi.org/10.1111/grow.12408

Geuting, E., Ham, M., & De Leve, E. (2021, January). *Ongebruikte grondposities: Een onderzoek naar de benutting van braakliggende terreinen*. Stec Groep. https://www.tweedekamer.nl/ kamerstukken/ brieven_regering/detail?id=2021Z03024&did=2021D06600

Glick, M. A., & Campbell, D. (2007). Market Definition and Concentration: One Size Does Not Fit All. *The Antitrust Bulletin, 52*(2), 229–237. https://doi.org/10.1177/0003603x0705200205

Grenadier, S.R. (1996). The Strategic Exercise of Options: Development Cascades and Overbuilding in Real Estate Markets. *The Journal of Finance, 51*(5), 1653–1679. https://doi.org/10.1111/j.1540-6261.1996.tb05221.x

Hahn, R. W. (1984). Market Power and Transferable Property Rights. *The Quarterly Journal of Economics, 99*(4), 753. https://doi.org/10.2307/1883124

Healey, P. (1992). An institutional model of the development process. *Journal of Property Research, 9*(1), 33–44. https://doi.org/10.1080/09599919208724049

Hicks, J. R. (1935). Annual Survey of Economic Theory: The Theory of Monopoly. *Econometrica, 3*(1), 1. https://doi.org/10.2307/1907343

Knipp, S. (2018). Senioren gaan woningmarkt vlot trekken. *Geron, 20*(4), 42–45. https://doi.org/10.1007/s40718-018-0172-4

Lakshmi, S., Mohideen, M. A. (2013). Issues in reliability and validity of research. *International Journal of Management Research and Review, 3*(4), 2752–2758.

Lauf, S., Haase, D., Seppelt, R., & Schwarz, N. (2012). Simulating Demography and Housing Demand in an Urban Region under Scenarios of Growth and Shrinkage. *Environment and Planning B: Planning and Design, 39*(2), 229–246. https://doi.org/10.1068/b36046t

Ledyard, J.O. (1989). Market Failure. In: *Eatwell, J., Milgate, M., & Newman, P. (eds). Allocation, Information and Markets (The New Palgrave)*. Palgrave Macmillan, London. https://doi.org/10.1007/978-1-349-20215-7_19

Lerner, A. P. (1934). The Concept of Monopoly and the Measurement of Monopoly Power. *The Review of Economic Studies, 1*(3), 157–175. https://doi.org/10.2307/2967480

Leung, C. K. Y., & Wang, W. (2007). An examination of the Chinese housing market through the lens of the Dipasquale-Wheaton model: a graphical attempt. *International Real Estate Review, 10*(2), 131-165.

Lin, D., Allan, A., & Cui, J. (2015). The impact of polycentric urban development on commuting behaviour in urban China: Evidence from four sub-centres of Beijing. *Habitat International, 50*, 195–205. https://doi.org/10.1016/j.habitatint.2015.08.018

Lindenberg, E. B., & Ross, S. A. (1981). Tobin's *q* Ratio and Industrial Organization. *The Journal of Business, 54*(1), 1. https://doi.org/10.1086/296120

Lisi, G. (2015). Real Estate Macroeconomics and the Four-Quadrant Model: DiPasquale-Wheaton-Colwell Meet Mortensen-Pissarides. *Journal of Real Estate Practice and Education, 18*(1), 87–106. https://doi.org/10.1080/10835547.2015.12091745

Markusen, J.R., & Scheffman, D.T. (1978). Ownership Concentration and Market Power in Urban Land Markets. *The Review of Economics Studies, 45*(3), 519-526. https://doi.org/10.2307/2297253

Matsumoto, A., Merlone, U., & Szidarovszky, F. (2011). Some notes on applying the Herfindahl–Hirschman Index. *Applied Economics Letters, 19*(2), 181–184. https://doi.org/10.1080/13504851.2011.570705

McAllister, P., Street, E., & Wyatt, P. (2016). An empirical investigation of stalled residential sites in England. *Planning Practice & Research, 31*(2), 132-153. https://doi.org/10.1080/02697459.2015.1115658

Michielsen, T., Groot, S., & Van Maarsseveen, R. (2017). *Prijselasticiteit van het woningaanbod*. Den Haag, CPB.

Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. *Annals of the Association of American Geographers, 94*(2), 284–289. https://doi.org/10.1111/j.1467-8306.2004.09402005.x

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2018, January). *Indeling gemeenten krimpregio's en anticipeerregio's per 1 januari 2018*. https://www.rijksoverheid.nl/onderwerpen/bevolkingsdaling/krimpgebieden-en-anticipeergebieden

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2018, November). *Staat van de woningmarkt 2018*. https://www.rijksoverheid.nl/documenten/rapporten/2018/11/16/rapport-staat-van-de-woningmarkt

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2020a, June). *Staat van de woningmarkt rapportage 2020.* https://www.rijksoverheid.nl/documenten/rapporten/2020/06/15/staat-van-de-woningmarkt-jaarrapportage-2020

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2020b, November). *Kamerbrief over voortgang versnelling woningbouw.* Kamerstuk | Rijksoverheid.nl. https://www.rijksoverheid.nl/documenten/kamerstukken/2020/11/06/kamerbrief-over-voortgang-versnelling-woningbouw

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2021a, January 28). *Doelstelling aantal nieuwe woningen in 2020 gehaald*. Nieuwsbericht | Rijksoverheid.nl. https://www.rijksoverheid.nl/actueel/nieuws/2021/01/28/doelstelling-aantal-nieuwe-woningen-in-2020-gehaald

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties. (2021b, February 11). *Detail 2021D06600 | Tweede Kamer der Staten-Generaal*. Rijksoverheid. https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2021Z03024&did=2021D06600

Ott, S. H., Hughen, W. K., & Read, D. C. (2011). Optimal Phasing and Inventory Decisions for Large-Scale Residential Development Projects. *The Journal of Real Estate Finance and Economics, 45*(4), 888–918. https://doi.org/10.1007/s11146-011-9299-y

Öztürk, B., Van Dijk, D., & Van Hoenselaar, F. (2018). Aanbodbeperkingen hebben effect op huizenprijzen. In ESB, 103(4767), 498-500.

Peng, C. Y. J., Lee, K. L., & Ingersoll, G. M. (2002). An Introduction to Logistic Regression Analysis and Reporting. *The Journal of Educational Research, 96*(1), 3–14. https://doi.org/10.1080/00220670209598786

Pindyck, R. S. (1985). The Measurement of Monopoly Power in Dynamic Markets. *The Journal of Law and Economics, 28*(1), 193–222. https://doi.org/10.1086/467080

Priemus, H., & Louw, E. (2003). Changes in Dutch Land Policy: From Monopoly towards Competition in the Building Market. *Environment and Planning B: Planning and Design, 30*(3), 369–378. https://doi.org/10.1068/b12982

Priemus, H. (2007). Van bouwkartel naar grondpositie: Nieuwe opgaven voor professioneel opdrachtgeverschap. *Building Business, 9*(2), 54-59.

Read, C. (1997). Development Effort in Speculative Real Estate Competitions. *Journal of Housing Economics, 6*(1), 1–15. https://doi.org/10.1006/jhec.1997.0201

Renes, G., Thissen, M., & Segeren, A. (2006). *Betaalbaarheid van koopwoningen en het ruimtelijk beleid*. Den Haag, PBL.

Rhoades, S.A. (1993). The Herfindahl-Hirschman Index. *Federal Reserve Bulletin, 79*(3), 188-189.

Somerville, C. T. (1999). The Industrial Organization of Housing Supply: Market Activity, Land Supply and the Size of Homebuilder Firms. *Real Estate Economics, 27*(4), 669–694. https://doi.org/10.1111/1540-6229.00788

Spit, T., & Zoete, P. (2016). Planologie: Een wetenschappelijke introductie in de ruimtelijke ordening in Nederland (1st edition). Coöperatie In Planning U.A.

Swank, J., Kakes, J., & Tieman, A.F. (2002). *The housing ladder, taxation and borrowing constraints*. Amsterdam, DNB.

Titman, S. (1985). Urban Land Prices Under Uncertainty. *The American Economic Review, 75*(3), 505-514.

Tobler, W. R. (1970). A Computer Movie Simulating Urban Growth in the Detroit Region. *Economic Geography, 46*, 234–240. https://doi.org/10.2307/143141

Vennix, J. (2016). *Onderzoeks- en interventiemethodologie* (6de editie). Pearson Benelux B.V.

Wang, K., & Zhou, Y. (2006). Equilibrium Real Options Exercise Strategies with Multiple Players: The Case of Real Estate Markets. Real Estate Economics, 34(1), 1–49. https://doi.org/10.1111/j.1540-6229.2006.00158.x

Wen, H., & Tao, Y. (2015). Polycentric urban structure and housing price in the transitional China: Evidence from Hangzhou. *Habitat International, 46*, 138–146. https://doi.org/10.1016/j.habitatint.2014.11.006

Williams, J. T. (1993). Equilibrium and Options on Real Assets. *Review of Financial Studies, 6*(4), 825–850. https://doi.org/10.1093/rfs/6.4.825

White, P. (1985). Land Availability, Land Banking and the Price of Land for Housing: a Review of Recent Debates. *Land Development Studies, 3*(2), 101-111. https://doi.org/10.1080/02640828608723904