
The Dutch challenges:
Spare capacity,
Shortage of housing &
Soaring rental prices

The Dutch challenges: spare capacity, shortage of housing and soaring rental prices

A quantitative analysis about the relationship between plan capacity, new-build housing production and rental prices in the private rented sector in the Netherlands

Master's thesis

in partial fulfilment of the requirements for obtaining the title of

Master of Science in Spatial Planning

to

Nijmegen School of Management

Spatial Planning, specialization in Planning, Land and Real Estate Development

Radboud University

by

T.G.J. (Twan) Lucassen

Colophon

Master's thesis Spatial Planning

The Dutch challenges: spare capacity, shortage of housing and soaring rental prices

A quantitative analysis about the relationship between plan capacity, housing production and rental prices in the private rented sector in the Netherlands

Nijmegen, July 2020

Educational institute
Nijmegen School of Management
Spatial Planning: Planning, Land and Real Estate Development
Radboud University

Student
T.G.J. (Twan) Lucassen
Studentnumber: S1029997

Program coordinator
Prof. Dr. E. van der Krabben

First assessor/supervisor
Prof. Dr. E. van der Krabben

Second assessor
Dr. ir. D.A.A. Samsura

Internship organization
Sweco Nederland
Sweco Capital Consultants

Internship supervisor
Mr. T. van Duren

Radboud Universiteit

SWECO

Preface

When I started writing my master's thesis, I thought very doubtful and exaggerated about writing a preface. What was the point of it? Why would I need to write something about my experience? It is only time-consuming and not particularly contributing to the research findings. Now, that I have experienced the process of writing a master's thesis myself, my mind has changed. I see it as a way to describe the various feelings and expressions during this whole process. I am glad that by writing the preface, I can finish my process in a light-hearted way. Especially in uncertain times as these, where a certain virus is dominating the current developments in the world, this is definitely needed.

In January 2020, I put the first ideas of my master's thesis on paper. Looking back now, I find little resemblance with how the thesis eventually turned out. That is not to say that I am not satisfied with the end result; the opposite is true. I am delighted with the changes that have been made throughout the writing and which have led to the current form of my master's thesis. These changes are symbolizing the ups and downs I went through while writing.

At the end of an intensive, exciting and also interesting period of internship and conducting research, I can proudly present this master thesis. It has been an educational process, in which I was able to acquire many new skills and knowledge. A big thank you to those who contributed to my research and who played an important role in my internship and research trajectory.

First of all, I would like to thank my thesis supervisor Erwin van der Krabben. His guidance has enabled me to complete my thesis in its present form. The quality of the result has been improved by his critical eye, extensive feedback and careful advise on various aspects of my research. Second, I would like to thank Huub Ploegmakers for his contribution in the data analysis aspect. Without his help, my thesis wouldn't be here right now. By making extensive use of his expertise about the dataset related to plan capacity and the entire STATA statistical program, I was able to complete this thesis within my own time limit. He took the time and patience to guide me through the statistical part of my research.

Last but not least, I would also like to thank my supervisor at Sweco, Tim van Duren. I have got to know the department of Sweco Capital Consultants as a friendly, interesting, hard-working team with short lines of communication, which I admired very much. Even though the internship didn't turn out the way I thought about it in advance (something with a certain virus), it still left me with a educational and satisfied feeling. Tim, thank you for the opportunities at Sweco, the time you took to guide me and the interesting conversations which contributed to my research outcome.

For me, the thesis period and student time are over (for now). I'm looking forward to a new challenge. For now, I would like to wish you a lot of fun reading my thesis.

Twan Lucassen
Nijmegen, July 2020

Abstract

The housing market is currently a hot topic in the public debate in the Netherlands. There is talk of a (regional) housing crisis as the current supply cannot meet demand. As a result of this form of scarcity, housing prices in the Netherlands are rising, even more in denser areas as the Randstad. The current housing shortage, combined with changes in policy reforms, have led to rising rental prices in the private rented sector in recent decades. Demographic developments contribute to this, with migration and the number of single-person households increasing in the upcoming years. This increase will enforce the pressure on the housing market; wherein 2030, the housing shortage is estimated at 200,000 homes.

The Dutch government is eager to take measures to tackle this problem. The government provided a new vision document with as most important goal: to build 75.000 new dwellings per year until 2025 to meet the growing demand. It remains to be seen whether this objective can actually be achieved. The number of houses produced in 2019 was 71.500, and for 2020 it is estimated at 65.000 new dwellings. In addition, issues such as the nitrogen and PFAS, create new problems and are causing delays in the current housing construction. In line with this, from a sustainability point of view, it is assumed that the Netherlands is simply too full, with not enough space and locations for housing being available. The perpetual debate between the pros and cons of inner-city or suburban construction reinforces this. After all, municipalities would not make sufficient locations available for housing construction. However, the assumption that not enough is being built because too few locations are available is incorrect. Previous research has already shown that there is sufficient plan capacity available for housing.

Although this plan capacity is not fully utilized and because this plan capacity has to go through a full legal process before it is irrevocable, this means that there is enough room to facilitate the housing shortage in the coming years. New housing production could also stop the ever-rising rental prices in the private rented sector. In order to investigate the relationship between plan capacity, housing production and rental prices, the following research question has been created: '*What is the effect of planning restrictions, in terms of plan capacity, on the rental housing prices in the private rented sector in the Netherlands?'* In order to answer this research question, data about plan capacity, housing production and rental prices in the private rented sector has been used. The effect of the plan capacity on the number of newly built dwellings at the municipal level and the rental prices have been tested using an regression analysis. For this purpose, quantitative secondary data was obtained from municipalities in six Dutch provinces between 2007-2017. Also, a dataset about housing production and for rental prices per m² has been provided. In addition, additional factors have been identified based on literature review and have been added to analyze the effect on housing production and rental prices.

Based on the literature review and the datasets provided, two central equations have been established: First, the relation between plan capacity and housing production, and, second, the relation between housing production and rental prices in the private rented sector have been analyzed in a regression analysis. The empirical findings suggest that an increase in plan capacity has a partial effect on the number of building permits granted, and therefore the new-build housing production. A 1% increase in private rented plan capacity leads to a 0.44% increase in the number of building permits granted. Also, when it is assumed that there is a delay between the hard plan capacity and the final start of construction, there appears to be a significant, positive relationship. A one per cent increase in a 1-year delayed plan capacity leads to an increase of 0,27% in the number of building permits granted, and so housing production.

Regarding the rental prices in the private rented sector, the regression outcome suggests only a small, positive relation between housing production and rental prices. An increase of building permits granted, and therefore housing production, of 1% leads to an increase in rental prices of 0.03% in the estimations. By adding the plan capacity in the equation, there is not a substantial effect upon the rental prices. An increase in gross, hard plan capacity of 1% would lead to a rental price increase of 0.01%, which is almost nihil. It can be concluded that (spare) plan capacity has a small influence on the housing production and (indirectly) on the rental prices in the private rented sector. The profound influence of plan capacity indicates that both relationships, the housing production and the price developments in the private rented sector, are mostly affected by other factors.

Table of content

1. Introduction

In the first chapter the research topic is being introduced. The first paragraph discusses the problem statement related to the research topic. The second and third paragraph explain the research aim and research question(s). In the fourth and fifth paragraph, the societal and scientific relevance of this research are being discussed.

1.1. Problem statement

In the 'Nationale Woonagenda 2018-2021' the Dutch government introduced a new vision document about the housing market. One of the most important targets in this vision document is to build 75.000 new dwellings per year until 2025 to meet the growing demand (Ollongren, 2018). In 2019, the highest number of new-build houses of this decade was realized, namely 71.500 new dwellings. In 2020 the number of new-build homes is expected to decrease compared with 2019 to 65.000 new dwellings (ING, 2019). The housing shortage in the Netherlands is increasing faster than expected and rose to 315.000 at the beginning of 2020, representing a shortage of 4% of the total housing stock (Capital Value, 2020). In 2030 the current deficit is expected to be around 200.000 dwellings[1]. A reason for this shortage can be sought in (expected) demographic trends in the Netherlands. The number of single-person households is increasing and will only grow further, due to the ageing population, until 40% in 2030 (CBS, 2018). This growth leads to a change in demand and the type of housing. However, there are significant regional differences in the housing shortage; in the densest regions, the deficit is above 6%, while the Middelburg region has no housing deficit at all (Ministry of the Interior and Kingdom Relations, 2019).

The goal of the Dutch government of increasing the housing supply can only be achieved by fastening the current housing plans and providing additional residential building locations (Ollongren, 2018). These responsibilities lay mainly in the hands of municipalities. At the national level, there is sufficient plan capacity available to meet the housing needs. According to ABF Research (2019), the recent inventory of plan capacity, the net plan capacity has been estimated at 828.000 dwellings for the period 2019 until 2030. There are adequate plans to provide a housing construction increase in new-build houses in all provinces. The data about plan capacity offers an indication of the number of dwellings that can be built according to current spatial plans but is not the same as the actual number of new-build houses delivered. There is a delay in current, approved environmental plans and the exact start and end of construction, which causes the current (regional) shortage of housing. This shortage inflates the owner-occupied housing prices and together with the long waiting list for people moving into a social sector dwelling, also increases the rental prices in the private rented sector.

In the first quarter of 2019, rents in the private rented sector in the Netherlands have increased with 5.4% to an average of €1.077,- per month, compared to a year ago (NVM & VGM NL, 2019). The rental price per m² in the private rented sector has increased with 25%, from €9,23 to €11,58 per m² between 2014 and 2019, while the average size of a dwelling has decreased from 108 m² to 98 m² in the same period. However, there are some significant regional differences: an m² in Friesland costs €8,58 per month, while in Noord-Holland, it costs €16,05 per month (NVM, 2019). An explanation for this lies in the fact that the market is not functioning adequately; supply remains behind demand. The housing market was locked for years due to the financial crisis in 2007-2008, in which construction was no longer possible. The total supply of houses is determined by, among other things, the number of new buildings delivered, which depends on the availability of suitable land. The number of available lands has fallen significantly in recent years (FD, 2017). It also takes municipalities longer to approve new land-use plans and building permits (environmental plans), delaying new construction from taking place. This delay of approving plans leads to a current shortage of private rented sector rental houses (Pararius, 2017). The supply of rental dwellings in the private rented sector in existing buildings remains 11% behind the demand in the first year (ABF Research, 2019). The consequences of this are that the desired flow in the housing market is insufficient and stuck. Starters are not able to enter the housing market, newcomers are stuck in a social rental house, and the elderly are not able to change their owner-

[1] It is not the case that all these people are on the street. Often they do have a home but it doesn't meet their requirements - or rather it is assumed that it doesn't fit.

occupied house for a rental dwelling because there are simply not enough of them. These fluctuations lead to a sensitive and unpredictable housing market.

This research is trying to find an answer for the current housing shortage, the rising rental prices in the private rented sector and the underutilization of plan capacity by municipalities. Within plan capacity, the juridical status of available plans indicates the current phase of a land-use plan with a distinction between hard and soft plan capacity. This legal status does not explain to what extent and acceleration plans are actually realized. Well-developed and substantiated soft plans can be realized relatively quickly, while hard plan capacity can be delayed in time due to (unforeseen) circumstances. In order to properly monitor building production and to gain a more accurate insight into the status of building plans, more research into plan capacity is important (Ollongren, 2019). To improve the shortage in the housing market, the relationship between the number of plans (plan capacity) and the amount of new-build housing constructed must be further analysed on a lower (municipality) scale. By examining whether there are too many plans delayed or not used, meaning that less construction is going on, it can be determined whether this is in relation with the rising rents in the middle segment in the Netherlands.

1.2. Research aim

The purpose of this research is, first, to examine the effect of plan capacity, in combination with other planning restrictions, on the new-build housing production in municipalities in the Netherlands. Second, the effect of this housing production, which is assumed to be in light of the available plan capacity, on the rental prices in the private rented sector in the Netherlands is examined.

1.3. Research questions

Main research question(s):

What is the effect of planning restrictions, in terms of plan capacity, on the rental housing prices in the private rented sector in the Netherlands?

1) What is the effect of plan capacity on the new-build housing production in the private rented sector?
2) What is the effect of housing production on rental prices in the private rented sector in the Netherlands?

1.4. Societal relevance

The problem statement shows that there is a societal interest in a well-functioning, balanced housing market, in which the current housing shortage (amongst others, in private rented sector rental dwellings) is addressed. More insight into how rental prices are established, and the current rental housing market situation in the Netherlands is therefore important to analyse. The supply lags behind the demand, which forces more people to live longer in their original homes. The number of ‘skewers’ is growing, i.e. people who earn enough to be eligible for a rental house in the middle segment, but due to insufficient supply of these types of houses, still have to stay in a social rental house and thereby blocking the flow of the rental housing market from operating. To oppose the housing shortage, the government decided that 75,000 new dwellings must be built each year (Ollongren, 2018). This goal can only be achieved if there are sufficient new-build housing locations available and when plans can be implemented quickly. It is, therefore important to investigate the relationship between plan capacity and the actual number of dwellings being built.

According to Buitelaar & Van Schie (2018), several plans have been approved for housing construction, but the actual construction has not yet started. These so-called stalled sites have an influence on the current shortage in housing development and supply. To examine how many plans are having a building permit, but are not in construction yet, a better overview of the current planning market in the Netherlands is needed. Reasons and answers for these delays and impacts on the market can be scientifically sought. To gain more insight into the status of building plans, more research into plan capacity is important (Ollongren, 2019). The new-build housing production delay is also affecting the prices of owner-occupied houses and rental prices in the private rented sector. The middle-segment in the housing market is a fundamental part of the housing stock of municipalities in the Netherlands

(Schilder & Conijn, 2017). Both for the housing needs of different target groups and for the future of the city, sufficient private rented properties should be available.

With a housing stock that fits the current and future demand of residents, the housing market comes into balance (Van Gijzel, 2018). Currently, this balance in the housing market does not exist in the Netherlands, which is assumed to effect the prices in the private rented sector. More research about this imbalance and price developments, and the possible causes and solutions for this, is therefore needed. This research will examine the variation in private rented sector rental prices, based on the plan capacity and new-build production of municipalities. The relationship between planning restrictions affecting the plan capacity and new-build housing production, and how this relationship relates to private rented sector rental prices, and therefore supply and demand in the housing market, has never been scientifically examined. That is why this relationship is central to this study.

1.5. Scientific relevance

This research is scientifically relevant because there has been limited research conducted in the Netherlands about the possible impact of planning restrictions on housing production. In an international context, there has been studies conducted about the relation between planning restrictions and the housing supply. Bramley (1993) argued that there is very little correlation between planning permissions granted and the number of dwellings completed. More plan capacity does not lead to more housing production. Bramley calls this the "implementation gap". In the Dutch context, it seems that there is also an implementation gap. The number of housing plans does not match with the number of dwellings being built (Buitelaar, 2019).

Research in the UK and USA have mostly focused on the effect of planning restrictions on the housing price elasticity (Gyourko & Molloy, 2015; Hilber & Vermeulen, 2016). The body of research done about the regulation of housing supply is proliferating, but much is still unknown about its causes and effects (Gyourko & Molloy, 2015). Bramley & Watkins (2014) argue that a permanent increase in the number of planning permissions by 40% per year would only lead to a rise in the number of completed new-build houses by 12-18%. The completion of new houses responds with a delay towards an increase in the amount of land available for residential construction and is always smaller than the total amount of additional land made available. It is not automatically possible to copy findings from international research for the Dutch housing market because these markets differ significantly. Therefore research focused on the Dutch housing market is preferable. Besides this, compared to the owner-occupied housing market, relatively few studies have been conducted on the rental market in the Netherlands (Francke, Harleman & Kosterman, 2017).

Already existing studies in the Netherlands were mainly focused on the supply elasticity of the housing stock, without considering the effect of planning policies (Vermeulen & Rouwendaal 2007; Michielsen, Groot & Maarseveen, 2017) or were measuring the effects of planning restrictions in an indirect way (Besseling, Bovenberg, Romijn & Vermeulen, 2008). These studies did research on a meso-level without considering the plan capacity of individual municipalities in the Netherlands. The relation between supply constraints, housing production and housing prices in the Netherlands has been researched before (De Vries & Boelhouwer, 2004; Öztürk, van Dijk, van Hoenselaar & Burgers, 2018). Previous research about plan capacity assumes that plans initiated for housing are actually being constructed (Hilber & Vermeulen, 2016). But there is a difference between the implementation of these plans because some plans take more time than others (Leeuwerik, 2018; Verhagen 2018).

This research builds further on previous work using plan capacity data of provinces in the Netherlands. This research will examine the implementation gap more precisely, by examining the effect of plan capacity on housing production. It is assumed that the effect of (spare) plan capacity on the housing production is limited. Also, the effect of housing production on the rental prices in the private rented sector in the Netherlands is examined, and is assumed to have a dominant role on the rental price increases. The research makes an empirical contribution to Dutch and international scientific debate about the effects of spatial planning restrictions on the number of new houses being built. This contribution is made by using a regression analysis for Dutch municipalities to estimate the effect of the size of the plan capacity on the number of new houses being built, and the therefrom deriving impact on the rental prices in the private rented sector in the Netherlands.

2. Theoretical framework

In this chapter, the underlying theories related to the research question are being discussed. In order to answer the research question, this chapter starts with outlining how the housing market functions regarding demand and supply. Planning restrictions have an impact on the functioning of the housing market and the new-build housing production. Plan capacity can be seen as an indicator for planning restrictions. The Dutch rental housing market is affected by these restrictions, resulting in an increasing rental price in the private rented sector, mainly due to supply-related issues. The next paragraphs elaborately discuss these restrictions and issues individually. The characterizations and developments in the Dutch (private) rental housing market will be discussed more detailed in chapter 3.

2.1. Market functioning and scales levels

The functioning of the housing market is based on a system wherein an ideal situation demand and supply are in equilibrium. Sufficient housing supply, or a lack of it, is affected by certain restrictions is a central topic in this research. The effect of these supply restrictions can be analysed on different scale levels in research, which are elaborately discussed in paragraph 2.1.2.

2.1.1. Theoretical market functioning

The four-quadrant model of DiPasquale & Wheaton (1992) evaluates the theoretical functioning of commercial real estate markets, such as the market for rental properties. With this model, the supply and demand for rental properties can be examined. The upper right quadrant in Figure 2.1 shows the demand side of the space market. A certain stock leads with a certain demand (elastic) to a certain rental price of real estate. This confrontation between these three aspects takes place on the investors market (top left quadrant). The rental price, in combination with the return obtained from investors, determines the real estate value. On the construction- and development market (bottom left quadrant), the real estate value and the elasticity of the supply theoretically lead to the construction of new real estate. The newly built construction is added to the stock in the lower right quadrant. The inventory in this quadrant is adjusted by additions of new buildings minus the withdrawals (demolition) in which the effect of *market clearing* occurs. The model assumes that the market corrects itself because supply and demand become balanced after a shock in the market (also known as 'market clearing') (Buitelaar, Sorel, Verwest, van Dongen & Bregman, 2013). In this way, an increase in stock with a constant or falling demand leads to lower rents and property prices and thus to less new constructions or even withdrawals, to prevent the stock from rising further (DiPasqualle & Wheaton, 1992; 1996; Buitelaar et al., 2013; Buitelaar & Van Dongen, 2016).

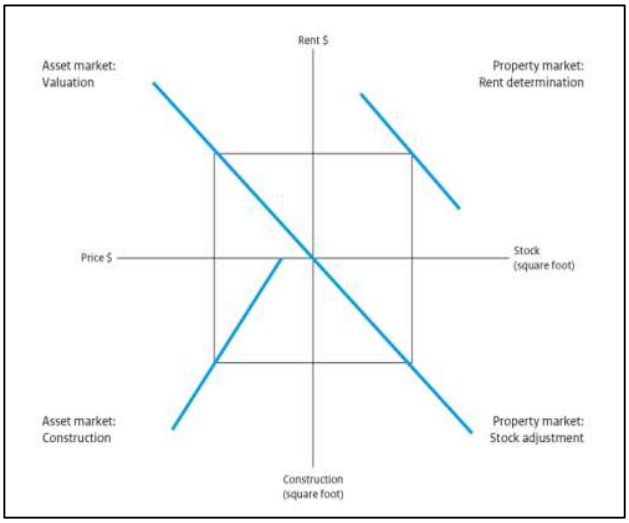

Figure 2.1: Four-quadrant model DiPasquale & Wheaton (1992)

The four-quadrant model of DiPasquale & Wheaton (1992) is an implicit system dynamic model: it establishes the relationship between many variables and suggests - considering it cyclical nature - correction mechanisms between demand and supplied quantities and prices itself. As with any model, the four-quadrant model is a simplification of reality. Previous research and practical lessons from the past have already implicated that market clearing – the process of an equilibrium between supply and demand - is absent (or infrequent) in the real estate market (Van Gool, Jager, Theebe & Weisz, 2013; Buitelaar et al., 2013). After all, there has been an over-supply of office and retail space for a long time in the Netherlands. If the concept of market clearing did exist, this would be the result of intentional decisions and institutional changes, and not the result from an invisible hand as many neoclassical economists (implicitly) suggest (Buitelaar et al., 2013).

Buitelaar et al. (2013, p.17) defines the real estate market and area development as a complex, *tightly coupled system*. The real estate market consists of three sub-markets: the space market, the investment market and the construction and development market, which are closely connected to the capital market. Figure 2.2 shows these submarkets, including the blocks with traded (or rather: rights to) goods. Area development is primarily implemented within the construction- and development market (lower left quadrant). The distinction between 'raw' building land and land ready for construction often only exists if municipalities pursue an active land policy, which has been prevalent in the Netherlands for the last decades (Needham, 2006). When this is not the case, developers are generally responsible for the whole chain; from raw building land to the development of new real estate. Based on the functioning of these sub-markets, the demand and supply of real estate can be understood and adjusted over time. In a perfectly functioning market, the relation between these sub-markets is balanced (market clearing), whereby all actors and owners would benefit (Buitelaar et al., 2013). In practice, these intertwined markets are never balanced, and alterations happen all the time. Policies, technical issues and the economic situation are causing delays in the whole process, resulting in an unbalanced market (Buitelaar et al., 2013). Overall, the model shows the developments in the real estate market for the longer term and makes it possible to predict how the property market responds to changes in financial markets, economic activity, inflation, regulation and construction costs (Van Gool et al., 2013).

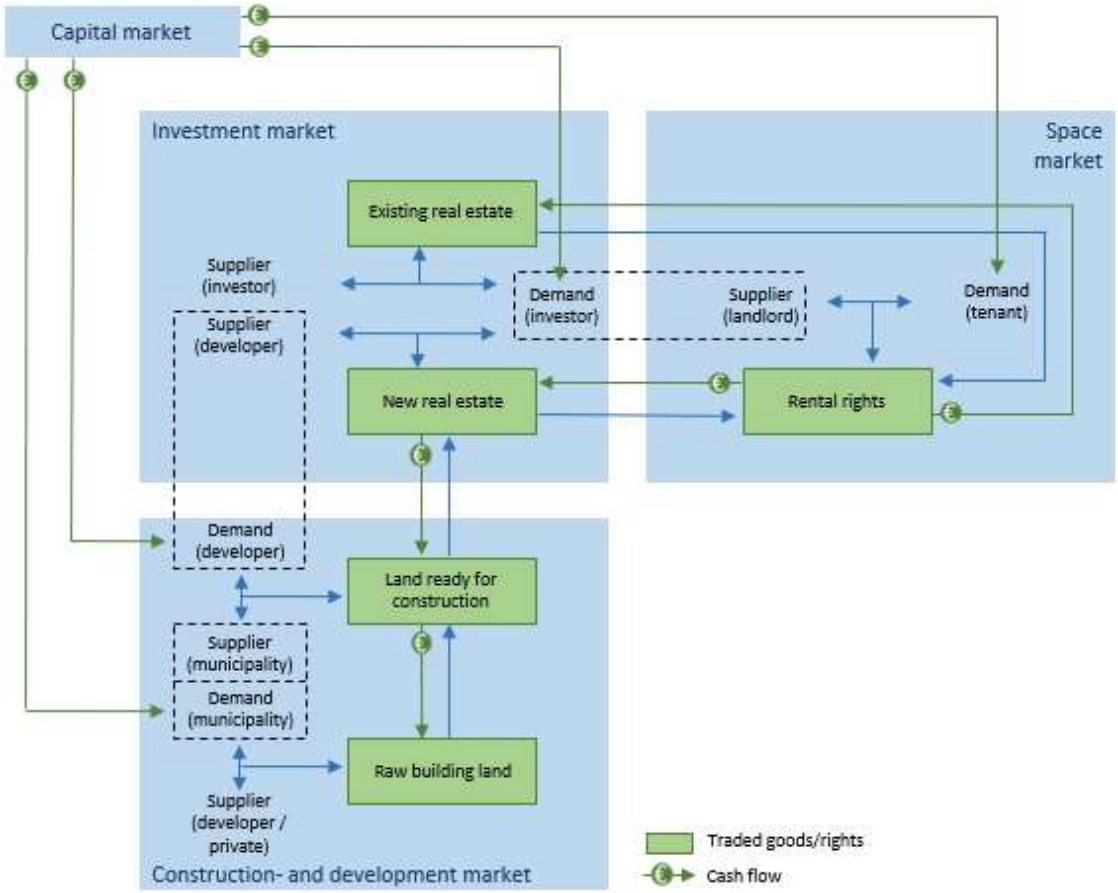

Figure 2.2: Four quadrant model (Buitelaar et al., 2013; own editing)

The financial crisis of 2007-08 exposed the limitations in this 'tightly coupled' real estate 'system' (Buitelaar et al., 2013). The connections between the space market on the one hand, and the investment market and construction- and development market, on the other hand, are relatively loose (loosely coupled). After all, the real estate supply responds incompletely and slowly to the demand for space, which is mainly the effect of market dynamics and (in)formal institutions (Buitelaar et al., 2013). These institutions have reinforced and exposed issues related to the functioning of the real estate market. Residential real estate has in particular been valued based on historical rental agreements, which may deviate from the current, actual market rent. As a result, actual market developments are being delayed, which has a flattened effect on valuations of residential real estate. Thus, in times of economic

uncertainty with falling prices, demand is overestimated, which has led to an excess of new construction, especially of offices during that time. High valuations of real estate also restrict the extent to which commercial real estate can be transformed into other functions, such as housing. In addition, landlords have been using rental incentives instead of lowering rents to not negatively affect future real estate valuations. Besides this, withdrawals of real estate from the existing stock by transformation (or demolition and new construction) into residential dwellings have been more expensive (due to taxes) than restructuring, whereby the function as an office or shop would be retained (Buitelaar et al., 2013).

The analysis of this system is used to expose the errors within the real estate market system and how these errors translate to the individual submarkets and long-term developments in supply and demand. In this research, the space- and investment market (quadrant 1 and 2) are expected to influence area development (quadrant 3), whereas the outcome of area development affects the number of houses provided (quadrant 4) and so on the space market (quadrant 1). The four-quadrant model of DiPasquale & Wheaton (1992) and the *tightly coupled system* of Buitelaar et al. (2013) form the starting point of this research. Within this market, several factors are contributing to and affecting the (proper) functioning of the real estate housing market. Spatial planning policies initiated by the government have a significant effect on the level of housing prices (Glaeser, Gyourko & Saks 2005; Besseling et al. 2008), as well as on the volatility (Hilber & Vermeulen 2010) as will be further explained in the following paragraphs. These restrictions mostly arise within the construction- and development market and the investment market (quadrant 2 and 3). The main focus of this research is to analyse the effect of planning restrictions upon housing production and the rental prices in the private rented sector in the Netherlands. The functioning of the private rented sector in the Netherlands is further elaborated in chapter 3.

2.1.2. Scale levels for modelling the supply

In order to model the housing supply, it is important to analyse the different (geographical) scales in which research about the property market can be conducted. A distinction can be made between supply models at macro, meso and micro level. There are several studies which have researched the housing supply on a macro-and meso-level (Glaeser et al., 2005; Hilber & Vermeulen, 2016; Oztürk et al., 2018). However, research about the housing supply on micro-level is scarce (Bramley, 2013). The starting point of this study depends very much on the chosen scale level. The scale levels and relevant aspects are discussed in the following section.

Macro-level

Macro-level studies focus on housing production or housing prices at (inter-)national level. With the use of statistical models and aggregated data, the average housing price or the construction of new housing on a national level can be determined. Alterations in factors, such as average income, interest rates, inflation and demographic features (e.g. total population growth) are included within these models because macro variables are empirically relevant to predicting the time-series movement of rental housing prices (Lin & Wachter, 2019). In macro-level studies, time series analyses are often applied to examine trends in variables and demand cycles over a longer period (Bramley, 2013). The goal of research about the housing market on a macro-level is often related to measuring the price elasticity of housing supply. The price elasticity of supply measures the extent to which housing production reacts on an alteration in housing prices (De Vries & Boelhouwer, 2004). In a market where supply elasticity is high, housing providers respond to a demand shock by adjusting the supply. In a perfectly functioning market, the housing supply would be perfectly elastic. When supply is inelastic, a change in demand leads to a change in price, not to a changing supply. Glaeser Gyourko and Saiz (2008) argue that housing supply is relatively inelastic. In places where housing supply is inelastic (i.e. places with tight regulation), housing prices are expected to increase more during boom phases. Housing bubbles are also more common and last longer in places where supply is inelastic. Inelastic markets will have bigger price swings in response to a housing bubble, but the welfare losses will be smaller since there is less of a construction and mobility response (Glaeser et al., 2008).

According to De Vries & Boelhouwer (2004), the supply of new housing on a short term (six to eight months) is always inelastic, due to the long construction time of new dwellings. The supply does not react on a changing price; the same number of dwellings is produced at a certain price level, which means that the new-build sector has hardly any direct influence on the housing price (De Vries &

Boelhouwer, 2004). According to Vermeulen (2008), housing supply in the Netherlands at the short- to medium run is almost fully inelastic, which does not necessarily point to a distorting impact of land use regulation. On the long term, an increase in price is followed by a proportional increase in production, making it elastic. Glaeser & Gyourko (2003) argue that physical dwellings can be offered almost perfectly elastic; the inelasticity of housing supply is merely a result of the land component of housing. The availability of land is inelastically supplied, limiting the supply of new housing. In the Dutch housing market, the price elasticity of the housing supply is low which is partially related to the relatively high population density: the price elasticity is generally lower in major cities compared to the rest of the country (Green, Malpezzi & Mayo, 2005; Caldera & Johansson, 2013; Michielsen et al., 2017). Also, the supply is more rigid in cities with a higher population density. The relation between population density and housing growth occurs mainly because high-density places have less land available for continual growth (Levine, 1999). In the literature, a low supply elasticity is often linked to geographical supply constraints or a rigid planning system (Saiz, 2010; Nijskens, Lohuis, Hilbers & Heeringa, 2019, p.141). According to Green et al. (2005), supply elasticity is determined by population levels, population alterations, density, house price levels and the regulatory climate.

The results of research on macro-level housing supply are related to the price elasticity of houses (Bramley, 2013). With the outcome, assumptions can be made about the national trends of changing housing prices. At an international level, different countries can be compared using macro analysis (see, for example, Ball, Meen, & Nygaard, 2010). The various supply elasticities provide a valuable answer in analysing the different housing markets of countries. In addition to analysis on a macro-level, analysis at lower scales are also relevant. In contrast to macro-level analysis, these lower scale levels also take regional and/or individual characteristics into account. The housing supply and prices can vary significantly by region, being influenced by some regional structural aspects as is discussed in the next section.

Meso-level

The second scale on which the housing supply can be analysed is the meso-level. At the meso-level, differences in regions are explicitly included in the model. This insertion is relevant because there is no national, homogeneous functioning housing market in the Netherlands; instead, there are differences within housing regions (De Vries & Boelhouwer, 2004). Regional conditions, such as population density, amount of available land, the structure of the existing housing stock and the size and development of the labour market are not evenly spread across the country. Differences in regional conditions can affect the number of houses being built in an area and are difficult to process in the outcomes of macro models (Ball et al., 2010). Mayer & Somerville (2000a) used quarterly data over 12 years to analyse the relationship between planning restrictions and housing production in 44 metropolitan regions in the US. They report that cities with more restrictive planning policies have lower housing production. Regulations have a significant influence on the supply of new-build houses. There is a continuous lack of houses, without a lack of space. In the UK, planning restrictions also have a positive influence on increasing housing prices (Bramley & Leishman, 2005; Hilber & Vermeulen, 2010; 2016). By testing regional differences in a model on a meso-level, estimations can be made about to what extent the housing production is affected by additional variables on a regional scale. In the Netherlands, these estimates can be applied at most spatial scales, such as municipality, COROP, province or housing market region level. Because planning restrictions are mostly applied locally, a local level of analyses, combined with cyclical economic influences emanating from national and regional economic conditions, is the best way of observing the effects (Leishman & Bramley, 2005). Most relevant and conceptually attractive is the municipal level because most spatial policies are made at this level, while provinces have a more coordinating role (Michielsen et al., 2017).

Micro-level

Research about housing prices and housing production has not been examined much on a micro-level. There is often no (validated) data available for conducting research on a micro-level. On macro- and meso-level research calculations are made upon the average housing prices, which is strongly dependent of economic factors. Individual plan or housing characteristics are not used in research on these scales, while the importance of these characteristics is high; individual characteristics can influence the housing prices in a certain region (Ball et al., 2010). More research about the influence of

individual characteristics on housing (rental) prices is, therefore, arguable. However, there has been some research done about the housing market on a micro-level. Glaeser & Ward (2009) have researched the influence of planning restrictions on the growth of Boston. More development occurs in areas with a higher density. Also, an increase in lot sizes and planning restrictions lead to higher housing prices, because the new-build housing production is opposed. These supply restrictions are not related to a lack of available building land; rather, development postponements are a consequence of institutional policies (Glaeser & Ward, 2009). Maric, Quercia and Simons (1998) have researched the effect of availability of new housing production in the neighbourhood on the sale price of nearby properties. The availability of new housing production in the surroundings of a dwelling has a positive influence on the value of that dwelling. New-build housing production contributes to a higher attractiveness of the environment of a neighbourhood.

This research focuses on the plan capacity, housing production and rental housing prices in the private rented sector on a municipal level. The municipal level is part of the meso-level; regional differences are analysed to gather knowledge about the phenomena. Analysis of individual plans within municipalities are not addressed within this research.

2.2. Planning restrictions

The previous chapter argued that a free, balanced market within the property market never exists. Spatial planning has an impact on how the property market functions and has the ability to improve or aggravate this market by the use of restrictions. Only a few empirical papers have explored the impact of supply restrictions, particularly regulation, on the dynamics of the housing markets (Paciorek, 2013). One of the central problems within empirical research has been about how to actually measure planning restrictions (Bramley & Leishman, 2005). Bramley (1998) reviews a range of objective and subjective measures and considers their plausible interrelationships and establishes some drawbacks of interpretation. In the short term, the impact of planning on the housing market may be expected to be limited. Disentangling the price (or other effects of planning) on the housing market is therefore extremely difficult (Gurran & Bramley, 2017).

The national, provincial or local government can initiate restrictive policies which can limit the supply of housing by making less land available for housing. In the literature, a discussion has going on about the influence of planning restrictions, initiated by the government, on the price of existing dwellings. Planning restrictions can create scarcity, which could lead to a value increase of properties. Scarcity of available building plots could also lead to a price increase per plot. According to the four-quadrant model (DiPasquale & Wheaton, 1992), the market should react to these unexpected price increases by adding new supply to the existing stock. Market imperfections can be one of the reasons for the government to interfere. Planning interventions which could cause restrictions are divers; the influence of national- and local governments, population density, the amount of public space available and the supply of new houses. The supply of new dwellings depends on the number of established plans which on a local- and project level. Besides this, the supply depends on the production capacity in the property market. Spatial procedures, and therefrom deriving objection procedures, is a variable to measure as restrictions. Building height restrictions also relate to the number of new-build houses permitted on a specific plot of land; the higher a developer is allowed to build, the more houses can be developed.

The relation between government interferences, the spatial planning system, and the effect on the housing prices and housing supply has been studied before. Many studies have already pointed out the price-driving effect of astringent spatial planning system related to the housing market, both nationally (Vermeulen & Rouwendal 2007; Besseling et al., 2008) and internationally (Glaeser et al., 2005; Hilber & Vermeulen, 2010; 2016). Regulatory restrictions have become more binding in the last few decades and have been affecting the housing prices even more strongly (Glaeser et al., 2005; Glaeser & Ward, 2009; Hilber & Vermeulen, 2016). The way in which planning restrictions take shape in spatial planning policies differs between country, region and municipality. For example, research by Gyourko, Saiz, & Summers (2008) shows that certain areas in the USA have a different degree of restrictiveness.

This paragraph makes a distinction between two different kinds of supply restrictions based on government interference. First, regulatory restrictions which have an impact on the flexibility and feasibility of a plot of land. Restrictions on land use can have an effect on the number and size of houses

which can be built. Second, physical supply restrictions have an impact on the availability of land. A distinction is made between restrictions on the total number of land available for housing developments and restrictions on the usage of land. These restrictions have an impact on the supply of new-build housing production, as is discussed in the third section. Finally, the impact of these restrictions upon housing production also has an effect on housing prices, which is an important part of this research. The latter relationship will be discussed in the last paragraph.

2.2.1. Regulatory supply restrictions

Land-use planning is perhaps the most essential form of regulatory intervention in the housing market (Bramley, 1993; Leishman & Bramley, 2005). Planning- and land-use policies intend to reduce negative externalities associated with new housing construction (Cheshire & Sheppard, 2002). The intention of land use zoning (or land use plans) is to separate incompatible land uses, instead of restricting the amount of developable land (Gurran & Bramley, 2017). Poorly designed policies could restrict the responsiveness of supply, e.g. in countries where it takes longer to acquire a building permit. Besides the regulations on land-use, the provision of infrastructure and other public services supplementary to housing, such as water drainage and road junctions, is also likely to influence (the velocity of new) supply. Besides this, the degree of competition within the residential construction industry is also affecting housing supply (Caldera & Johansson, 2013).

Different studies have shown that regulation reduces the supply of residential land and the number of available dwellings (Glaeser & Gyourko, 2003; Glaeser et al., 2005). Planning restrictions are initiated, so that building on a plot of land without permission is being impeded. Besides this, these restrictions also concentrate on the authorized function of a plot of land. Houses can only be built on plots specifically determined for a housing function. These limitations result in a lower number of dwellings realized than in an unregulated market situation. By limiting the supply of available land for residential developments, housing prices increase, because less supply is available for the same demand. Moreover, the government tries to influence land-use restrictions by discouraging segregation from happening. The idea behind this is that a mixed distribution of population groups has a favourable effect on social prosperity. This distribution mainly aims at interventions in the rental property market. However, it is not known, whether the distribution of population groups is indeed leading to higher prosperity, because it has both advantages and disadvantages (Donders, van Dijk & Romijn, 2010).

Research about the impact of land-use regulation on housing prices has mainly focused on cities in the US, concluding that land-use regulation reduces the housing supply price elasticity, whilst raising price levels (Glaeser & Gyourko, 2003; Quighley & Raphael, 2005). Hilber and Robert-Nicoud (2013) explain that more developed places in the US tend to be more regulated. Mayer and Somerville (2000a) report that the elasticity of building permit supply may be up to 20 per cent lower in regulated cities. This effect is mainly the result of delays in receiving approval for the changed land-use plan. More desirable locations are more developed, resulting in land-use constraints which benefit owners of developed land (via increasing property prices) but hurting owners of undeveloped land (via rising development costs). As a consequence of these political economy forces, more developed places will be more regulated. Recently, studies outside the US have been concentrating on this relation in the UK and the Netherlands (Hilber & Vermeulen, 2016; Nijskens et al., 2019).

However, there are also some benefits of planning regulations. Regulation of land use can be used as a method for providing valued public goods (improving neighbourhood quality) and amenities (urban open space) by approbation, rather than through taxes and public sector production (Cheshire & Sheppard, 2002). Provision of free space that is publicly accessible reduces inequality, while free space that is inaccessible for the public increases inequality. Cheshire & Sheppard (2002) overall conclusion is that the benefits produced by the planning system favour those who are already favoured with higher incomes. Regulation of building types on land can serve to limit the loss from property taxation.

The cost of land use planning can be calculated in the form of increased land- and housing costs from restrictions upon the availability of developable land (Cheshire & Sheppard, 1997). According to Hilber & Vermeulen (2010) regulatory restrictiveness can be directly measured in two ways: 1) Based on an index about regulatory decisions (Saks, 2008; Saiz, 2010) or, 2) based on measuring the gap between housing prices and marginal construction costs, also known as the regulatory tax (Glaeser et al., 2005).

Glaeser et al. (2005) have calculated the regulatory tax on housing prices for US metropolitan areas. The part of the housing price that exceeds construction costs is attributed to restrictiveness, especially from a spatial planning perspective. Cheshire & Hilber (2008) have done the same by calculating the regulatory tax in the office market in the UK. The difference in value is due to the change in the use of the land. The restrictions are creating an implicit tax on the supply of residential land. The implicit tax causes spatial planning to be accounted for an increased price in residential land, and the resultant constructed dwellings (Besseling et al., 2008).

2.2.2. Physical supply restrictions

The government implements its spatial planning policy based upon agglomeration advantages and disadvantages that can occur with the growth of cities. The goal of the spatial planning system is to reach a size for cities which is beneficial for social prosperity. The government also wants to provide and prevent sufficient public space and nature with its spatial planning policies (Donders et al., 2010). According to Hilber & Vermeulen (2016) and Saiz (2010), geographical restrictions are constraining the elasticity of housing supply. Housing supply inelasticity occurs directly, by reducing the amount of available land, and indirectly, through increased land values and higher incentives by antigrowth regulations. Studies in the US show that higher housing prices in some cities occur by a cause of national demographic growth and increased urbanization (Saiz, 2010). Paciorek (2013) has shown that geographical restrictions on land availability increase housing costs substantially and lower the average construction.

The literature broadly suggests two types of physical supply constraint measures (Hilber & Vermeulen, 2010). The first measure is the share developed land – the share of all developable land that is already developed. The second measure, ruggedness and steep slopes, are also expected to limit new residential development (Saiz, 2010). According to Saiz (2010), the presence of geographical construction restrictions (such as water areas or steep slopes) leads not only to a higher price level but also to a lower supply elasticity in response to occurring demand shocks. In cities with geographical limitations, the number of locations where due to a price increase construction can take place cost-efficiently is smaller, than in cities without geographical limitations (Saiz, 2010). Saiz (2010) developed a measure to estimate physical supply constrains in the US by making use of elevation in the landscape. Elevation levels in the Netherlands are deficient and similar, meaning that this measure is not suitable for this study. Instead, the measure applied by Hilber & Vermeulen (2016) is used, in which the amount of already developed land is related to the total available developable land.

Furthermore, the capacity within the construction sector can be seen as physical supply restrictions. The shortage of staff, materials, production and space, are considered as construction capacity. Due to the financial crisis in 2007-2008, many employees have had to leave the construction industry, sometimes temporarily, but often permanently. The construction sector is struggling with many vacancies, sharply rising construction costs and bankruptcies of construction companies (due to this rise in construction costs). Partly because construction workers have had to turn their backs on this sector permanently, the number of vacancies is substantial and rising (Buitelaar, 2019). These developments in the construction sector in the Netherlands are also expected to have an impact on housing production and prices. Research by Topel & Rosen (1988) has shown that hourly wage rates and employment of construction labour closely follow house prices and new construction. A strong increase in demand for labour and building materials leads to an increase in building costs. New-build construction has only slowly recovered since the crisis due to capacity restrictions. Both municipalities and builders reduced their capacity after the onset of the crisis. Since 2010, nearly 80.000 jobs have lost, leading to a shortage of construction workers (Nijskens & Lohuis, 2019).

Both physical and regulatory supply constraints are highly correlated in practice (Saiz, 2010). In cities that lack of buildable, residential land, urbanization leads to price increases. In de Randstad this is also the case where much of the land surface is already built up. Here is the expansion of larger cities impeded due to the location near the coast or green belt, which is protected by nationally determined zoning restrictions (Nijskens & Lohuis, 2019). Policies related to nature protection, and especially nature conservation areas, can cause more zoning restrictions, resulting in less building land suitable for construction (Hekwolter, Nijskens & Heeringa, 2017).

2.2.3. Effect on supply

Planning is only one of many factors influencing the new-build housing production (Gurran & Bramley, 2017). Planning policies can be both a supply and a demand indicator since the local government at a municipality can influence the availability of developable land directly as well as indirectly influence the demand for that land (e.g. through land-use planning decisions which increase or decrease the number of units that can be built) (Levine, 1999). Planning can be seen as a constraint on the available amount of land being provided for housing production. The application of certain restrictions can cause delays and can exclude development from happening. Any certain level of demand, increases the prices of houses, both new and second-hand, given their interconnected markets (Bramley, 2013). It is the availability of land which is restricted, and as a result, the land value rises most, rather than the construction costs. Land is an indispensable material for the production of new houses, but through zoning, land-use plans are limiting the amount of land being available for residential construction (Vermeulen, 2008). When available land for housing becomes rarer, the competition between housebuilders will increase, bidding up the prices and decreasing possible expected profit. In order to have a positive margin, developers will try to compress more houses on a building plot, raising housing densities and heights (Bramley, 2013).

Planning has, through its land allocation functions and development control, a direct effect on the supply of opportunities for housing development. Indirectly, planning may also influence supply through local economies, local amenities and transport infrastructure (Gurran & Bramley, 2017). The allocation of housing sites (through land-use plans) and controlling the design and density of new housing, affect both the quantity and cost of new housing production (Gurran & Bramley, 2017). However, it is difficult to determine the relative impact of these functions because many other factors (e.g. land acquisition, materials, marketing and selling costs, compliance fees, etc.) influence the housing production.

Planning regulations are generally accepted as the most efficient mechanism for managing the problem of externalities and public goods (Needham, 2006; Gurran & Bramley, 2017). One of the most direct ways in which planning can influence the housing market is by altering the costs of housing production (Gurran & Bramley, 2017). Housing production is only one single factor determining housing prices. The extent to which these costs are passed to house buyers depends on market conditions at the time of sale. Regulatory requirements can be factored into land acquisition and effectively passed back to land sellers if costs are known in advance (Gurran & Bramley, 2017). Furthermore, the planning system is associated with the need to exhibit or refer a proposal to specific (authorized) groups. The need to decide within elected authorities can cause delays for new housing supply. A long decision process also contributes to the costs of the development process, although these costs can, in theory, be passed back to the landowner. According to Paciorek (2013), delays are caused by cost-shifting regulations imposed by local governments like the amount of time for preparation and acquisition of a building permit, density restrictions and open space requirements.

Restrictions on the availability of land for residential development can constrain the responsiveness of supply. Slow administrative procedures, strict zoning rules and devious building locations can restrict the amount of developable land (Girouard et al., 2006). Also declines in the average size of households, high rates of net migration and increases in population cohorts of individuals in their thirties will boost housing demand. In several countries, including the Netherlands, the high shares of such households have been associated with significant increases in real housing prices (Girouard, Kennedy, van den Noord & André, 2006).

Delays may also be an essential component of regulation regarding the elasticity of supply. The last few decades, the interest in how local land-use regulation might influence the elasticity of housing supply has grown. The increased attention is at least partly due to a suspicion that the local residential land-use regulatory environment has grown stricter and has become more binding over time, particularly in areas facing strong demand for entry (Gyourko & Molloy, 2015). According to Paciorek (2013), supply restrictions increase price volatility in two ways: First, regulation lowers the elasticity of new housing supply by increasing delays in the building permit process, which indirectly adds to the cost of supplying new dwellings on a margin (costs that rise with each additional house being built in a given year). This can be the result of a variety of types of regulation, for example, minimum lot size requirements, actions of homeowners' associations or annual limits on building permits. Second, less investment on average

occurs due to geographic limitations (such as steep slopes and water bodies) on the available area for housing construction. Thus, these restrictions appear to reduce the responsiveness of housing supply to demand shocks (Paciorek, 2013), as well as influence the size of metropolitan areas and the type of constructions which are being built (Gyourko & Molloy, 2015).

It is important to note that, irrespective of any restrictions imposed by urban planning regulation, there will always be inherent restrictions in the supply of new houses, because of the unique nature of housing – particularly the qualities of spatial fixity and durability (Gurran & Bramley, 2017). Houses are needed in and tied to a particular place. Dwellings take time to construct, which can last a long time, so that adjustments in the quantity and distribution of the housing stock in response to population changes, occur slowly. However, if regulatory systems infuriate these inherent restrictions, through overly restrictive development controls or because of slow, uncertain or expensive decision processes, the number of new houses will be reduced, leading to consequential price effects (Gurran & Bramley, 2017).

2.2.4. Effect on (rental) housing prices

According to Chiu, Liu and Renaud (2019), there are three main views on the relationship between residential land supply and housing prices. First, land-use restrictions limit the amount of land available for residential housing construction, creating scarcity and forcing residential land prices to rise, which in turn results in a decline in the supply of new housing (Quigley & Raphael, 2005; Glaeser & Ward, 2009) and a rise of housing prices (Glaeser et al., 2005; Glaeser et al., 2008). Second, land-use restrictions raise both residential land prices and housing prices. And third, land supply restrictions can cause higher housing prices from the capitalization of higher expected rents, which encourages capital-land substitution in housing production (Peng & Wheaton, 1994).

However, an essential question in the literature about the supply of housing is whether new-build housing is determined by the level of housing prices or by alterations in them (Ball et al., 2010). Empirical evidence about the price responsiveness of new housing supply is scarce, which is primarily because of measurement issues (DiPasquale, 1999; Vermeulen & Rouwendal, 2007). Housing supply emerges through various channels, such as new construction or alterations in the existing stock. Also, the housing quality, location and investments in the existing stock are important aspects. One of the early works about modelling the housing market estimated that the price of housing is a major determinant of new construction (Poterba, 1984). According to Mayer & Somerville (2000a), an increase in house prices leads to a rise in the stock of housing, accomplished by a temporary (rather than a permanent) increase in new construction, ignoring the replacement of units withdrawn from the stock. A 10% rise in real house prices leads to an 0,8% increase in housing stock in the USA (Mayer & Somerville, 2000a). Research in the Netherlands has shown a different perspective for the short and medium-long term. Swank, Kakes, & Tieman. (2003) estimate, based on time series analysis, the (medium) long-term price elasticity of the supply of new houses for the Netherlands at 0.3: if the price of houses rises by one per cent, the volume of new houses will increase in the medium long-term by 3 per cent. In the short term, supply elasticity is assumed to be zero. This implies that no new houses will be built in the short term in response to a house price increase. In the medium and long term, however, the housing supply will increase, albeit only marginally. Vermeulen and Rouwendal (2007) have also researched the relationship between housing supply and prices in multiple European countries. Their results show that the housing supply is almost entirely inelastic in at least the short to medium-long term. New-construction in the owner-occupied housing segment rises with 0,04% after a 1% price increase in the same year.

Examples of the effect of supply and housing prices have been shown in several studies. Poterba (1984) finds in his empirical research that real housing prices (excluding land) are the primary factor influencing housing investment (that is housing construction). Credit rationing, or the availability of investment capital, has significantly proved to be an essential factor influencing new construction of supply. According to Topel and Rosen (1988), time-to-sale has a substantial effect on new development. They find in their estimates that an additional month of sales delay reduces investment by 30 per cent. Their main empirical findings are that investment responds elastically to changes in asset prices (Topel & Rosen, 1988). Poterba (1984) and Topel and Rosen (1988) estimate the price elasticity of housing investment and not the price elasticity of the housing stock. These elasticities may differ primarily, but a stock-adjustment framework by DiPasquale & Wheaton (1992) has shown that they are equal in

equilibrium (Vermeulen, 2008). One important aspect ignored in earlier studies of housing supply and housing prices (Poterba 1984; Topel and Rosen, 1988; Blackley, 1999) is the relationship with land-use (Vermeulen, 2008).

Planning shows some responsiveness to higher housing prices, whereby rising prices slightly result in more land release, which is mainly the result of developers applying for more permissions (Bramley, 1993). However, the supply of planning permissions is not strongly explained by planning policies, which enforces the idea that the planning system suffers from an implementation gap (Bramley, 1993). Cheshire and Sheppard (1997) conclude that planning controls in the UK tends to increase housing prices moderately, but its main welfare impact occurs by increasing density. The housing price volatility depends on both the elasticity of new housing supply as well as the level of new supply relative to the size of the existing stock, which is partly determined by the quantity of the availability of land for development (Paciorek, 2013). Paciorek (2013) finds that an increase in regulation by one standard deviation is associated with approximately 30% increase in price volatility across cities in the US.

The growing wedge between housing prices and construction costs illustrates that the price of land has been moving upward over time (Gyourko & Molloy, 2015). Gyourko & Molloy (2015) finds that regulation appears to raise house prices, reduce construction, reduce the elasticity of housing supply, and alter urban form. However, according to several papers, differences in construction and house price levels across metropolitan areas in the USA, are the result of differences in regulation and community opposition towards new construction, rather than higher building costs or shortages of land (Mayer & Sommerville, 2000b; Glaeser et al., 2005; Quigley and Raphael, 2005).

In the future, planning restrictions may even become more binding during upswings, especially in highly urbanized areas where housing prices may even rise more dramatically (Hilber & Robert-Nicoud, 2013; Hilber & Vermeulen, 2016).

2.3. Plan capacity

In this study, the degree of supply restrictions per municipality is determined based on the plan capacity available in a municipality. The available plan capacity is a very accurate indicator for measuring the influence of planning policies (Bramley & Watkins, 2014). The government regulates the supply by restrictions so that there is more certainty about the new-build offer for the coming period. The new-build housing production can be seen as an indicator for the current economic situation (demand and supply). Plan capacity is considered suitable to reduce the impact of restrictions from the spatial policy on construction speed. The plan capacity can be considered as the amount of land that has been made (physically) available or is reserved for (future) residential construction. Dwellings which are already realized are not falling under plan capacity. This paragraph discusses the essence of this concept and which subdivisions of plan capacity are being used.

The spatial planning system is often designated as the cause of a housing supply shortage of new-build locations because not enough housing locations would be made available. The plan capacity is an indicator of the number of housing locations available in the future. To increase the plan capacity of municipalities, more housing locations should be assigned. Every municipality has made locations available where new houses are allowed to be built. This may involve sites where construction is already taking place, but also locations where development is reserved for the future. Whether or not the construction can take place depends on the legal status assigned to the building plot. Building permits (officially known as an environmental permit in the Netherlands) cannot be granted for plans which have not been accepted by the municipal council of a certain municipality. For locations where a land-use plan has been established, a building permit can be granted.

Within plan capacity, there can be made a distinction between gross- and net plan capacity. Gross plan capacity is the number of new-built houses that are planned for current and future reserved locations. Net plan capacity is the number of dwellings added or subtracted (e.g. demolished) from the total housing stock (Scheele-Goedhart & Van der Reijden, 2008). Besides this, the plan capacity consists of ‘hard’ and ‘soft’ plans, which is a legal differentiation and depends on the juridical phase of the plan. The hard plan capacity is the number of dwellings that may be built according to the established land-use plan, but which have not been realized yet. The soft plan capacity consists of plans that have not yet

been formalized into a land-use plan, but where the location is possibly included in a regional, structural or environmental plan (Michielsen, Groot & Veenstra, 2019). Soft plans could also occur when contractual or financial agreements have been made with companies and/or developers. The distinction between the different types of plan capacity is relevant because the estimated time required for procedures to arrive at legally available plan capacity is considerably longer with soft plan capacity than with hard plan capacity.

Hard plan capacity relates to the extent to which plan capacity is directly executable, i.e. whether the building permit can be granted. Hard plan capacity can, therefore, lead to the delivery of new houses more quickly and has a greater chance of actually being used for residential construction, while soft plans still have to go through the land-use plan procedure. The duration of this procedure depends on the characteristics of the plan. Factors like the type of location inner-city or greenfield location and age of the plan have a possible influence on the land-use plan procedure (Ball, 2011; Leeuwerik, 2018).

The different juridical phases, the indication of duration until legally available plan capacity and the actual practicability are shown in table 2.1. The EC (Executive Council, Dutch: Gedeputeerde Staten) is legally approving the plan capacity in status 1A and 1B.

<table>
<tr><th>Juridical status in the Dutch spatial planning law (WRO)</th><th>Duration</th><th>Practicability</th></tr>
<tr><td>1A: Legally available plan capacity; approved by EC and irrevocable;
1B: Legally available plan capacity; approved by EC and irrevocable sub-plan to be worked out</td><td></td><td rowspan="3">Hard</td></tr>
<tr><td>2: Approved plan capacity by EC, but not yet irrevocable (appeal is still possible)</td><td>3 - 14 months</td></tr>
<tr><td>3: Established; plan capacity determined by the city council</td><td>7 - 24 months</td></tr>
<tr><td>4: In preparation</td><td>22 - 48 months</td><td rowspan="2">Soft</td></tr>
<tr><td>5: Potential plan capacity; according to current insights, may be available for residential construction in the future</td><td>48 > months</td></tr>
</table>

Table 2.1: Juridical categories of plan capacity with indication of status and duration (Scheele-Goedhart & Van der Reijden, 2008).

This research examines the distinction between hard and soft plan capacity only by looking at the legal planning status of plans. Contract agreements between municipalities and developers as well as the availability of residential buildings plans in existing structural plans or environmental plans, are disregarded. This research uses the hard plan capacity as the indicator to measure the ‘implementation gap’ (Bramley, 1993) between juridical available construction possibilities and the actual new construction being made. The hard plan capacity refers to the number of dwellings where the construction is juridically possible, whereas the actual new-build production represents the actual realization.

The total hard plan capacity will be examined to analyse the effect of the implementation gap (Bramley, 1993) between actually realized dwellings and the number of houses possible regarding their juridical status, i.e. the spare capacity that has not been used yet. The hard plan capacity is analysed based on the assumption that a shorter legal procedure and, therefore, a higher chance of possible development, has a greater influence on the number of constructed dwellings. Measuring the effect of plan capacity on housing production, and the effect of housing production on rental prices in the private rented is the primary goal of this research. It is assumed that in certain municipalities with a higher plan capacity and a higher housing production deriving from this capacity, that a higher rental price development has occurred in the last decade.

2.4. Conceptual model

The theoretical definitions and concepts explored in this chapter are operationalized into a conceptual model, as is shown in figure 2.3. The influence of the concept of planning restrictions on the plan capacity available in municipalities and the housing production deriving from this is reflected in this model. It is assumed that housing production is influenced by the plan capacity within the Dutch market. The relationship between the variables of actual housing production and the rental prices in the private rented sector in the Netherlands has been reflected in the model. Rental prices in the private rented sector are assumed to be indirectly affected by the plan capacity made available by municipalities.

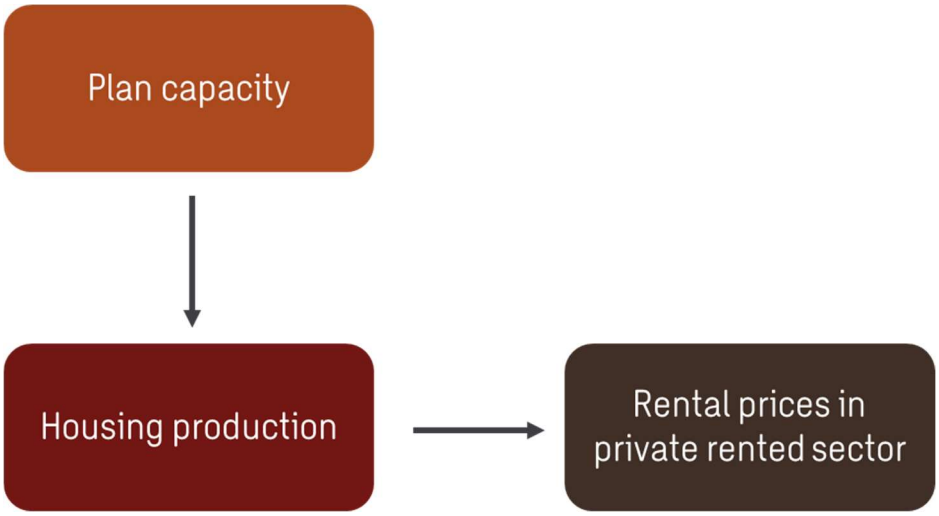

Figure 2.3: Conceptual framework (own creation, 2020)

3. The Dutch rental housing market

The Dutch housing market currently functions in an inefficient and insufficient way, in which the previously mentioned market equilibrium (see, paragraph 2.1.1.), has not been endowed. In an appropriate functioning housing market, the four-quadrant model by DiPasquale & Wheaton (1992) would succeed, resulting in demand and supply (nearly) in balance. However, the Dutch housing market shows a different perspective; demand exceeds supply, production is delayed and falling behind, and market housing prices accelerate. The Dutch housing market is divided into a market for owner-occupied houses and a market for rental houses. This research is focused on the private rented sector. Paragraph 3.1. discusses the characterisations of the Dutch rental housing market. In paragraph 3.2. the developments in the Dutch rental market will be explored. For this research, it is essential to understand the way the Dutch rental housing market is regulated, is operating and has been evolving over the last decades. The (recent) developments in the different segments of the housing market have had an impact on the (spare) plan capacity, housing production and rising rental prices in the private rented sector in the Netherlands.

3.1. Classification of the Dutch rental market

The Dutch rental housing market is divided into two segments: the social sector and the private rental sector. The Dutch rental housing market can be classified in three ways: by legal classification, property classification and economic classification. These classifications will be discussed below.

Legal classification

The Dutch rental housing market is characterized as a market with the largest social sector in Europe (e.g. Pittini et al., 2017). The definition of social rental housing differs per country, but in the Netherlands, two main issues need to be considered when looking at social housing: ownership and rent regulation (Schilder & Scherpenisse, 2018). Social rent applies to rental properties with a maximum rent of €737,14 (Ministry of General Affairs, 2019). For social rent, rent-regulating provisions apply such as a maximum rental price and rent allowance. Rental houses in the private rented sector are houses with a minimum rental price of € 737,14 per month. In the Netherlands, this financial boundary is called 'liberalisatiegrens' and has the function to provide enough affordable houses within the regulated housing market. There are no rent-regulating provisions and no subsidies for the private rented sector.

Government interventions in the Dutch rental housing market consist of three elements. First, the government influences rents directly by limiting the rent of most rental houses to a maximum through rent regulation. The government sets the maximum reasonable rent for rental properties in the regulated segment of the market and also determines the maximum annual rent increase for these properties. Due to this rental price regulation, the Dutch rental housing market no longer functions as a regular market (Renes & Jókövi, 2008). Second, the government influences housing rents by imposing a statutory task for housing associations in which they are obligated to focus mainly on the quality and affordability of housing for low-income households. The housing associations can fulfil this task partly because of assets built up with public money, and the implicit and explicit subsidies and banking guarantees from which they can benefit. Thirdly, the government provides a housing allowance for low-income households for whom rents are being too high in relation to their income. This allowance, which has replaced the former individual rental subsidy in 2006, is paid by tax authorities (Donders et al., 2010). Reasons for the government to intervene in the rental property market are diverse (as has been discussed in paragraph 2.2). An important argument for intervening is to keep housing affordable.

The maximum rental price for rental properties in the Netherlands is set in the 'woningwaarderingsstelsel' (WWS) or residential valuation system. This system ensures that rental prices cannot be excessively high in areas where (too) few (rental) houses are available or being built. Independent rental properties in the Netherlands receive points according to this residential valuation system. These points are calculated based upon several aspects which the dwelling/building contains, i.e. size (m²), number of heated spaces, kitchen condition, number of toilets, the WOZ value etc. The number of points of a rented dwelling determines the maximum rent of the house. The more points, the higher the rent may be (Ministry of the Interior and Kingdom Relations, 2020). An independent rental

property with 144 'WWS-points' is per 1 July 2019 legally – regardless of the ownership situation – assigned as a regulated rental property. Dwellings consisting of 145 or more WWS-points fall under the non-regulated rental property (private rented sector). The residential valuation system in the Netherlands does only apply for rental properties in the social sector and not in the private rented sector. According to CBS (2019), 2,3 million dwellings are defined as the regulated segment; 30 per cent of all rental houses.

Economic classification

The economic classification of the Dutch rental housing market is related to the rental price and affordability of rental houses. In the literature, a distinction is being made between 'low', 'middle' and 'high' segment (rental) dwellings. The term middle-segment is an important phenomenon in the literature because it is supposed to be a missing submarket in the Dutch housing market. Jonker-Verkaart & Wassenberg (2015) show in their research, by a comparison between the supply curve and the national income distribution, and compared to the number of Dutch middle incomes, that there is a relatively low stock of medium-priced houses available in the Netherlands. Although owner-occupied and rental dwellings have been taken together in their research, it shows that there is a limited middle housing segment in the Netherlands. Within the rental housing market, rental price increases in new rental contracts are considered a threat for the middle segment. The lack of liberalized rental homes is problematic for the functioning of the housing market: it reduces residential mobility, creates suboptimal outcomes and affects labour mobility (Rabobank, 2019).

In the literature is much debate about the definition for 'middle-segment'. According to Jonker-Verkaart & Wassenberg (2015), the middle-segment are rental houses with a rental price between €710,68 (liberalisatiegrens at the time) and €1000 a month. ABF Research (2019b) also considers the middle segment as rental prices between the 'liberalisatiegrens' and €1000. PBL (2017) indicates all rental properties with a rental price of €710,68 or more as middle-segment. Also, private rental dwellings with a rental price below the 'liberalisatiegrens' can, under certain circumstances, be seen as middle-segment (Vlak, van Middelkoop, Schilder & Eskinasi, 2017). This research defines the middle-segment as rental dwellings between the current 'liberalisatiegrens' €737,14 and €1000. What should be noted is that regional differences are causing this middle-segment to grow in more dense and popular places. In Amsterdam, the middle-segment can be seen as rental prices between €737,14 and €1200.

Property ownership classification

The total Dutch housing stock in 2018 consisted of almost 8 million houses, in which the owner-occupied market represented 57 per cent while the rental housing market represented 42 per cent of the housing market (CBS, 2019)[2]. The majority of these rental properties, 69 per cent, were in possession of housing associations. The other 31 per cent of the rental properties were owned by other landlords: companies, institutional investors and private landlords (47 per cent) (CBS, 2019). In 2018, 7 per cent of the total housing market were dwellings in the private rented sector (Rabobank, 2019). The ownership in the owner-occupied housing sector is held by private owners, who, in most cases, are inhabiting the dwellings themselves. The social rental sector is defined as all houses of housing associations - or 'authorized institutions' - within the regulated housing segment. Housing associations may also possess dwellings within the private rented sector under the circumstances, initiated by the Housing Act.

The 2015 Housing Act (Woningwet 2015)[3] provides rules regarding the main focus area of housing associations, creating better supervision and a more prominent role for municipalities and tenant organizations. Housing associations must allocate at least 80 per cent of the released social rental housing (with a rent of up to €737,14) to their target groups: households with an income below €39,055 (price level of 2020). In addition, housing associations are allowed to allocate 10 per cent of the vacant houses to households with an income between €39,055 and €43,574 (price level 2020) until 2021. Housing associations are free to allocate the remaining, maximum of 10% of the released rental houses (Ministry of the Interior and Kingdom Relations, 2020). In this study, the private rental sector is defined

[2] 1 percent was unknown

[3] The renewed law was in line with the recommendations of the Parlementaire Enquêtecommissie Woningcorporaties in 2014. One of the main conclusions stated by the survey is that housing associations should focus on their primary task, namely to build and manage social rental houses for people with low incomes.

as all rental properties owned by private renters. These private actors are, for example, institutional investors, corporate investors or small-scale private investors.

3.2. Developments in the Dutch rental housing market

The middle segment in the Dutch housing market has been a hot topic in the Netherlands. Since the 1970s the private rented sector in the Netherlands has steadily shrunk to less than 10% of all currently available dwellings. Although the supply of private rental housing in cities is higher than in the rest of the Netherlands, the demand here is also bigger. In the middle segment, this creates a shortage of rental housing, especially in Amsterdam and Utrecht (Schilder & Conijn, 2015). The limited accessibility of the social rental market for middle-income earners (due to regulations and long waiting lists) also leads to a higher demand for private rental dwellings (Hekwolter et al., 2017). Schilder & Conijn (2017) argue that due to societal changes and changes in the property market, it is likely that de demand of affordable and accessible rental houses in the middle segment will increase in the future. The problems in the middle segment rental housing market are related to underdevelopment and rising rental prices, in which the effects are also noticeable in other segments. The insufficient size of an affordable and accessible middle segment is often seen as one of the causes hampering the proper functioning of the housing market (Conijn, Rouwendal & Schilder, 2016). Amongst others, it hinders the relocation mobility within the Dutch housing market and enables skewing from taking place (Donders et al., 2010)

The housing demand in the Netherlands has increased substantially over the past decades as a consequence of rising incomes, demographic developments and falling interest rates. Rising demand leads to rising prices if supply does not respond (Vermeulen & Rouwendal, 2007). Vermeulen & Rouwendal (2007) argue that the Dutch housing supply is almost fully inelastic as a consequence of land-use regulation. Government interventions in the Dutch land and housing markets have contributed significantly to the present high level of housing prices. That the housing and rental prices in the Netherlands have been rising the last decade has been established in multiple pieces of research (see, for example, Ministry of the Interior and Kingdom Relations, 2019). The price-to-income and price-to-rent ratios confirm that there is overheating in the major urban housing markets in the Netherlands; both ratios are above the pre-crisis average (Hekwolter et al., 2017). However, the Dutch housing market cannot be addressed as one, single market; instead, it consists of several regional or local housing markets (Vlak et al., 2017). This means that there are differences within regions among the Netherlands. The supply of private rented dwellings and the rental price in bigger cities have grown more than in the countryside of the Netherlands.

Indirect institutional disadvantages

As well as in the rental property market as the owner-occupied market, institutional disadvantages occur which have had an effect on the current problems within the middle-segment. A significant cause of the small-size middle segment in The Netherlands is the (implicit) subsidy for both owner-occupied (by fiscal subsidy) and social rental properties (by housing allowance) (Conijn et al., 2016; Whitehead et al., 2016; Vlak et al., 2017). The middle segment is not subsidized, resulting in a malfunctioning housing market. Also, the sale of rental properties by commercial landlords in the past, which enabled them to receive both the selling price and the operating value of the rental property, has ensured that the Netherlands has a relatively small middle-segment in the rental sector (Conijn et al. 2016). Furthermore, interest rates have been falling steadily since the early 1980s. The interest rate has a significant influence on the housing market, and the effects are different in the owner-occupied sector than in the social rental sector and the private rented sector. The effects are more directly felt in the owner-occupied sector than in the rental sector. Starters and refinancers in the owner-occupied sector directly feel the effects of lower interest rates on mortgage costs (Ministry of the Interior and Kingdom Relations, 2016).

In the rental sector, the interrelationship between social and private rental properties has had indirect contributions to a growing mismatch. The literature assumes that there is a form of unequal competition between authorized institutions (i.e. housing associations) and private landlords. It is assumed, based on the 2015 Housing Act, that housing associations will, in order to prevent a possible (forced) sale or administrative or legal separation from happening, consciously or unconsciously keep rents low, against non-market rents (i.e. under the liberalisatiegrens) (Schilder & Conijn, 2015). This would involve approximately one-third of the total number of housing association dwellings that could possibly be

liberalized, according to Jonker-Verkaart & Wassenberg (2015, p.23). As a result, housing associations are undermining the 'rules of the game' by keeping rents artificially low and maintaining skewed housing from taking place. This form of unequal competition, in which housing corporations have institutional advantages and favourable financing options, may lead to private landlords dropping out (Boelhouwer & Priemus, 2014). As a result, private landlords would experience a squeezing effect on the returns to be achieved, which could prevent them from entering or even withdrawing from the rental housing market (Schilder & Conijn, 2015; Jonker-Verkaart & Wassenberg, 2015). These are reinforced in part by the fact that private landlords face higher financing costs and land prices. The above assumes a missing level playing field in the rental housing market, which is translated into lower housing production and higher rental prices in the private rented sector.

Causes for housing price developments in the Netherlands

If the demand for housing increases because of demographic developments, rising incomes, a declining trend in mortgage rates and/or innovations in financial services, but the supply does not or hardly react upon this, then this demand-increase is reflected in rising housing prices. Housing subsidies, such as mortgage interest relief, rent restrictions and rent subsidies, also translate into high prices if the supply of housing does not (or hardly) responds to the increased demand (Besseling et al., 2008). The current high level of housing prices is determined by factors that prevent and limit the elastic housing supply. Housing supply in the Netherlands is significantly less elastic than in for example the USA (Caldera & Johansson, 2013), and real housing prices have also risen faster here than in most other countries in the EU in the last decades (Eurostat, 2020). It could be assumed that this is the result of free-market forces; after all, land is simply scarce in a small, densely populated country like the Netherlands. Historic density is not expected to directly (other than through land scarcity) explain changes in housing prices (Hilber & Vermeulen, 2016). Places with a higher degree of density are also expected to have higher housing prices (Saiz, 2010). However, this assumption would imply that scarcity premiums are paid for any kind of land use, though the vast majority of Dutch land is still used for agriculture which does not require a substantial scarcity premium[4] (Besseling et al., 2008).

The observation that the gap between housing prices and marginal production costs does not lead to more new construction must, therefore, be understood from the existence of binding (spatial) restrictions (Besseling et al., 2008). Spatial planning imposes restrictions on the supply of residential land. The power and effectiveness of these restrictions can be found back in the value increase of land after it is permitted from agricultural land into residential land. Segeren (2007) estimated that the price of land increases with 65 to 70 times at the Randstad after the land-use plan has changed.

In the Netherlands, spatial planning takes the form of direct regulation. When direct regulation does not adapt to an increase in demand, the extent to which it is binding increases, along with the implicit tax (see paragraph 2.2.) it creates. Spatial restrictions also limit the type of building that may be built on the land intended for housing construction. In attractive places, demand for housing has to exceed supply (by a certain margin) before new construction in less attractive locations becomes profitable (Besseling et al., 2008). However, if demand rises and the policy in attractive areas are sufficiently restrictive, prices in less attractive locations will automatically reach the level of marginal construction costs. Regulations that allow new construction mainly in locations that are inferior in terms of willingness-to-pay, therefore, lead to higher house prices on an aggregate level (Besseling et al., 2008). The same applies to restrictions on the type of house. When density-policies in Vinex-locations make the constructed houses less attractive than they would have been in a free market, the policy restricts supply and drives up housing prices (Besseling et al., 2008).

Besides spatial planning, there are other factors which are restricting an elastic housing supply from happening. The strategies pursued by landowners, project developers and municipalities in their negotiations on land, can cause delays in the development process. In such a restricted market, procedures for receiving a land-use plan can take much longer than in an unregulated market. Another

[4] Although prices for agricultural land, mainly due to the usage of land for other purposes, have also risen sharply in recent years (Berntsen, de Ruyter & Menkveld, 2019).

aspect is the regulation of housing quality by means of the Building Decree, which can make the requirements for housing quality more expensive (Besseling et al., 2008). All of these aspects influence the prices and, thus, rental prices in the private rented sector.

Difference in price-developments with owner occupied-segment

Research by Francke, Harleman and Kosterman (2017) shows differences in price developments between owner-occupied and rental dwellings. In their study, they use market transactions and property characteristics to conduct a hedonic price analysis for the private rented sector in the Netherlands between 2005 and 2015. Their results show that rental prices in the private rented sector have decreased significantly less than prices for owner-occupied dwellings between 2008 and 2013. Also, the price increase before the financial crisis of 2007-2008 is lower in the private rented sector than in the owner-occupied sector. In addition, the room for negotiation on the rental market is much smaller than on the owner-occupier market. The room for negotiation is also smaller when rents rise (Francke, Harleman & Kosterman, 2017). Differences between the two markets depend on the development of mortgage interest rates, credit conditions such as tax benefits for homeownership, borrowing constraints, property tax, the risk of renting and owner-occupancy, depreciation and maintenance costs and any expected gains from owning a house (Girouard et al., 2006). An equilibrium between these two markets occurs when the expected annual costs of owning a home equal that of renting one.

The Dutch housing market has been characterized as a non-transparent market over the last decades (Berkhout & Bartels, 2016). A non-transparent character of the real estate market can reinforce price increase or price drops. Because only a little information is available, market parties are influenced by each message, which can lead to herd behaviour and mass withdrawal from the market (Berkhout & Bartels, 2016). As argued in paragraph 2.1, the non-transparency in the housing market leads to lags in the actual price developments in the housing market (Buitelaar et al., 2013). Based on the fact that the private rented market and owner-occupied market are different markets, it can be argued that these lags resulting from non-transparency have a different outcome on both markets. Within the private rented market, landlords, brokers and intermediaries have a relatively dominant position, especially in scarcity areas like Western and Central Areas. The lack of transparency of supply even reinforces this. Their dominant position is reflected in the formation of prices. Providers of rental properties use quite a few mechanisms to make people looking for a house, and tenants pay a hefty price for access to this tight market (Risseeuw, 2013). Based on this dominant position of these actors and the use of these mechanisms, the private rented market can be considered as more difficult to interpreted rental price developments than the owner-occupied sector. It is, therefore, that this segment is the base of this research.

The indirect, institutional disadvantages have had a negative impact on the growth of the middle-segment in the Netherlands. The favourable situation in the owner-occupied market, where mortgage interest rates have been continuously declining, made it more interesting to invest in these properties, compared to the rental market. Together with the unequal competition between housing associations and private landlords, have made it less interesting to invest in the middle-segment. Also, by undermining the investment capacity of housing associations (by imposing a Landlord Levy) and restricting their role, the ability for housing associations to make a contribution to the growing shortage of private rental housing has been jeopardized (Boelhouwer & Priemus, 2014). These developments in the Dutch housing market could have had a reduced effect on the plan capacity made available for rental properties. It could be assumed that this lower available plan capacity, leads to lower rental housing production and higher rental prices. In order to estimate this, the following section will discuss the methodology used in this study.

4. Methodology

In this chapter, the methodology of the research is discussed. In the first paragraph, the leading research philosophy (and research paradigm) is examined, which is needed in order to justify and underpin the methodological choice, research strategy, data collection and data analysis (Saunders, Thornhill & Lewis, 2019). In the second paragraph, the research strategy will be discussed, in which the methods used in this research are further elaborated. The third paragraph explains how the data is collected, adjusted and analysed. Finally, the fourth chapter describes how the research deals with the concepts of validity and reliability.

4.1. Research philosophy

A research philosophy refers to 'a system of beliefs and assumptions about the development of knowledge' (Saunders et al., 2019). In every research assumptions are made; assumptions about the realities you encounter in research (ontological), about human knowledge (epistemological) and to what extent the researcher's values and ethics influence the research process (axiological). The questions and methods in research are secondary to the questions of paradigm. The paradigm is a worldview or basic belief system which guides an investigator in ontologically and epistemologically fundamental ways. These fundamental ways are the basis for the distinction between methods applicable for the research (Guba & Lincoln, 1994).

This research is based on a positivistic perspective (Guba & Lincoln, 1994). The emphasis of the positivism paradigm lies on a scientific, empiricist method designed to yield facts and data, which is not influenced by human interpretation or biases (Saunders et al., 2019). The objective of a positivistic perspective is to discover observable and measurable regularities and facts, which would lead to the production of meaningful and credible information. Essential in a positivistic viewpoint is to remain neutral and detached from the research and data, avoiding influencing the findings and results. The situation understudy is noticed from a distance; researchers do not participate in any physical situation. The data collected is based on objective facts and should be neutral, relevant and scientifically usable so that the substance of the data cannot be altered. In order to facilitate replication, a structured methodology will be used with an emphasis on quantifiable observations for statistical analysis. The goal of the research consists of finding causal relations within the available data to establish generalizations for answering the research question. In this research, the relationship between plan capacity and new-build housing production will be examined. Objective data is being used to analyse the extent to which possible new construction increases or decreases based on a change in plan capacity and other influencing factors. Secondly, the influence of housing production on rental prices in the private rented sector will be determined. The possible influence of housing production and restrictions on the rising housing prices is empirically sought. The outcome of the research will be to analyse, explain and predict behaviour and events in the private rented sector in the Netherlands.

The deductive approach of this research will be carried out based on already existing theories and knowledge of the subject under study. Quantitative data is used to estimate causal relationships which are prevailing in deductive research. The existing theories will be used for formulating hypotheses. These hypotheses can then be tested and verified/falsified, which leads to further development of the existing theory. Predictions and expectations derived from the test will be observed and compared with the situation in reality. In case more knowledge of the research problem is gathered, new problems could occur, which could affect the research subsequently (Van Thiel, 2014).

4.2. Research strategy and methods

A research strategy is a methodological link between research philosophy and choice of methods to collect and analyse data. The key of the research strategy choice is to achieve a reasonable level of coherence through the research design, enabling particular research question(s) to be answered and accomplishing objectives (Saunders et al., 2019). According to the goal and research questions formulated, this research will be a quantitative research with a deductive approach, using data to test theories about plan capacity, new-build housing production and the private rented sector. Statistical and graphical techniques measure and analyse the relationships between different variables. The research goal and questions show that this research attempts to gather broad and deep knowledge about the

problems on the Dutch private rental property market. In order to answer the research questions, a literature study and quantitative data and methods are required. The testing of existing theories (deduction) is an important part of this research, aiming for broad insights and generalizability. By using a dataset with a large number of municipalities and years improves the generalizability of the research findings. The research has an empirical approach. In this study, data from six provinces and from 282 municipalities (ca. 73% of all municipalities in 2017) were collected and extensively edited in order to make plan capacity comparable. As a result, the effect of plan capacity on private rental housing production could be measured empirically and directly. The choice for empirical research also follows from the research objective. There was no already existing empirical research available in which the effect of planning restrictions upon the rental prices in the private rented sector in the Netherlands was examined. This research tries to contribute to the direct, empirical measurement of the influence of plan capacity upon the housing production and the private rented sector in the Netherlands.

The research starts with a descriptive part in which the phenomenon is explained. It is important to have a clear overview of the phenomenon upon which data is collected. Based on that, explanatory research is conducted in which relationships between variables are sought. The research starts with a literature study followed by a (multiple) linear regression analysis. The literature study fulfils a number of important functions within this research (Saunders et al., 2019; Creswell, 2013). The deductive nature of this research requires a thorough literature study, because both the research problem, goal and question, hypotheses and theories to be tested are the result of an extensive literature study. To arrive at a clear objective and problem identification, not only scientific literature will be studied but also market reports, policy studies, position papers, news articles etc. Based on the literature study, the data needed to answer the research question will be collected. The underlying method for analysing the data is a (multiple) linear regression analysis. Regression analysis is a statistical technique to analyse data with a possible correlation. Linear regression estimates this correlation between the dependent variable Y and the independent variable X. The regression analysis consists of a singular- and multiple regression analysis. A singular regression analysis consists of the following three parts: dependent variable, independent variable and the error variable. The following equation is used:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i$$

The dependent variable (Y) within this research is housing production and the rental price of private rented sector dwellings. The single independent variable (X) explains the development of the dependent variable (Y) over time (t). The model describes a line with a slope (B1) and y-intercept or constant (B0). Both parameters cannot be directly observed, but are estimated using the values of y and x. The relationship between y and x is not exact but is rather subject to some error, which is indicated by the error term (E). The unobserved deviations in the above equation are known as errors. The goal of the linear regression model is to find estimated values for parameters B0 and B1, which would provide the ‘best’ fit. The best fit can be understood as a line that minimizes the sum of squared residuals, the ordinary least-squares approach (OLS). The multiple regression analysis is a variant of the singular regression analysis. The only difference is that a multiple regression analysis makes use of multiple dependent variables (e.g. B2*X2, B3*X3, etc.).

Often research has been conducted with cross-sectional data, in which subjects can be analysed at one point or period of time (see, e.g. Bramley, 1993). Also, time-series analyses, in which data combined from several measurements are observed at various points in time. Another type of data, panel data (also known as longitudinal data) combines both cross-sectional and time-series data. It examines how subjects change over a period of time (for example, Bramley & Leishman, 2005). Other research has shown to combine time- and cross-sectional dimensions of variation in a panel data framework (Mayer & Sommerville, 2000a). This research examines the same subjects in different times using (unbalanced) panel data of MSCI on the one hand and combines this with a combination of time-series and cross-sectional data of the municipalities and CBS in the plan capacity dataset on the other hand.

4.3. Data collection, adjustments and analysis

The quantitative research design in this research will use a single data collection technique, which is secondary data analysis. Secondary data is data that was initially collected for other purposes (Saunders et al., 2019). This data can be further analysed to provide additional or different knowledge, interpretations or conclusions. In order to answer the research question(s), secondary data of multiple databases are used, which will be further discussed in section 4.3.1. The datasets provided by the different institutions has been adjusted to use it for statistical analysis. This adjustment process is further elaborated in paragraph 4.3.2. For the linear regression analysis, the dataset has to comply with several regression model assumptions which have been tested and explained in paragraph 4.3.3.

4.3.1. Data collection

The data being used in this research consists of datasets provided by three organizations. The first dataset consists of a file with market rental values of 150 municipalities in the Netherlands. This file is provided by Morgan Stanley Capital International (MSCI), an American finance company which is serving as a global provider of fixed income, equity, stock market indexes, and multi-asset portfolio analysis tools. The second dataset contains the plan capacity of six provinces: Noord-Holland, Zuid-Holland, Utrecht, Gelderland, Noord-Brabant and Limburg in the period 2007 until 2017. The last dataset is extracted from the Centraal Bureau voor de Statistiek (CBS). These datasets will be linked to each other in order to determine the influence of plan capacity on housing production and the rental prices in the private rented sector in the Netherlands. The three different institutions providing the data will be discussed individually in the next section.

Dataset 1: MSCI

The first dataset comes from MSCI. MSCI collects quarterly financial performance indexes about real estate markets around the world. In the Netherlands, they provide quarterly data consisting of performance indicators for retail, office, industrial and residential segment. The data is provided by different large institutional investors in the Netherlands. The data is available on different scales, namely on a regional, provincial, COROP and municipality level. For this research, only the residential data from the MSCI dataset on a municipality level is important and will, therefore, be used. Multiple key performance indicators have been collected and presented in an Excel document. The data that is used for this research consists of residential data regarding the period between 2008 and 2017. The performance indicator, which is used as a dependent variable in this research is the *market rental value in €/m2*. This variable provides the market rental price per m² of 150 municipalities in the Netherlands between 2008 until 2017 quarterly. The rental prices per m² are in the private rented sector. The private rented sector is the matter of this research and indicates an objective reflection of the price the market is willing to pay for a rental property in a given location. A dwelling rented out at market rents is less influenced by government policies on pricing and supply than dwellings rented out in the regulated segment. The data of market rental values have been adjusted in order to retain a representative dataset. Other variables influencing the rental prices in the private rented sector like the number of properties, property characteristics, size, vacancy rate etc. have not been collected or provided by MSCI.

Dataset 2: Plan capacity from municipalities

The second dataset consists of the plan capacity of six provinces in the Netherlands. These datasets were conducted by the individual provinces in the Netherlands and acquired by Radboud University. From the data obtained from these six provinces, it becomes clear that all provinces have differently measured the plan capacity. Certain provinces categorize plans as either hard or soft, while the other provinces classify plans on the basis of the stage the plan has reached (zoning plan in the idea phase, design phase, approval phase and irrevocable). For the analysis is both the total plan capacity used as well as the hard plan capacity. Leishman and Bramley (2005) use in their supply model the available building land also of 2 years before. In this research, the plan capacity of the previous two years is also used as a variable, because it can take up to several months before housing construction gets started.

Dataset 3: CBS

The third dataset is a combination of several datasets from the *Centraal Bureau voor de Statistiek (CBS)*. CBS collects data about the Dutch society independently to function as information for social debate, policy development and decision-making within the Dutch government. The transparent data collected from CBS (Statline) relates to the theme of housing and construction. Table 4.1 presents the independent variables gathered from CBS, which are used for this research. Only the raw datasets have been collected on a municipality, COROP or provincial level. These variables are further explained and operationalized in chapter 5.

Variable	Definition	Level	Source
Housing production	Number of new-build housing production per year between 2007-2017	Municipality	CBS Statline. For 2007-2011: - “Veranderingen in de woningvoorraad; 1995-2011” For 2012-2019: - "Voorraad woningen en niet-woningen; mutaties, gebruiksfunctie, regio"
Building permits granted	Number of building permits granted for housing per year between 2007-2017	Municipality	CBS Statline. For 2007-2011: - “Nieuwbouwwoningen; vergunningen naar opdrachtgever, eigendomsvorm 1995-2016” For 2012-2017: - “Bouwvergunningen woonruimten; type, opdrachtgever, eigendom, gemeente”
Housing stock	Number of total rental housing stock between 2007-2017	Municipality	CBS Statline. For 2007-2011: - “Woningvoorraad naar eigendom; regio, 2006-2012” For 2012-2017: - "Voorraad woningen; eigendom, type verhuurder, bewoning, regio"
Construction costs per m³ (average)	Average construction costs per province per m³ for houses between 2007-2017	Province	CBS Statline. For 1990-2016: - "Bouwvergunningen; huur- en koopwoningen, bouwkosten, inhoud 1990-2016"
Land prices per m² (median)	Median land price for residential construction per year between 2007-2017	COROP	Kadaster
Housing prices	Average sales price for houses per year between 2007-2017 (x €1000)	Municipality	CBS Statline “Bestaande koopwoningen; gemiddelde verkoopprijzen, regio”
Share developable land already developed	Number of developable land/total developed land in 2015 (%)	Municipality	CBS Statline "Bodemgebruik; uitgebreide gebruiksvorm, per gemeente"
Standardized income	Average standard income per year between 2011-2017 in euros	Municipality	CBS Statline. - “Regionale Kerncijfers Nederland”
Population density	Number of population per km² in 2017	Municipality	CBS Statline - "Regionale kerncijfers Nederland"
Population size	Number of inhabitants per municipality between 2007-2017	Municipality	CBS Statline - "Regionale kerncijfers Nederland"

Table 4.1: Variables extracted from database CBS

4.3.2. Data adjustments and transformation

The dataset provided by MSCI consisted of several variables, including the market rental value per m². In this dataset only the market rental value per m² per municipality has been used, meaning that other variables have been deleted from the Excel file. The final dataset consisted of quarterly market rental values per municipality. However, this dataset had some missing data. The data were missing at random; the market rental value was available in a particular quarter, was missing in the next quarter and came available in the next quarter again. A reason for this could be that the market rental value for a specific quarter/year was not collected or noted because institutional investors did not provide their information. All alterations in the source data were performed in the STATA program using do.files. These do.files have been written for this research to make the data analysis and adjustments phase more transparent. The quarterly data was transformed into annual data by calculating the mean of the quarterly data in a given year. Each name of a municipality was given a unique municipality code, which is similar to the municipality codes in other datasets used for this research. Based on the municipality codes and years, the dataset with market rental prices was merged with the dataset about plan capacity.

The datasets about plan capacity provided by the provinces were already collected and transformed before by other researchers (Leeuwerik, 2018; Verhagen, 2018; De Vries, 2018). The previously performed transformation consisted of transforming all municipality codes into the (new) municipality classification in 2017, the estimation and replacement of missing values in specific years by data provided in other years (e.g. for land prices), the characterization of unknown plan types and the interpolation of unrealistic or erroneous values. All these adjustments were made, and the datasets were merged into one dataset for hard plan capacity per municipality per year. This dataset has been used in this research without any adjustments being made.

The several datasets gathered from CBS were firstly adjusted in Excel by deleting all variables and columns which were not necessary for this research. In STATA, quarterly data was transformed into annual data by using the mean of the quarterly data in a certain year. The datasets were firstly merged with the transformation file about municipality reclassification, transforming the old municipality classification into a new municipality classification which was valid in 2017. Afterwards, it was merged with the plan capacity dataset based on the municipality code and year, providing a total dataset of plan capacity, market rental values per m² and CBS data.

Transformation

The variables consisting of absolute numbers have been transformed for the usage in the statistical analysis. The natural logarithm, Ln(x), of each variable was taken before the outset of the regression analysis. In this way, both the dependent and the independent variables are expressed in logarithmic terms, so that the estimated coefficients from the regression analysis can (almost) directly be interpreted as elasticities (Leishman & Bramley, 2005). In addition, this transformation ensures that the distribution of the variables is closer to the natural distribution and reduces the influence of outliers. This is important, for example, for the variables ‘housing stock’, ‘building permits granted’ and 'number of inhabitants' which have a limited number of high values. Also, some of the variables are consisting of large values. By using a logarithm value, the skewness these large values often consist, can be reduced. The variance of the regression residuals is increasing with the regression predictions. By taking the log of the variables, heteroscedasticity may be eliminated. Negative values related to the total housing stock in a certain municipality in a certain year have been transformed into ‘1’ values for the usage of logarithmic terms. These negative values occur when, in a certain year, the housing stock has been declined compared to the previous year. Without this transformation, the values were not applicable in the analysis and would be altering the regression outcomes and the number of observations.

4.3.3. Data analysis

The standard approach of linear regression analysis is the method of least squares, also known as ordinary least squares (OLS). The method minimizes the sum of squares of the residuals made in the results of every single equation and gives the equation that best fits the data (Daniels & Minot, 2019). OLS presents the best linear unbiased estimates (BLUE) of the coefficients if the model has the lowest variance of the error terms (Best), the dependent variable is a linear function of the independent variables (Linear) and if the estimated coefficients are not systematically lower or higher than the true

coefficients across different samples (Unbiased). In order to be BLUE, the ordinary least squares regression analysis has to meet several regression model assumptions (Saunders et al., 2019).

The first regression model assumption is that the analysed data consists of a non-random sample and independent observations. A non-random sample of plan capacity from Dutch municipalities has been used as well as the data gathered from CBS. However, the selection of market rental values is determined by the availability of data from MSCI, which in turn depends on the transparency of institutional investors in the Netherlands. As a result, it is not possible to generalize the empirical findings to the Netherlands as a whole. The observations under study are not all Dutch municipalities, but concerns only the municipalities participating in the dataset. The dataset consists of unique market rental values, plan capacity data and other independent variables across year and place. It can be assumed that these are independent observations.

Second, linear regression needs the relationship between the independent and dependent variables to be linear. To assess whether the relationship between the dependent variable and the independent variables is linear, a scatterplot of standardized residues and standardized predicted values has been visually evaluated. The results did not show any (curved) pattern that might indicate a different type of relationship. A linear relationship is, therefore, assumed in the rest of the study.

The third regression model assumption is that the error terms are preferably normally distributed. This requirement is considered convenient, but not necessary because even without normally distributed errors, OLS will still generate the best linear unbiased estimates of the coefficients (Daniels & Minot, 2019). However, normal distribution ensures p-values and confidence intervals to be correct. Histograms have been made to test normal distribution visually. The histograms with normal curves of the standardized residues show that the residues are normally distributed in all regression models after logarithmic transformation of the variables.

A fourth regression model assumption is that the variance of the residues should be equal for all possible values of the independent variables. If unequal variances exist (heteroscedasticity), it may also still be possible to carry out the analysis. To assess whether the variance of the residues is homoscedastic (constant), the scatterplot of standardized residues and standardized predicted values can be studied. The scatterplot shows a constant variance of the residues in the regression models. The values in the scatterplot are sufficiently balanced around the zero line. The variance of the residues is not greater for either higher or lower values on the x-axis. This leads to the conclusion that the data complies with the assumption of homoscedasticity.

The fifth regression model assumption is that there is no multicollinearity between the independent explanatory variables. There should not be two or more independent variables measuring roughly similar aspects, because it will be challenging to determine the separate effects upon the dependent variable. If independent variables are too closely interrelated, only one of these variables should be included in the model. To calculate if there is multicollinearity, the Variance Inflation Factor index (VIF) can be used. There is no general agreement on the VIF threshold for considering multicollinearity a problem, but generally, as a rule of thumb, a VIF greater than 10 deserves attention. However, some researchers prefer a VIF threshold of 4 (Daniels & Minot, 2019). The correlation matrix shows a strong correlation between the number of inhabitants per km² and the share of developable land already developed. Similar results occur in the VIF test where the variables are given a score of 12 and 11, which is higher than the rule of thumb. Although both variables are measuring a degree of density, the way in which they influence the dependent variable is different. Also, in other studies, both variables where empirically tested and will, therefore, remain in the regression analysis (Hilber & Vermeulen, 2010; 2016).

4.4. Validity and reliability of the research

Reliability refers to the replication and consistency of the research. Validity refers to the appropriateness of the measures used, the accuracy of the analysis and the generalizability of the results (Saunders et al., 2019). Important related to reliability and validity concerning the data used in the research is to examine the context in which the existing data was collected, the quality of the data and who produced the database (Van Thiel, 2014).

The reliability of a study depends on the sample size, which increases if the size of the selected research units is extended. The sample size required for reliable research is related to the homogeneity of the research unit. In this study, the research unit is very heterogeneous, so a large sample in relation to the research population is required. The sample size concerning the research population is considerable due to the use of secondary data. Possible threats could have been found in the collection and process of data by provinces. Municipalities and provinces collected the information about plan capacity in different ways, making it more difficult and more time-consuming to adjust, merge and analyse the data. This process was already executed in previous research, which has resulted in a reliable dataset about plan capacity usable for this study. The datasets provided by CBS and MSCI are assumed to be reliable, as these institutions have a social, economic and research interest in providing valid and reliable data.

All the adjustments made in datasets have been reported in do. files and executed by automatic scripts in the STATA program. In this way, the research can easily be repeated by other researchers with the same dataset(s). As this research only uses quantified research data, substantial differences in interpretation between researchers are unlikely to occur. After all, in contrast to qualitative data, quantitative data leaves little or no room for the researcher's interpretation or different interpretations by different researchers. Thus, the so-called observer bias is excluded.

Validity examines how accurately the method that has been chosen measures something by preventing systematic errors to occur. A distinction can be made between four different types of measurement validity. Construct validity refers to the extent to which a concept is correctly measured - the unambiguous operationalization of concepts based on a literature study can prevent this. The same applies to content validity. Content validity refers to the aspects of a concept and whether these have been correctly translated into the questions. Face validity is a subjective measure which considers the suitability of the content on the surface. The criterion validity evaluates if the results of a test correspond to the results of different tests. The internal and external validity are referring to the testing of cause-and-effect relationships. Internal validity refers to the extent to which all relevant factors and cause-and-effect relationships can be correctly identified and substantiated - and thus to the quality of the conclusions. The extent to which the results of the study can be generalized determines external validity. Important conditions for an externally valid study are that the sample is randomly taken and representative for the entire population.

Heterogeneity in statistics assumes that the populations, samples and results are different. Both heterogeneity and homogeneity refer to the consistency and stability of the particular dataset or relationship between variables. Whether heterogeneity is good or bad, depends on the analysis chosen. However, unobserved heterogeneity has to be retained. Unobserved heterogeneity describes the existence of unmeasured differences between study samples that are associated with the observed variables of interest. To prevent that unobserved heterogeneity can lead to incorrect regression results, fixed effects are included in the regression models that correct for this unobserved heterogeneity. Also, the use of panel data can control for time unobserved invariant heterogeneity and is therefore widely used for causality research. Similar research in the UK (Hilber & Vermeulen, 2016) has also used year-fixed effects and LPA-fixed effects (Local Planning Authority) to capture all unobserved characteristics that do not vary across space or over time. The use of fixed effects enhances the internal validity of the study since it reduces the chance that estimated significant regression results are caused by factors not included in the model.

Ethical research concerns

This study did not use data about natural persons, so there are no consequences for the privacy of natural persons. In addition, no measures were needed to ensure that individuals or organizations participated voluntarily in the study. The data from CBS is publicly available and accessible, and the data provided by MSCI has been downloaded on behalf of the internship organization. Provincial authorities voluntarily shared the not-publicly accessible data about plan capacity under the condition that they were only used exclusively for research purposes and are never made public. In order to comply with these conditions, the data are only reported in the thesis in a format in which they cannot be traced back to the plan- or municipal level. There is no qualitative data such as opinions or professional insights of specific persons or organizations, which eliminates the possibility of misinterpretation by the researcher.

5. Operationalization

In this paragraph, the variables in the conceptual model are being operationalized. The theoretical concepts are translated into entities which can be observed and measured in the real world (Van Thiel, 2014). Decisions about which variables to omit, involve judgements based on both prior theoretical expectations and the results of other work. The important variables in the analysis are divided into two equations. The first equation in paragraph 5.1. consists of the housing production and plan capacity. The housing production is the dependent variable, while the plan capacity is the main independent variable. The second equation, in paragraph 5.2., consists of the rental prices in the private rented sector and the housing production. The rental prices in the private rented sector is the dependent variable, while the housing production is the independent variable. In paragraph 5.3, other independent variables that have a possible influence on both equations are being discussed. These have been separated on variables of which data was available on a municipal level (5.3.1.) or on a regional level (5.3.2.). The other independent variables have also been used in the regression analysis in chapter 6.

5.1. Equation 1: plan capacity and housing production

The first equation used for the regression analysis is the relationship between the independent variable, plan capacity, and the dependent variable, housing production, in the Netherlands.

Plan capacity

In the Netherlands, a discussion is going on about housing production planning. Residential construction can be developed at greenfield or inner-city locations. Governments often prefer the latter to retain and preserve the countryside, to connect to already existing infrastructure and to transform underutilized or deteriorated locations. On the contrary, building on greenfield locations would be a shorter and less complicated process compared to inner-city locations, making it more profitable to build in the countryside. Besides, the costs of building in inner-city locations are often higher than in greenfield locations (Needham, 2014). However, it has not been sufficiently investigated yet whether inner-city projects actually take significantly longer, and thus possibly delay construction speed (Buitelaar, 2019). Greenfield locations might take longer because the province has to check whether the housing needs met by the plan cannot be realized within the urban area. Because the province itself determines the standards against which this is tested, the province has a great deal of freedom in this respect (Michielsen et al., 2019). In order to analyse the differences in construction speed and possible delays, a different scope of research should be used on a more micro-level to see the effects between different plans.

This research, however, focuses on the plan capacity on a municipal level. Delays in plan capacity to become irrevocable and before receiving a building permit can cause delays for the start of construction. The actual time for a plan in a certain municipality to become ‘hard’, should be needed in order to analyse the effect on the housing production. The implementation time between the initiation of a plan, acquiring the land-use plan and the actual start of construction could expand the extent of this research in a beneficial way, creating a deeper scientific understanding about possible causes for a housing production delay. However, the current dataset does not consist of such data about implementation time and can, therefore, not be further studied. A delay in plan capacity for 1-year and 2-year could be calculated based on the available plan capacity data. This research can be seen as a starting point, in which the effect of a delay in plan capacity on housing production is estimated.

The independent variable of plan capacity explains the total size of plan capacity in a certain municipality in the Netherlands. The plan capacity data used consists only out of the gross, hard plan capacity. Previous chapters have already discussed why this type of plan capacity is used. Only the plan capacity of the province of Gelderland and Noord-Brabant have classified the available data in rental categories. The plan capacity for the province of Gelderland and Noord-Brabant is divided into plan capacity destinated for ‘laag’, ‘middelduur’ and ‘hoog’ rent. Only the middle- and high rents are combined and used to estimate the effect in the private rented sector.

Housing production

First, the housing production in this research is both a dependent variable as well as an independent variable. In the first equation, the effect of plan capacity on housing production is analysed. In the second equation, the effect of the housing production on the rental prices in the private rented sector is analysed. The effect of the size of (hard) plan capacity of municipalities in the Netherlands on the number of new-build houses that will be delivered, is tested. The plan capacity of this year (base year) and of the previous two years is used because it can take up to 24 months before a plan can actually be used for residential construction as a 'hard' plan. Besides, houses have a construction time of several months, which creates a delay between the start of development and the delivery of homes. Including the so-called "lags" (delayed values) ensures that this delay is corrected (over time). Second, the number of houses being developed over the years are being compared with the rental price developments in the private rented sector to analyse if there is a relation between these two variables.

The data about new-build housing production is provided by CBS. However, the dataset consists of the total new-build housing production per municipality per year. This study is focused on the rental housing market, and so only the number of new-build houses that are produced for the (private) rented sector are needed. Because no distinction can be made between owner-occupied and rental dwellings in the new-build housing production, other variables related to the housing production are used.

First, the number of building permits provided for new-build houses are used as a variable. Here a distinction can be made between building permits granted for owner-occupied and rental properties. Also, the dataset provides information about the type of client, i.e. to which party the building permit is granted. The following types of clients can be distinguished: government and housing associations, builders of the market (including institutional investors) and other clients (including collective private clientship). Because all of these clients could have been providing private rented dwellings, at least until 2015, a separation in the analysis has not been made.

Second, the dataset of total housing stock in a certain year in a certain municipality is used. The difference in rental housing stock between the current and previous year has been calculated, to know the number of dwellings included or extracted from the existing housing stock. In the total number of rental dwellings, a distinction can be made between the property owner (e.g. landlord). The property owner is divided into the housing association and other landlords. The 2015 Housing Act has restricted the number of dwellings that housing corporations are allowed to have in the private rented sector. However, because the dataset used in the analysis is between 2007-2017, in which housing associations were mostly still allowed to have a substantial amount of private rented dwellings, a separation between these two types of property owners has not been made.

5.2. Equation 2: housing production and rental prices

The second equation used for the regression analysis is the relationship between the independent variable, housing production, and the dependent variable, rental prices in the private rented sector, in the Netherlands. The housing production has already been discussed above, so only the rental prices in the private rented sector will be further specified.

Rental prices in the private rented sector

The dependent variable in this research is rental prices in the private rented sector. A goal of this research is to analyse the effect of housing production on rental price development in different municipalities/regions in the Netherlands. Previous research focused on the relationship between housing supply restrictions upon the housing prices (Hilber & Vermeulen, 2010; 2016; Oztürk et al., 2018), while this research is using similar independent variables to estimate the effect on the rental prices in the private rented sector in the Netherlands. The rental prices between 2008-2017 in the private rented sector in the Netherlands are used to analyse the relationship, also by making use of these other independent variables, which are discussed in the next paragraph.

5.3. Other independent variables

Based on the literature review, there are several other independent variables which are possibly affecting the relationships between either, plan capacity and housing production, or between housing production and rental prices. These other variables are discussed below. A distinction has been made between variables available on a municipal level and variables available on a regional level.

5.3.1. Municipality characteristics

The operationalized variables on a municipal level are the average standardized income, population size, population density, housing prices and share developable land.

Average standardized household income

As discussed in paragraph 2.1., the real estate market is affected by the mechanism of demand and supply. In an optimal market, an equilibrium is assumed between demand and supply. Without any demand, future restrictions addressing this supply are not needed. To analyse the demand in the real estate market, the average standardized income of the working population in the Netherlands is used. Household income is arguably the most important proxy for housing demand (Hilber & Vermeulen, 2010). The proposition is that the demand for space per person rises with income; wealthier households buy higher quality or larger houses (Hilber & Vermeulen, 2016). This proposition also occurs in the rental market, where people with a higher income are able to afford a property with a higher rental price. Hence, restrictions in the Dutch rental housing market also force people with a higher income to rent a more expensive property (as has been discussed in chapter 3).

Idiosyncratic tastes for the unique amenities of this specific location have not been taken into account in this research, which in contrast has been used in (Hilber & Vermeulen 2016). This taste for different amenities affects the households willingness-to-pay to live in a specific location. Hilber & Vermeulen (2016) take into account the earnings of households in their theoretical framework. They expect supply constraints to have a similar effect on both the house price-earnings elasticity as well as the rent-earnings elasticity. The reason for this is, according to Hilber and Vermeulen (2016) is that profit-maximising landlords will pass on any earnings shock-induced change in house prices to their tenants. They assume that a rise in earnings should effect the willingness-to-pay of tenants.

In this research, the average standardized household income is used as an independent variable which could possibly affect the rental price developments in the private rental sector. The standardized income is the disposable income adjusted for differences in household size and composition, which is expected to give a more reliable image compared to the average income only.

Population size and number of inhabitants per m²

The population size per municipality is used to compare the plan capacity between municipalities in this research. Municipalities with a high number of population size often tend also to have a high number of absolute plan capacity in stock and often build a high number of dwellings in absolute terms. To prevent this from becoming a strong, false relationship between plan capacity and housing production, this is corrected by the population size and fixed effects between municipalities.

In addition to the population size per municipality, the number of inhabitants per m² is also used in the model. A reason for this is that the population size cannot be seen as a sufficient measure for calculating the degree of urbanity of a specific municipality. After all, municipalities with a high number of inhabitants can have a low degree of urbanity, if they cover a large area with multiple cores. Smaller municipalities around large cities could, on the contrary, cover a high degree of urbanity with a low number of inhabitants. Besides this, previous research (Hilber & Vermeulen, 2010; 2016) used historical population density as an instrument to identify the share of developable land that is already developed. By including the number of inhabitants per m² (i.e. population density) in the model, it is possible to estimate the extent to which the urbanity of a municipality determines the number of dwellings being built. The degree of urbanity itself has not been used in the regression analysis, because the correlation with population density is substantial. This could make that multicollinearity could occur.

Housing prices

Multiple research before has used housing prices as an explanatory variable to model housing supply (see, for example, Leishman & Bramley, 2005). Assuming a positive price elasticity of the housing supply, an increase in housing prices would lead to an increase in the number of newly built houses. This, in combination with the theoretical expectations out of paragraph 2.1.1., made the decision to use housing prices in this research.

Share developable land already developed

A next variable included in the model is the proportion of potential buildable land area that has already been built on. This factor is used as an indicator to analyse to what extend physical space for housing is available within a certain municipality. The possibilities in a municipality for housing construction are not only determined by the local government's attitude towards housing in relation to the land-use planning and development of new construction sites but also the available physical space has a role in new construction possibilities (Bramley & Watkins, 2014; Hilber & Vermeulen, 2016). For example, Saiz (2010) argued that the price elasticity of the housing supply is lower in areas where steep slopes and water surfaces make a greater proportion of the land unsuitable for housing. In the Dutch context, a shortage of potentially buildable surface area can play a role mainly in municipalities with a limited spatial extent and where the municipal boundaries are almost exclusively built-up areas, and water surfaces include. For this reason, the proportion of potentially cultivable land that is already built-up is included in the model as an explanatory variable. New construction is strongly influenced by the amount of land which is available with planning permission (Leishman & Bramley, 2005).

5.3.2. Regional characteristics

The regional characteristics consists of land prices, of which data is available on a COROP level, and construction costs, of which data is available on a provincial level.

Land prices

Most municipalities in the Netherlands have been using an active land policy regarding their development locations for decades. An active land policy means that the municipality is the owner of the land and can decide for what price the land should be sold to developers. Municipalities used a residual land value as a basis to calculate the selling price for developers, creating some development profit for themselves and reducing the (possible) profit for developers (Needham, 2014). It is assumed that high land prices from municipalities result in slow-building speed and higher housing prices. The current residual method of calculating the land price exacerbates the problems of housing production (Buitelaar, 2019). A possible explanation for a restricted price elasticity of the housing supply is that when housing prices rise, with an inelastic supply of building land, a part of the price increase is adopted into the land price (Grimes & Aitken, 2010). To estimate the actual effect of land prices on the housing production and (rental) housing prices, the (median) land prices per m² on a COROP level are included in the analysis.

Construction costs

In previous research about the housing production, construction costs have been used as a variable to declare the number of new build houses being produced (Vermeulen & Rouwendal, 2007; Ball et al., 2010, Hilber & Vermeulen, 2010; 2016). Topel and Rosen (1988) have shown that price movements and construction activity are positively correlated, suggesting a rising supply price of new houses. Higher construction costs would, unsurprisingly, lead to less new housing production (see, for example, Paciorek, 2013), because the profit for developer or municipality would be lower. Moreover, empirical studies have measured the regulatory restrictiveness, amongst others, by calculating the gap between prices and marginal construction costs, also known as the regulatory tax (Glaeser et al., 2005; Cheshire & Hilber 2008; Hilber & Vermeulen, 2010; 2016). This construction costs per m³ will be used to analyse the effect of building costs on (delay of) housing production and the rental price developments.

6. Empirical analysis

In this chapter, an empirical analysis will be conducted to examine the relationship between plan capacity and housing production, and between housing production and rental prices in the private rented sector. Empirical research is carried out based upon the theoretical framework discussed in chapter 2 and the dataset provided by several institutions analysed in chapter 4. The primary empirical strategy of this research is to measure the relation between plan capacity and new build production upon the rental prices in the private rented sector. In order to enhance the robustness of these estimates, a range of demand and supply measures are considered. Annual-time series data of plan capacity, new build production and rental prices in the private rented sector are observed from 2007 until 2017. The distinction between the private rented sector from the social and owner-occupied sector, is important in this case because the latter two sectors are heavily regulated. To examine if the results are different for the total rental sector compared with the private rented sector, an empirical analysis has also been conducted for the total rental sector from which the results have been added in the appendix.

6.1. Descriptive statistics

The dataset used for the analysis is containing several explanatory variables. In this paragraph, these variables are explained and presented in tables to examine the size, average and variation of each (in)dependent variable.

Since this study focuses on the possible effect of plan capacity on the housing production and of housing production on rental prices in the private rented sector, these two equations are discussed in greater detail in this section. Table 6.1 shows the summary statistics of the three core variables in the explanatory analyses. The dependent variable in the first equation is the (rental) building permits granted and the change in rental housing stock between the previous and current year. The gross, hard plan capacity per municipality is the primary independent variable in this equation. This research only focuses on hard plan capacity, because these plans are irrevocable, meaning that a building permit can be granted sooner and the start of housing construction can advance more rapidly. The total gross plan capacity in the dataset consists of 3102 observations, although only 1084 observations are expressing the numbers of plans assigned for (private) rental housing (located in the provinces of Noord-Brabant and Gelderland). In the second equation, the rental price per m² per municipality in the Netherlands is the dependent variable. The number of building permits granted and the difference in rental housing stock is used as the main independent variable to estimate the difference in rental price among municipalities. It is assumed that less housing production and building permits granted will have an increasing price effect on the rental price in the private rented sector. The rental prices per m² in this dataset consists of 562 unique observations in a period between 2008-2017. The other independent variables affecting both equations are presented in table 6.2.

Variable	Obs.	Mean	Standard deviation	Min.	Max.
Dependent variable					
Rental price per m²	562	93,97	14,96	62,00	157,09
(In)dependent variables					
Building permits rent	3102	51,27	154,67	0	3062
Housing stock rent	3065	143,86	688,54	1	26278
Independent variables					
Gross plan capacity	3102	1192,86	2663,79	0	45714
Gross plan capacity rent	1084	319,18	558,86	0	5535
Gross plan capacity private rented sector	1084	167,61	315,51	0	3759

Table 6.1: descriptive statistics for dependent and independent variables

The results in table 6.1 show that the mean rental price in the dataset equals €93,97 per m². The distribution between the minimum and the maximum rental price is substantial, with €62 per m² as lowest value and €157,09 per m² as the highest value. That is a difference of €95 per m² between municipalities over a period of 2008 until 2017. An explanation for this substantial difference could be caused by the financial crisis of 2007-08. Rental prices could have dropped during the elaboration of the financial crisis.

To examine this, a histogram of the average rental price per m² between 2008-2017 has been made and presented in figure 6.1.

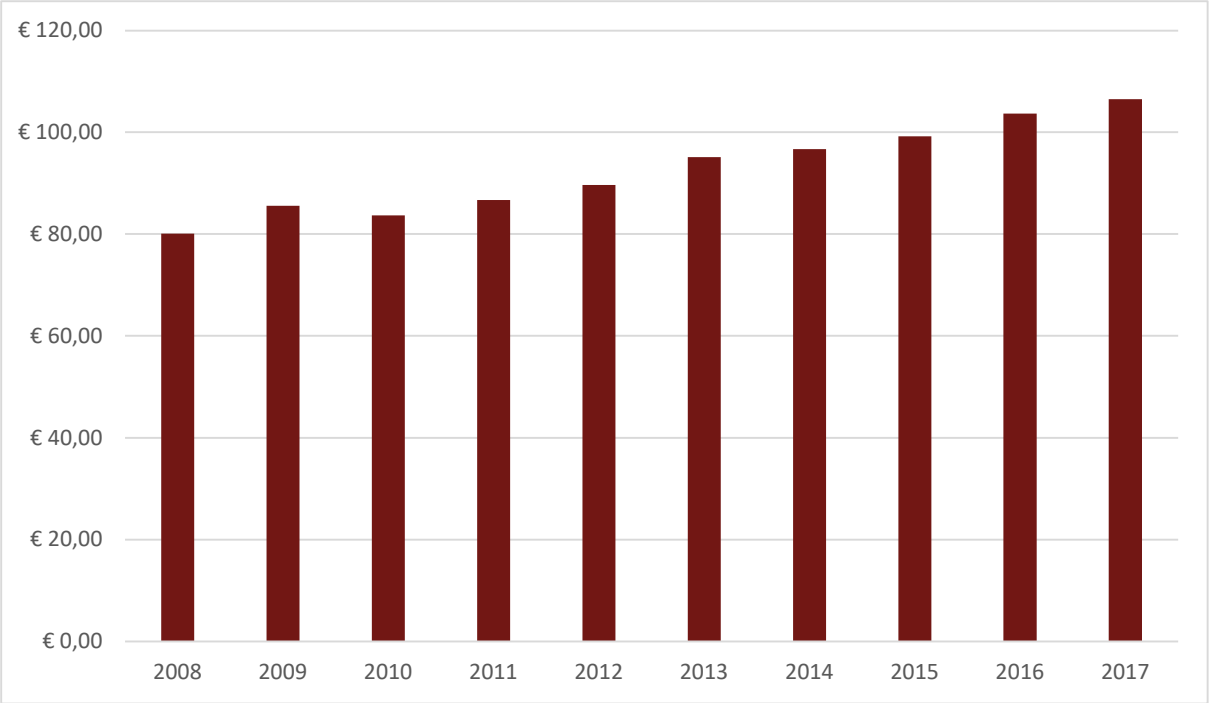

Figure 6.1: Mean rental price per m² per year between 2008 and 2019 in the private rented sector in the Netherlands

The results show that the rental price per m² has, contrary to the expectations, been increased almost annually between 2008 and 2017. According to the dataset, the financial crisis of 2007-2008 did not have an influence on the price developments in the private rented sector. The difference in the rental price can, therefore, not be seen over the years but between different regions. This effect was also expected because of the previously examined characteristics of the Dutch (rental) housing market (chapter 3). The Dutch housing market has been characterized as not one single housing market but is rather consisting of differences between regions, which is expected to influence the substantial gap between the minimal and maximum rental price per m² in the dataset.

The relation between the building permits granted for housing development and the actual new-build housing production is also an important element in this study. Previous research has shown that the hard plan capacity in Dutch municipalities is high enough to tackle the current housing shortage (ABF Research, 2019). However, the hard plan capacity also needs to result in more environmental permits (i.e. building permits) granted for new housing construction. Figure 6.2 shows the number of building permits granted in relation to the housing production between 2007 and 2017. Between 2007 and 2008 (during the financial crisis), the building permits granted have been higher than the actual new build housing production. A reason for this could be that developers were waiting to start with construction based on the more uncertain time they were facing during that time. After 2008 the housing production has improved with at some points even being higher as the number of building permits granted. For example, in 2012 and 2013, the new build production has been significantly higher than the building permits granted. A reason for this might be that developers who received a building permit in 2008, started with constructing only just in 2013. A developer can have multiple reasons to wait with the actual start of construction, but the most logical would be that the return on investments (ROI) would be higher by *stalling* the permitted land and delaying the production (Buitelaar & Van Schie, 2018). However, municipalities in the Netherlands are often taking juridical conditions up in their agreements to prevent this delay from occurring and keeping the construction going on. What should be kept in mind is that this dataset represents 3102 observations of six provinces in the Netherlands which could differ from the numbers of the entire country. In other words, the relation between building permits granted and the housing production may be significantly different at the whole national level.

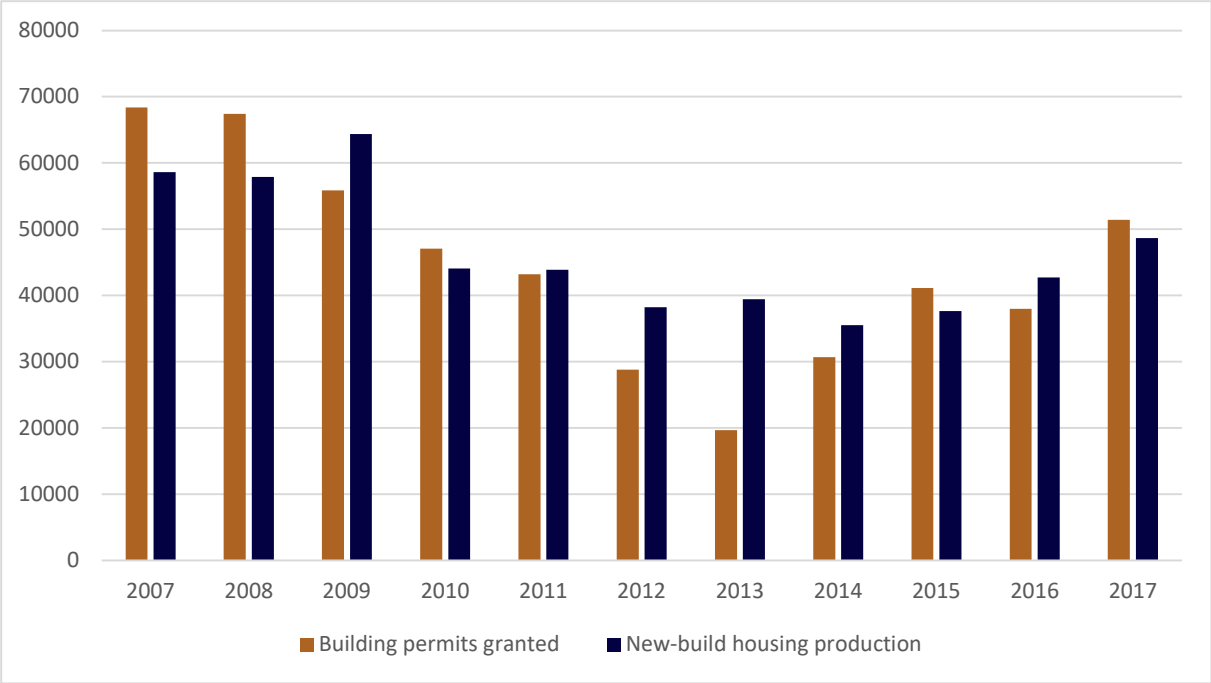

Figure 6.2: Relation between total building permits granted and actual housing production between 2007-2017

Figure 6.2 shows the total building permits and housing production in the Netherlands for all municipalities under study. The results show that building permits granted and actual new-build housing production are intrinsically linked. While the data about new-build housing production can only be examined for the whole housing categories per municipality (i.e. owner-occupied, social rent and private rent combined), the building permits granted can, therefore, be seen as a closely related substitute for measuring the effects in the housing production. The latter can be separated into building permits issued for rental or for owner-occupied housing. This research focuses on the private rented sector. For the empirical analysis is therefore chosen to use data related to this sector.

Table 6.1 also shows high standard deviation and substantial differences between minimum and maximum values of plan capacity, building permits and housing stock. Municipality characteristics mainly cause this considerable variation within these variables. The number of population, size, density and available land in a specific municipality, have an effect on these variables, as well as on the (rental) housing prices. In the analysis will be corrected for these different characteristics in each municipality by the use of fixed effects. Also, the regional characteristics affect the plan capacity and housing production, but on a higher level, having a less significant influence on the dependent variables. In addition to the hard plan capacity per year, the plan capacity of two years earlier is also included. This is in line with an English supply model used in a study by Leishman and Bramley (2005) in which the available land from two years earlier has been added. In this way, the assumption is made that a part of the hard plan capacity is not directly available for housing (see the juridical procedure in paragraph 2.3) and that it can take up to several months before the start of construction.

In table 6.2, the core statistics of the other independent variables used in the regression analysis are presented. A distinction on measurement level has been made between the municipality and regional characteristics. The municipality characteristics consist of data provided on a municipal scale level, while the regional characteristics consist of data on a provincial or COROP scale level. All these independent variables presented in table 3 are expected to influence the housing production and rental prices in the private rented sector in the Netherlands.

Variable	Obs.	Mean	Standard deviation	Min.	Max.
Municipality characteristics					
Population	3102	45204,49	71376,02	4463	844947
Number of inhabitants per km²	3102	8,70	9,31	0,29	53,49
Share developed land	3102	0,27	0,18	0,04	0,85
Housing price	3102	259998,40	69840,57	126057	803413
Standardized income	1410	28,49	3,28	22,2	54,9
Regional characteristics					
Construction costs per m³	3102	259,77	11,34	235	284
Land prices	3102	498,88	121,80	274,60	859,82

Table 6.2: Descriptive statistics for independent variables between 2007-2017

Nearly all independent variables in table 6.2 have 3102 numbers of observations, except the standardized income. The data collected about standardized income has been in a period between 2011-2017, resulting in lower numbers of observations. The underpinning of the chosen independent variables presented in table 6.2 has been elaborately discussed in chapter 5. The results show that the variation between minimum and maximum within the number of inhabitants (per km²) is significant. The dataset provides information about small towns with a minimum of 4463 inhabitants and bigger cities like Amsterdam with 844.947 inhabitants. These municipal and regional differences create differences in housing production and rental price development. The higher standard deviation also indicates these substantial differences in the dataset. Density indicators (like the number of inhabitants per km² and the share developed land) influence the demand and supply and therefore the functioning of the (rental) housing market. The housing prices are examined simultaneously with the rental prices, while they are expected, based on the theory, to function similarly. The number of population and density levels also account for the high standard deviation in housing prices. A rise in standardized income is also expected to interfere with increasing market rental prices. The regional characteristics are expected to have a small influence on the housing production and private rental price in this research, while they are both measured on a provincial level. These variables on a regional level less explain differences between municipalities and within municipalities.

6.2. Multiple regression analysis

This paragraph discusses the empirical results of the regression analysis conducted in Stata. The variables in each of the two equations are estimated through the use of the ordinary least square estimation (OLS). The regression analysis uses two equations to estimate the central relationships in this research: the relationship between plan capacity and housing production and between housing production and rental prices in the private rented sector. It is argued that both relations have an effect on the rental price development in the private rented sector in the Netherlands. The analysis has been conducted based on different models and different model specifications, in which the number of independent variables and fixed effects is being increased for every model. By using this kind of technique, the robustness of each model will be tested in combination with the toughness of each relation over time. Inevitable delays, such as the production started years after the permit granted, are also evaluated.

For the regression analysis, a distinction has been made between the hard plan capacity for the total rental sector and the private rented sector. Because this research is focused on the developments in the private rented sector, this will be the basis. The regression analysis conducted on the total rented sector is added in the appendix and is referred to estimate whether certain relations are different, stronger or more/less significant in the total rented sector compared to the private rented sector. As discussed before, the building permits granted and the difference between housing stock are both used, individually, as new build housing production. The plan capacity is used to estimate the influence on building permits granted (as new-build housing production) and on the difference in the (rental) housing stock (as new-build housing production).

6.2.1. Equation 1: Plan capacity and housing production

The first equation consists of the relation between plan capacity and the new-build housing production (which has been assigned as the building permits granted and the change in total housing stock). The results of the regression analysis are shown in table 6.3 until table 6.6. These regression output tables all differ slightly in the main dependent and/or independent variable and will be discussed in order and individually. For each table, different model specifications are used in which the number of explanatory variables increases in every regression analysis. All variables are measured with logarithms, and the coefficients may, therefore, directly being interpreted as elasticities (Leishman & Bramley, 2005). In every model specification, more variables are included as well as more information is excluded, to create the best possible estimation of the effect; an unbiased effect.

Table 6.3 presents the estimated supply equation between the total hard rental plan capacity and the number of building permits granted. The results are mixed. Several variables are statically significant and suggest that plan capacity has a substantial influence on the building permits granted.

Table 6.3: Relation between plan capacity and building permits granted for private rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity private rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
Plan capacity private rented sector (ln)	0.438*** (14.17)	0.442*** (14.20)	0.139*** (3.42)	0.137** (2.49)
Municipality characteristics				
Population (ln)			0.696*** (8.96)	0.614 (0.17)
Number of inhabitants per km² (ln)			0.238* (1.80)	-0.543 (-0.15)
Share of buildable area already built (ln)			-0.213 (-0.26)	3.034 (0.18)
Selling price (ln)			0.141 (0.47)	0.0530 (0.05)
Regional characteristics				
Land price (ln)			0.784** (2.22)	-0.493 (-0.71)
Building costs (ln)			2.565 (1.46)	-3.646 (-0.92)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	644	644	644	644
R^2	0.237	0.251	0.393	0.056
R^2 within				0.056
F-statistic	200.717	21.360	33.829	2.352

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The results in Table 6.3 are mixed. The coefficients in model specification 1 of 0,438 seem to indicate that an increase in plan capacity has a partial effect on the number of building permits granted, and therefore the new-build housing production. A 1% increase in plan capacity leads to a 0.44% increase in the number of building permits granted. However, the explanatory power of the overall model is not high. The value of R-squared is 0.237. This outcome means that nearly 24% of the variation in building permits can be attributed to the hard plan capacity in this model, indicating a small positive linear association. The relatively low explanatory power of the first model suggests that other factors explain the variance in the number of building permits granted.

In the second model specification, year fixed effects are included. Year fixed effects refer to a model in which the group of means are non-random, which is often the case in time-series analysis and panel-data. The year fixed effect assists in controlling for omitted variable bias, which can be caused by unobserved heterogeneity. The fixed effect assumption is that the dependent variable effects are correlated with the independent variables. By adding the year fixed effects, the building permits granted and plan capacity are correlated over the years. The result shows that the relation between plan capacity and building permits granted, as well as the explanatory power of the model, has slightly improved. Respectively, these parameters exceed 0.442 and 0.251 in model specification 2.

The third model specification consists of the year fixed effects and several other independent variables. These other independent variables are divided into two groups, municipality and regional characteristics. This division is based on the availability of data and the aggregated level on which this data is provided. Based on the theory, these independent variables are expected to influence housing production. According to the results, the number of inhabitants and the price of land are both strongly effecting the number of building permits granted. The number of inhabitants per km², which is an indicator for the density in a certain municipality, also has an effect (0.238) on the housing production. Other independent variables are not significant and not affecting the dependent variable in any significant way. However, adding these other independent variables enabled the relationship between plan capacity and building permits granted to deteriorate. The relation dropped between model specification two and three from 0.442 to 0.139, whilst still being significant. The explanatory power of the model has improved, indicating that 39% of the variation in building permits can be attributed to these independent variables.

The fourth model specification is extended by also adding municipality fixed effects in the regression analysis. By adding this municipality fixed effects, the model corrects for the differences within municipalities. The model only estimates the variation in a specific municipality calculated against the mean within that municipality over the years. The results show that looking at the differences in a municipality only, by adding these fixed effects, both the relationship between plan capacity and building permits granted, as well as the overall explanatory power of the model, have decreased. All other independent variables are not significant. A possible explanation for this could be that the variation of results in each municipality does not strongly change over the years related to the mean in that municipality.

Table A1 (Appendix) shows the relation between the plan capacity in the total rented sector and the building permits granted. The regression analysis has been conducted in the same manner compared to the regression analysis in Table 6.3. The results in Table A1 show a stronger relationship between plan capacity and building permits granted in model specification one and two. The results in model specification three and four show the same pattern (equal variables significant) as in Table 6.3. The explanatory power of all model specifications (R^2) has increased by calculating for the entire rental sector.

The second linear regression analysis has been calculated in the same way but with a different dependent variable. In this analysis, the difference in total housing stock between the current and previous year has been calculated for the private rented sector. The difference between housing stock can be seen as an indicator of new-build housing production. However, also the number of buildings demolished or altered are calculated in this difference. The results of the regression analysis are shown in table 6.4.

Table 6.4: Relation between plan capacity and housing stock in the private rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity private rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
Plan capacity private rented sector (ln)	0.292*** (5.75)	0.303*** (6.93)	0.0664 (1.29)	0.135* (1.84)
Municipality characteristics				
Population (ln)			0.892*** (7.04)	4.017 (0.38)
Number of inhabitants per km² (ln)			-0.173 (-0.77)	16.69* (1.72)
Share of buildable area already built (ln)			1.035 (0.66)	-42.49** (-2.19)
Selling price (ln)			0.871** (2.22)	1.372 (1.05)
Regional characteristics				
Land price (ln)			0.587 (1.28)	0.267 (0.31)
Building costs (ln)			4.035* (1.76)	0.938 (0.16)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	989	989	989	989
R^2	0.035	0.373	0.425	0.409
R^2 within				0.409
F-statistic	33.070	84.412	82.937	57.524

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

First of all, the number of observations has been increased because the municipality and year can be compared with more plan capacity and housing stock data. Model specification 1 shows the relation between plan capacity and the change in housing stock with random effects. The relation is significant, but with a lower correlation as when using building permits granted or the housing stock in the total rented sector (Resp. Table 6.3 and Table A2). An increase in plan capacity with 1% leads to an increase in housing stock with 0,29%. The explanatory power of this model is deficient, signifying almost no positive linear regression. An explanation for this could be that the variation per year and municipality is very high, corresponding to the explanatory power in the other model specifications.

The relation between plan capacity and housing stock in model specification 2 is almost similar to specification 1. However, the explanatory power of the model is strongly increased by adding the year fixed effects. In model specification 3 the other independent variables are included, indicating that the population and selling price have a strong significant relation with the change in the housing stock. This was expected based on the theory, which suggests that an increase/decrease in the number of inhabitants and selling price, can alter the existing housing stock. By adding the other independent variables, the relationship between plan capacity and housing stock became not significant. This outcome could be caused by other more substantial correlated variables, negatively influencing the relationship between plan capacity and housing stock. In model specification 4 the municipality fixed effects are included. The relation between plan capacity and housing stock in a certain municipality over the years is slightly positively correlated. An increase of 1% of plan capacity in a specific municipality, results in a 0,14% change in the housing stock. Other independent variables are almost not significant or giving not representable effects of the current model estimation. The results in the appendix table A2 provide a somewhat similar outcome. By using the total rental housing stock, the relation with plan capacity became not significant in model specification 4.

In the third and fourth regression analysis (in table 6.5 & 6.6), a delay in plan capacity has been used instead of the plan capacity in a similar year for the private rented sector. A separation is made between a 1-year and a 2-year delay. As discussed earlier, depending on the juridical status, the new build housing production can be started later than the actual hard plan capacity assigned. The lagged plan capacity serves as a proxy for housing produced in the near future. In table 6.5, the regression analysis has been conducted based on the delay in plan capacity and the building permits granted.

Table 6.5: Relation between delay in plan capacity and building permits granted for the private rented sector

	(1)	(2)	(3)	(4)
	Only change in plan capacity private rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
1-year lag Plan capacity private rented sector (ln)	0.267*** (2.79)	0.255*** (2.60)	0.144* (1.95)	0.119* (1.80)
2-year lag Plan capacity private rented sector (ln)	0.0990 (1.37)	0.0837 (1.15)	-0.0275 (-0.46)	-0.0751 (-1.15)
Municipality characteristics				
Population (ln)			0.882*** (11.64)	9.883** (2.02)
Number of inhabitants per km² (ln)			0.248 (1.53)	-10.88 (-1.50)
Share of buildable area already built (ln)			0.160 (0.17)	43.70* (1.85)
Selling price (ln)			0.483 (1.25)	2.184 (1.38)
Regional characteristics				
Land price per m² (ln)			1.003** (2.42)	-0.929 (-0.87)
Building costs per m³ (ln)			-1.013 (-0.56)	-9.205* (-1.81)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	461	461	461	461
R^2	0.020	0.034	0.402	0.090
R^2 within				0.090
F-statistic	4.435	1.865	26.586	2.793

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

In model specification 1 in table 6.5, the effect of the 1-year and 2-year lagged plan capacity on the building permits granted has been estimated. The 1-year lagged value in plan capacity has a positive, significant relationship with the building permits granted. A one per cent increase in plan capacity leads to an increase of 0,27% in building permits issued. When using a two-year plan capacity lag, the estimates become not significant anymore. In model specification 2, with included year fixed effects, similar results are established. The explanatory power of both model specifications is deficient, creating almost no positive linear regression. By adding other independent variables in the equation, the R-squared of the model increases to 0.402. This increase is mainly the cause of including the population, which is a reliable indicator for the explanatory power of the model (without using population as an independent variable, the R-square would exceed 0.266). In this way, a higher population also means more building permits granted. In model specification 4, the municipality fixed effects are included, decreasing the explanatory power of the model to 0.09. The relation between the 1-year lag plan capacity and building permits granted stays positively related.

The results between the 1-year and 2-year lagged plan capacity and the building permit granted for the total rental sector are included in the appendix table A3. These results are almost similar to the results for the private rented sector.

In regression 4 in table 6.6, the dependent variable has been replaced by the change in housing stock. The independent variables are the 1-year and 2-year lagged plan capacity. The results are shown in table 6.6.

Table 6.6: Relation between delay in plan capacity and delay in plan capacity and housing stock for the private rented sector

	(1)	(2)	(3)	(4)
	Only change in plan capacity private rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
1-year lag Plan capacity private rented sector (ln)	0.106 (1.05)	0.0501 (0.59)	-0.0320 (-0.42)	-0.0630 (-0.78)
2-year lag Plan capacity private rented sector (ln)	0.124 (1.13)	0.145* (1.75)	0.0897 (1.19)	0.0660 (0.95)
Municipality characteristics				
Population (ln)			1.067*** (8.35)	-3.270 (-0.16)
Number of inhabitants per km² (ln)			-0.195 (-0.74)	24.60 (1.20)
Share of buildable area already built (ln)			1.690 (0.97)	-22.46 (-0.58)
Selling price (ln)			0.520 (1.09)	-0.825 (-0.48)
Regional characteristics				
Land price (ln)			0.809 (1.55)	0.314 (0.27)
Building costs (ln)			3.037 (1.26)	-2.264 (-0.30)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	723	723	723	723
R^2	0.003	0.345	0.459	0.416
R^2 within				0.416
F-statistic	1.067	65.622	84.160	51.596

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The results show that the relation between the 1-year and 2-year lagged plan capacity and the change in private rental housing stock between this year and previous year is not significant in all of the model specifications. This result means that the model in unusable. An explanation for the non-significant relationship can be sought in the fact that demolishments are also included in the difference between housing stock. Demolition can have a negative impact on the model specification because in one year there can be no demolishment (positive increase in housing stock, or housing production), while in another year there can be demolition of houses in a certain municipality and new build production (decrease of housing stock). This creates unbalanced and uncertain outcomes, which is represented in the regression outcome. The explanatory power of the model specification 2, 3,4 is better compared with regression 3. However, with other numbers of observations and non-significant findings, this is not relevant.

Appendix table A4 shows the relation between the 1-year and 2-year lagged plan capacity and the change in the total rental housing stock. The outcomes are different from the estimations with private rental housing. Model specification 3 and 4 in table A4, show both a significant relationship between a 1-year lagged plan capacity and the change in the rental housing stock. However, this significant relationship is negative. In model specification 3, a 1% increase in rental plan capacity leads to a decrease of 0,24% in the total housing stock. In model specification 4, this even leads to a decrease of 0,30% with municipality fixed effects included. A reason for this can be that in the observations, more municipalities in the countryside have been used. Municipalities in the countryside could have done more demolishing than denser cities.

6.2.2. Equation 2: housing production and rental prices in the private rented sector

The previous paragraph discussed the relationship between plan capacity and housing production in the private rented sector. In order to gain more knowledge about the current Dutch housing shortage and to answer the research question, the relation between housing production and the rental prices in the private rented sector will be estimated in this paragraph. According to the theoretical framework and the knowledge about the Dutch private rented market, it is assumed that rental prices increase due to a shortage of rental housing. The relation between the housing production and rental prices in the private rented sector is analysed in a (multiple) regression analysis of which the results are shown in Table 6.7.

Table 6.7: Relation between housing stock and rental prices in the private rented sector

	(1)	(2)	(3)	(4)	(5)
	Only change in housing stock used	Year fixed effects included	Municipality and regional characteris-tics included	Plan capacity included	Municipality fixed effects included
Housing production					
Change in housing stock (ln)	0.00460* (1.85)	0.00673** (2.52)	0.000260 (0.11)	0.0000516 (0.01)	-0.000576 (-0.41)
Plan capacity					
Plan capacity private rented sector (ln)				0.00856 (0.99)	0.0101** (2.36)
1-year lag Plan capacity private rented sector (ln)				-0.00994 (-0.79)	-0.00672 (-1.43)
2-year lag Plan capacity private rented sector (ln)				0.00263 (0.21)	-0.00424 (-0.70)
Municipality characteristics					
Standardized income (ln)			0.405*** (3.02)	0.194 (0.93)	-0.517 (-1.09)
Population (ln)			0.0731*** (9.51)	0.0628*** (3.44)	-0.410 (-0.79)
Number of inhabitants per km² (ln)			0.0259 (1.27)	0.0446 (0.82)	-0.00691 (-0.02)
Share of buildable area already built (ln)			0.0516 (0.68)	-0.0409 (-0.18)	1.256 (0.78)
Selling price (ln)			0.102* (1.87)	0.590*** (5.50)	-0.0949 (-0.94)
Regional characteristics					
Land price (ln)			0.0836** (2.48)	0.253*** (3.60)	0.0684 (0.80)
Building costs (ln)			0.250 (1.34)	-0.221 (-0.61)	-0.724 (-1.33)
Fixed effects					
Year fixed effects	No	Yes	Yes	Yes	Yes
Municipality fixed effects	No	No	No	No	Yes
Observations	560	560	354	123	123
R^2	0.006	0.286	0.550	0.608	0.731
R^2 within					0.731
F-statistic	3.415	19.823	38.040	19.851	27.902

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The results in model specification 1 show that the relation between housing stock and rental prices in the private rented sector is significant. According to the results, an increase in housing stock of 1% leads to a rise in rental prices of 0,005%. This price increase is almost nihil but is still different from what would have been expected out of theory. Lower housing supply would lead to higher prices (DiPasquale & Wheaton, 1996; Glaeser et al., 2005). However, this outcome can be explained by the fact that the first model estimation is estimated based on random effects, meaning that the change of rental prices between municipalities and especially over the years has not been taken into account. The explanatory power of the overall model is also shallow, meaning that there is just a slightly positive regression.

The second model specification includes the year fixed effects. By using the year fixed effects, the explanatory power of the model increases significantly to 0.286. The relation between change in housing stock and rental prices slightly improves, which is still contrary to the results of the theory. In model specification 3, other independent variables are included. According to the theory, rental prices increase similar to income growth in the Netherlands. The results show that there is a relation between income; however, a reasonably small relation. An increase in income of 1% would lead to an increase in rental prices of 0.37%. In addition, the land price has an influence on rental prices, which is in relation to the theory. This relation is yet rather small: an increase in land prices by 1% would lead to an increase in rental prices in the private rented sector of 0.08%. Also, the assumption that the selling price and rental prices are interrelated with each other can been seen in the outcome of the regression analysis in model specification three. The explanatory power of the model has increased until 0.550, leaving the relation between the housing stock and rental prices not significant anymore.

In model specification 4, the plan capacity is implemented. The (delay in) plan capacity is expected to have an indirect influence on the rental prices. However, the outcome does not show this relation. All independent variables are not significant. The relation between housing prices and land prices on rental prices has increased. Both are estimated to have a more substantial effect on the rental prices in the private rented sector in model specification four. In model specification 5 the municipality fixed effects have been included in calculating the effect between the variation of the mean in every single municipality. The results indicate a significant relationship between plan capacity and rental prices in the private rented sector. An increase in gross, hard plan capacity of 1% would lead to a rental price increase of 0.01%, which is almost nihil. All other independent variables are not significant. In comparison with model specification 4, where the same amount of observations are used, the explanatory power of the model (R-squared) has improved to 0.731. Model specification 5 shows a robust model with, unfortunately, almost no variables influencing the rental prices in the private rented sector.

The same analysis as in table 6.7 has also be calculated with building permits granted as the main independent variable. Based on the theory and previous paragraph, the building permits granted can be seen as an even better variable for housing production, in order to estimate the effects upon the rental prices. The results of this (multiple) regression analysis are presented in table 6.8.

Table 6.8: Relation between building permits granted and rental prices in the private rented sector

	(1)	(2)	(3)	(4)	(5)
	Only change in housing stock used	Year fixed effects included	Municipality and regional characteris-tics included	Plan capacity included	Municipality fixed effects included
Housing production					
Building permits granted (ln)	0.0262*** (3.82)	0.0259*** (4.09)	-0.00394 (-0.55)	0.00208 (0.23)	0.00570 (1.37)
Plan capacity					
Plan capacity private rented sector (ln)				-0.000777 (-0.07)	0.0148** (2.09)
1-year lag Plan capacity private rented sector (ln)				-0.0127 (-0.66)	-0.0166 (-1.51)
2-year lag Plan capacity private rented sector (ln)				0.00877 (0.45)	-0.00757 (-0.71)
Municipality characteristics					
Standardized income (ln)			0.370** (2.16)	0.367 (1.22)	-0.493 (-0.70)
Population (ln)			0.0657*** (6.04)	0.0550** (2.22)	-0.153 (-0.30)
Number of inhabitants per km² (ln)			0.0306 (1.23)	0.0784 (1.27)	-0.0360 (-0.09)
Share of buildable area already built (ln)			0.0769 (0.82)	-0.0799 (-0.33)	1.904 (1.01)
Selling price (ln)			0.135** (2.03)	0.636*** (3.91)	-0.227* (-1.90)
Regional characteristics					
Land price (ln)			0.0680* (1.66)	0.260*** (2.94)	-0.137 (-1.63)
Building costs (ln)			0.363* (1.75)	-0.426 (-0.87)	-0.357 (-0.82)
Fixed effects					
Year fixed effects	No	Yes	Yes	Yes	Yes
Municipality fixed effects	No	No	No	No	Yes
Observations	412	412	252	87	87
R^2	0.049	0.311	0.553	0.609	0.762
R^2 within					0.762
F-statistic	14.625	16.126	26.372	12.977	97.185

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The results of the regression analysis in table 6.8 present a somewhat similar result compared to previous regression analysis. The number of observations has decreased, meaning that fewer observations in the building permits granted could be assigned to and compared with the rental prices in the private rented sector and all other independent variables. Model specification 1 and 2 both show a positive, significant relation between building permits granted and rental prices. The usage of year fixed effects does almost not affect this relation: an increase of building permits of 1% leads to an increase in rental prices of 0.03% in both estimations. The results in model estimation 3 are very similar to the results in table 6.7. However, the effect of building costs on the rental prices is, by using building permits granted as the main independent variable, significant. An increase in building costs of 1% would lead to an increase in rental prices of 0.36%.

Model specification 4 shows similar results as previous regression analysis: population, selling price and land price are the only significant, positive independent variables in this regression analysis. In model specification 5 also similar pattern is shown compared with table 6.7, except for the selling price. By adding municipality fixed effects, it seems that the selling price has a negative, significant relationship with the rental price. It would indicate that an increase in selling price by 1% would lead to a decrease in rental price by -0,22%. An explanation for this could be that the rental price and selling price have not been increasing in similarly over the years per municipality. Regional differences can have a significant impact on the functioning of the housing market, and therefore the price development. The demand for owner-occupied housing could be substantially more prominent than the need for rented housing and vice versa. This would explain the negative relation between rental prices and selling prices between the municipalities used. What also should be noted is that the number of observations has decreased; this could indicate that only certain municipalities have been used in which the rental price did not increase similar to the selling price. Table 6.8 also shows that the explanatory power of every consecutive regression analysis has been increasing to the highest point reaching in model specification 5, with 0.762.

7. Conclusion and recommendation

In this chapter, answers to the main research question(s) will be formulated. The literature study and the regression results of the empirical analysis used in the previous chapters allow conclusions to be drawn to answer the research questions formulated in the first chapter. Based on these conclusions, recommendations for future research or practical situations can be made. The conclusions will be described in Section 7.1, in which paragraph 7.1.1. and 7.1.2. give an answer to the research questions. In paragraph 7.2, limitations of the research and recommendations for further research will be made based on the primary findings of this study.

7.1. Conclusion

The central question in this research is: *'What is the effect of planning restrictions, in terms of plan capacity, on the rental housing prices in the private rented sector in the Netherlands?'* In order to find an answer to this main question, the sub-questions formulated in this study need to be answered. The answers to these sub-questions together form the answer to the main question of this study. The sub-questions in this research will be answered in the following sections.

7.1.1. The relation between plan capacity and housing production

The first sub-question in this study relates to the plan capacity and housing production in the Netherlands, represented into the following question: *'What is the effect of plan capacity on the new-build housing production in the private rented sector?'.* Although in the literature, various forms of planning restrictions that influence the development of new housing production are given, this study looks at the plan capacity at a municipal level as main restriction. It was hypothesized that a higher plan capacity in a certain municipality could possibly lead to more housing production, based on the fact that more space would be available for investors and developers.

The regression analysis tested this hypothesis by estimating the relationship between the (gross) hard plan capacity and rental housing production. First of all, the result does indeed point to a link between plan capacity and new-build housing production. It should be noted, however, that for housing production, on the one hand, the change in the housing stock was taken into account and, on the other hand, the number of building permits granted that function as new building production. The regression results indicate that an increase in the amount of plan capacity increases the number of newly built houses in the private rented sector, but this is not equally distributed. A 1% increase in the current plan capacity will only lead to an increase in building permits granted, in terms of new housing production, of approximately 0.44%. At the same time, an increase of 1% in plan capacity leads to an increase in housing stock, in terms of new-build housing production, of approximately 0,29%. The results for the total rented sector present a similar outcome, with higher significant relations between the total rented plan capacity and the new-build rental housing production. Based on the empirical analysis, in which also the explanatory power of the analysis has been assessed, the building permits granted can be seen as a better indicator for housing production compared to the change in housing stock.

Based on the literature, it has been assumed that the plan capacity could lead to new housing construction with a delayed effect (see, for example, Ball, 2011). Hence, the estimated time from hard plan until the start of construction has been calculated at a maximum of 24 months in the Netherlands (Scheele-Goedhart & Van der Reijden, 2008). The regression results show that a 2-years delay of (private rented) plan capacity shows that a 1% increase leads to an increase in building permits granted by 0,26% one year later (including the year fixed effects). It can be concluded that there is indeed a delay between plan capacity and housing production. However, this effect seems to be relatively small. The effect between both variables in the same year is stronger and therefore, more reliable.

In other research, different variables have been included in the regression analysis which are expected to affect the number of new-build houses produced (see, for example, Leishman & Bramley, 2005; Hilber & Vermeulen, 2010). The other independent variables included in the empirical analysis were expected to influence housing production. The results in the equation show that the population and number of inhabitants per m² have a significant influence on the new-build rental housing production. Both are an

indicator of how expansive a certain municipality is. Denser cities tend to be more regulated and are having a substantial influence on the houses being produced in the rented sector. The land price, building costs and selling price of houses also present, to some extent, significant results in the different regression analysis. The price of land was expected to influence the investors and developers decision, on the hand, in buying the land for a most profitable price and, on the other hand, to start constructing when housing prices are expected to be the highest and building costs the lowest.

The fixed effects included in the model specifications appear to have a substantial impact on the results. Model specifications without fixed effects estimate a higher and more significant coefficient for plan capacity and housing production. However, this significance decreased when fixed effects for municipality, provincial or COROP areas are added in the various model specifications. In contrast, the explanatory power of the different model specification increases by making use of fixed effects. A decreased significance indicates that the significant effect of housing and land prices can be explained by regional characteristics not included in the regression model. For example, high land and housing prices can both be considered as a result of a more tight and active regional housing market. The municipality fixed effects corrected for these differences between municipalities, resulted in small relationships between plan capacity and housing production. This could indicate that other variables are influencing the new-build rental housing production in certain municipalities even more.

The literature suggested that an implementation gap between the plan capacity available in a certain year and the total new-build housing production existed (Bramley, 1993). However, the results in the empirical analysis do not substantially indicate the existing of this implementation gap. The regression results indicate that the (underutilized) plan capacity, which has been evaluated in previous research, has a limited influence on the new-build housing production. This is in line with Bramley (1993), who argued that there is very little correlation between planning permissions granted and the number of dwellings completed. Based on these findings, it can be assumed that the delay and shortage in housing production in the rental sector is generally not been influenced by (spare) plan capacity, but, rather by other factors. Also, the relatively low explanatory power of the models (measured by R^2) could indicate that a relevant variable, a so-called omitted variable, is missing from the equation (Daniels & Minot, 2019).

7.1.2. The relation between housing production and rental prices in the private rented sector

The second sub-question in this research is related to the relationship between housing production and rental prices in the private rented sector, and formulated into the following question: *'What is the effect of housing production on rental prices in the private rented sector in the Netherlands?'* This question has been stated because it is assumed that the lower housing production has an increasing effect on the rental prices in the private rented sector. In multiple research, this form of scarcity has already proven to increase housing prices in areas (Glaeser et al., 2005; Glaeser et al., 2008; Hilber & Vermeulen, 2010). However, the relationship between housing production and rental prices in the private rented sector has been far more neglected in previous research. Furthermore, the price developments in the rental market have been proven to be different to some extent in relation with the owner-occupied market. It is, therefore, that the assumption, as mentioned above, has been tested in a regression analysis.

The outcome of the regression analysis has shown that the relation between housing production and rental prices can be seen as significant. However, this relationship is almost nihil between both variables. According to the results, an increase in building permits granted (i.e. housing production) with 1% would only lead to an increase in rental prices with 0.02%. This contradicts the theory, which would have assumed that there would be a negative relation established. A lower production would lead to less housing available, so a scarcer product, meaning prices to rise. Based on the regression analysis, there also does not seem to be a relation between plan capacity and rental prices.

The previously stated assumption (see paragraph 7.1.1.) that spare plan capacity has a low influence on the housing production has (indirectly) also an effect on the rental prices in the private rented sector. The low influence of plan capacity indicates that for both relationships, the price developments in the private rented sector have been developed by other factors. Other variables have been tested in the

regression analysis. The outcome shows that the average standardized income of households has a positive, significant effect on rental price developments. An increase in standardized income of 1% leads to an increase in rental price between 0.37% and 0,41%. However, by using the plan capacity in the model specification, this significant relationship between average standardized income and rental prices disappears. This is in line with Daniels and Minot (2019), who acknowledge that the usage of an omitted variable (in this case plan capacity) in correlation with other independent variables in the model could enable the estimated coefficients of these variables to be biased and thus not significant (Daniels & Minot, 2019).

Another reason for the small relation between housing production and rental prices in the private rented sector can be sought in regional differences. By evaluating the variation towards the average over the years in individual municipalities, the plan capacity became significant in the equation. A small positive relation between plan capacity and rental prices indicates a price-effect, but the reason for increasing rental prices should be sought somewhere else, possibly even the other way around. Rising prices can go accompanied by reductions in development in more attractive and denser places, which appears not to be caused by a decline in the availability of land. This could be the result of a changing regulatory regime, which enables large-scale housing production to be increasingly difficult in expensive regions (Glaeser and Gyourko, 2003; Glaeser et al., 2005).

Institutional disadvantages have been considered to influence the price developments in the Dutch private rental housing market. The submarkets in the Dutch housing market are intertwined, meaning that a misfunctioning of one market has an impact on other markets. According to Rabobank (2019), the Dutch middle segment has mainly grown to changes in other sectors of the housing market, especially at the expense of the owner-occupied market.

The above here mentioned conclusions indicate that the relation between housing production and rental prices in the private rented sector is not as strong as assumed. The role of spare plan capacity has a limited influence on the housing production, and therefore also on the rental prices in the private rented sector. It is for this that other variables, institutional changes and effects in other submarkets are expected to have a big influence on the rental price increases in the private rented sector in the Netherlands.

7.2. Discussion

This research has focused firstly on the relationship between plan capacity (as a form of planning restrictions) and housing production, and secondly on the relation between housing production and rental prices in the private rented sector in the Netherlands. Based on the findings of this study and the conclusions in the previous section, a number of recommendations can be made for future research, due to the fact that new issues have arisen from this research. Also, some limitations within this research are acknowledged and discussed.

7.2.1. Limitations of the research

The study has a number of limitations. Firstly, the results of this study cannot be generalized to the situation in the Netherlands as a whole. This is in relation to the earlier statement that international literature cannot be fully copied for the Dutch context, as the Dutch (rental) housing market consists of different characteristics. Regarding the data about plan capacity, the selection of research units in this study was not random. It was bound to the availability of data from 282 municipalities in the Netherlands (73% of all municipalities) from 6 non-random provinces. Furthermore, this data only consists of plan capacity between 2007 and 2017. Also, only the provinces of Noord-Brabant and Gelderland consisted of data about rental plan capacity. The provinces that had already participated in the study were asked to share the data of 2018 and 2019 as well, which most of them have done at this moment. Due to time constraints, it was decided not to wait until the data from 2018 and 2019 was received in order to be able to complete the research in the preferred timeframe.

The data gathered from CBS does not contain the number of new-build dwellings in the private rented segment. Instead, the difference in housing stock and the number of building permits are used as an alternative. Both do not actually represent the number of new-build dwellings created in a certain year

in the private rented sector and can, therefore, have a different outcome compared to the actual new-build production. Also, there has been no distinction made in the type of client or the type of owner, which could have been done as has been discussed in paragraph 5.1. By making these distinctions, the results of the empirical analysis could be different.

The data about rental prices in the private rented sector in the Netherlands could also be extended. The current dataset consists of different municipalities in the Netherlands, which was merged and related to the plan capacity and housing production datasets. Within this merge, several observations from which rental prices were available, were deleted because there was no plan capacity data existing. The results could be different when using the total number of observations in the rental dataset. Also, there was no further information available from the dataset about the rental property characteristics which could declare some rental price developments in certain municipalities. By including these property characteristics, results can change or become more or less significant. Another type of analysis could then also be considered in order to measure the extent of certain restrictions on rents (e.g. by using a hedonic price analysis). Also, not all data provides was on a similar scale. The building costs and land prices were on a regional scale. Regression outcome could have been different when using only data on a municipal level.

In addition, the choice for an analysis with (almost) only variables at the municipal level (meso level) results in limitations with regard to the variance in the housing production that can be analysed. The disappearance of the significance of some explanatory variables by including fixed effects indicates that unobserved factors influence the number of new-build dwellings delivered per municipality. The effect of fixed effects per year can possibly be explained by factors not included in the model at a macro level, such as the economic cycle and the mortgage interest rate, as well as at a micro level, such as vacancy rates and neighbourhood aspects. Research by Hakvoort & Matysiak (1997) already showed that the private rented sector was considerably reduced because of the economic depression at the beginning of the 1980s. However, with the current research design, it is not possible to demonstrate which underlying unobserved factors are actually responsible for the effects. Future research can provide more insight into this by operationalising these macro and micro factors and adding them to the regression models, rather than classifying them as fixed effects.

7.2.2. Recommendations for future research

This research has focused on the (gross) hard plan capacity from municipalities, while the juridical phase is closer to achieving a building permit. In future research, hard plan capacity could be replaced by soft plan capacity to estimate the effects of the ‘longer’ plan capacity. The relationship with differences in the rental price and housing production can be different by using soft plan capacity. Also, the dataset provided is containing information about the various legal phases a current plan is in. By separating these plans into the juridical phases, as can be seen in table 2.1, different relations can be tested to measure the possible effect (and delays) in housing production and rental prices in the private rented sector. What should also be noted, is that in these analyses only has been looked at the plan capacity and housing production of (private) rental dwellings. It could be argued that for the owner-occupied housing market, different results would occur. By using the same dataset, the results between both markets can be analysed to see if there are similar patterns.

It may also be possible to include additional factors at meso level in future research that have not been included in this study. One of these could be to estimate the effect of construction capacity in both equations. It can be assumed that a shortage of builders or materials could lead to delay in housing construction and also indirectly have some effect on (rental) housing prices. The decrease in the number of significant variables by making use of fixed effects also indicated that there are further relevant explanatory factors. It has also already been stated that the inclusion of some of these omitted variables could impact the results in the current equations (negatively), so caution is advised.

The influence of policy reforms in the Netherlands can be researched to analyse the effect of these alterations on housing production and price developments. These policy reforms may have caused the current housing shortage, and substantial price increases. The introduction of the 2015 Housing Act, in which housing associations are allowed to have only a certain number of their total assets in the private rented sector, could have major influences on the production- and price developments. By restricting

the ‘playing field’ of housing associations, fewer rental dwellings in the private rented sector are being built. This means less available dwellings in these segments, which could have possibly influenced the price developments. This creates inequality to a certain extent between private investors and housing associations. Also, the introduction of the ‘verhuurdersheffing’ (landlord levy) increases this effect. The idea behind this tax is that housing associations have to sell more of their private rented dwellings and that more houses become liberalised (so above the ‘liberalisatiegrens’). The latter was empowered by the adjustment in the WWS-system in 2015, in which the WOZ-value gained a more dominant role in the determination of points that a dwelling receives. These policy reforms, in combination with the fact that the different submarkets in the Netherlands are strongly intertwined, makes it interesting to conduct further research about these effects.

Lastly, research on a micro level, which has been mostly neglected in similar studies mainly due to the availability of data, could also contribute to a more in-depth analysis and understanding of specific factors influencing housing production and the rental prices in the private rented sector. The current research at the meso level only operationalizes plan capacity from the legal planning phase. This means that not all potentially relevant aspects of housing plans are visible. In addition, studies at a micro level can better analyse the delay in plan capacity and the construction process. The decisions taken by investors and developers could contribute to the understanding about certain delays. The assumed implementation gap can also be better analysed. By examining the reasons and causes of this at a micro level, it is possible to explain what exactly affects the current shortage in housing production, and which is assumed to be related to rising rents in the private rented sector.

References

ABF Research. (2019). *Functie van en vraag naar middenhuurwoningen*. Retrieved from https://zoek.officielebekendmakingen.nl/blg-891362.pdf

Ball, M. (2011). Planning delay and the responsiveness of English housing supply. *Urban Studies*, *48*(2), 349-362

Ball, M., Meen, G., & Nygaard, C. (2010). Housing supply price elasticities revisited: Evidence from international, national, local and company data. *Journal of Housing Economics*, *19*(4), 255-268.

Berntsen, P., de Ruyter, J., & Menkveld, N. (2019). *Grond om te boeren: Prijsverschillen in landbouwgrond nemen komende jaren toe*. Retrieved from https://insights.abnamro.nl/2019/12/prijsverschillen-in-landbouwgrond-nemen-komende-jaren-toe/

Besseling, P. J., Bovenberg, A. L., Romijn, G., & Vermeulen, W. J. V. (2008). De Nederlandse woningmarkt en overheidsbeleid: over aanbodrestricties en vraagsubsidies. *Agenda Voor de Woningmarkt. KVS Preadviezen 2008*, 13-79.

Berkhout, T. M., & Bartels, S. (2016). Vastgoedfinanciering: Klaar voor de toekomst. *Congresbundel van de stichting Fundatie Bachiene*, (6).

Blackley, D. M. (1999). The long-run elasticity of new housing supply in the United States: Empirical evidence for 1950 to 1994. *The Journal of Real Estate Finance and Economics*, *18*(1), 25-42.

Boelhouwer, P., & Priemus, H. (2014). Demise of the Dutch social housing tradition: impact of budget cuts and political changes. *Journal of Housing and the Built Environment*, *29*(2), 221-235.

Bramley, G. (1993). Land-use planning and the housing market in Britain: the impact on housebuilding and house prices. *Environment and Planning A*, *25*(7), 1021-1051.

Bramley, G. (1998). Measuring planning: indicators of planning restraint and its impact on housing land supply. *Environment and Planning B: Planning and Design*, *25*(1), 31-57.

Bramley, G. (2013). Housing market models and planning. *Town Planning Review*, *84*(1), 9-35.

Bramley, G., & Leishman, C. (2005). Planning and housing supply in two-speed Britain: Modelling local market outcomes. *Urban Studies*, *42*(12), 2213-2244.

Bramley, G., & Watkins, D. (2014). 'Measure twice, cut once'—revisiting the strength and impact of local planning regulation of housing development in England. *Environment and Planning B: Planning and Design*, *41*(5), 863-884.

Buitelaar, E. (2019). Versnelling van de woningbouw: van korte-naar langetermijnperspectief. *Real Estate Research Quarterly*, *2*, 5-11.

Buitelaar, E. & Van Dongen, F. (2016). Toenemende kantorenleegstand: over divergentie tussen de gebruikers en beleggers. *TPEdigitaal*, *10*(2), 42-53.

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

Buitelaar, E., Sorel, N., Verwest, F., van Dongen, F., & Bregman, A. (2013). Gebiedsontwikkeling en commerciële vastgoedmarkten: een institutionele analyse van het (over) aanbod van winkels en kantoren. *Den Haag/Amsterdam: Planbureau voor de Leefomgeving/Amsterdam School of Real Estate*.

Caldera, A., & Johansson, Å. (2013). The price responsiveness of housing supply in OECD countries. *Journal of Housing Economics*, *22*(3), 231-249.

Capital Value. (2020, 10 februari). *Beleggers kunnen komende 3 jaar 100.000 huurwoningen realiseren*. Geraadpleegd op 11 februari 2020, van https://www.capitalvalue.nl/nieuws/beleggers-kunnen-komende-3-jaar-100-000-huurwoningen-realiseren

CBS. (2018, December 18). Prognose: 3,5 miljoen alleenwonenden in 2030. Retrieved from https://www.cbs.nl/nl-nl/nieuws/2018/51/prognose-3-5-miljoen-alleenwonenden-in-2030#:%7E:text=Het%20aantal%20huishoudens%20neemt%20tussen,duizend%20meer%20dan%20nu.

CBS. (2019, April 1). Bijna half miljoen woningen in particuliere verhuur. Retrieved from https://www.cbs.nl/nl-nl/nieuws/2019/14/bijna-half-miljoen-woningen-in-particuliere-verhuur

Cheshire, P.C. & Hilber, C.A.L. (2008). 'Office space supply restrictions in Britain: the political economy of market revenge'*, Economic Journal*, vol. 118(529), pp. F185–221.

Cheshire, P. C., & Sheppard, S. (1997). *The welfare economics of land use regulation*. London School of Economics, Department of Geography.

Cheshire, P., & Sheppard, S. (2002). The welfare economics of land use planning. *Journal of Urban economics*, *52*(2), 242-269.

Chiu, R. L., Liu, Z., & Renaud, B. (Eds.). (2019). *International Housing Market Experience and Implications for China*. Routledge.

Conijn, J., Rouwendal, J., & Schilder, F. (2016). Veranderde verhoudingen op de Nederlandse woningmarkt. *TPE digitaal*, *10*(2), 23-41.

Creswell, W. (2013). John. 2013. *Qualitative inquiry and research design: Choosing among five approaches*.

Daniels, L., & Minot, N. (2019). *An Introduction to Statistics and Data Analysis Using Stata®: From Research Design to Final Report*. Sage Publications.

De Vries, A. J. (2018). *Plancapaciteit en prijsverschillen op de Nederlandse grondmarkt*. Nijmegen, Netherlands: Radboud University.

DiPasquale, D., & Wheaton, W. C. (1992). The markets for real estate assets and space: A conceptual framework. *Real Estate Economics*, *20*(2), 181-198.

DiPasquale, D. (1999). Why don't we know more about housing supply?. *The Journal of Real Estate Finance and Economics*, *18*(1), 9-23.

DiPasquale, D., & Wheaton, W. C. (1996). The urban land market: rents and prices. *Urban Economics and Real Estate Markets*, 34-59.

Donders, J., van Dijk, M., & Romijn, G. (2010). *Hervorming van het Nederlandse woonbeleid* (No. 84. rdf). CPB Netherlands Bureau for Economic Policy Analysis.

Eurostat. (2020, April 8). House price index: annual data. Retrieved from http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

FD. (2017, June 22). Bouwgrond raakt op, woningbouw in de knel. Retrieved 4 February 2020, from https://fd.nl/cookiewall?target=%2Fondernemen%2F1206311%2Fbouwgrond-raakt-op-woningbouw-in-de-knel

Francke, M., Harleman, F., & Kosterman, W. (2017). Determinanten en dynamiek van de huren in de vrije sector. *Economisch-Statistische Berichten*, *102*.

Girouard, N., Kennedy, M., Van Den Noord, P., & André, C. (2006). Recent house price developments: the role of fundamentals, *OECD Economics Department Working Papers*, No. 475, OECD Publishing, Paris, https://doi.org/10.1787/864035447847.

Glaeser, E. L., & Gyourko, J. (2003). The impact of building restrictions on housing affordability. *Economic Policy Review*, *9*(2).

Glaeser, E.L., Gyourko, J. and Saks, R.E. (2005). 'Why have housing prices gone up?', *American Economic Review*, vol. 95(2), pp. 329–33.

Glaeser, E. L., Gyourko, J., & Saiz, A. (2008). Housing supply and housing bubbles. *Journal of urban Economics*, *64*(2), 198-217.

Glaeser, E. L., & Ward, B. A. (2009). The causes and consequences of land use regulation: Evidence from Greater Boston. *Journal of Urban Economics, 65*(3), 265-278.

Green, R. K., Malpezzi, S., & Mayo, S. K. (2005). Metropolitan-specific estimates of the price elasticity of supply of housing, and their sources. *American Economic Review*, *95*(2), 334-339.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research*, *2*(163-194), 105.

Gurran, N., & Bramley, G. (2017). *Urban Planning and the Housing Market*. Palgrave Macmillan: London, UK.

Gyourko, J., & Molloy, R. (2015). Regulation and housing supply. In *Handbook of regional and urban economics* (Vol. 5, pp. 1289-1337). Elsevier.

Gyourko, J., Saiz, A., & Summers, A. (2008). A new measure of the local regulatory environment for housing markets: The Wharton Residential Land Use Regulatory Index. *Urban Studies*, *45*(3), 693-729.

Hakfoort, J., & Matysiak, G. (1997). Housing investment in the Netherlands. *Economic Modelling*, *14*(4), 501-516.

Hekwolter, M., Nijskens, R., & Heeringa, W. (2017). *De woningmarkt in de grote steden*. Technical report, De Nederlandsche Bank.

Hilber, C.A.L. and Robert-Nicoud, F. (2013). 'On the origins of land use regulations: theory and evidence from US metro areas', *Journal of Urban Economics*, vol. 75(1), pp. 29–43.

Hilber, C., & Vermeulen, W. (2010). The Impact of Restructuring Housing Supply on Housing Prices and Affordability. *Final Report, Department of Communities and Local Government, London*.

Hilber, C. A., & Vermeulen, W. (2016). The impact of supply constraints on house prices in England. *The Economic Journal*, *126*(591), 358-405.

ING. (2019, December 1). Minder nieuwbouwwoningen in 2020. Retrieved from https://www.ing.nl/zakelijk/kennis-over-de-economie/uw-sector/outlook/woningbouw.html

Jonker-Verkaart, M., & Wassenberg, F. A. G. (2015). *Kansen voor particuliere huur in Nederland*. Platform31.

Leeuwerik, T. (2018). De realisatie van woningbouwplannen: Een analyse van factoren die bepalen of woningbouwplannen gerealiseerd worden.

Leishman, C., & Bramley, G. (2005). A local housing market model with spatial interaction and land-use planning controls. *Environment and Planning A*, *37*(9), 1637-1649.

Levine, N. (1999). The effects of local growth controls on regional housing production and population redistribution in California. *Urban Studies*, *36*(12), 2047-2068.

Lin, D., & Wachter, S. M. (2019). The Effect of Land Use Regulation on Housing Prices: Theory and Evidence from California. *Available at SSRN*, *3363947*.

Maric, I., Quercia, R., & Simons, R. A. (1998). The Value Impact of New Residential Construction and Neighborhood Disinvestment on Residential Sales Price. *Journal of Real Estate Research*, *15*(1/2).

Mayer, C. J., & Somerville, C. T. (2000a). Residential construction: Using the urban growth model to estimate housing supply. *Journal of urban economics*, *48*(1), 85-109.

Mayer, C. J., & Somerville, C. T. (2000b). Land use regulation and new construction. *Regional Science and Urban Economics*, *30*(6), 639-662.

Michielsen, T., Groot, S., & Maarseveen, R. (2017). Prijselasticiteit van het woningaanbod. *CPB Notitie*.

Michielsen, T., Groot, S., & Veenstra, J. (2019). Het bouwproces van nieuwe woningen. *Den Haag*.

Ministry of General Affairs. (2019, 20 december). *Wat is de huurliberalisatiegrens?* Geraadpleegd van https://www.rijksoverheid.nl/onderwerpen/huurverhoging/vraag-en-antwoord/huurliberalisatiegrens

Ministry of the Interior and Kingdom Relations. (2016). *Staat van de Woningmarkt: Jaarrapportage 2019*

Ministry of the Interior and Kingdom Relations. (2019). *Staat van de Woningmarkt: Jaarrapportage 2019*.

Ministry of the Interior and Kingdom Relations. (2020, January 29). Regels voor toewijzen sociale huurwoningen. Retrieved from https://www.rijksoverheid.nl/onderwerpen/woningcorporaties/toewijzen-betaalbare-woningen

Needham, B. (2006). *Planning, Law and Economics: The rules we make for using land*. Routledge.

Needham, B. (2014). *Dutch land-use planning: The principles and the practice*. Ashgate Publishing, Ltd..

Nijskens, R., & Lohuis, M. (2019). The housing market in major Dutch cities. In *Hot Property* (pp. 23-35). Springer, Cham.

Nijskens, R., Lohuis, M., Hilbers, P., & Heeringa, W. (2019). *Hot Property*. Springer International Publishing.

NVM. (2019). *Vastgoedmarkt in beeld 2019*. Retrieved from https://www.nvm.nl/media/0mjb3afb/vastgoedmarkt-in-beeld-2019.pdf

NVM & VGM NL. (2019). *Transparantie in de verhuurmarkt*. Retrieved from https://vgm.nl/nieuwsdoc/78411_190703-Rapportage-huurtransacties-H1-2019.pdf

Ollongren, K. H. (2018). *Nationale woonagenda 2018-2021*. Retrieved from https://www.rijksoverheid.nl/documenten/publicaties/2018/05/23/nationale-woonagenda-2018-2021

Ollongren, K. H. (2019, 13 september). *Kamerbrief over plancapaciteit Utrecht*. Retrieved from https://www.rijksoverheid.nl/documenten/kamerstukken/2019/09/13/kamerbrief-over-kamerbrief-plancapaciteit-utrecht

Öztürk, B., van Dijk, D., van Hoenselaar, F., & Burgers, S. (2019). The Relationship Between Supply Constraints and House Price Dynamics in the Netherlands. In *Hot Property* (pp. 141-152). Springer, Cham.

Paciorek, A. (2013). Supply constraints and housing market dynamics. *Journal of Urban Economics*, *77*, 11-26.

Pararius. (2017, February 27). Grote vraag naar middeldure huurwoningen. Retrieved 4 February 2020, from https://www.pararius.nl/nieuws/grote-vraag-naar-middeldure-huurwoningen#note-1

Peng, R., & Wheaton, W. C. (1994). Effects of restrictive land supply on housing in Hong Kong: an econometric analysis. *Journal of housing research*, 263-291.

Pittini, A., Koessl, G., Dijol, J., Lakatos, E., Ghekiere, L., & Goudis, M. (2017). The State of Housing in the EU. *Housing in Europe Review*.

Poterba, J. M. (1984). Tax subsidies to owner-occupied housing: an asset-market approach. *The quarterly journal of economics*, *99*(4), 729-752.

Quigley, J. M., & Raphael, S. (2005). Regulation and the high cost of housing in California. *American Economic Review*, *95*(2), 323-328.

Rabobank. (2019, July). *Too soon to celebrate growth of mid-market rental in the Netherlands*. Retrieved from https://economics.rabobank.com/publications/2019/july/growth-of-mid-rental-segment-in-the-netherlands/

Renes, G., & Jókövi, E. M. (2008). *Doorstroming op de woningmarkt: van huur naar koop*. NAi Uitgevers.

Risseeuw, P. (2013). Huurmarkt blijkt gevoelig voor malversaties en misstanden. *Tijdschrift Voor de Volkshuisvesting*, *6*, 42–46. Retrieved from https://www.ruimteenwonen.nl/huurmarkt-blijkt-gevoelig-voor-malversaties-en-misstanden

Saiz, A. (2010). The geographic determinants of housing supply. *The Quarterly Journal of Economics*, *125*(3), 1253-1296.

Saks, R. E. (2008). Job creation and housing construction: Constraints on metropolitan area employment growth. *Journal of Urban Economics*, *64*(1), 178-195.

Saunders, M. N. K., Thornhill, A., & Lewis, P. (2019). *Research methods for business students*. Retrieved from https://ebookcentral.proquest.com

Scheele-Goedhart, J., & Van der Reijden, H. (2008). *Plancapaciteit stedelijke regio's 2008* (99630). Amsterdam: RIGO Research en Advies BV. Opgehaald van https://zoek.officielebekendmakingen.nl/kst-31700-XVIII-11-b1.pdf

Schilder, F., & Conijn, J. (2015). Middeninkomens en het middensegment: De ontbrekende schakel op de woningmarkt. *ASRE Research Paper 2015*, *10*.

Schilder, F., & Conijn, J. (2017). Middeninkomens op de woningmarkt–Ontwikkelingen in een veranderend economisch en maatschappelijk klimaat. Amsterdam, The Netherlands: ASRE.

Schilder, F., & Scherpenisse, R. (2018). Policy and practise: affordable housing in the Netherlands. *Informationen zur Raumentwicklung*, *Heft4/2018*(3336).

Segeren, A. (2007). *De grondmarkt voor woningbouwlocaties: Belangen en strategieën van grondeigenaren*. Ruimtelijk Planbureau.

Swank, J., Kakes, J., & Tieman, A. F. (2003). The housing ladder, taxation, and borrowing constraints.

Topel, R., & Rosen, S. (1988). Housing investment in the United States. *Journal of political economy*, *96*(4), 718-740.

Van Gijzel, R. (2018). Samen bouwen aan middenhuur–Ervaringen van één jaar Samenwerkingstafel middenhuur.

Van Gool, P., Jager, P., Theebe, M. & Weisz B. (2013). *Onroerend goed als belegging* (vijfde druk). Groningen/Houten. Noordhoff Uitgevers.

Van Thiel, S. (2014). *Research methods in public administration and public management: An introduction*. Routledge.

Verhagen, J. (2018). Meer plancapaciteit, meer bouwen? Een kwantitatieve analyse op gemeenteniveau van de effecten van plancapaciteit op het aantal nieuwbouwwoningen.

Vermeulen, W., & Rouwendal, J. (2007). *Housing supply in the Netherlands*. The Hague: CPB Netherlands Bureau for Economic Policy Analysis.

Vermeulen, W. (2008). *Essays on housing supply, land use regulation and regional labourmarkets* (No. 430). Rozenberg Publishers.

Vlak, A., van Middelkoop, M., Schilder, F., & Eskinasi, M. (2017). Perspectieven voor het middensegment van de woningmarkt. Verkenning van maatregelen ter bevordering van het aanbod.

Vries, P., & Boelhouwer, P. J. (2004). *Langetermijnevenwicht op de koopwoningmarkt: Relatie woningprijs, inkomen en woningproductie*. NETHUR.

Whitehead, C. M., Scanlon, K., Monk, S., Tang, C., Haffner, M., Lunde, J., ... & Voigtländer, M. (2016). *Understanding the role of private renting: A four country case study*. Boligokonomisk Videcenter.

Appendix 1

Table A1: Relation between plan capacity and building permits granted for the total rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity total rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
Plan capacity rented sector (ln)	0.560*** (15.54)	0.561*** (15.58)	0.223*** (4.28)	0.177** (2.47)
Municipality characteristics				
Population (ln)			0.587*** (6.88)	1.386 (0.40)
Number of inhabitants per km² (ln)			0.200 (1.55)	-0.693 (-0.19)
Share of buildable area already built (ln)			-0.120 (-0.15)	6.396 (0.37)
Selling price (ln)			0.0205 (0.07)	0.157 (0.16)
Regional characteristics				
Land price (ln)			0.760** (2.19)	-0.388 (-0.57)
Building costs (ln)			1.432 (0.88)	-3.383 (-0.89)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	675	675	675	675
R^2	0.317	0.328	0.402	0.054
R^2 within				0.054
F-statistic	241.482	26.547	35.573	2.024

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table A2: Relation between plan capacity and housing stock in the total rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity total rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
Plan capacity rented sector (ln)	0.379*** (6.63)	0.372*** (7.59)	0.00684 (0.11)	0.108 (1.45)
Municipality characteristics				
Population (ln)			0.940*** (7.17)	4.348 (0.39)
Number of inhabitants per km² (ln)			-0.163 (-0.76)	16.63 (1.61)
Share of buildable area already built (ln)			1.179 (0.77)	-37.86* (-1.96)
Selling price (ln)			0.903** (2.35)	1.233 (0.98)
Regional characteristics				
Land price (ln)			0.565 (1.25)	0.488 (0.62)
Building costs (ln)			2.905 (1.35)	-0.805 (-0.13)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	1054	1054	1054	1054
R^2	0.047	0.379	0.419	0.404
R^2 within				0.404
F-statistic	44.006	95.466	87.296	65.559

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table A3: Relation between delay in plan capacity and building permits granted for the total rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity total rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
1-year lag Plan capacity private rented sector (ln)	0.265** (2.58)	0.255** (2.50)	0.210** (2.57)	0.135** (2.08)
2-year lag Plan capacity private rented sector (ln)	0.113 (1.09)	0.0779 (0.75)	-0.0266 (-0.31)	-0.119 (-1.19)
Municipality characteristics				
Population (ln)			0.868*** (12.60)	9.629* (1.84)
Number of inhabitants per km² (ln)			0.212 (1.37)	-12.01 (-1.64)
Share of buildable area already built (ln)			0.337 (0.36)	46.23* (1.97)
Selling price (ln)			0.249 (0.67)	1.814 (1.25)
Regional characteristics				
Land price (ln)			1.059*** (2.66)	-0.755 (-0.79)
Building costs (ln)			-0.190 (-0.11)	-6.553 (-1.35)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	503	503	503	503
R^2	0.015	0.029	0.406	0.085
R^2 within				0.085
F-statistic	3.705	1.809	29.637	2.759

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table A4: Relation between delay in plan capacity and housing stock for the total rented sector

	(1)	(2)	(3)	(4)
	Only plan capacity total rent	Year fixed effects included	Municipality and regional characteristics included	Municipality fixed effects included
Plan capacity				
1-year lag Plan capacity private rented sector (ln)	-0.100 (-0.89)	-0.175* (-1.85)	-0.235*** (-2.77)	-0.304*** (-3.15)
2-year lag Plan capacity private rented sector (ln)	0.175 (1.42)	0.152 (1.54)	0.0989 (1.07)	0.0977 (1.16)
Municipality characteristics				
Population (ln)			1.066*** (8.87)	-2.698 (-0.13)
Number of inhabitants per km² (ln)			-0.245 (-0.99)	24.90 (1.19)
Share of buildable area already built (ln)			2.067 (1.22)	-17.82 (-0.48)
Selling price (ln)			0.804* (1.76)	0.103 (0.07)
Regional characteristics				
Land price (ln)			0.563 (1.10)	-0.508 (-0.48)
Building costs (ln)			3.522 (1.53)	-4.035 (-0.58)
Fixed effects				
Year fixed effects	No	Yes	Yes	Yes
Municipality fixed effects	No	No	No	Yes
Observations	799	799	799	799
R^2	0.004	0.338	0.450	0.420
R^2 within				0.420
F-statistic	1.502	71.051	88.879	68.498

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01