Social housing on the move
A system dynamics model about the developments on the social housing market

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By

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Preface

The transition of the social housing market is discussed in the thesis. I have approached the subject from a scientific point of view; reflective on the development of the social housing market and pragmatic on the research methods. The discussion was aimed on the developments of the social housing market in the long term with a perspective from the housing association Havensteder and tenants in general. I am still convinced this was the right perspective, although the relation with individual housing is limited. In my opinion housing is one of the basic necessities of life. A sustainable environment should be ensured and social housing is needed to accommodate housing. Where housing associations have large property, which represents a large value, I hope they will not lose their attention on the individual tenants with minimum income. For a general housing association could rent levels, number of dwellings and portfolio value just become numbers, for a tenant a small increase of rent or a simple improvement in the quality of the dwelling could make a difference in basic necessity. General measurements will not evidential lead to a better livability, only an individual approach of the tenant and customized solutions will. I am convinced the social housing market is, despite any changes described in this thesis, able to provide in a basic necessity, although the aim should be on the individual tenant to make real improvements.

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Corné Venema
Vlaardingen, 2016
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Abstract

A new housing act became applicable to the Dutch housing market on the first of July 2015. One of the objectives of the law is that housing associations should only be active in the social housing market. In all likelihood, the structure of the Dutch rental housing market will change as a result of the legislation. The rental housing market is approached through the framework of the dual rental market and the unitary rental market. The paper follows the assumption that the social housing market will become separated from the rest of the housing market, indicating that the rental housing market will become a more dual rental market. The housing association Havensteder, located in the region of Rotterdam, will be the subject of the project. With the help of model based policy analysis, this research explores how the housing association could manage its housing portfolio in order to comply with the political developments. The research discusses the extent to which the housing association would make a transition in the rental housing market. To measure the transition of the rental housing market, the following variables are taken into account: Number of movements, rent levels, concentration of low income groups and demand surplus.

Three research methodologies are used to define and operate a conceptual model. An interview with housing association Havensteder is used to acknowledge the policy and objectives of Havensteder on the housing market. A data-analysis is used to achieve insight in the housing portfolio of Havensteder and characteristics of the tenants, such as annual income and moving behaviour. With a system dynamics analysis is the conceptual model convert in a simplistic housing market model. The model is used to test several policies of the housing association. The objective of the model is to find answers on the transition on the social housing market to a dual or a unitary rental market. Here the outcomes for the financial position and number of dwellings on the rental market are important for Havensteder. The model combines the effects in terms of rent level, number of dwellings, number of households and the financial position.

It was assumed that Havensteder’s main problem would be the new legislation, but it could be concluded that the financial position is a similarly troubling or even larger problem. In order to solve their financial problems, the new legislation can be considered part of the solution. The new legislation can provide an incentive to move property to the commercial assets and to make profit on the property. To improve the financial position, the housing association cut down on business costs. The income from rent is increased through the increase of rents for new tenants.

Annual income marks the difference between the target group and the current tenants. Households with an income above €33,614 are not part of Havensteder’s target group. The characteristics of this group of tenants are that they are often found in the single-family dwellings of the housing association or the dwellings with a higher quality. The group of tenants with a higher income is more willing to move outside the rental market and buy a dwelling. This group’s behaviour can be explained by the fact that this group has a larger opportunity to succeed in the purchase of a dwelling. Although, there is a group with a high income that is not willing or not able to leave the rental market.

The group of tenants with a higher income will be excluded from the social housing market. As a result, the social housing market will aim solely on tenants with a lower or middle income. Higher rent levels will result in less available dwellings on the social housing market, as the dwellings with a higher quality will instead be rented on the commercial housing market. Although the relative available dwellings for the target group
on the social housing market increases slightly. The number of movements decreases on the social housing market. It cannot be concluded that the housing market becomes a dual rental market, because the rent levels increase and it is not proven that the demand surplus is also increasing, because more dwellings are available.

It is suggested that Havensteder saves some of the higher quality properties for the social housing market. A distribution based on income level becomes apparent: lower income households in low quality dwellings, middle income households in medium quality dwellings and higher income households in high quality dwellings on the commercial housing market. Rent levels will increase and it is questionable how social a social housing market can be when the maximum rent is demanded based on the quality of the dwelling.

Due to the reorganisation of the housing association, financial resources are available to improve the quality of the social housing market. A trade-off is evident between more high quality dwellings on the social housing market or a lower rent level for lower and middle income households. Tenants desire both. It is the housing association’s objective to find a good balance in this trade-off. If needed, Havensteder could decide to sell some of their commercial housing portfolio in order to improve their financial situation.

Two of the four variables indicate a transition towards a more dual rental housing market, but the other two variables indicate a transition to a more unitary rental market. The demand surplus is not considered large and may, according to Havensteder’s policies, remain absent. The increase in rent level partly originates in the landlord levy and the financial position of the housing association. It is not based on the realisation of a more competitive price, although it cannot be neglected that both variables indicate a move towards a unitary rental market. For that reason, it cannot be concluded that Havensteder’s social housing market will become a more dual rental housing market.

The results demonstrate that the financial position of the housing association improves and that the housing association has a choice to adapt its current policy. There are two available measurements to improve the connection with the housing preferences: lower the rent levels and save specific dwellings for the social housing market. The higher quality dwellings are preferred in the social housing market and saving these dwellings increases the size of the social housing market for the target group of tenants. Furthermore, a lower rent level is preferred. A rent level of 80% of the maximum rent for new tenants should be possible. It will become difficult for households with a higher income to find appropriate dwellings. Business opportunities arises to serve this group of tenants.
Over the last decade, housing associations have frequently received negative publicity. The subject of this scrutiny varies from specific excesses to high-risk financial investments. Housing associations tend to extend their business activities outside the social housing market. The public’s objection to housing association’s place in the market was that housing associations were not capable or intended to perform commercial activities. Housing association’s mistakes were highlighted publicity. More importantly, however, association’s commercial activities have raised the political question of whether or not housing associations should perform activities outside the social market, or alternatively, should solely remain in the social housing market. A parliamentary inquiry has been executed to investigate the social housing market. To summarize the conclusion of the parliamentary inquiry: housing associations had too much freedom, and in some situations, their business activities became too risky (Commissie Parlementaire enquête woningcorporaties, 2014). Did housing associations take too many risks, or did the government grant them their position? This complicated question was not answered by the parliamentary inquiry and will not be answered in this research. Rather, this study views this development as a given situation that emerged from the development of the housing market in recent history. This research will take the current situation as its starting point.

1.1 The housing act
A new housing act became applicable to the Dutch housing market on the first of July 2015. The origin of the new housing act was not derived from the recommendations of the parliamentary inquiry, but more from a political urge to change the housing market. The legislation, which is important to the business activities of housing associations, is discussed in chapter 2. According to the new law, housing associations are in general forced to limit their activities. The objective of the law is that housing associations should only be active in the social housing market. In all likelihood, the structure of the Dutch rental housing market will change as a result of the legislation. As explained in the literature review, this study approaches the rental housing market through the framework of the dual rental market and the unitary rental market. The paper follows the assumption that the social housing market will become separated from the rest of the housing market, indicating that the rental housing market will become a more dual rental market.

The new structure of the social housing market will influence the role of housing associations. Housing associations will be subjected to the new legislation and will make different decisions in regard to their activities in the housing market. It is uncertain how their decisions will influence the housing market.

1.2 Objective
This study’s objective is to see whether or not a design, which would provide a transition in the rental housing market, could be realised in the Dutch housing market. The subject is delineated to one housing
association, in order to make the design as specific and explicit as possible. The housing association Havensteder, located in the region of Rotterdam, will be the subject of the project. With the help of policy analysis, this research explores how the housing association could manage its housing portfolio in order to comply with the political developments. The research discusses the extent to which the housing association would make a transition in the rental housing market.

1.3 Research question
According to the circumstances described above, it is still unclear what role housing associations will have in the future. The research question is:

*What impact does the new housing act have on the behaviour of housing associations and is a transition made in rental housing that fits the housing preferences of future tenants?*

This research project emphasises one housing association in order to find solutions that are applicable to the specific housing association. It is important for the housing association to recognize their target group in the social housing sector, so that their portfolio can be adapted towards this group.

1.4 Scope
As already mentioned, housing associations have often been publicly discussed over the past few years. Rather, the starting point is the new legislation on the housing market. The literature review explains the effects of the legislation, but will not form a judgment in regard to the legislation. The project’s scope, given a certain situation and legislation, is to support the housing association Havensteder manage its housing portfolio and to provide insight into the effects of the current policy. This study researches how the structure of the rental housing market will transition.

In the region of Rotterdam, several housing associations are active in the social housing market. Although the scope of the project is to focus on housing association Havensteder, the competition between housing associations is not ignored. In situations in which rent levels and share on the social housing market are important, this study discusses the competition.

This research only takes Havensteder’s activities within the social housing market into consideration. The association’s other activities, for example their role in the commercial housing market, are outside the scope of the research. In instances in which the housing association moves dwellings from the social housing market into the commercial housing market, the dwellings are then outside the scope of the research, although these properties do still influence the overall financial performance of the housing association.

1.5 Relevance
This subject’s scientific relevance lies in the possible partial transition between a unitary rental market and a dual rental market. These types of movements in housing markets seldom occur and are of special interest for research. The societal relevance is found in the problems that housing associations experience with the political developments. The research suggests solutions for one housing association in regard to the housing preferences of the new target group of tenants and their housing needs.
1.6 Structure of the thesis

The next chapter’s literature review relates the new housing act to the existing literature about the social housing market. The chapter explains the transition of the market from a unitary to a dual rental market. The chapter concludes with the research’s sub questions. The third chapter describes the methodologies and conceptualisation of the social housing market. Chapter four elaborates upon Havensteder’s position and the housing preferences of tenants. The basis of the chapter is an interview with Havensteder and a data-analysis. Chapter five describes the development of the social housing market according to a system dynamics analysis. The results of the system dynamics analysis are presented in chapter six. The seventh chapter answers the research question and makes recommendations for further research, and finally, reflects upon the entire research project.
The Dutch housing act outlines the legislation on the housing market in the Netherlands. The revised housing act (herziene woning wet) (Staten Generaal, 2015) serves as an urgent response to political developments. The project does not distinguish between political opinions, but it is necessary in this case to mention the European Commission’s ruling (EC) about state aid and the social housing market. This chapter mentions the most important regulations in the revised housing act, partly following from the ruling of the EC for housing associations. First, the literature review explains the unitary and dual rental market models in order to place the developments in a theoretical framework. The end of the chapter introduces the research’s sub questions.

2.1 The Dutch housing market

The Dutch housing market can be divided in two types: a rental market and an owner occupied market. Households with a lower income are not able to find a suitable dwelling in a competitive housing market. Generally, the owner occupied market is an entirely competitive market, because there is no governmental or other authority to assist households to find a dwelling. Some assistance is evident in regulations to assist first time buyers to the housing market. The extent of these regulations, however, is small in comparison to the assistance offered in the rental market. In the rental housing market, two types of dwellings are recognized: social rental dwellings and commercial rental dwellings. In the Dutch housing market, the commercial rental housing market is considered small. Most of the rental dwellings are in the social housing market and are rented by housing associations.

Kemeny (1995) describes a framework that distinguishes between a unitary rental market and a dual rental market. The framework describes how the social housing sector is embedded within the rental housing market. In a dual rental market, the social housing is strongly segregated from the rest of the housing market: there is no competition with other parts of the housing system. The social housing market is strongly regulated. The rent level is independent from the current market price and social housing is only available to the lowest income groups. In a unitary rental market, the social housing is integrated within other parts of the housing system. Social housing can be seen as a complementary part of the housing market that provides low-priced dwellings. Some competition exists between social housing and other parts of the housing market. Housing associations offer dwellings with a lower quality at a lower price. The rent level is slightly dependent on the market price, but is always beneath the market price. Due to the competition in a unitary rental market, the dwellings are available to other income groups other than the lowest income groups.

The Dutch rental housing market could be described as a unitary rental market (Elsinga, Haffner, & Heijden, 2005), but the new legislation could result in adoptions to the Dutch unitary housing market. Studies have
argued that the legislation could lead to the dismantling of the unitary rental market (Elsinga, Haffner, & Heijden, 2008), although the extent is still unclear. Unitary and dual rental markets are two extreme conditions on the rental housing market. In reality, the Dutch rental housing market exists between these two extreme positions. Legislation or housing association’s specific decisions can result in a housing market’s transition towards a more unitary or a more dual rental market.

### 2.2 Revised housing act

The EC has made objections to the structure of Dutch housing market. The social housing market contains too many aspects that disrupt the housing market and implies state aid. To improve the social housing market, several adaptations should be made.

According to the EC, the maximum rent levels for the target group should be regulated in the revised housing act (Priemus & Gruis, 2011). In 2015, the maximum rent level for social housing is determined to be €710 per month (BZK, 2014). Research highlights that the rent levels in the social housing market increase rapidly: 5.0% in 2013 and 4.8% in 2014 (Companen, 2014). As a result, a portion of the social housing properties could exceed the maximum rent level and will no longer be part of the social housing market. The other possibility is that housing associations will temper the increase of the rent levels. Housing associations have several opportunities to increase the rent levels. The rent can be increased to compensate for inflation each year. The rent level for households with a higher income can be increased by an additional 0.5% or 2.5% (BZK, 2014). The measure should encourage households with a higher income to move to dwellings outside the social housing market. Housing associations furthermore have the opportunity to increase rental revenues when a dwelling is rented to a new tenant. In this situation, the housing association can raise the rent and the increase is limited only by the maximum rent based on the quality of the dwelling.

The objective of the social housing market is to provide housing for those households that cannot rent a dwelling on the competitive housing market. The group is defined by their annual household income. In 2015, the maximum annual income for the target group is €34,911 (BZK, 2014). This maximum income is stated in article 48 (Staten Generaal, 2015) of the revised housing act. In addition to the regulation, the act is proposed to serve the income class that is slightly above the target group for social housing, but still has difficulties finding other available housing. The act proposes that housing associations are allowed to rent portions of dwellings to an income group between €34,000 and €38,000, but only for the first five years that the legislation is applicable (Monasch, 2013). Housing associations are obligated to allocate 90% of the property to the target group (Staten Generaal, 2015). When the housing association rents more than 10% of the dwellings to households with an annual income above the maximum income, the demand for households within the target group is deemed to be too low. In the first five years, an additional 10% of dwellings can be allocated to households with an income slightly above the maximum income of the target group (Monasch, 2013). The EC argues that in a market in which too many dwellings are rented to households with an income above the allowed income, the size of the social housing market is too large and therefore disrupts the competition of the housing market (Priemus & Gruis, 2011). As a consequence, the housing association will not receive access to the financial resources provided by the government (Waarborgfonds Sociale Woningbouw) to develop new dwellings, because more social housing is deemed unnecessary in the specific housing market.
The landlord levy (verhuurdersheffing) presents another regulation of the social housing market as stated in the housing agreement (woonakkoord)(BZK, 2013). The landlord levy is based on the value of the property on the social housing market. The purpose of the landlord levy is to compensate the costs for a housing allowance for the Dutch government. As a result of the increasing rents, households receive a greater housing allowance. Housing associations could also use the additional rent increase for households with a higher income to compensate for the landlord levy. In a previous study, Priemus had already concluded that housing associations would not be able to fulfil the landlord levy with the additional rent revenues from the first years (Priemus, 2014). After a few years, the additional rental profit would be able to cover the costs of the landlord levy.

### 2.3 Solutions proposed in the literature

In the revised housing act, a solution for a housing association is described as a way for them to meet the requirement of being 90% occupied by lower income households. In the act, a distinction is made between social dwellings (Diensten van Algemeen Economisch Belang) and commercial dwellings (niet Diensten van Algemeen Economisch Belang). Housing associations are able to divide themselves and create a new commercial housing company. All tenants with a rent above the social housing maximum rent level (€710) will be placed within the commercial business. Tenants with such a rent will probably have a higher income. The regulation concerning the maximum annual income of households is only applicable to the dwellings that are in the social housing market. The landlord levy is also only applicable to dwellings that are rented in the social housing market. In the future, the structure will probably result in a stronger commercial rental market, especially in the cast that the new commercial housing companies act independently of the housing association, which will lead to more private landlords. It is questionable whether or not there will be more private landlords in the future.

Besides transferring the property towards the social housing portfolio or commercial portfolio, the housing associations also have the agency to sell dwellings. The selling price is regulated, because if the property is brought on the market for an unreasonable price, the housing market will probably be disrupted. Therefore, housing associations have the obligation to sell dwellings from the social portfolio for at least 75% of the value. Dwellings from the commercial portfolio should be sold for at least 90% of the value (Blok, 2013). In general, these dwellings are of a higher quality, because they can be rented as commercial dwellings, and are more competitive with dwellings on the owner occupied market.

The more general perspective of housing associations is that their business should be executed more moderately. By making fewer investments on the housing market and aiming more on the social housing market and not on the commercial side of the housing market, lower risk investments will lead the business to be more stable. The realisation of new dwellings can be decreased, and instead, emphasis can be placed solely on the social housing market. Maintenance can be utilised in two instances: more investments in renovations will improve the quality of the dwellings, and with fewer investments, the housing association can save financial resources. The operating costs of the housing associations could be lowered, which would fit the more moderate position of the housing association.

All the proposed solutions influence the housing portfolio of the housing association in terms of quantity, quality and pricing. Housing associations’ policies aim to find a suitable balance in the housing portfolio with a reasonable financial position. Each housing association must make specific choices based on their position in the social housing market.
2.4 Unitary or dual rental market

Based on the ruling of the EC, the revised housing act and the solutions proposed in literature, it is expected that the social housing market will go through a transformation. It is assumed that the housing market will become more of a dual rental market.

![Diagram of dual or unitary rental market]

**Figure 2.1: Dual or unitary rental market?**

There are studies that measure the type of rental housing market (unitary rental market or dual rental market). Lennartz (2014) explains a concept to measure whether or not perfect competition exists in a certain region. Competition on a rental housing market does not explicitly distinguish between unitary or dual rental markets. In a unitary market, the competition should be found in the complete rental housing market. In a dual rental market, the competition should only be found in the commercial housing market and not in the social housing market. In the commercial housing market, the competition should function even better in comparison to the unitary rental market. Competition in the social housing market should not exist in a dual rental market. The distinction between a unitary rental market and a dual rental market is not the same concern as the measurement of the competition in a rental market. When the competition in the social housing market is measured with the number of movements to the social sector, it is arguable whether there is a more dual or unitary rental market (Elsinga, Haffner, Heijden, & Oxley, 2009). In a dual rental market, the movements in the social housing market are assumed to be low. In a unitary rental market, the number of movements should increase.

Studies have tried to measure some aspects of unitary or dual rental markets in several regions. They do not take into account the development of housing regions over time. It is already argued that this development is already occurring in the Dutch housing market. This project aims to measure the transition between the two types of housing markets over time. The difficulty of such a measurement is that the dual rental market and the unitary rental market do not have a fixed beginning or end. To measure the transition of the rental housing market, the following variables are taken into account:

- **Number of movements**
  
The number of movements in the social housing market provides information about the accessibility of the housing markets. In a unitary rental market, dwellings are more accessible to households. In a dual rental market, the social housing market is less accessible and fewer movements are realisable. The disruption of movements should be taken into consideration due to the new legislation. Households with a higher income are more likely to leave the social housing market.

- **Rent levels**
  
  Due to the competition on the housing market, rent levels in a unitary market are sensible for competition. It is assumed that social housing will provide the dwellings with lower rents and a lower quality, although
there is an applicable price to quality ratio. The price to quality ratio is absent in the social sector of a dual rental market. Housing associations offers dwellings a rent that is based on the costs for the exploitation, which is independent of the market price.

- Concentration of low income groups
  In a dual rental market, the social housing sector is intended solely for the households with a low income, and that therefore, are unable to buy a dwelling on the owner occupied housing market. The social sector is not intended for households that are not willing to buy a dwelling, as they have a sufficient financial position. Households with a higher income must rent on the commercial rental market in the case that they wish not to buy a dwelling. In a unitary housing market, the social sector is in more circumstances available for higher income groups, even when they are able to buy a dwelling.

- Demand surplus
  In a dual rental market, the demand and supply on the private rental market is allocated due to competition. The rent should ideally balance the demand and supply. For that reason, a waiting list or demand surplus on the commercial rental market does not exist. In the social housing market, the rent is not allocated by competition and there is not a direct incentive for housing associations to develop more property. The result is a demand surplus on the social housing sector. The unitary housing market offers rental market dwellings with a price that is dependent on competition, but beneath the market price. Consequently, in a unitary market, a demand surplus is evident in all parts of the rental housing market.

2.5 Sub questions
In order to augment the main question, the thesis formulates four further sub questions.

Position of the housing association
Housing associations have an opinion of the changing environment in which they act. For the purposes of this research, it is of value to understand this opinion in order to understand the limits of solutions for housing associations. This question prompts several present policy issues for housing associations and helps to develop scenarios.

1. What does the housing association view as a problem and as possible solutions to their current position in the social housing market and what objectives are recognized in their review of these solutions?

Housing demand and supply
The group of tenants will change due to the expected decline of households that are allowed to rent a dwelling in the social housing sector. When the housing preferences of these groups are recognized, the housing association will know what type of dwellings they must deplete from their housing stock. Conversely, housing associations will be able to recognize what type of dwellings will be needed in the future.

2. What are the housing preferences of the current group of tenants? What are housing preferences of the target group of tenants? What are the main differences between these groups?
System dynamic model
The previous questions have provided a static solution to housing demand and supply in the social housing market. This static answer is then translated towards a system dynamics model. This study explores how housing associations must evolve their housing portfolio to serve the determined group of tenants. Furthermore, this study uses scenarios to search for several solutions. The objectives of the housing association limits these possible solutions.

3. **Does the current policy on the housing portfolio lead to a more dual rental housing system, given the housing preferences of tenants and the new legislation?**

4. **Is a strategy available to optimize the relation between the housing preferences of the target group and the housing portfolio of the housing association?**

These questions serve to determine whether a strategy is available to improve policies on the housing portfolio with the target group of tenants. This research mentions shortcomings and gives attention to the validity of the system dynamics model.
Research methodology and conceptualisation

This chapter discusses the research methodologies and provides a conceptualisation of the system dynamics model. As the same conceptualisation is already used for the other analysis, it is already clear what information is needed for the model.

3.1 Methodology
For each sub question, this chapter describes how the answer should be found. The research uses several techniques to find answers that best fit each question.

Position of the housing association
Housing associations have an opinion of the changing environment in which they act. For the purposes of this research, it is of value to understand this opinion in order to understand the limits of solutions for housing associations. This question prompts several present policy issues for housing associations and helps to develop scenarios.

1. What does the housing association view as a problem and as possible solutions to their current position in the social housing market and what objectives are recognized in their review of these solutions?

In order to answer this question, an interview will be held with the housing association. The interview will collect information about how the housing association views their future in the social housing market. In the interview it must be clear what information should be collected from the housing association. Some interesting topics for the interview include:

- Policy on the housing portfolio: What types of dwellings are needed or will be built in the future?
- Policy on business operations: Is the housing association economizing their business operations? Are there other financial choices?
- Relation with other actors: Do municipalities give opportunities for housing associations to develop their housing portfolio? Are other investors active on the housing market?
- Objectives of the housing association: What objectives does the housing association try to achieve?

Housing demand and supply
The group of tenants will change due to the expected decline of households that are allowed to rent a dwelling in the social housing sector. When the housing preferences of these groups are recognized, the housing association will know what type of dwellings they must deplete from their housing stock. Conversely, housing associations will be able to recognize what type of dwellings will be needed in the future.
2. **What are the housing preferences of the current group of tenants? What are housing preferences of the target group of tenants? What are the main differences between these groups?**

This question can be answered through data-analysis. Jansen ea. (2011) describe the analysis of housing preferences. This textbook provides several techniques for analysing housing preferences with the help of data-analysis. The housing association may provide the data used for the analysis, or alternatively, it can be found in the WoON 2012 survey (CBS & BZK, 2013). The research is executed with the data-analysis tool SPSS.

The tenants of the housing association are allocated into groups with specific characteristics. These characteristics are for example: income, type of current dwelling and quality, household composition and age of household. A trade-off exists between the number of characteristics that can be taken into account and the availability of data. The groups should remain large enough to provide reliable data. Research provides insight into the housing preferences of the tenants in the near future. The household composition will probably change or the household may desire to move to another city. Current tenants will likely buy a dwelling in the future or will rent another type of dwelling. This section mentions the reasons that a tenant may not buy a house in order to judge whether or not these reasons are strong enough to not buy a dwelling in the long term. Financial elements will be taken into account, such as the value of the current dwelling and the current rent level in order to make calculations for the housing association in the system dynamics analysis.

**Dynamic model**

The previous questions have provided a static solution to housing demand and supply in the social housing market. This static answer is then translated towards a system dynamics model. This study explores how housing associations must evolve their housing portfolio to serve the determined group of tenants. Furthermore, this study uses scenarios to search for several solutions. The objectives of the housing association limits these possible solutions.

3. **Does the current policy on the housing portfolio leads to a more dual rental housing system, given the housing preferences of tenants and the new legislation?**

4. **Is a strategy available to optimize the relation between the housing preferences of the target group and the housing portfolio of the housing association?**

These questions serve to determine whether a strategy is available to improve policies on the housing portfolio with the target group of tenants. This research mentions shortcomings and gives attention to the validity of the system dynamics model.

System dynamics analysis can be used to answer these questions. The analysis converts the more static outcome of the data-analysis to a more dynamic outcome about the mutation of the housing stock and the change of tenants. The methodology of system dynamics is extensively discussed by Sterman (2000) and Pruyt (2013). A more applied use of system dynamics model on the housing system is found in the system dynamics models of Eskinasi (2014). Data from the previous analysis serves as a source for system dynamics. Additional data about the population and household forecasts exists in national databases.
Assumptions about the future behaviour of tenants and housing associations can be used in several scenarios. The simulation model includes several components:

- **Housing demand**: the data-analysis derives a static representation from the housing demand, which is converted to a dynamic demand of housing. Governmental policies can be adapted in the model.
- **Housing supply**: the interview demonstrates how the housing association will manage their housing portfolio. The housing supply should match the housing demand, and if it does not, a waiting list or vacancy exists in the housing market.
- **Financial position housing associations**: due to changes in the housing stock, the financial position of the housing association will change. In order to measure the financial feasibility, “the loan to value” and “interest coverage ratio” are calculated. These factors are used by “Waarborgfonds sociale woningbouw” (2014).
- **Objectives of the housing association**: these objectives are collected during the interview.
- **Unitary rental market or dual rental market**: these components follow the descriptions from the literature review. They measure the extent to which a social housing market becomes more of a unitary rental market or a dual rental market.

The model is simulated over a time span of 30 years. The program Vensim Pro is used for the creation of the model.

### 3.2 Conceptualisation

Figure 3.1 shows a conceptualisation of the social housing market, which is used for the simulation. It is used to recognize the relationship between the real housing market and the model, which is only a representation of the housing system. The system diagram does not only give insight into the model within the simulation, but also in regard to the necessary information from the interview with Havensteder or from the data-analyses. The interview can for example provide input for housing association inputs and the data-analysis can provide input about the initial values in the model and tenants’ moving behaviour.
The conceptualisation determines the scope to create the simulation model. It attempts to produce a model that provides reliable answers for the purposes of the research project; e.g. it is impossible to make a model that completely describes the complete housing market. The structure represented in the second chapter about dual and unitary housing market is therefore implemented in figure 3.1. The model does not take into consideration further social issues, which are present in the relationship between the local government and the housing association. The remainder of the chapter explains the conceptual framework. Chapter 5 completes the framework with more detailed information that describes the simulation model.

**Havensteder’s policy**

The activities of the housing association influence the structure of the social housing market. There are two types of prevalent policies: policies on the housing portfolio and policies on the tenants.

In general, the housing association has a couple of ways in which it can modify its housing portfolio. It can increase its number of dwellings through the realisation of new dwellings or through the purchase of existing dwellings. A housing association can decrease its number of dwellings by demolishing property or...
by selling dwellings. Alternatively, a housing association can decrease its number of dwellings on the social housing market by transferring the dwellings from the social housing market to the commercial housing market. Maintenance can improve the quality of the dwellings.

The housing association has a policy on the rental price of the dwellings and the allocation of the tenants. The housing association can assign a maximum annual income for a given dwelling, to insure that the dwellings are rented to households that need housing on the social housing market. New tenants will have to pay rent for the dwelling. The housing association can, within a certain margin, decide the rent level of the property. Higher rent attracts fewer tenants and these tenants are likely to have a higher annual income. If the rent is above the level of liberalisation, the tenant and dwelling are placed in the commercial rental market and are no longer part of the housing association’s target group. The housing association determines the rent that new tenants pay. Current tenants’ rent increases each year by a percentage decided upon by the housing association. For tenants with an income above a certain level, an additional increase in rent may be demanded.

The interview with Havensteder explores Havensteder’s executed policy and the aspects of the policy that can be used for scenarios in the simulation model.

**Legislation**

The legislation, as described in the literature review, provides several inputs in the model. It provides both the ceiling of the annual income for the target group of the social housing market and the liberalisation level of the rent. The legislation also describes the percentage of property that the housing association is allowed to rent to tenants above the income ceiling. If this percentage is exceeded, the housing association will be unable to receive financial resources for the realisation of new property. The landlord levy is determined according to the value of the housing association’s social dwellings in the housing agreement. The legislation further describes the additional rent increase for households with an income above the target group.

**Demography and economy**

The demand for housing develops due to three different factors. First, the general housing demand is dependent on the development of Dutch households and the Dutch population. For example, if the population decreases, the demand for housing also decreases. Secondly, a regional housing demand exists when a region becomes more or less popular for tenants in comparison to other regions. Lastly, housing associations must compete with other housing associations in the region. Housing demand is dependent on this competition, because in the case that housing associations perform better than Havensteder, they are able to attract more tenants.

Moving behaviour is also used as an input in the model. It describes the probability that a household will move and to what type of dwelling: the tenant decides either to rent a dwelling or to buy a dwelling. The data-analysis researches the moving behaviour. The outcomes from the data-analysis provide the household’s static behaviour. The simulation uses this result, but it is noteworthy that the moving behaviour and choice of housing are dependent on several variables and could change in the future. It is uncertain how the moving behaviour will develop in the future and there are no available guidelines to make reliable assumptions about its development. The static results from the data-analysis describe the
real moving behaviour within certain limitations, but are the best available results that can be used for the simulation.

The economy’s development influences many aspects of the housing market and the position of households. For this reason, the simulation adapts an economic perspective, although the simulation does not entirely emphasise economic developments. Such an emphasis on the influence of the economic developments on the housing market is not the purpose of the research. Economic developments are conceptualised in an inflation rate and on the evolution of the annual income of households. Economic growth is described as a higher inflation rate and a higher evolution of the annual income of households. Economic development is a variable that is not controlled by the housing association and is much more complex. The transition of the social housing market is assumed to be not strongly related to the economic developments and is therefore not extensively researched in this project.

**Structure of the housing market**

The structure of the housing market is conceptualised as a number of households and a number of dwellings, where each household is attached to a dwelling. The households have several characteristics, such as an annual income or a housing preference. Dwellings have characteristics such as rent level, location and quality. The housing market is a system in which households try to find the desired dwelling for their current situation.

In the upcoming chapter, the dwellings and households are divided into groups, based on their similar characteristics. For each type of dwelling or household, an average rent or housing preference is defined. The characteristics are used in the model to simulate the social housing market. The data, as taken from either Havensteder or the WoON 2012 survey (CBS & BZK, 2013), is used to create the groups and to simulate the housing market.

Havensteder’s policies, as well as the demography and economy and of the new legislation, have an influence on the housing market’s dynamics. The housing association can partly control the system in which households try to find the desired dwelling.

Households may move from one dwelling to another dwelling, or alternatively, can leave the social housing market altogether. The simulation takes into consideration that households can only move to a dwelling that is vacant due to another movement. When households move from one social dwelling to another, it is assumed that they remain within the Havensteder housing association. In reality, however, households can easily move from one housing association to another. Here, the structure is approached from the housing association’s viewpoint. When a dwelling becomes vacant, a household will move somewhere within the social housing market. They will leave one dwelling, which a household rented that likely had a dwelling at Havensteder. This simplification in the simulation makes the model more understandable, but does not completely describe all movements. It is assumed that the demand for certain types of dwellings is much higher compared to other dwellings and that the other housing associations have a comparable demand.

The model assumes that the current tenants have precedence over new households on the social housing market when they want to move to a dwelling. To find a dwelling on the social housing market, it is necessary for a household to improve their position on the waiting list. Current tenants are able to wait in
their current dwelling until the desired type of dwelling becomes vacant. It is assumed that new tenants have less time to improve their position on the waiting list and choose the dwelling that is easier to rent, because current tenants do not intend to rent that type of dwelling.

When households buy a dwelling, they leave the social housing market. When the rent level exceeds the level of liberalisation, they also leave the social housing market. For these households, the way in which they move to other dwellings is not simulated. It is assumed that the housing association rents the dwellings on the commercial housing market for a market rent. To measure the rental housing market’s transition, it is important to consider how large the commercial housing market is, but it is not necessary to describe the movement in this sector of the market. It is assumed that only households with a higher income are able to rent dwellings in the commercial housing market.

The model assumes that the housing association will only develop new dwellings when less than 10% of the dwellings are rented to households with an income above the target group. In reality, housing association could build new dwellings with other types of loans, but it is assumed that they would not do so. Newly developed dwellings always have an average or high quality. Some dwellings are demolished over time, and the simulation assumes housing associations only demolish dwellings with a lower quality. The model does not provide a system that describes the maturation of dwellings and their decrease of quality, and furthermore, does not provide a system that describes the increase of quality due to maintenance. The simulation assumes that maintenance and maturation neutralize the effect on the quality of the dwellings.

The structure of the housing market includes the variables that are used to determine how the housing market makes a transition to a dual or unitary rental market.

**Outcomes**

Two types of outcomes are recognized: outcomes that are of interest to distinguish between a unitary rental market and a dual rental market and outcomes that are of interest for the housing association.

**Unitary or dual rental market**

The number of movements from the social housing market to other parts of the housing market is measured to determine how accessible the other markets are for households within the social housing market. Rent levels provide information about the price of the dwellings, which can be used to interpret whether the rental market is unitary or dual. In a dual rental market, the concentration of low incomes will be higher, which the model measures. The demand surplus on the social housing market indicates the extent to which the demand of households can be recognized. It is a characteristic of a dual rental market that the demand cannot be recognized in the social housing market.

**The housing association**

The outcomes that are important for the housing associations are derived from the interview with Havensteder. This research expects that the housing association’s objectives are to be responsible in the housing market and to maintain a reasonable financial position.
Havensteder is a housing association in the region of Rotterdam. Havensteder faces changes in the social housing market, as many other housing associations do. The new legislation is already explained in the literature review. This chapter discusses Havensteder’s current position in the social housing market including the current position of the households and their moving behaviour. An interview held with Havensteder and a data-analysis provide input for this chapter. A full report of the interview can be found in Appendix B. Appendix C and Appendix D describe the complete outcome of the data-analysis.

4.1 Location

Havensteder’s properties are located in several cities in the Rotterdam region. Figure 4.1 shows how many dwellings Havensteder rents on the housing market. Only the property that is part of the housing market has been included in these numbers. Properties excluded from this table include for example shops or parking spaces.

<table>
<thead>
<tr>
<th>City</th>
<th>Number of dwellings</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>33364</td>
<td>72,5 %</td>
</tr>
<tr>
<td>Capelle aan den IJssel</td>
<td>11155</td>
<td>24,2 %</td>
</tr>
<tr>
<td>Albrandswaard</td>
<td>525</td>
<td>1,1 %</td>
</tr>
<tr>
<td>Barendrecht</td>
<td>514</td>
<td>1,1 %</td>
</tr>
<tr>
<td>Lansingerland</td>
<td>355</td>
<td>0,8 %</td>
</tr>
<tr>
<td>Krimpen aan den IJssel</td>
<td>89</td>
<td>0,2 %</td>
</tr>
<tr>
<td>Schiedam</td>
<td>11</td>
<td>0,0 %</td>
</tr>
<tr>
<td>total</td>
<td>46013</td>
<td>100 %</td>
</tr>
</tbody>
</table>

Figure 4.1: Location of property

Havensteder’s properties are mainly located in the city of Rotterdam and Capelle aan den IJssel. These cities are considered housing markets in which Havensteder should actively participate, and should additionally be responsible in their neighbourhoods. In the other cities, Havensteder is a smaller actor in the housing market, because other housing associations are more present. The position of these dwellings in the housing portfolio is uncertain. When opportunities are present, the sale of these properties is considered, but no urge exists to remove these dwellings from the housing portfolio and to concentrate only on the two main cities.
4.2 Position in the housing market

Havensteder has an active role in the housing markets of the cities of Rotterdam and Capelle aan den IJssel. Havensteder is an important player in the housing markets of these cities, as is shown in figure 4.2.

<table>
<thead>
<tr>
<th>City</th>
<th>Housing market (dwellings)</th>
<th>Property of housing associations (dwellings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotterdam</td>
<td>297445</td>
<td>139799</td>
</tr>
<tr>
<td>Capelle aan den IJssel</td>
<td>30360</td>
<td>11840</td>
</tr>
</tbody>
</table>

Figure 4.2: total dwellings on the housing market (CBS, 2012)

In the city of Rotterdam, there were around 300,000 dwellings in the year 2012. Almost half of these dwellings are owned by housing associations. Havensteder is accountable for 25% of the total property of the housing associations. In the city of Capelle aan den IJssel, Havensteder is almost the only housing association with property in the social housing market. It is noteworthy that the data from CBS is three years older than the data from Havensteder.

4.3 Type of dwelling

The conceptualisation of the model describes that the structure of the housing market is composed of several types of dwellings. To complement the conceptualisation, the dwellings are categorised into eight different groups. The groups are created based on three characteristics:

- Type of dwelling (multi-family dwelling, single-family dwelling)
- Quality of the dwelling

The quality of the dwelling is based on the maximum rent that a housing association may charge for the dwelling according to the property valuation system (woningwaarderingsstelsel). Dwellings with a high quality can be rented as commercial dwellings. Dwellings with a low quality are preferred for households with a low income, as these dwellings are below the housing allowance level. It is emphasised that the dwellings are not categorised on the actual rent level, but on the maximum rent level.

<table>
<thead>
<tr>
<th>Type of dwelling</th>
<th>Number of dwellings</th>
<th>Percentage</th>
<th>Mutation rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>4262</td>
<td>9.6 %</td>
<td>7.9 %</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>12881</td>
<td>28.9 %</td>
<td>6.9 %</td>
</tr>
<tr>
<td>multi-family, medium quality, &lt; 1955</td>
<td>1701</td>
<td>3.8 %</td>
<td>5.8 %</td>
</tr>
<tr>
<td>multi-family, medium quality, 1955 - 1985</td>
<td>6871</td>
<td>15.4 %</td>
<td>5.9 %</td>
</tr>
<tr>
<td>multi-family, medium quality, &gt; 1985</td>
<td>3542</td>
<td>8.0 %</td>
<td>5.5 %</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>6137</td>
<td>13.8 %</td>
<td>5.9 %</td>
</tr>
<tr>
<td>single-family, low and medium quality</td>
<td>3410</td>
<td>7.7 %</td>
<td>4.4 %</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>5702</td>
<td>12.8 %</td>
<td>4.7 %</td>
</tr>
</tbody>
</table>

Figure 4.3 type of dwelling and mutation rate

Figure 4.3 shows the groups that are created and the number of dwellings that are present in each group. The groups are defined so that there are enough dwellings in each group for other analyses and to limit the number of groups. Occasionally, a household makes the decision to move towards another dwelling. From
Havensteder, the mutation rate for each type of dwelling is derived from the past years. The chart shows that most of the dwellings are multi-family dwellings, as only 20.5% of the dwellings are single-family dwellings. Most dwellings belong in the low quality, built after 1955 and multi-family category. 26.8% of the dwellings are able to be rented on the commercial housing market.

4.4 Type of household
For each type of dwelling, it is further helpful to know what type of household occupies the property. To keep the structure simple, only the annual income of the household is taken into consideration. The annual income says something about the household’s chances on the housing market and the general position of the household. Other relevant aspects about the household include the age of the inhabitants or the household composition.

Three types of households are categorised according to their annual income, based on the WoON 2012:
- Lower income group (from 0 to maximum income for housing allowance: €22,650 for singles and €29,450 for families)
- Middle income group (from maximum income for housing allowance: €22,650 for singles and €29,450 for families to maximum allowed income for social housing: €33,614)
- Higher income group (above maximum allowed income for social housing: €33,614)

Along with the categorisation of the dwellings and households, the conceptual model presented in chapter three can be further completed. Figure 4.4 shows the structure of the housing market, with the initial number of households divided amongst the different types of dwellings and the different income groups.
Social housing on the move

Figure 4.4 shows the contribution of the households amongst the type of dwelling and the type of households. A separate row is created for the commercial dwellings that the housing association rents. The type of household that rents on the commercial market is not known, because the graphic’s scope remains solely on the social housing market. The main consideration should be that Havensteder is able to transfer dwellings to the commercial housing market. The figure further shows that part of the households are in the higher income group, despite the fact that this group is not social housing’s target group. It is also noticeable that the lower income group households are able to rent both the dwellings with a higher quality as well as the single-family dwellings. Households are able to improve their annual income and move towards another income group. Additionally, households may move to another dwelling. The mutation rate for each group is known, but it is not clear to what type of dwelling that the households in a specific group would like to move. The next section will provide some information about households’ housing preferences.

4.5 Housing preference and choice

After a certain period of time, a household is willing to move to a new dwelling. The mutation rate mentioned in figure 4.3 describes the average time. This section uses a household’s presumed thinking pattern to discuss to which type of dwelling a households is willing to move. A household’s first step is to make the decision to move because of a change in their housing preference. The next step is to decide upon a location to which the household would like to move. The research does not cover this portion and it is assumed that households that leave a dwelling from the housing association will be replaced with households that will enter the property from another housing association. The next question in the
research’s presumption concerns whether a household will buy or rent a dwelling. This question is answered differently amongst the different income classes.

<table>
<thead>
<tr>
<th>Income</th>
<th>Purchase a dwelling</th>
<th>Rent a dwelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower income class</td>
<td>21.7%</td>
<td>78.3%</td>
</tr>
<tr>
<td>Middle income class</td>
<td>12.1%</td>
<td>87.9%</td>
</tr>
<tr>
<td>Higher income class</td>
<td>31.7%</td>
<td>68.3%</td>
</tr>
</tbody>
</table>

Figure 4.5: purchase or rent a dwelling per income classes (CBS & BZK, 2013)

Figure 4.5 shows that the higher income class, for which the social housing market is not intended, looks more to buy dwellings in comparison to the other income classes, although 2/3 of the households in the higher income class still want to remain in the rental housing market. One reason behind this fact could be that there are many households that cannot or do not want to purchase a dwelling. These households may find a dwelling on the commercial rental market, although this market is very small. A possible solution to this issue is that the housing association could transfer dwellings to the commercial housing market. It is doubtful that transferring dwellings would completely solve the problem and that the higher income class may be forced to buy a dwelling in the case that they would really like to move. In the lower income group, 22% are willing to purchase a dwelling: It is doubtful that it is really possible for these households to finance a dwelling.

The next step is to determine which type of dwelling is preferred for the household that intends to move. A closer examination is taken to the choice between a single-family dwelling or multi-family dwelling, and furthermore, to the preferred quality of the dwelling. There is not enough data available to take into consideration the income of the household.

<table>
<thead>
<tr>
<th>Current Type of dwelling</th>
<th>Single-family dwelling</th>
<th>Multi-family dwelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>28.3%</td>
<td>71.7%</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>64.1%</td>
<td>35.9%</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>39.3%</td>
<td>60.7%</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>75.9%</td>
<td>24.1%</td>
</tr>
<tr>
<td>single-family, low and medium quality</td>
<td>52.4%</td>
<td>47.6%</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>28.3%</td>
<td>71.7%</td>
</tr>
<tr>
<td>total</td>
<td>48.4%</td>
<td>51.8%</td>
</tr>
</tbody>
</table>

Figure 4.6: preferred type of dwelling based on the current type of dwelling

In general, figure 4.6 shows that the preference for a single-family or multi-family dwelling is approximately equal, but the number of single-family dwellings is much smaller in comparison to multi-family dwellings. Households that are in a multi-family dwelling with a high quality would especially like to move to a single-family dwelling. Tenants that rent a low quality multi-family dwelling would rather move towards another multi-family dwelling. These structures seem natural: households improve their housing environment step by step. One contradiction to this logic, however, is found in the single-family dwellings with a high quality. These households would like to move towards a multi-family dwelling. One reason for this tendency could be that the group consists partly of the elderly, and in this group, households are forced to purchase a dwelling and must therefore find a dwelling of lower quality.
Figure 4.7: preferred quality based on the current type of dwelling

<table>
<thead>
<tr>
<th>Type of dwelling</th>
<th>Low quality</th>
<th>Medium quality</th>
<th>High quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>79.4%</td>
<td>8.0%</td>
<td>12.7%</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>56.2%</td>
<td>32.6%</td>
<td>11.2%</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>52.4%</td>
<td>47.6%</td>
<td>0.0%</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>80.6%</td>
<td>0.0%</td>
<td>19.4%</td>
</tr>
<tr>
<td>single-family, low and medium quality</td>
<td>73.7%</td>
<td>23.0%</td>
<td>3.3%</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>51.3%</td>
<td>38.3%</td>
<td>10.4%</td>
</tr>
<tr>
<td>total</td>
<td>58.8%</td>
<td>32.1%</td>
<td>9.1%</td>
</tr>
</tbody>
</table>

Figure 4.7 presents that level of quality that households demand for a new dwelling. There is a recognizable preference for dwellings with a low quality. This preference is explained by the way that demanded quality is determined: the rent a household is willing to pay for a dwelling. When a household does research on the housing market to make a housing choice, it is recognized that more money should be spent for housing in order to fulfil the housing preferences.

### 4.6 Havensteder’s position

The housing association Havensteder must find a feasible position in the housing market. New legislation and the financial position of the housing association has led to new policies within the social housing market. Havensteder’s position is explained with the help of an interview. The interviews complete outcome can be found in appendix B.

**New legislation**

Havensteder is aware of the newly applicable legislation. As a result of this new legislation, the housing association hopes to find a structure that fits within the new regulations, but more importantly, benefits Havensteder’s position. The new regulations are seen more as a new delineation in which Havensteder must perform. The question that Havensteder tries to answer is: for which income class will we provide housing and what rent is reasonable? Once the question is answered, it could be discussed whether or not the housing association’s solution fits within the new legislation. The problem of the new legislation is viewed as the breakdown of the housing association into two separate entities for social businesses and commercial businesses, even when only an administrative separation fulfils the regulations. Havensteder’s opinion is that the total seize of the social housing market will decline.

**Financial position**

As a result of their financial position, Havensteder is obligated to be careful about their behaviour in the housing market. In a supervision letter, it is determined which objectives the housing association have to improve the financial situation. These measures aim to decrease the business costs and improve income before investments are made (CFV, 2014). In the interview, the housing association explains that it must improve its financial position, but it is confident it will succeed. Dwellings rented to new tenants are priced 98% of the maximum rent, which helps to improve the financial position. Investments are only made when financial assets are available, and as a result the number of loans does not further increase. One consequence is that Havensteder is not able to develop many new dwellings. On the other hand, dwellings are only demolished when there is no other option, because the demolition of dwellings always results in a
financial loss. Havensteder aims at maintenance to improve the quality of dwellings. Another solution for the housing association is to sell property, but Havensteder is cautious with this course of action.

**Objectives for Havensteder**
The housing association’s primary objective is to provide social housing in the city of Rotterdam and Capelle aan den IJssel. In the current situation there is a demand surplus for dwellings. It could be argued that when a waiting list is present for social housing, the housing associations in the region do not provide enough social housing. In this case, not only Havensteder is responsible, but also the other housing associations and probably to a greater extent, the local government. With the new legislation, it is expected that the seize of the social market will decline. Havensteder’s objective is to hold their share of social houses on the market, relative to the other active housing associations in the region. In the event that the total seize of the social housing market declines, Havensteder will consider withdrawing dwellings from the social housing market. Due to the increase of rental prices to 98% of the maximum rent, it seems that Havensteder has replaced dwellings with commercial assets and does not provide social housing. This statement is not completely true, because some of Havensteder’s properties have a low quality and cannot be transferred to the commercial market. Some of the association’s properties, however, will be converted to the commercial assets. It is argued that the social housing will still profit from this structure, because the profit made on these assets is used to finance the social assets of the property. A secondary objective can be recognized here: improving the financial position of the housing association. Based on Havensteder’s objectives, the conceptualisation, as introduced in chapter 3, can be improved.

![Diagram](image)

**Figure 4.8: conceptualisation position Havensteder**

Figure 4.8 shows how the conceptualisation of the position of Havensteder is improved. The viability between good or bad is replaced with two different components: the financial position and the share on the social housing market. Improvements to both factors mean that the viability of Havensteder improves.
4.7 Conclusion

To conclude, an answer is formulated to two sub questions. First, the sub question based on the position of the tenants will be answered. Secondly, the sub question based on the position of the housing association will be answered.

What are the housing preferences of the current group of tenants? What are housing preferences of the target group of tenants? What are the main differences between these groups?

Annual income marks the difference between the target group and the current tenants. Households with an income above €33,614 are not part of Havensteder’s target group. The characteristics of this group of tenants are that they are often found in the single-family dwellings of the housing association or the dwellings with a higher quality. The group of tenants with a higher income is more willing to move outside the rental market and buy a dwelling. This group’s behaviour can be explained by the fact that this group has a larger opportunity to succeed in the purchase of a dwelling.

As a structure of a moving chain is recognized: households want to move from lower quality dwellings to higher quality dwellings in the multi-family dwellings and from a high quality multi-family dwelling to a single-family dwelling. To purchase a dwelling is not really the next step in the moving chain, but more a possibility once annual income is high enough. There is a group with a high income that is not willing or not able to leave the rental market and there is group that wants to return from a single-family dwelling to a multi-family dwelling. It has been explained that households would like to have a dwelling with a low quality, based on the rent they are able to pay. Conclusions about this result should be made cautiously. The best conclusion is probably that the price of a new dwelling is important and that households prefer to pay a lower price if possible, although the demands for quality are expected to be higher than suggested.

What does the housing association view as a problem and as possible solutions to their current position in the social housing market and what objectives are recognized in their review of these solutions?

This chapter assumed that Havensteder’s main problem would be the new legislation, but it could be concluded that the financial position is a similarly troubling or even larger problem. In order to solve their financial problems, the new legislation can be considered part of the solution. The new legislation can provide an incentive to move property to the commercial assets and to make profit on the property.

To improve the financial position, the housing association cut down on business costs. Investments are only made when the financial resources are available. The income from rent is increased though increased rents for new tenants. To provide social housing, current property must be retained. Even when part of the property becomes commercial assets, the social housing will benefit from the profit made on the commercial market. Due to the new legislation, the total seize of the social housing market may decline. Havensteder’s objective is to hold a share of 25% of the social housing market.

One interesting subject for Havensteder is to receive insight the ratio of social dwellings versus commercial dwellings in the long term. How many commercial assets are needed to make enough profit to balance the
costs of the social assets? In this situation, Havensteder’s financial position is balanced. This research seeks an answer to this question.
The system dynamics model

This chapter contains the description of the model used for the system dynamics analysis. First, it refers to the conceptual model as it is the basis for the system dynamics model. It further describes the model’s capabilities. Secondly, it explains the model’s general structure. Finally, the chapter considers the verification and validation of the model.

5.1 Conceptualisation

The model is built based on the conceptualisation as presented in chapter three and the adaptions of the conceptualisation presented in chapter four. A complete overview of the conceptualisation with the adaptions from chapter 4 is presented in figure 5.1.
The conceptualisation determines the scope for the model. The system dynamics model does not provide a perfect representation of the real social housing market in which Havensteder is one of the housing associations. The conceptualisation takes several subjects of the market into consideration. The model aims to provide results in regard to the transition between the unitary rental market and the dual rental market. Havensteder’s viability is an important condition for the transition. The system dynamics model can show the developments of the factors that distinguish between the unitary and dual rental market. For example, the model takes the housing preference and development of dwellings into consideration. Havensteder’s policy is used as a tool to model different outcomes in the unitary and dual rental markets as well as Havensteder’s viability. Developments in economy, demography and legislation are seen as inputs that the housing association cannot control. The model remains a simplification in many aspects; it does not speak to the livability of the housing environment, agreements with local governments, the type of maintenance, the behaviour of other housing associations, the evolution of housing preferences and many other aspects.

5.2 General structure

Four different parts are recognized in the system dynamics model: rent levels, households, dwellings and financials. These parts are related to each other and influences each other. In appendix E, screenshots are implemented of the complete model. Appendix F provides in a full overview of the equations used in the model. The eight types of dwellings are represented in layers, as determined in chapter 4. In each component, the layers are present, and only in the financial part of the model are the layers combined to a single value. First, the function of the layers is elaborated upon, and afterward, the different parts of the model are explained.

Type of dwelling

The eight types of dwellings are implemented in the model as layers. It can be seen as eight equal models, one for each type of dwelling. The models are related to one another in instances in which households move from one type of dwelling to another type. For each type of dwelling, the structure of the housing market is equal, but ratios can vary. For example, for each type of dwelling, a certain percentage is sold per year, but the percentage is different for each type of dwelling. The initial number of households, as shown in the conceptualisation in figure 5.1, are used in the different layers. Besides these factors, the model also uses the different mutation rates, initial rent levels and other values.

Rent level

Figure 5.2 shows the part of the model which determines the rent level. The rental profit from social property is based on the number of rented social dwellings multiplied by the average rent level. The model calculates the rent level of social housing. The rental profit from commercial assets is only roughly estimated so that it may be used in the financial part of the model. The rental profit may increase due to three measurements:

- Annual rent increase
- Additional annual rent increase for the high income group
- New rent level for new tenants
The annual rent increases are only a few percentage points per year. When a new household moves into a dwelling, a new rent is estimated. The rent is estimated based on a percentage of the maximum rent, and the maximum rent is estimated based on the quality of the dwelling. Havensteder has suggested that the rent level for new tenants is 98% of the maximum rent, although this rent price is part of a policy that could be adapted in different scenarios. The actual rent level is maximized by the maximum rent level. There are two possible reasons for a decrease of the rental income:

- Household leaves the dwelling
- The dwelling is transferred to the commercial assets

When a household leaves a dwelling, they no longer pay rent for the dwelling. When the household leaves, it will first lead to a decrease in the rental income, although the vacant dwelling will eventually be rented again to a new tenant. When the maximum rent permits a higher rent than the rent of liberalisation, the dwelling is transferred to the commercial housing market. The current household would not notice the transfer, but the tenant will no longer be renting in the social housing market. Only in the layers with dwellings of a high quality, can the rent level exceed the liberalisation rent level, and in these cases, a transfer is made to the commercial housing market. Each year the maximum rent and the liberalisation rent is increased according to the inflation rate. Furthermore, the rent may increase somewhat each year due to the inflation rate. Therefore, the model uses the rent level as a percentage of the maximum rent.

**Households**

Figure 5.3 shows the part of the model about the households. In each type of dwelling, three types of households are recognized: a lower income group, a middle income group and a higher income group. These groups have already been determined in chapter 4. Households have an incentive to move to a preferred dwelling, which is discussed in chapter 4 and is assumed in the model to be static. A household in a certain type of dwelling has the incentive to move to another type of dwelling based on a fixed percentage. The mutation rate and the desire to move are deemed as constant. When the number of households in a certain type of dwelling and income group decline, the remaining households will have less incentive to move, as these tenants are not willing to make a movement.
The social housing market is not intended for households with a higher income. These households are not allowed to start renting a dwelling on the social housing market; they may only leave the social housing market. The number of households in the higher income group increases due to households that are transferred from the middle income group to the higher income group, because these households have improved their income.

Households with a lower or middle income can leave the social housing market and may for example buy a dwelling. Another possibility is that these households may make an internal movement in the social housing market. These are not only households that move within Havensteder’s properties, but within the region’s property in the social housing market. It is assumed that the social housing market is homogenous and that the behaviour of other housing associations is similar to Havensteder’s. It is also suggested in the interview that tenants do not see any difference between housing associations and move without notice between them. The number of households that would like to move towards another dwelling is calculated based on the mutation rate. Based on the preferred dwelling, the households are allocated to different types of dwellings. Based on the vacancy, the movements are realised or not. When a movement is realised, the previous dwelling becomes vacant for another tenant. New households may enter the social housing market when dwellings are available.

**Dwellings**

Havensteder’s property is distinguished between social dwellings and commercial dwellings (figure 5.4), and this distinction is based on the rent level. When the current rent level is above the liberalisation rent level, the dwelling is placed on the commercial housing market. Only two types of dwellings can exceed the liberalisation rent, since the maximum rent level is based on the quality of the other type of dwellings is lower than the liberalisation rent. The social dwellings are transferred towards the commercial dwellings when the rent level exceeds the liberalisation rent.
The number of social dwellings can increase due to newly built dwellings. The housing association is only allowed to build new dwellings when the percentage of high income household is below 10% (or 20% in the first 5 years) of the total number of households in social dwellings. When Havensteder is allowed to build dwellings, each year a number of dwellings will be developed, based on a percentage of the total housing portfolio. Not all types of dwellings are built, because the quality is insufficient. It is assumed that the housing association does not build commercial dwellings. Each year, some of the dwellings are demolished. Havensteder’s focus is to demolish only dwellings of a lower quality. Some of the social and commercial dwellings are sold each year. The housing association can grant a discounted price on dwellings, which can influence the financial profit from sold dwellings.

**Financial part**

The financial part of the model, figure 5.5, describes in financial terms the consequences for the housing association based on the other three parts of the model. The dwelling value is determined for each type of dwelling and increases due to two factors:

- Annual value increase
- Maintenance increase

The value of the dwellings increases due to an annual value increase based on inflation. The maintenance that Havensteder executes also leads to an increase of the dwelling value. Only the maintenance that is executed to realise housing improvements leads to an increase in dwelling value. This maintenance is more likely to be a renovation. The structural maintenance does not influence the dwelling value. It is assumed that the dwelling value does not decrease. The dwelling value is needed to estimate the loan to value, landlord levy and the profits of sold dwellings.
Havensteder has several costs in the housing market. For this research, the main costs related to the business of renting dwellings are described in the model. These costs are:

- Demolition costs
- Investment costs for new dwellings
- Landlord levy
- Operating costs
- Maintenance costs
- Interest costs

A price per dwelling per year can be established for all these costs. Only the landlord levy is based on the value of the social dwellings and the interest costs are based on the total cumulative net cost. All these costs are added to the cumulative net costs. Two types of income are recognized in the model:

- Rental profit
- Sold dwellings

Rental income is the largest income for housing association. This is the rent of all dwellings on the rental housing market. Dwellings that are sold generate money for the housing association. A discount rate on the price of the dwelling can be provided.

In order to estimate the financial position of the housing association, two rates are used: the loan to value and the interest coverage ratio. The loan to value is a ratio in which the cumulative net costs are divided by the total value of all the dwellings. Ideally, all the loans of the housing association should be covered by the value of the dwellings. The interest coverage ratio estimates the portion of the rental income that is spent...
on the costs of interest. The interest costs should not be too large, because large interest costs will lead to a situation in which the loans will grow exponentially.

5.3 Model outcome indicators

The results of the different policies are measured with the defined variables indicated in the previous chapters. Not all the indicators are precisely found in the model, which will be explained in the following section.

The literature review describes four indicators to measure how the social housing market is evolving:

- Number of movements
- Rent levels
- Concentration of low income groups
- Demand surplus

The number of movements and the rent levels are measurable variables in the model. The concentration of low income groups is derived from the number of households with a lower, middle or higher income. In the model it is assumed that there is always a demand surplus for social housing, and in that way, the demand surplus is not measurable. The demand surplus is explained as the number of dwellings available for the lower and middle income group. When the number of available dwellings declines, the demand surplus for dwellings increases. In the initial situation, 35,000 dwellings are rented to households with this income.

The interview with Havensteder did provide two results that are important for the housing association:

- Financial feasibility
- Share on the regional social housing market

The model describes financial feasibility in terms of loan to value and interest coverage ratio. When these rates decrease, the financial feasibility improves. The share on the social housing market is not included in the model. The number of dwellings can be used to refer to association’s share within the rental housing market.

5.4 Validation

It is important that the developed model provides a representation of the real social housing market, in order to ensure that the model is extensively tested. Appendix G describes all the executed tests.

The input data for the system dynamics model is found in several sources. The rent levels, maximum rent levels, mutation rate, dwelling value and number of dwellings are provided by housing association Havensteder. With the help of WoON 2012 is data collected about the housing choice and income of tenants. Information about Havensteder’s policy are found in the financial data from the CFV: such as number of new realised dwellings, number of sold dwellings and number of demolished dwellings. Also the costs of these activities are derived from this data. The income improvement rates and the inflation rate are based on more general assumptions. It is concluded that most of the used data in the model has a strong empirical value. The downside is that some of the desired results from the data-analysis are not realised. The desire was to determine the mutation rate and housing preference based on several characteristics like rent level, households annual income or quality of the dwellings. Unfortunately, the
data-analysis did not provide in good useable results. For the system dynamics model more average mutation rates and general moving behaviour of households are used.

Several inputs in the model are related to the inflation: inflation rate, value increase rate, maximum rent increase rate, liberalisation rent increase rate and rent increase rate. The relation is not made in the model, because all variables do represent a different annual price increase. Although, it can be argued that when the inflation is high, the value increase of dwellings will also be higher. The same is argument is applicable for the rent increases. It would be rare that the inflation is about 3%, but the rent increase remains 1%. This research takes a certain sensitivity of the results into consideration. The inflation and all related variables will lead to much noise within the model output. This research places emphasis on the model outcomes that are most relevant: the development of households and dwellings. To avoid too much noise of the inflation, these variables remain equal in the sensitivity runs. The inflation rate is supposed to be in a range between 0% to 3%. For each variable related to inflation, in a specific run the percentage of inflation is equal.

The sensitivity of system dynamics model does take into consideration reasonable deviation in the housing market. Although turning points in the decisions of the housing association and other related actors are not taken into consideration. The choices of the housing association are partly covered in the different scenarios, but it is possible that after a couple of years complete different circumstances lead to new, unexplored, decisions for Havensteder. For example the government could decide that the current revised housing act does not achieve the desired results. Adoptions in legislation could lead to complete new incentives and behaviour of the housing association. Behaviour of other housing associations is assumed to be equal to the behaviour of Havensteder. Although, when a housing association in the region develops a strategy which changes the positions on the social housing market, Havensteder has to react on the occurring situation. When the rental housing market becomes a more dual rental market, the commercial housing market may become more attractive for private investors. This new actor could influence the complete rental housing market. Local governments can demand different results of housing associations in the future. The subject of the demand can be found in number of available dwellings, but also in developments on sustainability. Other events can influence the position of housing associations: for example the increase number of refugees that have to find housing on the social housing market. All these turning points are not taken into consideration in the system dynamics model.

The objective of the system dynamics model is to describe the transition between dual and rental market and the objectives of Havensteder on the social housing market. The structure of the model is already explained and it is argued that the model remains, within limited circumstances, valid. Although the result on the social housing market cannot be described precisely by the system dynamics model. There is always an uncertainty which should be taken into consideration. With the help of sensitivity analysis the uncertainty is described in appendix G. Here the results of the uncertainty are discussed for the main outcomes of the model.

- number of dwellings

The number of dwellings on the social housing market is controlled directly by Havensteder. Havensteder decides whether or not to sell, demolish or build new dwellings. These decisions are based on the financial
situation of Havensteder and the possibilities that a local government gives for the realisation of new dwellings. These relations are not present in the model. The model uses the average rates provided by the CFV. It is assumed that Havensteder can manage the housing portfolio to achieve the desired results. Only the percentage of high income households can make it hard for the housing association to start the realisation of new dwellings. Here some sensitivity becomes visible, because there exist an uncertainty about when the number of high income households drops below 10%. Furthermore the sensitivity for the number of dwellings is limited.

- Rent level
The rent level is determined by Havensteder when a household rents a new dwelling. At this point the housing association has much influence on the rent level. The annual increase of rent level gives the housing association limited influence on the rent level. The sensitivity of the rent level is assumed to be low, because it is controlled directly by the housing association. Only high or low inflation rates influence the annual rent increases, which gives some uncertainty in the total rent revenues.

- Financial feasibility
The loan to value and interest coverage ratio are very sensitive. In this instance, it is also considered that there are more financial activities that are not included in the model. For the different scenarios, the results mention whether they are financial feasible or not, but real numbers and figures are not used in these instances. It is not the purpose of the research to give a complete financial review of the housing association given a specific scenario. For a financial review of the housing association is a cost-benefit analysis more suitable. Although the financial feasibility is important for the housing association, it is not the objective of Havensteder to realise the best financial results.

- Number of movements and concentration of low income groups
The number of movements and the concentration of low income groups has a sensitivity of approximately 25%. This sensitivity is based on the uncertain variables about moving behaviour, housing preferences and income improvement of households. All these factors have been given a uncertainty. Moving behaviour and housing preferences have been researched in the data-analysis, but the results remain static, for a certain point in time. It is considered that the assumption for these results to remain equal for the upcoming 30 years is very uncertain. Also the development of household income is uncertain and strongly dependent on economic developments. It is not really taken into consideration that part of the households will easily realise income improvements, but another part of the households will never improve their income.
Development of the social housing market

This chapter describes the results from the system dynamics analysis. The model is used with the help of scenarios. The specific scenarios and outcomes can be found in appendix H. This chapter only mentions the main characteristics and not the results of complete scenarios. First, an answer to the third sub question is given. Next, an answer should be found to sub question four by moving through the different scenarios.

6.1 Choice of the housing association

It is generally arguable that housing associations’ behaviour results in the structure of the social housing market. These choices are limited by financial restrictions, but as shown, there is space for housing associations to make policies.

Havensteder has decided to reorganise as a company. Its goal is to cut back operation costs (such as salaries) from €1,632 to €1,320 per dwelling. Figure 6.1 shows that these cuts would result in a complete refund of the debts. The complete refund is not necessary: a reasonable debt is not considered a problem as long as the loan to value and interest coverage ratio do not rise. Several suggestions are made to adjust the housing association’s policies, which lower the profit of the housing association, but still improve the quality of the social housing market.
6.2 Current rent level

It is assumed that there is a surplus in the housing demand. Based on historical evidence and forecasts on the growth of the number of households, this assumption seems to hold true. Two counter points are not taken into consideration in this assumption: the maximum rent level and competition with other housing associations in the region.

The rental price for households that move into new dwellings is 98% of the maximum rental price, which is based on the quality of the dwelling. The new policy would make the rent for new tenants much higher. In contrast, the current average rent is only 80% of the maximum rent level. The percentage is based on the average rent level and not on the rent level at the point in time a household moves in the dwellings. The rent level slightly increases each year.

![Figure 6.2 rent level in percentage of maximum rent](image)

Figure 6.2 shows that the results are for the actual rent level in percentage of the maximum rent. In a few years, the average rental income will grow to 100% of the maximum rent. For a multi-family dwelling with a medium quality, the average rent will be €650 per month. For this type of dwelling, the rent level is considered high and some households cannot afford to pay such a high rent. This discrepancy could be a reason for the disappearance of the demand surplus.

An imbalance in the social housing market will become visible if other housing associations do not raise their rent level. When possible tenants notice that the rental prices are much higher compared to other housing associations, they will be unlikely to rent dwellings from Havensteder. The long waiting time in the housing market could be a reason for tenants to wait longer for a better dwelling.

The main objection to a rent that is 98% of the maximum rent is that it is questionable whether or not the housing market remains social. The housing association’s financial position demonstrates that a lower rent would be possible from a financial perspective. It is suggested that the rent for new tenants is 80% of the maximum rent, which is equal to the actual percentage of the maximum rent.
6.3 Current demand surplus

One of the characteristics of a dual rental market is that the demand surplus increases. Here it is measured as the number of available dwellings for the target group. Two structures become present: the transition of social dwelling to the commercial housing market and the decrease of the higher income group.

Figure 6.3 shows the number of dwellings: in the social and commercial housing market, and the number of households with an income above the target group. Havensteder’s total housing portfolio is declining slowly (red line). It is the result of selling and demolishing more property than is newly realised. In the first years a transition from dwellings to the commercial housing market is realised, due to the high rent levels (green and blue line). 40,000 dwellings are rented on the social housing market, but 15,000 are rented to households that do not belong on the social housing market. At the end of the simulation are 27,500 are rented on the social housing market, but they are all rented to households with an income suitable for social housing. It can be concluded that the seize of the social housing market increases with 2,500 dwellings.

6.4 Current number of movements

The number of movements in the social housing market says something about the accessibility of dwellings on the market. When more movements are realised, households seems have less difficulty in fulfilling their housing preference. Figure 6.4 shows percentage of realised movements, related to the desired dwellings.
The first years more movements are made in relation to the number of households that would like to make a movement. Reason is that many transitions from social to commercial dwellings are measured here has movements, although the households did not physically move. The graph stabilises on approximately 50%, in the scenarios it will be researched to increase this percentage.

6.5 Current concentration low income groups

It is already shown in figure 6.3 that the number of households with a high income will decline, although what influence will it have on the percentage of high and middle income households?

![Selected Variables](image)

The households from the middle income group benefit most from the decline of the high income group households. Figure 6.5 shows that the percentage of these households increases to 60% of the total tenants on the social housing market (green line). The group of households with a low income remains more or less equal. In several scenarios some assumptions can be made about the allocation of dwellings. It can be argued that there should be a larger emphasis on the lowest income group. Although, if the dwellings, with a suitable rent for lower income group, become scarce, there is not a complete solution found in a different allocation of the dwellings.

6.6 Sub question three

The previous section did provide an overview of the current policy of the housing association. It now possible to answer the third sub question:

*Does the current policy on the housing portfolio lead to a more dual rental housing system, given the housing preferences of tenants and the new legislation?*

The group of tenants with a higher income will become smaller in the future. As a result, the social housing market will aim solely on tenants with a lower or middle income. Higher rent levels will result in less available dwellings on the social housing market, as the dwellings with a higher quality will instead be rented on the commercial housing market. Although the relative available dwellings for the target group on the social housing market increases slightly. The number of movements decreases on the social housing
market. It cannot be concluded that the housing market becomes a dual rental market, because the rent levels increase and it is not proven that the demand surplus is also increasing, because more dwellings are available.

6.7 Rent levels

It is already mentioned that the rent level for new tenants of 98% is considered as very high. In different scenarios it is researched what the results would be if the entrance rent level is lower. It results mostly in different financial outcomes.

![Figure 6.6: rent levels](image)

Figure 6.6 shows the financial results and the rental income for scenarios with an entrance rent level of 70%, 80%, 90% and 98%. Rent levels of 90% and 98% lead to an unnecessary strong improvement of the financial position of Havensteder. Although a rent level of 70% of the maximum rent worsens the position of housing association. A rent level of 80 percent gives a reasonable financial result. It is slightly positive, which creates an position for Havensteder to make some other financial choices on the housing portfolio.

6.8 The high income group

Dwellings are not rented to households with a high income. In each scenario, a decline of the higher income group is visible, but it takes several years to decrease the total seize of the high income group.

![Figure 6.7: development of the high income group](image)

Figure 6.7 shows the decline of the higher income group in three scenarios. On average, it takes about 10 years before the higher income group comprises of only 10% of all the tenants. The simulation argues that when the number of tenants in a group declines, the likelihood for movements becomes smaller, although there is not a group of tenants that is determined not to move at all. In reality, such tenants may exist.

The slow decrease of the high income group results in a longer period in which the housing association is not able to realise new dwellings. Only after ten years, would the housing association be able to realise new dwellings. As established in the interview, Havensteder aims to improve dwellings and not to develop new
property. Other housing associations will probably encounter more problems with financing new property as a result of the new housing act.

### 6.9 Concentration of low income group

The households are divided into three income groups: lower, middle and higher. If it is argued that the middle income group is also low income, because with their given income it is possible to rent a social dwelling, the concentration of the lower income group is calculated to be 90% to 100%. Further, the higher income group is not able to rent on the social housing market, and their dwellings may be transferred to commercial assets. What is the consequence for the total number of dwellings available for the lower and middle income group on the social housing market?

**Figure 6.8: number of social dwellings**

Figure 6.8 considers three simulations. Initially, 42,500 dwellings (and households) were available on the social housing market, but also an additional 15,000 households with a higher income. When all the higher income households leave the housing market and the decline of dwellings are also factored into the model, in the basic simulation (green line), less dwellings are available for the lower and middle income group at the simulation’s end. The other two simulations are based on scenarios in which part of the higher quality dwellings are not transferred to the commercial market. In this situation, there is a larger number of available dwellings for lower and middle income households.

The lower and middle income groups are separated to see if there is a concentration of the lower income group.

**Figure 6.9: lower and middle income households**
In several simulations, the same structure is more or less visible. There is a small decrease in the lower income group and an increase of the middle income group. In figure 6.9, it is specifically taken into consideration that some of the dwellings are not transferred to the commercial assets, and therefore, the allocation of dwellings is adjusted. Dwellings with a low quality are allocated to households with a lower income; dwellings with a medium quality are allocated to households with middle income. This allocation resulted in the largest lower income group, and only in the case that all households are allocated to the lower income group, is the lower income group a bit larger.

The negative aspect of this outcome is that the number of households in the lower income group becomes smaller. Where do these households find a dwelling? It is almost impossible for the lower income group to rent a commercial dwelling or to buy a dwelling. Since they cannot find another dwelling, it is assumed that the pressure on this group of households in the social housing market grows and that they will rent dwellings of a medium quality. The model does not take into consideration the maturation of dwellings and the decrease of the lower income group grows in the last period of the simulation. The medium quality dwellings will perhaps be more accessible after several years.

The positive aspects of this outcome is that the middle income group remains present in the social housing market. It will ensure a mixture of lower and middle income households in neighbourhoods. When only one type of household is present in a neighbourhood, it could result in a negative perception about the neighbourhood.

### 6.10 Housing portfolio

Havensteder has several possibilities to manage their housing portfolio. The housing association’s preference is not to lose too many dwellings and to have an equal share on the social housing market in comparison to other housing associations. This section discusses three different policy measures to influence the housing portfolio.

![Figure 6.10: number of social and commercial dwellings](image)

Figure 6.10 shows the number of social dwellings and the number of commercial dwellings. In this figure, the total number of dwellings slowly declines. One cause of this phenomenon is that more dwellings are demolished and sold than the number of new dwellings built. Havensteder can influence the transition of dwellings from the social market to the commercial housing market. All dwellings with a high quality can be rented for a rent above the liberalisation level and will become commercially rented dwellings (green line). The social market becomes relatively small as the commercial market grows. The advantage of this
construction is that when the different types of dwellings are spread amongst neighbourhoods, a mixture of lower, middle and higher income households automatically arises.

The housing association can decide to hold the property in the social housing market. Here, the maximum rent cannot exceed the level of liberalisation (red line). It results in a smaller decline of the social dwellings and the market becomes larger for the lower and middle income households, because the higher income households may no longer enter the social housing market. The households with a higher income have to find another type of dwelling once they move. The housing association does not provide many commercial dwellings, so a rental dwelling will thus become difficult find. The households may decide to buy a dwelling.

Between these two alternatives, a policy is available that only partly transfers the social dwellings to the commercial market (blue line). Here, it is assumed that dwellings with a high quality that are currently rented by households with a high income will be transferred to the commercial market. The other dwellings with a high quality will remain in the social housing market. The advantage to this transfer is that the percentage of high income households is immediately lowered. There is also a decent number of high quality dwellings available for households with a high income on the commercial housing market, but the number of households with a lower or middle income that find a dwelling on the social housing market remains more or less equal. The decrease of dwellings is absorbed by the decrease of households with a high income. The advantage of this policy is double: a commercial housing market is realised and embedded within the current neighbourhoods and some of the higher quality dwellings are still available for the lower and middle income group.

If the housing association does not demand the maximum rent, it does influence the housing association’s financial results. The financial results are compared with an initial rent of 80% of the maximum rent.

![Figure 6.11: financial results of three scenarios](image)

A trade-off between the rent level and the number of households in the social market is recognized in figure 6.11. When dwellings are not actively kept in the social housing market, it is shown (green line) that the financial position of the housing association improves extremely. The housing association could consider demanding an even lower rent level for tenants when they move to a dwelling. In the situation in which all dwellings remain social dwellings (red line), it is shown that after a period of 30 years, the financial position worsens. The housing association could compensate for the financial struggle with a higher rent level. The financial position remains more or less constant when some of the dwellings are saved for the social housing market and the initial rent is 80% of the maximum rent. The results are
dependent upon the preferences of the housing association and the following trade-off: less social dwellings on the market with a lower rent, or a larger social market with higher rental prices.

6.11 Selling property

In general, it is not the housing association’s purpose to provide commercial housing. It is shown that in some situations, Havensteder rents commercial dwellings. An administrative separation is assumed between the social and commercial dwellings, in which social dwellings are rented in the social housing market and the commercial dwellings in the commercial housing market. Housing associations can decide to sell their commercial property. The property can be sold to another party or to a separate holding that is owned by the housing association. The sale of properties also influences the financial position of Havensteder.

Figure 6.12 displays the financial results when all commercial dwellings are sold with a discount rate of 25% and the new rent rate is 80%. A significant improvement of the financial position is visible in the first period, but at the end, the financial position becomes less positive. Selling property at a lower discount rate can result in a positive financial result.

Selling property is part of a strategic choice on the part of the housing association. This choice concerns what kind of separation is desired between the social and commercial property and how the housing association manages their commercial housing portfolio.

- When the commercial housing portfolio is sold to another actor on the housing market for the market price, Havensteder’s financial position improves, but their share on the rental housing market decreases. The reorganisation of the company will become more difficult, as they will hold fewer dwellings in their housing portfolio.
- When the commercial housing portfolio is sold to a holding owned by the housing association, the new holding should also be financially feasible. As it may be difficult to finance the holding, higher interest rates may result. The financial advantage of the social housing portfolio should not be cancelled by the disadvantages in the commercial housing portfolio.
- Only an administrative separation is simulated in the scenarios in which property is not sold in large quantities.
Besides the three general strategic choices, there are more possible solutions. This research does not provide an answer for the strategic choice, but these choices are taken into consideration for the interpretation of the structure of the social housing market.

### 6.12 Number of movements

The number of movements is measured in quantity and in the percentage of the desired movements. More movements indicate that the social housing market is more accessible and the circulation of households in the social housing market improves. Only movements from the lower and middle income group are shown in the simulations, because these are the target groups for the social housing market.

#### Figure 6.13: realised movements

The number of movements is influenced by the number of dwellings in the social housing market. More dwellings provide more opportunities to move, but do not automatically result in a higher percentage of realised movements, as more households are willing to move.

Figure 6.13 shows that the number of movements increases when the potential commercial property is completely or partially saved for the social housing market. This trend is partially the result of the larger number of households with a lower or middle income in the social housing market. On the other hand, a decrease in the number of social dwellings over time is present, and at the same time, the sum of movements increases. The differences in the percentage of realised movements can be considered small. The percentage above 100% is the result of the transition of dwellings into the commercial assets. When a portion of the dwellings is transferred to the commercial market, the percentage is slightly better in comparison to the other scenarios. Although the percentage remains around 60%, not all the movements are realised, relative to the average mutation rate.

#### Figure 6.14: sensitivity realised movements
Figure 6.14 shows that the sensitivity remains within a certain bandwidth and shows a more stable development of the total number of movements and the relative number of movements. It should be considered in figure 6.14 that the model needs a certain start up time, especially in these variables. The exponential increase in the first two years will not be shown on the housing market, but is the result of the model that need some iterations to run smoothly.

6.13 Sub question four

Finally, an answer to the fourth sub question can be given. As mentioned in the beginning of the chapter, the behaviour of the housing association is very important to the structure of the social housing market.

Is a strategy available to optimize the relation between the housing preferences of the target group and the housing portfolio of the housing association?

It is suggested that Havensteder save some of the higher quality properties for the social housing market. In that case, will the same number of dwellings be available for the same number tenants with a lower and middle income. A distribution based on income level becomes apparent: lower income households in low quality dwellings, middle income households in medium quality dwellings and higher income households in high quality dwellings on the commercial housing market. Rent levels will increase and it is questionable how social a social housing market can be when the maximum rent is demanded based on the quality of the dwelling.

Due to the reorganisation of the housing association, financial resources are available to improve the quality of the social housing market. A trade-off is evident between high quality dwellings on the social housing market for lower and middle income households. Tenants desire both. It is the housing association’s objective to find a good balance in this trade-off. It is suggested that Havensteder saves some of their higher quality dwellings for the social housing market and to periodically adapt the rent level for new households based on their given financial situation. If needed, Havensteder could decide to sell some of their commercial housing portfolio in order to improve their financial situation.
Conclusion and recommendations

The conclusion answer the study’s original research question. The research focuses on the housing association Havensteder. The project leaves several open spaces that can be filled with additional research. Some additional recommendations are made.

7.1 Research question

The research contains several components. An interview is held with housing association Havensteder, which provides information about the behaviour and role of the housing association. The data-analysis provides information about current tenants’ moving behaviour and housing preference in the social housing market. The system dynamics analysis describes the development of the social housing market. The conclusion of each analysis is found in the associated chapters. Here, the conclusions are combined to answer the main research question:

*What impact does the new housing act have on the behaviour of housing associations and is a transition made in rental housing that fits the housing preferences of future tenants?*

In order to answer this part of the research question, the conceptualisation as presented in chapter 2 is utilised.

![Diagram](image)

*Figure 7.1: Movements to dual or unitary rental market*

Figure 7.1 presents the movements that the four identified indicators made in the system dynamics analysis. In the following, each indicator is discussed briefly:

- Number of movements
The model compares the number of movements to the current average mutation rate, as stated in Havensteder’s data. The data reveals that on average between 50% and 60% of the expected number of movements are realised. Hence the number of movements declines, indicating a transition to a dual rental housing market.

- **Rent level**

A dual rental market is characterised by rent levels that are determined by housing associations’ costs and are far below the market price. Initially, the average rent level of the current tenants is 80% of the maximum rent. Havensteder chose to demand 98% of the maximum rent for new tenants. It is suggested to lower the rent for new tenants, but eventually, the average rents will rise above the current percentage, 80% of the maximum rent. Here, the market transitions towards the unitary rental market.

- **Concentration of low income**

The social housing market is only available to households with an income below the liberalisation level. The research shows that the income of a household determines the quality of the dwelling that they can rent. Households with a higher income are excluded from renting a dwelling on the social housing market and the size of the higher group declines to below 10% of the total group of tenants. The concentration of lower and middle income households indicates a transition towards a more dual rental market.

- **Demand surplus**

The size of the social housing market is dependent on Havensteder’s decisions. When all high quality dwellings are transferred to the commercial housing market, the available dwellings for the target group declines. On the other hand, households with a high income are excluded from the social housing market. This effect approximately balances and the number of dwellings available to the target group remains equal: 27,500. When Havensteder actively saves some of the dwellings for the social housing market, the number of dwellings for the target group could increase to approximately 35,000. An important assumption here is that the housing association succeeds in excluding tenants with a high income from the social housing market. The rental market does not move towards a dual rental market, but more to a unitary rental market, as more dwellings may possibly be available for the target group of tenants, resulting in a lower demand surplus.

### 7.2 Conclusion

Two of the four variables indicate a transition towards a more dual rental housing market, but the other two variables indicate a transition to a more unitary rental market. The demand surplus is not considered large and may, according to Havensteder’s policies, remain absent. The increase in rent level partly originates in the landlord levy and the financial position of the housing association. It is not based on the realisation of a more competitive price, although it cannot be neglected that both variables indicate a move towards a unitary rental market. For that reason, it cannot be concluded that Havensteder’s social housing market will become a more dual rental housing market.
7.3 Position of Havensteder

The research provides in insight on the position of Havensteder, besides the transition between unitary and dual rental market. The most important recommendations for the position of Havensteder on the social housing market will be mentioned:

- Lower the rent levels

The results demonstrate that the financial position of the housing association improves and that the housing association has a choice to adapt its current policy. With the current policy is a rent demanded of 98% of the maximum rent for new tenants. Considered the financial results of the simulations a rent level of 80% of the maximum rent for new tenants is sufficient for a financial feasible position. It is questionable how social a social housing market is when all dwellings are rented at the maximum rent level.

- Save high quality dwellings for the social housing market

It is recommended to save specific dwellings for the social housing market, which could be transferred to the commercial market. The higher quality dwellings are preferred in the social housing market and saving these dwellings increases the size of the social housing market for the target group of tenants. The demand surplus for dwellings on the social housing market will not vanish, but more households with a lower income can be served on the social housing market.

- The higher income group

The income group with an annual income slightly above the liberalisation level cannot find housing on the social housing market anymore. How can these households find a dwelling, when it is not feasible for them to purchase a dwelling? The group could become the main victim of the housing market in which dwellings are saved for the social housing market. It is not the completely responsibility of Havensteder to solve this problem, but business opportunities are present. For example selling only dwellings to households that are slightly above the liberalisation level. Other solution is to start a separate company that aims on the development of dwellings on the commercial rental housing market. Such a private landlord could solely aim on the rental housing market for the higher income group. The solution makes it easier to economize on the operational costs: employees could be transferred to the new commercial company.

7.4 Recommendations for research

This section provides recommendations for further research. The recommendations should not be seen as a complete list, but only as preliminary suggestions:

- Other housing associations

The research aims at the housing association Havensteder. Other housing associations face the same legislation, but have a different position in the housing market and will therefore make different choices. This research suggests the utilisation of the same model for other housing associations. The model should be adapted to other housing associations’ situations, although it is possible to use the model to find results
concerning the unitary and dual rental market. Are the same transitions evident in other housing associations?

- Regional studies

A housing association only possesses part of the social housing market. The behaviour of other housing associations on the housing market could be taken into consideration to achieve a full overview of the development of a specific region. The aim of the research could greater emphasise the interaction between housing associations.

- Specific neighbourhood

The scope of the research is the housing association and not a specific neighbourhood, although the general behaviour of the housing association has an influence on the livability of a neighbourhood. Research could be conducted to study the dynamics in a specific neighbourhood. What social aspects are changing? Are households with a lower income clustered in a neighbourhood and does it have consequence on the quality of life in the neighbourhood? What effective tools do housing associations have to improve the livability and are they allowed to use these tools within the policies of the new legislation?

- Further research

After a period of about ten years, the structure of the housing market will have changed. After this period, it would be of interest to research how the housing market has developed and whether or not the social housing market has become a more dual or unitary rental market.

7.5 Reflection

Throughout the execution of this research, certain decisions have been made that led to the results as presented in this report. Some of these choices are subjective and this section discusses these choices. The project started with a certain viewpoint on the social housing market. The reflection discusses whether or not the viewpoint has changed over the course of this research.

The research decidedly focusses on one specific housing association: Havensteder. The choice to focus on a specific housing association originated as an effort to determine the effects of the new legislation on a specific housing association. As the aim was to concentrate on the question of determining the market’s transition to a dual rental market and not on the effects on a housing association, it could be argued that the study would have benefitted from a more neutral viewpoint that considered the complete social housing market in a specific region. In this way, the study may have provided more general conclusions for all housing associations, although the specific situations of housing associations would not be factored into the research. One shortcoming of such a study would be that the provided data form Havensteder would not be available and more assumptions would have been in the development of the system dynamics model.

At the project’s start, it was not clear what data from Havensteder would be available. Much data in regard to the dwellings was provided, but a gap in the data of households became apparent. It could have been
earlier established that the housing association did not have specific data about households. The choice was made to gather additional data from other resources in order to achieve more data about the households. Besides that, the data was very useful for the system dynamics analysis, as it was not considered to make a choice between both data sets and to adapt the intended model to one dataset. For example, it could be argued that the research would benefit from the exclusive use of Havensteder’s data and the omission of all households’ characteristics. The combination of dwellings’ characteristics and households’ characteristics is valuable for the perspective on the social housing market and therefore the research’s choice can be defended. It is arguable, however, that a model based on one source of data could be more valid. The decision to use only dataset could only be made when the purpose of the research was adapted to such a decision.

The project describes and uses eight types of dwellings in all the analysis, although in the report this is not mentioned everywhere, because this categorisation would provide too much information. Was the choice to categorise eight types of dwellings a good decision? In all probability, the same results could have been achieved with only four categories. Looking back, it would have made the research more tangible in particular for the system dynamics analysis. The counter argument is that a system with eight group of dwellings is more specific and that a description on a higher level would not differ from a model with four groups.

The results from the data-analysis were somewhat disappointing. The research intended to use the results from several regression analyses in the system dynamics model. The data-analysis did not provide useable regressions for the system dynamics model. The choice was made to not use the results of the regression analysis. If the results were to be used, the system dynamics model would become much more complex and would have led to doubtful conclusions. The idea to use the regression analysis in system dynamics analysis is interesting, but it is important that the relations are very clear. Even with the large available dataset it was not possible to achieve effective results and to enrich the system dynamics model with the outcomes.

The position of the housing association in the social housing market was a difficult subject to research. It was assumed that the purpose of the housing association is to provide sufficient social housing. It is not that housing associations do not have that same objective, but there are several other objectives that should also be considered. Social housing associations face great pressure due to the developments in the past decade. New legislation places financial pressure on their activities. It has been made apparent in the past that housing associations are not able to make the supply of social housing their sole objective. Evasion of financial risk and financial solvency are likely more important factors for housing associations, as was made clear from the project’s beginning.

The research demonstrates that the social housing market is changing. For housing associations, activities in the social housing market will completely change. New regulations and a stronger separation between social and commercial activities characterise the emerging market. The rent levels are increasing, which the housing association can justify based on the financial needs, although other stakeholders may have a different opinion about the rising rent levels. Tenants do not view the new structure of the housing market and could argue that nothing in the market has changed because of the higher rent level. Tenants’ opinions of housing associations is likely not to improve: they are still companies that waste tenants’ money for the
sake of their ambitious endeavours. Local governments attempt to make agreements with the housing associations, because they see the size of the social housing market declining. Due to the rising rent levels, social housing becomes very expensive for the target group of households. Local government ensures social housing and argues that housing associations are responsible. When housing associations are not responsible, tenants’ pressure on local governments is likely to increase.

Perhaps not only the lower income households will suffer from the new situation. For higher income households, it will become much harder to find a suitable dwelling. These higher income households will be forced to leave the social housing market. The extent to which current policy will succeed is already doubtful, and the households will likely not move, as there are not many available. For the individual households, a situation could arise in which a dwelling cannot be bought, and even worse, it may be impossible to rent a dwelling on the social housing market. The only solution for the household is to rent a dwelling on the commercial rental market, in which the available dwellings are limited. In the current housing market, there is no available solution to this problem, besides the transfer of dwellings from housing associations transfer to the commercial housing market.
Appendix A: Bibliography


BZK, m. (2013). Wet van 18 december 2013 tot invoering van een verhuurderheffing over 2014 en volgende jaren alsmede wijziging van enige wetten met betrekking tot de nadere herziening van de fiscale behandeling van de eigen woning (Wet maatregelen woningmarkt 2014 II). staatsblad.


Appendix B: Interview Havensteder

Housing association Havensteder is subject of the research. To make the research as specific as possible an interview is held with the housing association. The main objective of the interview was to find an answer to the sub question about the objectives of the housing associations, the way to measure these objectives and the possible solutions for the future given the changed environment. The interview was held with Sophie van Welie, portfolio manager (Portefeuillemanager) at housing association Havensteder at March 31 2015. The results of the interview are described in this appendix.

Objectives for Havensteder

The primary objective of the housing association is to provide in social housing in the city of Rotterdam and Capelle aan den IJssel. The current property contains approximately 45,000 dwellings. Due to new legislation it is uncertain how large the total number of dwellings will remain in the future. The objective of Havensteder is to hold their share of social houses on the market, compared with other active housing associations in Rotterdam. When the social housing market becomes smaller, the housing association will also have to shrink their property. This can be realised by selling property or by making it commercial property. Besides this primary objective there are several secondary objectives, which are more seen as constraints. Most important constraint is to improve the financial position of the housing association. In the current situation there is less room for investments. Renovations are used to improve the quality of the property, which is needed for the tenants. This will also give opportunities for the increase of the rent level. Serving the target group can possibly imply that the tenants which are not part of the target group are faced with higher rent levels. These dwellings are transported to the commercial assets and the profits made here can be used for social assets. Selling property can also be used to improve the financial position of the housing association. Side effect is that more payable dwellings are available on the housing market, although the number of dwellings for households that cannot afford to buy a dwelling declines.

Accepting new households

New households find a dwelling with the help of a waiting list, which is applicable for all housing associations in the region. Here households can be selected based on their income. Normally only households with an income below the threshold will be selected for a vacant dwelling. The housing association has no influence on the development of the income of the household, so there for some households have an income above the threshold after a couple years. A higher rent can be asked from these households, but there aren’t more instruments available to give these households an incentive to move. The rent can grow rapidly and probably the dwelling will move in a few years to the commercial assets of the housing association.

Demand for dwellings

The demand for dwellings exceeds the supply of social housing in the region. When a dwelling becomes vacant it is rented towards another tenant within a couple of weeks. With the help of the waiting list the housing associations knows that there is always a large demand surplus. In a competitive market the rental prices should rise to a level where the demand will be more or less equal to the supply, but the social housing market is not a competitive market. There is a tension for housing associations to increase the price to make more revenues on a dwelling, although this will conflict with the social mission of the housing association.
**Rental prices**

Havensteder does increase the rent for current tenants within the margins which are determined by the government. For new tenants the rent for a dwelling is recalculated. The rent is determined with the help of the quality of the dwelling. The quality of the dwelling determines the maximum rent that is allowed to ask from the tenant. Havensteder charges a rent of 98% of the maximum allowed rent of the dwelling based on quality or the current liberalisation level. Due to this the rental revenues have increase in the past years. For roughly 50% of the dwellings is the quality the determining factor for the rent level. 10% to 20% of the property is rented above the liberalisation level. For the remaining dwellings the liberalisation level is the limiting factor for the rent. In a situation where the liberalisation level is frozen and the rent levels will rise slightly, it is possible that several households will be transferred automatically to the commercial assets, especially when the income of the household is above the income for social housing. The measuring of the quality level will probably change in the near future. The market value (WOZ-waarde) will become more important. Havensteder supposed that it will have a positive influence on the maximum rent they can ask, because the property is mostly located in the city of Rotterdam where the value of the location is high. Due to this the housing association will have more possibility to increase the rent.

**Property**

The property of Havensteder is mainly located in Rotterdam and Capelle aan den IJssel. Part of the property becomes older, although Havensteder tries to renovate these dwellings. Demolishing of property is not preferred, because it is from a financial perspective not favourable. With the help of renovation the costs for the housing association remain relative low and the number of dwellings does not decline. The financial situation of Havensteder does not give many possibilities for the realisation of new dwellings. Current ground positions are sold to other parties who will use these rights to do something with the location which fits to the social task of the housing association. A combination of demolish and rebuild is therefore in many occasions very hard to achieve, renovation is less difficult to realise. When dwellings are renovated it gives usually more room to increase the rent level. The location of the property is important for finding new tenants. The southern part of Rotterdam is a real different location compared with the northern part of Rotterdam. These different locations demands a different approach in managing of the property. The type of tenants does also differ on the several locations.

**Selling property**

Property can be sold to households with a discount of 10% on the market price. Havensteder tries to sell some part of the property when it becomes vacant, but in general it is difficult to do it. It is even more difficult to sell the property to the current tenants. Merely there is a resistance to buy the dwelling which is rented for a lower price in the current situation. Property with an higher value is easier to sell then property with a lower value. Due to this it is easier to sell the commercial assets, which will make it easier to aim on the social task of the housing association, although these commercial assets provide also in an annual profit on the rent. This is an argument to not sell these dwellings. Besides selling to households it occurs that property is sold to other parties. This is done from a more strategic perspective: To concentrate the current business to less different locations.

**Social assets versus commercial assets**

There is a tension within Havensteder to gain more revenues on the property or aiming more on the social task of the housing association. It is argued that the revenues of the commercial assets will benefit the
quality of the social assets. On the other hand it is important to hold a certain quantity of dwellings in the social assets, to fulfil the social task. Although, how many dwellings are needed in the social housing market? It can be argued it should be more as nowadays, because of the existence of the waiting list. On the other hand will the size of the market shrink, because of more strictly regulation about the ceiling in income. For Havensteder it is unclear how large the social assets will be in the future. Goal is to retain the same percentage of social assets in the region of Rotterdam. The behaviour of other housing associations is not completely clear, but they are faced with the same problems and tend to shrink their social assets. When the number of social assets declines to 36,000 dwellings it is assumed that Havensteder will retain their share on the social housing market and can fulfil the social objectives. The rest of the property can be placed in the commercial assets or sold.

For Havensteder it is unclear how the social assets will be divided from the commercial assets. New legislation gives room for several interpretations. An administrative distinction is probably enough, but it is also possible that a new firm will be created which will take care of the commercial rent of dwellings. In this situation the housing association will have less opportunities to transfer dwellings from the social assets to the commercial assets and vice versa.

**Competition with other housing associations**

Competition with other housing associations does not really exist. The transparency between the housing associations is very large and discussions are very open. Housing associations do not compete on price, because the rent level is largely regulated. Each housing association has property on specific locations in the city. Because of the demand surplus of dwellings there is no need between the housing associations to attract more tenants from other housing associations. The behaviour is adapted to each other and it is assumed that it wouldn’t make any difference for tenants to rent a dwelling from Havensteder or another housing association in Rotterdam.

**role of the municipality**

The municipality of Rotterdam has influence on housing associations with the making of performance agreements. In these agreements the municipality and housing associations lay down what they want to achieve in a certain region and who is responsible for certain aspects of these agreements. In general these agreements are very location specific and do not interfere with the general behaviour of Havensteder. Although, when the number of social assets will shrink too rapidly, the municipality could try to stop this trend.

**Housing behaviour**

Two types of households are recognized. The so called “starters” rent a dwelling for a couple of years and move outwards the social housing market afterwards. These households use the social housing market as a start of their housing career. Generally these households are young and cannot afford to buy a dwelling. After a few years the income of the households has improved and they decide to take their next step in the housing career.

The other type of household is a household which remains in the social housing market. Due to circumstances they cannot or do not want to buy a dwelling. These tenants stay longer in the dwelling and do have less intent to move. When they move, it is towards another dwelling in the social housing market.
Reason for the move is a significant change in housing preferences. Tenants are not bound to the property of Havensteder. They can easily move towards a dwelling form another housing association and would probably not notice any difference in housing experience.

**Future for Havensteder**

The social housing market is uncertain, not solely for Havensteder, but for all housing associations. The future of the market is uncertain in several aspects. The seize of the social housing market is under pressure. The political view will lead to less households which are eligible for the social housing market and gives an incentive to housing associations to limit their operations. This new conduct will have consequences for the business operations. Havensteder does not have made clear decisions about how to deal with the changing environment.

The financial situation of Havensteder is a main concern for the housing association. The financial results should be taken into consideration for each action on the housing market. The rent levels are increased to gain more financial revenues. Although it can be reasoned that an ongoing increase of rent levels is not desired. Advice on the rent level policy would be valuable.

Insight in the combination of social assets and commercial assets will be valuable for Havensteder. The profit on the commercial assets can be used to finance the social assets. Although a certain number of social assets is needed to hold the share of social housing market in the region. It is valuable to gain insight in the trade of between these aspects and to see if there is a balance in number of commercial assets and social assets.

Due to the demand surplus for social housing it is hard to see which type of dwellings are preferred by tenants. Even when the property of Havensteder will decline the demand surplus could probably increase. Although, when property is sold, Havensteder must have an idea about which type of dwelling should remain in the housing portfolio.
Appendix C: data-analysis on housing property of Havensteder

In this appendix the performed data-analysis is described step by step. The data is delivered by housing association Havensteder and gives a full image of the housing portfolio. The data is not a dataset with a selective number of respondents, from which the results of analysis could be converted to the general when the results are significant. The analysis will provide in results that are applicable on Havensteder. The results of the analysis cannot be converted to other housing associations, because the used data is solely from Havensteder and says nothing about the data of other housing associations.

Transforming data
The data is delivered in an excel file. For the analysis the data is transferred to a SPSS file. Some of the variables are needed to be recoded, so they can be used better in some of the analyses.

Duration of rent
It is known when the current tenants did start renting the current property. This start date of rent is transformed to the number of years that the tenant is renting the property on 1-1-2015. This is done with the following rule:

\[
\text{Duration of rent} = 2015 - (1900 + \left( \text{Start of rent date}/365.25 \right))
\]

This formula is used because with the transformation of the data from excel to SPSS the date was converted to a number. Now the formula results in the duration of rent in years.

Energy efficient label
The dwellings are all labelled based on the energy efficiency. The variable is measured on a nominal level, but it can be recoded towards an ordinal level. The nominal levels go from energy efficiency A to G, which is recoded to an ordinal level of energy efficiency to respectively 7 to 1. An energy efficiency of A is supposed to be the best energy efficiency label and is therefore recoded as the highest number. G is to lowest energy efficiency label and is recoded as 1.

Delineation of the property
The dataset exists of 53152 assets. Not all the property of Havensteder is part of the housing market. Part of the property is for example used for retail or is parking places. Figure C.1 shows the technical composition of the property.

<table>
<thead>
<tr>
<th>Technical type and number of property</th>
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<tbody>
<tr>
<td>Antenneopstelling</td>
</tr>
<tr>
<td>Bedrijfsruimte</td>
</tr>
<tr>
<td>Benedenwoning</td>
</tr>
<tr>
<td>Berging</td>
</tr>
<tr>
<td>Bovenwoning</td>
</tr>
<tr>
<td>Café/restaurant</td>
</tr>
<tr>
<td>Crèche/dagverblijf</td>
</tr>
<tr>
<td>Eengezinhoevewoning</td>
</tr>
<tr>
<td>Eengezinstussenwoning</td>
</tr>
<tr>
<td>Fietsenstalling</td>
</tr>
<tr>
<td>Flat</td>
</tr>
</tbody>
</table>
In the figure the bold text is assumed to be part of the social housing market and subject for the project. The other properties are excluded from the dataset, because they are not part of the housing market or have a very specific character. Figure C.2 summarizes the housing property of Havensteder.

<table>
<thead>
<tr>
<th>Housing property Havensteder</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benedenwoning</td>
<td>6</td>
<td>.0</td>
</tr>
<tr>
<td>Bovenwoning</td>
<td>1221</td>
<td>2.7</td>
</tr>
<tr>
<td>Eengezinshoekwoning</td>
<td>408</td>
<td>.9</td>
</tr>
<tr>
<td>Eengezinstussenwoning</td>
<td>9234</td>
<td>20.1</td>
</tr>
<tr>
<td>Flat</td>
<td>32473</td>
<td>70.6</td>
</tr>
<tr>
<td>Maisonette</td>
<td>2671</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>46013</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The figure shows that Havensteder has 46013 dwellings which can be rented on the housing market and the analyses will be based on these dwellings. The subdivision of type of dwelling is very unequal. It is shown that most of the property can be found in multi-family dwellings.

**Location**

The property of Havensteder is located in several cities in the region of Rotterdam. Figure C.3 shows how the property is divided over these cities.

<table>
<thead>
<tr>
<th>city</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALBRANDSWAARD</td>
<td>525</td>
<td>1.1</td>
</tr>
<tr>
<td>BARENDRECHT</td>
<td>514</td>
<td>1.1</td>
</tr>
<tr>
<td>CAPELLE AAN DEN IJssel</td>
<td>11155</td>
<td>24.2</td>
</tr>
<tr>
<td>KRIMPIN AAN DEN IJssel</td>
<td>89</td>
<td>.2</td>
</tr>
<tr>
<td>LANSINGERLAND</td>
<td>355</td>
<td>.8</td>
</tr>
<tr>
<td>ROTTERDAM</td>
<td>33364</td>
<td>72.5</td>
</tr>
<tr>
<td>SCHIEDAM</td>
<td>11</td>
<td>.0</td>
</tr>
<tr>
<td>Total</td>
<td>46013</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure C.1: technical composition of the property

Figure C.2: housing property of Havensteder

Figure C.3: Location of the property
Most of the property can be found in Rotterdam and Capelle aan den IJssel, respectively 72,5% and 24,2%. Only a very small number of dwellings are located in the other cities. It can be argued to exclude these dwellings from the analyses, because the property is located in another city where the housing market will conduct different. The choice is made to do not exclude these dwellings from the analysis, because the analysis aims on the objectives on the housing market for Havensteder and not on the development of a certain housing region. When the choice is made to exclude other cities from the analysis, it should be done for all cities. It leads to a great loss of data, because it will exclude also Capelle aan den IJssel from the analysis. From the interview it is also known that several districts within the city of Rotterdam have real other housing markets. Excluding several cities from the analysis will not solve that there are districts with specific characteristics in the housing market.

**Value of the property**

The value of the property is estimated on several dates. The property value is recalculated towards a fixed date, which is the first of January 2013 in this dataset. On this date the average housing value is € 121.039. When this is summed up the total value of the housing portfolio of Havensteder is € 5,6 billion. (€ 5.569.359.225)

The average rent for each tenant is € 505 per month estimated on 01-09-2014. The total rental income for Havensteder is € 23,2 million per month. (€ 23.243.007)

**Rent levels**

The current rent levels are known, but also the maximum rent which the housing association could ask from the tenants, based on the quality of the dwelling. A new variable is created which calculates the percentage of the max rent which the tenants pay.

<table>
<thead>
<tr>
<th>percent of max rent</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>percent of max rent</td>
<td>44081</td>
<td>.7998</td>
<td>.15378</td>
</tr>
</tbody>
</table>

*Figure C.4: percentage of rent based on maximum rent*

Figure C.4 shows tenants pay on average 80 % of the maximum rent which could be asked, based on the quality of the dwelling. From the interview it is known that the current policy aims on charging 98% of this maximum rent for new tenants. It can be tested with the time that the dwelling is rented of this is actually happening.

<table>
<thead>
<tr>
<th>duration of rent on 01-01-2015</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 2,00</td>
<td>37828</td>
<td>.7801</td>
<td>.14904</td>
</tr>
<tr>
<td>&lt; 2,00</td>
<td>6253</td>
<td>.9191</td>
<td>.12556</td>
</tr>
</tbody>
</table>

*Figure C.5: Percentage of maximum rent based on duration of rent*

When the rent for a dwelling started less than 2 years ago 92% of the maximum rent is charged on average. When the rent started more than 2 years ago only 78% of the maximum rent is charged. It is not exactly known from which point in time Havensteder started with charging the higher rent, but it shows, in figure C.5, Havensteder charged significant higher rent in the past two years.
Maximum rent and level of liberalisation

The maximum rent is determined by the quality of the dwelling. It is questioned how many dwellings can exceed the level of liberalisation. The rent levels are determined in 2014, where the liberalisation rent was € 699.

<table>
<thead>
<tr>
<th>Maximum rent and liberalisation</th>
<th>Max. rent 01-09-2014</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net rent 01-09-2014 &gt;= 699</td>
<td>11839</td>
<td>598,68</td>
<td>123,270</td>
<td></td>
</tr>
<tr>
<td>Net rent 01-09-2014 &lt; 699</td>
<td>32692</td>
<td>471,26</td>
<td>148,795</td>
<td></td>
</tr>
</tbody>
</table>

Figure C.6: possible number of dwellings under and above level of liberalisation

Figure C.6 shows that 11839 dwellings (26.6%) can exceed the liberalisation level. The other 32692 (73.4%) dwellings cannot exceed this level, because the quality of the dwelling is not sufficient. These dwellings will remain available on the social housing market, unless Havensteder decides to sell, renovate or demolish the property. The data contains some missing values, for that reason the percentages are calculated.

Commercial assets

In the current situation Havensteder has some property already rented as commercial dwellings. Figure C.7 shows that already 2250 dwellings (5.1%) are rented as commercial assets, because the rent is above € 699.

<table>
<thead>
<tr>
<th>Commercial assets</th>
<th>Net rent 01-09-2014</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ownDAEB &gt;= 699</td>
<td>2250</td>
<td>1,00</td>
<td>,000</td>
<td></td>
</tr>
<tr>
<td>ownDAEB &lt; 699</td>
<td>42281</td>
<td>,00</td>
<td>,000</td>
<td></td>
</tr>
</tbody>
</table>

Figure C.7: number of dwellings on social and commercial housing market

The other 9589 dwellings (21.5%) are rented as social assets, but the quality of these dwellings allows it to rent it as commercial assets. The “ownDAEB” is calculated by separation of the current rents, where rents below € 699 are marked as social assets (DAEB) and rent above € 699 are marked as commercial assets (Niet-DAEB). It is shown that all the property with a rent above € 699 is in the group of commercial assets. This makes sense, because the “ownDAEB” was created by this measure.

Comparison social assets and commercial assets method

The dataset has a column which mentions whether or not a dwelling is a social asset (DAEB) or commercial asset (Niet-DAEB). Although this classification can also be made by comparing the current rent with the liberalisation level. This measurement is used above. Figure C.8 shows the correlation between the two different measurements.

<table>
<thead>
<tr>
<th>Assets comparison</th>
<th>ownDAEB</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAEB</td>
<td>Niet-DAEB</td>
</tr>
<tr>
<td>DAEB</td>
<td>41863</td>
<td>872</td>
</tr>
<tr>
<td>Niet-DAEB</td>
<td>198</td>
<td>1282</td>
</tr>
<tr>
<td>Total</td>
<td>42061</td>
<td>2154</td>
</tr>
</tbody>
</table>

Figure C.8: Correlation DAEB and ownDAEB
It is shown that most of the property is classified on the same way in both methods, although there are some differences. 198 and 872 dwellings differ in result. There are also some missing values which are not included in this figure. The choice is made to use from now on the method where the social assets and commercial assets are calculated based on the current rent level. Arguments are that there are less missing values by using this method and that the way of calculation is a more straight forward way for making the distinction.

**Defining groups**

The housing portfolio will be divided in groups, based on several characteristics. These groups are used for the other analysis and the system dynamics part of the research. The objective is to create groups, which are more or less equal in size, but with specific characteristics.

Most important characteristic is the type of dwelling. Here is distinguished between single-family and multi-family dwellings, based on the technical type defined by Havensteder. Besides the type of the dwelling the quality of the dwelling is interesting. It is distinguish between low and high quality, based on the maximum rent. When the maximum rent is above the ceiling of liberalisation, the dwelling is classified as high quality.

<table>
<thead>
<tr>
<th>dwelling type</th>
<th>quality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low quality</td>
<td>high quality</td>
</tr>
<tr>
<td>multi-family dwelling</td>
<td>29282</td>
<td>6137</td>
</tr>
<tr>
<td>single-family dwelling</td>
<td>3410</td>
<td>5702</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>32692</td>
<td>11839</td>
</tr>
</tbody>
</table>

Figure C.9: Dwelling type and quality

Figure C.9 shows the number of dwellings in each group. It is shown that the group multi-family with low quality is much larger compared to the other groups. It is shown that the single-family dwellings are more often in the group with high quality, which makes sense, because the single-family dwellings are generally preferred above a multi-family dwelling.

To make more distinction between the property, the age of the dwellings is taken into consideration. Part of the property of Havensteder was build more than a century ago. The groups have to cover a large period in time, because it is not wished to make more than three groups. Three groups are created:
- dwellings build before 1955
- dwellings build between 1955 and 1985

The distinction between low and high quality is a bit too rough, It only distinguish between dwellings which could be used as social assets and commercial assets. It is desired to gain more insight of the social assets of housing associations, so the group of dwellings in this category should be more specified. Therefore the quality of the dwelling is grouped in three categories where the previous lower quality is divided into a low quality and a medium quality. The boundary between low and medium quality is set at € 597. Below this rent the households can receive housing allowance, but above this rent level this is not possible.
- low quality with a maximum rent of € 597
- medium quality with a rent between € 597 and € 699
- high quality with a rent above € 699

<table>
<thead>
<tr>
<th>Dwelling type</th>
<th>Construction groups</th>
<th>low quality</th>
<th>medium quality</th>
<th>high quality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family dwelling</td>
<td>&lt;1955</td>
<td>4262</td>
<td>1701</td>
<td>723</td>
<td>6686</td>
</tr>
<tr>
<td>single-family dwelling</td>
<td>887</td>
<td>2067</td>
<td>1766</td>
<td>4720</td>
<td></td>
</tr>
<tr>
<td>multi-family dwelling</td>
<td>10965</td>
<td>6871</td>
<td>2817</td>
<td>20653</td>
<td></td>
</tr>
<tr>
<td>single-family dwelling</td>
<td>28</td>
<td>344</td>
<td>2527</td>
<td>2899</td>
<td></td>
</tr>
<tr>
<td>multi-family dwelling</td>
<td>&gt;1985</td>
<td>1916</td>
<td>3542</td>
<td>2594</td>
<td>8052</td>
</tr>
<tr>
<td>single-family dwelling</td>
<td>46</td>
<td>9</td>
<td>1407</td>
<td>1462</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18104</td>
<td>14534</td>
<td>11834</td>
<td>44472</td>
<td></td>
</tr>
</tbody>
</table>

Figure C.10: Dwellings based on age, type and quality

Figure C.10 shows how many dwellings are present in each group. In some groups are only a few dwellings present. Using all this variables will provide in 18 different categories. This seems too much for the further analysis, so some of the smaller and less interesting groups of the research will be combined. The objective is to create 8 different categories.

The groups with single-family dwellings are occasionally very small. Therefore all the single-family dwellings will be presented in two groups: one group with the high quality dwellings and a group with the low and medium dwellings. The age of the dwellings is of less importance in these categories, because the newer single-family dwellings are frequently in the group dwellings with a high quality. The group of dwellings with a high quality is more divided amongst the three groups of construction, although because of the higher quality it is not likely that these dwellings will give problems for Havensteder on the housing market and are therefore of less importance of the research.

For the multi-family dwellings the same argumentation is made for the group of dwellings with an high quality. The age of the dwellings is of less importance, because the quality remains good. So in this group the age of the dwellings is not taken into consideration.

The multi-family dwellings with a low quality and a medium quality are researched separately. The group with a low quality is divided into two categories: dwellings build before 1955 and the dwellings build after 1955. Reason that two groups of construction are combined is that the group of dwellings build after 1985 is a bit too small for the analysis. The multi-family dwellings with a medium quality is categorised in the three different categories of age of the dwellings.
A table showing the types of dwellings and their property value and average rent.

**Figure C.11: types of dwelling**

<table>
<thead>
<tr>
<th>dwelling group</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>12881</td>
<td>28.9</td>
<td></td>
</tr>
<tr>
<td>multi-family, medium quality, &lt; 1955</td>
<td>1701</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>multi-family, medium quality, 1955 - 1985</td>
<td>6871</td>
<td>15.4</td>
<td></td>
</tr>
<tr>
<td>multi-family, medium quality, &gt; 1985</td>
<td>3542</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>6137</td>
<td>13.8</td>
<td></td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>3410</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>5702</td>
<td>12.8</td>
<td></td>
</tr>
</tbody>
</table>

**Total**                                        | 44506  | 100.0 |

*Figure C.11 shows the results of the categorisation of the dwellings. Not all groups are equal in size, but all groups seems large enough for the further analyses.*

**Characteristics of categories**

Now that the groups are defined, it is possible to mention some general characteristics of the several categories of dwellings.

**Property value**

The property value is based on a fixed date: 01-01-2013.

<table>
<thead>
<tr>
<th>dwelling group</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>85352.93</td>
<td>4219</td>
<td>21227,669</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>103186.09</td>
<td>12827</td>
<td>20895,705</td>
</tr>
<tr>
<td>multi-family, medium quality, &lt; 1955</td>
<td>99469.30</td>
<td>1694</td>
<td>18412,384</td>
</tr>
<tr>
<td>multi-family, medium quality, 1955 - 1985</td>
<td>119560.28</td>
<td>6868</td>
<td>14823,352</td>
</tr>
<tr>
<td>multi-family, medium quality, &gt; 1985</td>
<td>131299.43</td>
<td>3510</td>
<td>24237,287</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>142876.06</td>
<td>6003</td>
<td>32330,793</td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>131643.75</td>
<td>3346</td>
<td>39640,007</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>159721.90</td>
<td>5649</td>
<td>31182,196</td>
</tr>
<tr>
<td>Total</td>
<td>120922.30</td>
<td>44116</td>
<td>33998,286</td>
</tr>
</tbody>
</table>

*Figure C.12: Property value on 01-01-2013*

Figure C.12 shows that the average value of the property in each category is different. The results are like expected. The average value is lower for the older dwellings and the dwellings with less quality. It is recognized that the single family dwellings have an higher average property value. Although the multi-family dwellings with an high quality have a higher property value then the low and medium quality single-family dwellings.

**Average rent**

The average rent shows in figure C.13 the same as the average property value of the dwelling: the rent is higher when the quality and age of the dwelling is higher. The rent of the dwellings with a high quality does also include the dwellings which are commercial assets at the moment. The rent levels (and property value) of these dwellings will be separated in a later stage.
The percentage of rent that is paid, compared to the maximum rent, shows some remarkable results. It could be expected that in the category of dwellings with high quality, this percentage should be higher, because part of this property is rented commercial. Now it is seen that percentages are even lower in this group, compared to some of the other groups. Two arguments can explain it. First, Havensteder did not estimate the rent based on the maximum rent in the past, but determined a less segregated rent for all property. Secondly, the mutation rate in these types of dwellings is lower, so it will take longer for new rent policies to be seen in this category.

**Quality**

The quality of the dwellings is measured in the maximum rent. This maximum rent is estimated based on a ranking system to estimate the quality of the dwelling. Besides the maximum rent, also the energy efficiency is taken into consideration, because this measurement says something about the quality of the dwelling. It is recognized that the energy efficiency is also a factor in the estimation of the maximum rent.
Mutation
The mutation of the households that moving in or out the property is known in two ways. First by an average mutation rate, which is calculated in the past years per category of dwelling. Secondly by the time that the current household rents the dwelling. Both measurement methods are interesting, but for the further research the mutation rate will be used. Reason is that it is not completely known how up to date the current dataset exactly is. Also does the time of rent measurement not take into consideration how long other households in the past have rented the dwelling. The average mutation rate can be used better for this, although the results are more or less the same.

<table>
<thead>
<tr>
<th>dwellinggroupnew</th>
<th>Mutation rate</th>
<th>duration of rent on 01-01-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complex</td>
<td>01-2015</td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>7,8612%</td>
<td>10,1382</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>6,9374%</td>
<td>10,5711</td>
</tr>
<tr>
<td>multi-family, medium quality, &lt; 1955</td>
<td>5,8167%</td>
<td>14,1587</td>
</tr>
<tr>
<td>multi-family, medium quality, 1955 - 1985</td>
<td>5,9143%</td>
<td>13,9618</td>
</tr>
<tr>
<td>multi-family, medium quality, &gt; 1985</td>
<td>5,4741%</td>
<td>11,8447</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>5,9446%</td>
<td>12,6789</td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>4,3728%</td>
<td>17,4506</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>4,6540%</td>
<td>16,1109</td>
</tr>
</tbody>
</table>

Figure C.15: mutation of dwellings
In general figure C.15 shows that the mutation rate is lower, when the dwellings have more quality and are single-family dwellings. It means that households in these dwellings have less intention to move, compared to households in other dwellings. Probably these households are starters who wants to move as quickly as possible to a better dwelling. A movement for households in a single-family dwelling will probably only result in higher costs and not in improvement of the type of dwelling.

Social assets versus commercial assets
The group with high quality dwellings exists of dwellings which could be rented all as commercial assets, although not all these dwellings are rented as commercial assets. A distinction is made between the property that is actually rented as commercial assets and as social assets.
Figure C.16 shows the main differences between the social assets and the commercial assets. The most remarkable difference is found in the mutation rate in the multi-family dwellings. Commercial assets do have a mutation rate which is twice as high as the mutation rate of the social assets. Reason could be that tenants argue that the rent is too high and are willing to move, although this is just a guess. In the single-family dwellings the difference in mutation rate is much lower.

In general it is seen that the average quality and value of dwelling which are rented as commercial assets is slightly higher compared to the social assets. The difference in energy efficiency between the social assets and the commercial assets are negligible. The variation in rent is explained by the fact that the commercial assets and social assets are divided based on this variable.

**Vacancy**

The dataset contains only information about the property of Havensteder and not that much about the housing preferences and choice of households. It is therefore not know how large the demand surpluses are for each type of dwelling. Only indication which could be used is to take a look at the vacancy level of the dwellings.

**Figure C.17: Vacancy of dwellings**

Figure C.17 shows already that only 5,5% of the dwellings is vacant at the moment. This is a small group and does probably represent solely vacancy which exist due to the moving in and out households, not because the dwelling cannot be rented.

**Figure C.18: Vacancy per dwelling group**

<table>
<thead>
<tr>
<th>vacancy per dwelling group</th>
<th>vacancy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>rented</td>
<td>vacant</td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>4066</td>
<td>196</td>
</tr>
<tr>
<td></td>
<td>95,4%</td>
<td>4,6%</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>12676</td>
<td>205</td>
</tr>
</tbody>
</table>
Figure C.18 shows that the vacancy is spread more or less equally on the different groups of dwellings. Only the first type of dwelling shows a slightly higher percentage in vacancy. When here the average vacancy is recalculated it will be shown that the average is much lower compared to the total vacancy. Reason is that several missing values are not anymore present in the categories. Frequently dwellings which were vacant have missing values, because the current rent is removed. It can be concluded that the housing demand cannot be approached with the help of the vacancy of dwellings.
Appendix D: characteristics of tenants

According to the previous appendix, a knowledge gap is recognized on the characteristics of the tenants which rent a dwelling at Havensteder. The provided data gives only insight in the characteristics of the property of Havensteder. To achieve more information about the tenants of Havensteder another dataset is used: The “WoON2012” (CBS & BZK, 2013). This is a national survey which provides in data about the current housing and preferred housing situation of households. The data of the dataset is collected in 2011. In this appendix will therefor all data be related to the year of 2011. In a later stage the data will be translated to start year of the analyses.

Selection of data

From the data of the WoON2012 a selection is made which can be used for the analysis. It is wished to make a selection which provides in enough data, but which is also closely related to the housing association. A regional selection is made, based on the COROP region. Havensteder is located in the region of “Groot Rijnmond”, which is used as delineation. The property of Havensteder is located amongst several municipalities, therefor the delineation could not be realised on a single city. Furthermore only the respondents are selected which rent a substantive dwelling from a housing association: This results in 2479 respondents in the dataset.

Define groups

In the previous appendix, groups were created. It is wished to create the same groups for the analysis on households characteristics, so the results of both analysis can be combined. It is not needed that the distribution of the households amongst the groups is equal to the distribution of dwellings from Havensteder. The selection of households is much wider and is influenced by the property of other housing associations. The goal of this analysis is gain information of the characteristics of the households within each group, not about the relationship between the groups. The relationship between the groups is more accurate retrieved from the data from Havensteder.

The same groups are created, based on age of the dwelling, quality of the dwelling, and dwelling type. The quality of the dwelling is estimated based on the property valuation system (woningwaarderingsstelsel), but in the previous appendix the quality is estimated based on the maximum rent. The cutting points on quality are the housing allowance and the liberalisation level. For both points it is known that the related rent is € 555 and € 653 at 2011. Based on these rent levels it is known that the quality level for housing allowance is 120 points and for the liberalisation level is 140 points in the property valuation system. Based on these levels the groups are defined.

<table>
<thead>
<tr>
<th>Groups (not weighted, not combined)</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid multi-family, low quality, &lt;1955</td>
<td>49</td>
<td>2.0</td>
<td>14.2</td>
<td>14.2</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>144</td>
<td>5.8</td>
<td>41.7</td>
<td>55.9</td>
</tr>
<tr>
<td>multi-family, medium quality, &lt; 1955</td>
<td>4</td>
<td>0.2</td>
<td>1.2</td>
<td>57.1</td>
</tr>
<tr>
<td>multi-family, medium quality, 1955 - 1985</td>
<td>24</td>
<td>1.0</td>
<td>7.0</td>
<td>64.1</td>
</tr>
</tbody>
</table>
Figure D.1: Number of respondents in dwelling groups

Figure D.1 shows that there are many missing values: 2134. These missing values find their origin in the quality of the dwelling; probably many tenants don’t know how many points their dwelling has on the property valuation system. Implication is that in two groups the number of respondents becomes too low. This is solved to combine three groups to one group by not taking into account the age of the dwelling. The new group of tenants is the multi-family dwellings with a medium quality. These groups are not combined all the analyses of the research, but the results from the WoON 2012 dataset are equal for these three groups.

Figure D.2: Seize of dwelling groups

The data is weighted by the WoON2012 dataset, because not all type of households are equal represented in the dataset. The seize of the groups (shown in figure D.2) is not relevant, because it is based on all housing associations in the region and there are many missing values.

Income and family composition

From each group it is desired to know something about the income and the family composition. Because there are only 345 respondents left in the analysis, the number of family compositions and income classes are limited. Two types of families are recognized:

- Single (one person households)
- Families (more than one person household)

Three levels of household income are recognized:
- Lower income group (from 0 to maximum income for housing allowance: € 22650 for singles and € 29450 for families)
- Middle income group (from maximum income for housing allowance: € 22650 for singles and € 29450 for families to maximum allowed income for social housing: € 33614)
- Higher income group (above maximum allowed income for social housing: € 33614)

### Household composition and income per group

<table>
<thead>
<tr>
<th>Household composition</th>
<th>Lower income</th>
<th>Middle income</th>
<th>Higher income</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>single</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>477</td>
<td>291</td>
<td>44</td>
<td>812</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>2606</td>
<td>1327</td>
<td>345</td>
<td>4278</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>490</td>
<td>373</td>
<td>464</td>
<td>1327</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>91</td>
<td>4</td>
<td>393</td>
<td>488</td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>864</td>
<td>412</td>
<td>0</td>
<td>1276</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>201</td>
<td>31</td>
<td>14</td>
<td>246</td>
</tr>
<tr>
<td>family</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>518</td>
<td>67</td>
<td>303</td>
<td>888</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>1005</td>
<td>740</td>
<td>2508</td>
<td>4253</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>595</td>
<td>304</td>
<td>1181</td>
<td>2080</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>410</td>
<td>24</td>
<td>445</td>
<td>879</td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>1437</td>
<td>454</td>
<td>935</td>
<td>2826</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>1680</td>
<td>782</td>
<td>1553</td>
<td>4015</td>
</tr>
</tbody>
</table>

**Figure D.3** shows the number of households that are present in each type of dwelling and with some characteristics of income and household composition. These numbers should be translated to percentages to be of use for further analyses. In some situations the number of households becomes too small. This is not noticed because of the weight of the respondents, but the single households with a high quality dwelling are too small and should therefore be combined with the family households in further analyses.

### Willingness to move

Households have sometimes the intention to move towards another dwelling. For each group it is analysed how much of the households has the intention to move within 2 years. It is not possible to take into consideration the household composition and the income of the household, because the groups will become too small for significant results.
Social housing on the move

Figure D.4: Willingness to purchase or rent another dwelling

Figure D.4 shows how many households are willing to move within two years. The number of households should be related towards the number of households that are present in the specific group. It is shown that there is a preference to rent a dwelling when a household is willing to move.

<table>
<thead>
<tr>
<th>Willingness to move per income class</th>
<th>Purchase dwelling</th>
<th>Rental dwelling</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower income class</td>
<td>530</td>
<td>1908</td>
<td>2438</td>
</tr>
<tr>
<td>Middle income class</td>
<td>228</td>
<td>1653</td>
<td>1881</td>
</tr>
<tr>
<td>Higher income class</td>
<td>770</td>
<td>1656</td>
<td>2426</td>
</tr>
<tr>
<td>Total</td>
<td>1528</td>
<td>5218</td>
<td>6746</td>
</tr>
</tbody>
</table>

Figure D.5: Willingness to buy or rent per income class

When the willingness to move per income class is calculated, as shown in figure D.5, it is shown that households at the higher income class have more intention to purchase a dwelling, compared to the other income classes.

The households which are willing to move have also mentioned to which type of dwelling, single-family or multi-family, they want to move.

<table>
<thead>
<tr>
<th>preferred type of dwelling</th>
<th>Type of dwelling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single-family dwelling</td>
</tr>
<tr>
<td>groups</td>
<td>2524</td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>165</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>1376</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>275</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>101</td>
</tr>
<tr>
<td>single family, low and medium quality</td>
<td>293</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>314</td>
</tr>
</tbody>
</table>

Figure D.6: preferred type of dwelling based on current dwelling

It is hard to explain the outcomes of figure D.6. The first to groups show opposite results, although only the age of the current dwelling is different. Probably tenants in an older dwelling have the desire to move to a similar dwelling which is slightly better. Tenants which are already in these type of dwelling want to move to single-family dwelling. Same argument could be applicable for the results of the group multi-family dwelling with a medium and high quality. There are relative much tenants which would like to move from a single-family dwelling towards a multi-family dwelling.
**Preferred rent levels**

From tenants that have the intention to move within two years to a rental dwelling, it is known what they are willing to pay for rent for the new dwelling.

<table>
<thead>
<tr>
<th>Preferred rent groups</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>443.86</td>
<td>552</td>
<td>139,328</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>545.61</td>
<td>2644</td>
<td>103,255</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>572.02</td>
<td>709</td>
<td>29,87</td>
</tr>
<tr>
<td>multi-family, high quality</td>
<td>447.10</td>
<td>109</td>
<td>150,906</td>
</tr>
<tr>
<td>single-family, low and medium quality</td>
<td>508.59</td>
<td>513</td>
<td>114,980</td>
</tr>
<tr>
<td>single-family, high quality</td>
<td>559.11</td>
<td>1272</td>
<td>107,359</td>
</tr>
<tr>
<td>Total</td>
<td>537.51</td>
<td>5883</td>
<td>110,114</td>
</tr>
</tbody>
</table>

**Figure D.7: Preferred rent of new dwelling**

For each group the average rent for the new desired dwelling is shown in figure D.7. It explains partly the preference for a multi-family dwelling or a single-family dwelling. The first group has the intention to pay less rent for a future dwelling. When households are able to pay more rent, they will have a higher demand about the new dwelling. Households that are used to pay more rent for their current dwelling, will be able to pay a higher rent for a new dwelling, compared to households that pays a lower rent in the current situation.

<table>
<thead>
<tr>
<th>Preferred rent per income class</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower income</td>
<td>481.30</td>
<td>35978</td>
<td>129,123</td>
</tr>
<tr>
<td>Middle income</td>
<td>508.73</td>
<td>11312</td>
<td>135,098</td>
</tr>
<tr>
<td>Higher income</td>
<td>572.98</td>
<td>16532</td>
<td>130,418</td>
</tr>
<tr>
<td>Total</td>
<td>509.91</td>
<td>63822</td>
<td>136,129</td>
</tr>
</tbody>
</table>

**Figure D.8: Preferred rent per income class**

Figure D.8 shows that the income of the households influences the rent the household is able to pay for a future dwelling. The higher income class is able to pay almost € 100 per month more compared to the lower income class. Hereby it should be taken into consideration that the lower income class will receive housing allowance and the higher and middle income classes will not.

Based on the rent a household is willing or able to pay for a future dwelling, it can be recognized for what quality level the household is searching.

<table>
<thead>
<tr>
<th>Preferred quality</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>multi-family, low quality, &lt;1955</td>
<td>438</td>
<td>44</td>
<td>70</td>
<td>552</td>
</tr>
<tr>
<td>multi-family, low quality, &gt; 1955</td>
<td>1487</td>
<td>861</td>
<td>296</td>
<td>2644</td>
</tr>
<tr>
<td>multi-family, medium quality</td>
<td>416</td>
<td>378</td>
<td>0</td>
<td>794</td>
</tr>
</tbody>
</table>
Figure D.9: preferred quality of new dwelling

<table>
<thead>
<tr>
<th></th>
<th>Multi-family, high quality</th>
<th>Single family, low and medium quality</th>
<th>Single-family, high quality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>87</td>
<td>0</td>
<td>21</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>378</td>
<td>118</td>
<td>17</td>
<td>513</td>
</tr>
<tr>
<td></td>
<td>652</td>
<td>487</td>
<td>132</td>
<td>1271</td>
</tr>
<tr>
<td></td>
<td>3458</td>
<td>1888</td>
<td>536</td>
<td>5882</td>
</tr>
</tbody>
</table>

Figure D.9 shows how the households, that are searching for a rental dwelling, are divided amongst the three different quality levels. It is shown that the most households would like to have a dwelling with a low quality. It should be recognized that households will probably be able to pay more rent when they see what is the consequence for a low rent. Although, when households are able to pay more for housing, the will make more often the choice to buy a dwelling instead of rent a dwelling.
Appendix E: model screenshots

The appendix shows screenshots of the model that is used for the system dynamics analysis. The screenshots provide an overview of how the model looks like. It should be noticed that the model uses layers to describe the different types of dwellings and households that live in the dwelling. Here the model is divided in four parts: the rent of the dwelling, movements of households, housing portfolio of the housing association and financial position of the housing association.

The rent level of dwellings

This part of the model describes the rent level which households have to pay, how the rent level develops over time and the height of the rent compared to the maximum rent. The sum of all the rent is the rental income for the housing association.

Legend

Type of dwelling:

A: multi-family, low quality, <1955
B: multi-family, low quality, >1955
C: multi-family, medium quality, <1955
E: multi-family, medium quality, >1985
F: multi-family, high quality
G: single-family, low and medium quality
H: single-family, high quality

Type of variable:

External variables: orange
Instruments: green
Model outcomes: red
Summations: blue
movements of households
This part of the model describes the movements of households on the social housing market. Households move from one type of a dwelling to another type of dwelling. With the movements they leave a dwelling vacant for another household. The model takes into consideration that not always the desired dwelling is available and that it is not possible to make a movement. It is taken into consideration that part of the households will achieve an income improvement and makes a transition to a higher income group.
Housing portfolio of the housing association

This part of the model describes how the housing portfolio is divided on the social and commercial housing market. Part of the dwellings will be demolished over time or is sold. New dwelling can only be build when the percentage of high income households is below 10% of the total households on the social housing market.
financial position of the housing association

This part of the model describes the financial consequences for the housing association. The costs and incomes for the housing association are used to calculate the development of the cumulative net costs. The value of the dwellings is used to see the development of the loan to value. The interest coverage ratio describes which part of the rental income is used to discharge the interest costs.
Appendix F: model equations

This appendix is extracted from the program VENSIM pro and contains a list of all the equations used in the model. This appendix can be used to find the exact relations between variables. With the data of this appendix the model could be rebuild completely.

maximum rent[type] =
  initial maximum rent[type] * (1 + maximum rent increase rate) * (Time * timespan)
  ~ Euro/(Year * household)
  ~ based on the quality of the dwelling

sold rate commercial =
  0.005
  ~ 1/Year

sold commercial[type] =
  commercial dwellings[type] * sold rate commercial
  ~ dwelling/Year
  ~ dwellings that are sold, which are in the commercial assets

annual rent increase[type] =
  MAX(0, MIN( (maximum rent[type] - rent level[type]) * total households[type], social housing rental income\[type] * rent increase rate ))
  ~ Euro/(Year * Year)
  ~ annual rent increase: rent can only be increased when the maximum rent is not exceeded.

total movements out[type] =
  leave social market HI[type] + movements out LI and MI[type]
  ~ household/Year

rent level decrease moving out[type] =
  MAX(0, (total movements out[type] - households to commercial assets[type]) * rent level[type])
  ~ Euro/(Year * Year)
  ~ when a households moves towards a new dwelling, it will not longer pay rent for the previous dwelling.

inflation =
  (1 + inflation rate) * (Time * timespan)
  ~ 1

landlord levy rate =
  0.00381 + (increase of landlord levy rate * Time)
  ~ 1/Year
  ~ the landlord levy rate will increase each year

leave social market HI[type] =
  MAX(0, (MIN(higher income group[type], higher income group[type] / initial higher income group[type] * HI desired moves[type] + (LI desired moves[type] + MI desired moves[type] - movements out LI and MI[type]) * (higher income group[type] / total households[type] * households to commercial assets[type]) / household / Year)
  ~ percentage of households that leave the social housing market from the higher income group. Households with a high income can only move when they leave the social housing market, because the income is too high to rent another dwelling on the social housing market.
higher income group = INTEG {
    income improvement2 - leave social market HI
    initial higher income group
    ~ household
    ~
}

rent decrease move to commercial assets =
    liberalisation rent * households to commercial assets
    ~ Euro/(Year*Year)
    ~ when the rent level exceeds the liberalisation rent level, the dwelling is transferred to the commercial assets. Here only the rental income for the social housing is taken into consideration.
    ~

middle income group = INTEG {
    new households MI + MI internal movements in + income improvement - income improvement2 - MI internal movements out
    initial middle income group
    ~ household
    ~
}

deviation rent level =
    4
    ~ 1
    ~

liberalisation rent =
    8388 * (1 + liberalisation rent increase rate) * (Time * timespan)
    ~ Euro/(Year*household)
    ~ the liberalisation rent is the maximum rent on the social housing market
    ~

households to commercial assets =
    IF THEN ELSE(maximum rent - liberalisation rent, (rent level / liberalisation rent / deviation rent level) * total households * timespan, 0)
    ~ household/Year
    ~ when the rent level of a dwelling exceeds the level of liberalisation, the dwelling should be transferred towards the commercial assets
    ~

actual rent level in percentage of maximum rent =
    rent level / maximum rent
    ~ 1
    ~

SUM vacancy =
    SUM(vacancy)
    ~ household/Year
    ~

rental income =
    SUM(commercial housing rental income) + SUM social housing rental income
    ~ Euro/Year
    ~ total annual rental income
    ~

SUM of dwellings =
    SUM commercial dwellings + SUM social dwellings
    ~ dwelling
    ~

SUM commercial dwellings =
    SUM(commercial dwellings)
    ~ dwelling
    ~

new dwellings =
    (new dwellings rate * SUM of dwellings) * building allowed

Social housing on the move
new buildings are only realised for the social housing market and can logically not be build in the groups with dwellings build before 1985

SUM social housing rental income=

SUM(social housing rental income[type!=])

~ Euro/Year

~ rental income for the housing association for the social dwellings

increase of landlord levy rate=

0.0005

~ 1/(Year*Year)

~ the landlord levy rate will increase each year

SUM lower income group=

SUM(lower income group[type!=])

~ household

~

allowed percentage high income=

IF THEN ELSE(Time<7, 0.2 , 0.1 )

~ 1

~ Building is only allowed when a certain percentage of the dwellings is not rented buy households with a high income: the first seven years this is 20% after that period only 10 percent of the dwellings should be rented by higher income households.

new households rent increase[type]=

total movements in[type]*new rent

~ Euro/(Year*Year)

~ the rent that new tenants have to pay when they move towards the dwelling.

building allowed=

IF THEN ELSE(percentage high income<allowed percentage high income, 1 , 0 )

~ 1

~

SUM higher income=

SUM(higher income group[type!=])

~ household

~ percentage of higher income group in the total social households

~

total movements in[type]=

LI internal movements in[type]+MI internal movements in[type]+new households LI[type]+new households MI[type]

~ household/Year

~ total of each group movements in, used to determine the number of new rental contracts

movements out LI and MI[type]=

leave social market LI[type]+leave social market MI[type]+LI internal movements out[type]+MI internal movements out[type]

~ household/Year

~

percentage lower income=

SUM lower income group/SUM total households

~ 1

~ percentage of total lower income group in the total social households

~

percentage middle income=
SUM middle income/SUM total households
~ 1
~

SUM total households =
SUM(total households[type!])
~ household
~

SUM middle income =
SUM(middle income group[type!])
~ household
~ percentage of total middle income group in the total social households
|

inflation rate =
0.01
~ 1
~ the constant rate of inflation
|

percentage high income =
SUM higher income/SUM total households
~ 1
~

Cumulative net cost = INTEG (demolish costs + interest costs + landlord levy + maintenance costs + new dwelling costs + operating costs - rental income - sold dwellings income, 1.83547e+009)
~ Euro
~ The debt of the housing association: the debt is covered by the value of the dwellings
|

percentage realised movements =
"Sum of movements LI & MI"/"Sum desired moves LI & MI"
~ 1
~ how much of the desired movements can be realised?
|

"Sum desired moves LI & MI" =
SUM(LI desired moves[type!]) + SUM(MI desired moves[type!])
~ household/Year
~

SUM social dwellings =
SUM(social dwellings[type!])
~ dwelling
~

interest coverage ratio =
(Cumulative net cost * interest ratio)/rental income
~ 1
~ describes which part of the rental income is expended on interest costs
|

"Sum of movements LI & MI" =
SUM(movements out LI and MI[type!])
~ household/Year
~ movements out of the current dwellings in the lower income group and the middle income group
|

additional annual rent increase[type] =
MAX(0, MIN((maximum rent[type] - rent level[type]) * total households[type], (higher income group\[type]/total households[type]) * social housing rental income[type] * additional rent increase rate[\])
~ Euro/(Year * Year)
~ annual rent increase for higher income group: rent can only be increased \
Social housing on the move

when the maximum rent is not exceeded.

liberalisation rent increase rate =

0.01 ~ 1
~ each year the level of liberalisation will be increased slightly

rent level =
social housing rental income / total households
~ Euro / (Year * household)
~ the average rent level for tenants for each group.

commercial housing rental income =
commercial dwellings * maximum rent * households per dwelling
~ Euro / Year
~ rental income for the housing association for the commercial dwellings

maximum rent increase rate =
0.01 ~ 1
~ increase of the maximum rent level of the dwelling

social housing rental income = INTEG{
additional annual rent increase + annual rent increase + new households rent increase
[type] - rent decrease move to commercial asset[type] - rent level decrease moving out[type],
initial rent level[type] * total households[type]}
~ Euro / Year
~ rental income for the housing association for each type of dwelling

value increase rate =
0.01 ~ 1 / Year
~

dwelling value = INTEG{
maintenance increase + value increase[type],
initial dwelling value[type]}
~ Euro / dwelling
~ average dwelling value based on WOZ-value

initial dwelling value =
85353, 103186, 99469, 119560, 131299, 142876, 131644, 159722
~ Euro / dwelling
~

maintenance increase =
housing improvement rate * housing improvement maintenance costs * inflation
~ Euro / (Year * dwelling)
~ average increase of dwelling value for each dwelling, due to renovation

commercial housing group value =
commercial dwellings * dwelling value
~ Euro
~ total value of commercial dwellings in each group

sold dwelling value =
sold commercial[type] + sold social[type] * dwelling value
~ Euro / Year
~ the value of the dwellings that are sold in each group
new dwelling costs = 
  \text{SUM(new dwellings[type])}\times \text{building costs per dwelling}\times \text{inflation} \\
  \approx \text{Euro/Year} \\
  \approx \text{total costs for new dwellings} \\

\text{demolish costs} = 
  \text{SUM(demolish[type])}\times \text{demolish costs per dwelling}\times \text{inflation} \\
  \approx \text{Euro/Year} \\
  \approx \text{total costs for demolish dwellings for each year} \\

\text{social housing group value[type]} = 
  \text{dwelling value[type]}\times \text{social dwellings[type]} \\
  \approx \text{Euro} \\
  \approx \text{total value of social dwellings in each group} \\

\text{value increase[type]} = 
  \text{dwelling value[type]}\times \text{value increase rate} \\
  \approx \text{Euro/(Year\times dwelling)} \\
  \approx \text{each year the value of the dwellings will slightly improve} \\

\text{initial maximum rent[type]} = 
  5870, 6200, 7706, 7604, 7821, 9127, 7301, 9771 \\
  \approx \text{Euro/(Year\times household)} \\
  \approx \text{The initial average maximum rent for each type of dwelling, retrieved from the data of Havensteder} \\

\text{operating costs} = 
  (\text{SUM(commercial dwellings[type])} + \text{SUM(social dwellings[type])})\times \text{operating costs per dwelling}\times \text{inflation} \\
  \approx \text{Euro/Year} \\
  \approx \text{when the total assets of the housing associations decline, there is less labor needed to do the work and the operating costs will also decline} \\

\text{maintenance costs} = 
  (\text{SUM(commercial dwellings[type])} + \text{SUM(social dwellings[type])})\times \text{structural maintenance costs per dwelling}\times \text{inflation} + (\text{SUM(commercial dwellings[type])} + \text{SUM(social dwellings[type])})\times \text{maintenance increase} \\
  \approx \text{Euro/Year} \\
  \approx \text{maintenance exist out of two parts: housing improvement and structural maintenance: it is assumed that the housing improvement can be controlled by the housing association, but the structural maintenance is seen as an external input} \\

\text{loan to value} = 
  \text{Cumulative net cost}/(\text{SUM(social housing group value[type])} + \text{SUM(commercial housing group value[type])}) \\
  \approx 1 \\
  \approx \text{describes the ratio between debts and underlying value of the property} \\

\text{sold dwellings income} = 
  \text{SUM(sold dwelling value[type])}\times \text{discount rate} \\
  \approx \text{Euro/Year} \\
  \approx \text{total income of the dwellings which are sold} \\

\text{commercial dwellings[type]} = \text{INTEG} \\
  \text{transition to commercial market[type]} - \text{sold commercial[type]}, \text{initial commercial dwellings[type]}, \text{dwelling} \\
  \approx \text{dwellings} \\

\text{demolish[type]} =
demolish rate[type]*social dwellings[type]
~ dwelling/Year
~ Part of the property becomes too old to rent and has to be demolished, \
Only the oldest dwellings with a low quality are demolished

new households MI[type]=
new households[type]*[1-new households allocation[type]]
~ household/Year
~ part of the new households will have a lower income and the other part \ will have a middle income

landlord levy=
SUM(social housing group value[type])*landlord levy rate
~ euro/Year
~ the landlord levy is calculated based only on the social assets

housing demand=
100000
~ household/Year
~ housing demand is seen as an external variable. It is assumed that in the \ upcoming years the housing demand is always larger than the housing \ supply. Therefore the number of 100000 can be seen as symbolic.

new households LI[type]=
new households[type]*new households allocation[type]
~ household/Year
~ part of the new households will have a lower income and the other part \ will have a middle income

new households allocation[type]=
0.67,0.67,0.67,0.67,0.5,0.5,0.5,0.5
~ 1
~ the housing association can make a selection about which households can \ enter the social housing market. This variable describes which percentage \ of the new households has a lower income. The rest of the dwellings is \ granted towards households with a middle income. Dwellings are not given \ to households with a high income

new households[type]=
MAX(0 , MIN(vacancy[type]-LI internal movements in[type] - MI internal movements in[type], housing demand ))
~ household/Year
~ the number of households that can enter the housing market is dependent on \ the vacancy after the internal movements on the housing market.

leave social market MI[type]=
MI desired moves[type]*leave rate MI+(middle income group[type]/total households[type] )\*households to commercial assets[type]
~ household/Year
~ households leave the social housing market with a movement(calculated with \ the leave rate and the amount of households) or when the rent exceeds the \ social housing market rent and the dwelling is transferred to the \ commercial assets

MI internal movements in[type]=
MIN( SUM(MI desired moves[type])\*MI allocation[type] , vacancy[type] )
~ household/Year
~ Households will move towards their desired type of dwelling when there is \ a dwelling vacant

leave social market LI[type]=
Social housing on the move

LI desired moves[type]*leave rate LI+(lower income group[type]/total households[type])~households to commercial assets[type]

~ household/Year

~ households leave the social housing market with a movement(calculated with \ the leave rate and the amount of households) or when the rent exceeds the \ social housing market rent and the dwelling is transferred to the \ commercial assets

vacancy[type]=MAX(((social dwellings[type]*households per dwelling)-total households[type])*timespan\ , 0)~ household/Year

~ number of dwellings that are available for households to move in: \ described as possible places for households

leave rate MI=0.12

~ 1~ percentage of households that leave the social housing market from the \ middle income group

MI allocation[type]=

0,0,0.1,0.15,0.2,0.1,0.21,0.11

~ 1~ Describes the housing preference of households that are moving. The moving \ households would like to go to these type of dwelling.

transition to commercial market[type]=

(IF THEN ELSE(new rent[type]>liberalisation rent, vacancy[type] , 0)+households to commercial assets\ [type])/households per dwelling

~ dwelling/Year

~ dwellings with a rent above the liberalisation level are placed in the \ commercial assets: these dwellings move towards the commercial assets when \ the current rent level exceeds the rent of liberalisation or when the new \ rent level is above the rent of liberalisation.

~

timespan=1

~ 1/Year

structural maintenance costs per dwelling=1400

~ Euro/(dwelling*Year)

~ the structural "small" maintenance for dwellings each year.

leave rate LI=0.05

~ 1~ percentage of households that leave the social housing market from the \ lower income group

initial higher income group[type]=870,4308,821,3318,1710,2917,777,975

~ household

building costs per dwelling=165000

~ Euro/dwelling

~ the costs for building a new dwelling
hulling improvement maintenance costs =
10750
~ Euro/dwelling
~ The average cost of improvement when a dwelling is renovated

initial social dwellings[type] =
4262,12881,1701,6871,3542,5292,3410,4580
~ dwelling

MI desired moves[type] =
(middle income group[type]/initial middle income group[type]) * mutation rate[type] * middle income group
~ household/Year
~ the number of households that would like to move. When the seize of the group declines it is assumed that less households are willing to move, to represent the households which do not have any intention to move.

interest costs =
interest ratio * Cumulative net cost
~ Euro/Year
~ the interest cost for each year

LI internal movements out[type] =
(lower income group[type]/sum(lower income group[type])*sum(LI internal movements in[type])
~ household/Year
~ When households make a movement, they will also leave a dwelling, which becomes available for new tenants. The movements are equal distributed over the groups of dwellings.

HI desired moves[type] =
mutation rate[type] * higher income group[type]
~ household/Year
~ The number of households that would like to move

initial middle income group[type] =
898,3121,338,1365,704,126,720,1088
~ household

housing improvement rate =
0.07
~ 1/Year
~ part of the property that is renovated each year

LI desired moves[type] =
(lower income group[type]/initial lower income group[type])*mutation rate[type]*lower income group
~ household/Year
~ the number of households that would like to move. When the seize of the group declines it is assumed that less households are willing to move, to represent the households which do not have any intention to move.

initial lower income group[type] =
2495,5452,542,2186,1128,2249,1913,2517
~ household

operating costs per dwelling =
1320
~ Euro/(Year*dwelling)
~ costs like salary and office building: are seen as instruments, because
the housing association is able to influence these costs.

\begin{verbatim}
initial commercial dwellings[type] =
   0,0,0,0.845,0.1122
~ dwelling

social dwellings[type] = INTEG {
   new dwellings[type]-demolish[type]-sold social[type]-transition to commercial market[type],
   initial social dwellings[type])
~ dwelling

lower income group[type] = INTEG {
   new households LI[type]+LI internal movements in[type]-LI internal movements out[type] -leave social market LI[type]-income improvement[type],
   initial lower income group[type])
~ household

initial rent level[type] =
   4643.5456,5535.6243,6476,6637,5687,6827
~ Euro/(Year*household)
~

additional rent increase rate =
   0.01
~ 1/Year
~ tenants with a higher income will have higher rent increase to give an additional incentive to move

demolish costs per dwelling =
   11573
~ Euro/dwelling
~ some dwellings will be demolished, because they cannot be renovated or sold and have to less quality to rent

demolish rate[type] =
   0.016,0.005,0.0,0,0,0,0
~ 1/Year
~ percentage of dwellings which are demolished each year. Only the older dwellings are demolished.

discount rate =
   0.9
~ 1
dwellings are frequently sold with a certain discount rate

households per dwelling =
   1
~ household/dwelling
~

income improve rate =
   0.05
~ 1/Year
~ The income of households will improve in time, due to the development of household. It is assumed that each year 5% of the households in the lower income group will have an income increase that will transfer the households to the middle income group

income improve rate2 =
   0.02
\end{verbatim}
The income of households will improve in time, due to the development of household. It is assumed that each year 2% of the households in the middle income group will have an income increase that will transfer the households to the higher income group.

\[
\text{income improvement[type]} = \text{income improve rate} \times \text{lower income group[type]} / \text{household/Year}
\]

\[
\text{net households that move from to a higher income group based on the improvement rate and number of households}
\]

\[
\text{income improvement2[type]} = \text{income improve rate2} \times \text{middle income group[type]} / \text{household/Year}
\]

\[
\text{net households that move from to a higher income group based on the improvement rate and number of households}
\]

\[
\text{interest ratio} = 0.0422 / \text{1/Year}
\]

\[
\text{the average interest that is paid by the housing association}
\]

\[
\text{LI allocation[type]} = [0.0, 0.04, 0.1, 1, 0, 0.41, 0.2]
\]

\[
\text{Describes the housing preference of households that are moving. The moving households would like to go to these type of dwelling.}
\]

\[
\text{LI internal movements in[type]} = \text{MIN( SUM(LI desired moves[type]) * LI allocation[type] }, vacancy[type] ) / \text{household/Year}
\]

\[
\text{Households will move towards their desired type of dwelling when there is a dwelling vacant}
\]

\[
\text{total households[type]} = (\text{higher income group[type]} + \text{lower income group[type]} + \text{middle income group[type]}) / \text{household}
\]

\[
\text{mutation rate[type]} = [0.0786, 0.0694, 0.0582, 0.0591, 0.0547, 0.0594, 0.0437, 0.0465] / \text{1/Year}
\]

\[
\text{from the data it is known for each group which percentage of the households move.}
\]

\[
\text{new dwellings rate[type]} = [0, 0, 0, 0.0015, 0, 0.0015, 0] / \text{1/Year}
\]

\[
\text{percentage of dwellings which are new build each year, based on the total amount of dwellings}
\]

\[
\text{sold social[type]} = \text{social dwellings[type]} \times \text{sold rate} / \text{dwelling/Year}
\]

\[
\text{dwellings that are sold, which are in the social assets}
\]

\[
\text{new rent[type]} = \text{maximum rent[type]} \times \text{new rent rate} / \text{Euro/(Year*household)}
\]

\[
\text{percentage of dwellings which are new build each year, based on the total amount of dwellings}
\]
new rent rate=
  0.98
  ~   1
  ~ described as a percentage of the maximum rent

sold rate=
  0.005
  ~   1/Year
  ~ percentage of dwellings which are sold each year, based on the total amount of dwellings

Mi internal movements out[type]=
  middle income group[type]/SUM(middle income group[type])*SUM(Mi internal movements in[type])
  ~ household/Year
  ~ When households make a movement, they will also leave a dwelling, which becomes available for new tenants. The movements are equal distributed over the groups of dwellings.

rent increase rate=
  0.01
  ~   1/Year
  ~ The rent can be increased each year for the current tenants

type:
  A,B,C,D,E,F,G,H
  ~
  ~

********************************************************
| Control
********************************************************

Simulation Control Parameters

FINAL TIME = 30
  ~   Year
  ~ The final time for the simulation.

INITIAL TIME = 0
  ~   Year
  ~ The initial time for the simulation.

SAVEPER =
  TIME STEP
  ~   Year [0,?] 
  ~ The frequency with which output is stored.

TIME STEP = 0.125
  ~   Year [0,?] 
  ~ The time step for the simulation.

\\---// Sketch information - do not modify anything except names
Appendix G: model verification and validation

In this appendix the verification and validation of the model is discussed. The outcomes of the model testing are summarized in this chapter. Several methods are used to improve the model.

Model check

The coding of the model is corrected manually. For each variable is checked whether or not the outcomes have a logic value. For example, it is not possible that the number of dwellings or households become negative in the model. It is also analysed if the number of households is equal to the number of dwellings in the model: It is shown there is a small difference between the two variables, which is explained by the vacancy. The percentage of realised movements is in the first years a short period above 100%, but it is explained by the high number of transitions towards the commercial assets.

It is noticed that the average rent level for dwelling type F and H drops to an extremely low rent level. The rent level in this dwelling type can barely increase, because many of the dwellings are transferred to the commercial assets. Only a small part of the dwellings remains in the social assets: these dwellings should have a higher rent level, but for the other part of the model the influence is considered small. It could be considered as realistic that a small part of these dwellings remains in the social market, because these dwellings have a specific social function: for example for tenants who are physically handicapped.

Dimension analysis

Vensim provides in a tool to analyse the consistence of units in the model, although the dimension of the variables are verified manually. One error is found in the dimension analysis. The variable “leave social housing market HI” has a function which determines the maximum value of two calculations, which is done to prevent the level of higher income group becoming negative. It is argued that not more households could leave the level, then there are present, although here a time dimension is missing in the equation. The error in the dimension does not give any problems in the simulation of the model.

In some variables in the model it is needed to calculate a yearly increase with a certain percentage, like “inflation”, “maximum rent” or “liberalisation rent”. This is done with an exponential function, but the time dimension is needed in that function. For that reason the “time” is divided by a certain “timespan” to exclude the dimension within exponential functions.

Integration method and timestep

Two integration methods are tested for the model: RK4 and EULER. The model has some variables which use a discrete calculation. For that reason RK4 is not preferred. The differences between the two integration methods are minimal and therefor EULER will be used in the simulation. Different timesteps are explored, and the choice is made to use a timestep of 0.125.

Extreme conditions

With extreme conditions is the model behaviour simulated under extreme circumstances. With this extreme circumstances it is easier to understand the behaviour of the model and to determine the validity of the model. All the simulations are mentioned in figure G.1.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Model Value</th>
<th>Extreme Value</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>New rent rate</td>
<td>0.98</td>
<td>0.10</td>
<td>Decline rental income: negative financial results. Only small number of dwellings not transferred to commercial dwellings, because initial rent is high.</td>
</tr>
<tr>
<td>additional rent increase rate</td>
<td>0.01</td>
<td>0.50</td>
<td>Rent levels already grow to maximum rent: maximum rent is not exceeded.</td>
</tr>
<tr>
<td>Maximum rent increase rate</td>
<td>0.01</td>
<td>0.20</td>
<td>All type of dwellings go to commercial market, rent levels increase and financials are good. Percentage high income increases.</td>
</tr>
<tr>
<td>Liberalisation rent increase rate</td>
<td>0.01</td>
<td>0.50</td>
<td>More dwellings stay in social market, only at start some transfers.</td>
</tr>
<tr>
<td>Housing demand</td>
<td>100000</td>
<td>0</td>
<td>Much vacancy, but more movements are realised.</td>
</tr>
<tr>
<td>New households allocation</td>
<td>0.67, 0.67, 0.67, 0.67, 0.5, 0.5, 0.5, 0.5</td>
<td>0</td>
<td>Only new middle income group households: higher percentage of middle income, instead of lower income. Higher vacancy, because some type of dwelling is not attractive for middle income.</td>
</tr>
<tr>
<td>New households allocation</td>
<td>0.67, 0.67, 0.67, 0.67, 0.5, 0.5, 0.5, 0.5</td>
<td>1</td>
<td>Only new lower income group households: higher percentage of lower income, instead of middle income. Lower vacancy and less movements.</td>
</tr>
<tr>
<td>Income improve rate</td>
<td>0.05</td>
<td>0.50</td>
<td>Fast decline of households in low income group: more “movements out” realised in total.</td>
</tr>
<tr>
<td>Income improve rate2</td>
<td>0.02</td>
<td>0.50</td>
<td>More dwellings available for lower income group, but largest part of tenants is higher income households: less movements are realised in lower and middle income.</td>
</tr>
<tr>
<td>Leave rate LI and Leave rate MI</td>
<td>0.05 and 0.12</td>
<td>1 and 1</td>
<td>Realised movements to 100%, higher income group remains large, because of the already realised movements.</td>
</tr>
<tr>
<td>New dwellings rate</td>
<td>0.003</td>
<td>0.3</td>
<td>Explosion of number of dwellings in group E&amp;F. Loan to value above 1: new dwellings are not beneficial for housing association.</td>
</tr>
<tr>
<td>Sold rate</td>
<td>0.005</td>
<td>0.5</td>
<td>All dwellings are sold in couple of years. Profit from all sold dwellings compensates the cumulative net costs.</td>
</tr>
<tr>
<td>Inflation rate</td>
<td>0.01</td>
<td>0.1</td>
<td>Increase of all costs: does not influence households and dwellings.</td>
</tr>
<tr>
<td>Housing improvement rate</td>
<td>0.07</td>
<td>0.70</td>
<td>Increase of dwelling value and cumulative net cost.</td>
</tr>
</tbody>
</table>

Based upon the extreme condition tests two adaptions have been made to the model: The rent increase rate and additional rent increase rate have been modified, in order to prevent the rent level exceed the maximum rent level. When the difference between the maximum rent and current rent level was smaller than the increase of the rent, the maximum rent would be exceeded.
The assumption is made that there is always a housing demand, which is not limited by the height of the rent level or other circumstances on the housing market. This housing demand can be seen as an extreme condition. In the scenario’s it is taken into consideration that the housing demand could be of larger impact on the model as simulated.

**Empirical confirmation**

The input data in the model is found is several sources. The rent levels, maximum rent levels, mutation rate, dwelling value and number of dwellings are provided by housing association Havensteder. With the help of WoON 2012 is data collected about the housing choice and income of tenants. Information about the financials of Havensteder are found in data from the CFV: such as number of new dwellings, number of sold dwellings and number of demolished dwellings. Also the costs of these activities are derived from this data. The income improvement rates and the inflation rate are based on more general assumptions. It is concluded that most of the used data in the model has a strong empirical value, which is good for the validation of the model.

**Partial simulation**

The different parts of the model are simulated separate. Variables which influence the specific part of the model remain constant. These tests provides information about the validity of the specific parts of the model: which becomes better visible when other parts of the model remain constant. The results are shown in figure G.2.

<table>
<thead>
<tr>
<th>Model part</th>
<th>outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent</td>
<td>No new households enter the model, but households do also not move. The rent does only increase due to annual increases. The rent does decrease due to transition to commercial assets. It is discovered that the formula’s for annual rent increase does somewhere give an extreme value. This is taken into consideration.</td>
</tr>
<tr>
<td>Households</td>
<td>There are no dwellings transferred to the commercial assets, so more dwellings remain available in the social market, which has an influence on the number of households and the percentage of each income group in the model.</td>
</tr>
<tr>
<td>Dwellings</td>
<td>The transition of dwellings from social to commercial is constant in the partial simulation, but of a large extend. Consequence is that the social housing stock goes below zero: which is not possible in the simulations in the complete model.</td>
</tr>
<tr>
<td>Financials</td>
<td>Some of the structural costs increase each year. But in the simulation the rental income remains equal. The result is that the financial outcome for the housing association is slightly decreasing.</td>
</tr>
</tbody>
</table>

**Boundary adequacy of behaviour**

As mentioned before, it is known that the housing demand is not a realistic number, but an expression about the knowledge that there is demand surplus of households on the social housing market. It could be argued that with increasing rent levels, the demand surplus disappears. The model does not have a relation between the rent level and the housing demand. Although, it is almost impossible for households in the
lower income group to rent a dwelling with a high quality and a maximum rent. It is hard to imagine how the relation between housing demand and rent level should be described. For that reason it should be taken into consideration in the simulations that high rent levels could be a cause for vacancy, which is absent in the simulation. This will be mentioned in the evaluation of the simulations.

**Sensitivity analysis**

The sensitivity analysis is performed to determine which variables have a large impact on the model with small adjustments. This sensitivity should be taken into consideration for the results from different scenarios. Some sensitivity analysis are performed to give insight in the behaviour of the model. To conclude is mentioned which variables will be implemented in the results for the different scenario’s.

**Maximum rent and liberalisation rent**

The analysis is performed with a maximum rent increase and liberalisation rent increase between 0 and 3%, and 1% is assumed to be average.

In figure G.3 are large difference shown in rental income. Even the social housing rental income could become almost zero, because dwellings are transferred to the commercial assets. This occurs when the maximum rent exceeds the liberalisation rent and dwellings from categories with a middle or even low quality can have a rent above the liberalisation rent.

When the assumption is made that the maximum rent increase is maximized by the liberalisation rent increase it shown in figure G.4 that the deviation in social rental income is much smaller.
Deviation rent level
The deviation of the rent level is used to determine how fast dwellings are transferred when the rent level exceeds the rent of liberalisation. Initial the deviation is set to 4, but for the sensitivity analysis the minimum is one and the maximum is 8.

Value increase rate and inflation
The value increase rate and the inflation rate is given a sensitivity between 0 % and 3%, where 1 % is assumed as value in the model. Both variables do mainly influence the cumulative net costs.
Figure G.6 shows that a difference of three percent in value increase and inflation can lead after 30 year to a difference of roughly € 5 Billion. The graph represents for the most part the influence of the inflation. The influence of the value increase of the dwellings is better represented in the loan to value rate: here is a same kind of deviation visible.

**Interest ratio**
Currently the housing association pays 4.22 % interest. This is an average interest amongst multiple loans, and will therefore convert slowly over time. For the sensitivity analysis it is assumed that the interest can be between 2 % and 7% on any moment of time.

The cumulative net costs can develop from € 7 billion to almost zero. It should be taken into consideration that in the analysis the interest ratio can differ much more than in reality.
Household movements
To achieve insight in the sensitivity of households movement are the mutation rate and household allocations adjusted with 2% under and above the average value. Also the number of households that increase their income is taken in consideration: from the lower income group to the middle income group from 2% minimum to 10% maximum and from the middle income group to the higher income group from 0% minimum to 5% maximum.

Figure G.8 shows an equal deviation in the sum of movements in the lower and middle income group. The relative seize of each income group has during a time period of 30 year a margin of 20 % for 50 percent of the observations. The reason for this relative small deviation is that the market is constantly filled with a surplus of housing demand, which limits the moving behaviour of tenants. It is shown that there is less influence on the number of dwellings and the financial outcome in this sensitivity analysis.

Thoughts about inflation
Several inputs in the model are related to the inflation: inflation rate, value increase rate, maximum rent increase rate, liberalisation rent increase rate and rent increase rate. The relation is not made in the model, because all variables do all represent a different annual price increase. Although, it can be argued that when the inflation is high, the value increase of dwellings will also be higher. The same is argument is
applicable for the rent increases. It would be rare that the inflation is about 3%, but the rent increase remains 1%.

**Input for scenario’s**
For the input of the scenarios are not all sensitivity variables selected. Only the variables as used in the households movements are used, in combination with the deviation of the rent level. It is argued that the inflation and all related variables will give much noise on the model output. The choice is made to aim more on the model outcomes that are relevant for the research: the development of households and dwellings.
Appendix H: Model scenarios and outcomes

Several scenarios will be tested in the model. The outcome of the scenarios will be discussed in this appendix. For each scenario is first explained which goal is try to achieved and which instruments are used to change the outcome of the model. After that is explained what is the result of the structure of the social housing market and if the scenario is feasible for the housing association.

Basic model

Goal
The results of the basic model describe the outcome of the housing association, given the current policy. The result is used as a zero-scenario.

Adjusted instruments
None.

Structure social housing market

The basic model gives an indication about how the housing market will develop in the future.

Figure H.1 shows that the percentage of high income declines. Also the households with a lower income do have a smaller share in the social housing market. The number of social dwellings does decline also and therefor the number of households with a lower income will be smaller. The middle income group will grow. Part of the property of the housing market will be transferred to the commercial housing market. These households will become accessible for households with a higher income. The households with a lower income find difficulties to enter the social housing market. After 30 years housing association Havensteder will have approximately 37,000 dwellings in the housing portfolio.
The rent levels increase rapidly to the maximum rent of the dwellings, based on the quality of the dwelling. It can be argued that the rent levels become reasonable too high for part of the households. These households cannot afford it to rent a dwelling with such a high rent. It is questioned whether or not the social housing market is served with such high rent levels. The number of movements remains constant: 1500 movements each year.

**Feasibility result**
The feasibility of the model outcomes describes to what extent the outcome is appreciated by the housing association. Here is the seize of the housing portfolio and the financial result for Havensteder most important.

![Figure H.3: Basic model, loan to value and interest coverage ratio](image)

The financial result for the housing association can be considered as very good. The total debt will almost be returned and this has a positive result on the loan to value and interest ratio. The results seems a bit too good. Although it is known from the validation and verification that when the annual rent return is set to zero, instead of 2% plus 1% additional for higher income households, that the cumulative net costs will have a breakpoint and will increase again after a certain time. In different scenarios it will be shown what the financial results are.

**Reorganisation**

<table>
<thead>
<tr>
<th>Goal</th>
<th>The reorganisation of the housing association will lead to a saving on the operating costs per dwelling. Goal is to improve the financial position of Havensteder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted instruments</td>
<td>Operating costs per dwelling from € 1630 to € 1320</td>
</tr>
</tbody>
</table>

**Structure social housing market**
This measurement does not influence the structure of the social housing market.

**Feasibility result**
It is shown in figure H.4 that the reorganisation does lead to a saving of € 13 million to € 16 million each year. The complete financial result becomes even more positive.
The new operating costs will be used as the standard for all the other scenarios.

**Decrease rent**

**Goal**

It is assumed that the rent levels become too high for the new tenants. Goal of the scenario is to find a rent level which does better fits to the income of households.

**Adjusted instruments**

New rent rate from 98% to 90%, 80%, 70%.

Rent increase rate from 2% to 1%.

**Structure social housing market**

The lower rents do not have influence on the number of households, because the demand surplus is still applicable. It should be expected that part of the dwellings with a high quality should not exceed the liberalisation rent level, because of the lower rent level. This is not seen in the simulation. Explanation is that even a rent of 70% is too much to hold these dwellings in the social housing market, but it should be taken into consideration that in the model is assumed that the within a certain type of dwellings one average rent is used.

**Feasibility result**

The financial results for the housing association shows that there are some possibilities to lower the rent. Although it should be taken into consideration that the model is probably a bit too optimistic compared with reality.

Figure H.5 shows that with a rent between 70% and 80% of the maximum rent when moving in, the financial results remain neutral for the housing association. The consequence of the annual increase of the
rent results in an average rent rate of approximately 90% of the maximum rent. This can still be considered as a very high rent rate.

**Sell commercial**

<table>
<thead>
<tr>
<th>Goal</th>
<th>The housing association aims at social housing: commercial assets are sold.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted</td>
<td>Sold rate commercial from 0.005 to 1</td>
</tr>
<tr>
<td>instruments</td>
<td>Rent rate 80% or 98%</td>
</tr>
</tbody>
</table>

**Structure social housing market**

In the simulation are commercial dwellings sold towards the market. It should be assumed that the dwellings are not sold to tenants or households, but to commercial parties which rent the dwellings.

The result is that the number of dwellings declines, but the remaining dwellings are all social dwellings (figure H.6). The choice to sell commercial assets does not change the moving behaviour of the tenants. It is assumed that households do not take into consideration who owns the specific dwelling.

**Feasibility result**

The result of selling dwellings is that in the first years the financial inflow will be large, but in the future the rental income will be lower. The costs for interest will be lower, because part of the debt can be paid back in an earlier stage, as is shown in figure H.7.

In the first year the income of sold dwellings around € 300 million. The number of dwellings which are transferred to the commercial assets become smaller, but the income is large enough to return all the cumulative net costs.
Sell commercial: lower selling price

Goal
The housing association aims at social housing: commercial assets are sold. What is the lowest price for the commercial assets.

Adjusted instruments
- Sold rate commercial from 0.005 to 1
- Rent rate 80%
- Discount rate from 90% to 75%, 50%

Structure social housing market
The structure of the social housing market does not change from the previous simulation. There are only financial consequences for the scenario.

Feasibility result
For this scenario the question arises why a housing association should sell dwellings below the market price. In the model is assumed that the social dwellings and commercial dwellings are separated, which indicates an administrative separation. This simulation represents more a complete separation: the dwellings are placed in another holding. Although it could be that the housing association is the owner of the holding. To make to holding financial feasible the debts should be not too high. The holding with the commercial dwellings is not represented in the model.

Figure H.8: sell commercial at lower price, cumulative net costs and sold dwellings income

Figure H.8 shows that, with a rent of 80% of the maximum rent based on quality, the discount rate strongly influence the cumulative net costs. When the selling price is only 50% of the value of the dwelling, the cumulative net costs decrease in the first ten years, but after that period the costs increase above the initial cumulative net costs. With a selling price of 75%, a balance seems to be found.

Figure H.9: sell commercial at 75%, cumulative net costs and loan to value
The cumulative costs, as shown in figure H.9, decrease to € 500 million and increase slightly after at the end of the simulation. For the loan to value is the same result visible. The value of the assets decreases, but also the cumulative net costs. Proportional the value of the assets decreases more than the cumulative net costs, because of the selling price of 75%. For that reason the loan to value improves in the first phase of the simulation.

**Liberalisation rent level is maximum rent**

<table>
<thead>
<tr>
<th>Goal</th>
<th>Avoid dwellings being transferred to the commercial assets by making the liberalisation rent level the maximum rent level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted instruments</td>
<td>Maximum rent: not higher than liberalisation rent</td>
</tr>
</tbody>
</table>

**Structure social housing market**

The result of not having a higher rent than the liberalisation rent is that dwellings are not transferred to the commercial dwellings portfolio. The decline in dwellings on the social market follows from dwellings that are sold or demolished.

It is shown that the number of movements in the lower and middle income group increases. The increase is partly explained by a larger number of dwellings in the social housing market. The percentages of higher income households increases a bit compared to the basic scenario, but will be under the 10% of the total number of households.

**Feasibility result**

Holding all the dwellings in the social housing portfolio influences the financial results for the housing association.
Figure H.11: maximum liberalisation rent, loan to value and interest coverage ratio

Figure H.11 shows that when dwellings are not rented as commercial assets the financial results could be acceptable, but the rent rate for new tenants should be 98% of the maximum rent (or liberalisation rent). When the new rent rate is decreased to 80% the financial result becomes negative. It can be questioned if the lower and middle income group are served with a larger social housing market but with higher rent levels.

**Partial liberalisation, rent level is maximum rent**

**Goal**
Avoid dwellings being transferred to the commercial assets by making the liberalisation rent level the maximum rent level, but part of the dwellings is transferred manually to the commercial assets

**Adjusted instruments**
- Maximum rent: not higher than liberalisation rent
- New rent rate remains 98% or 80%
- Initial high income group F&H dwellings to commercial assets

**Structure social housing market**
In the simulation is initial decided to allocate part of the dwellings as commercial assets. The housing association has the opportunity to do this at the start of the separation of social assets or commercial assets. The choice is made to designate dwellings with a high quality rented by households with a high income as commercial assets. 2917 dwellings from type F and 975 dwellings from type H are transferred to the commercial assets. The result should be that the seize of the higher income group should decline.

Initial the percentage of high income households is lower, but the decrease of these households is smaller, as shown in figure H.12. The results for the building allowance are small. It should be taken into
consideration that the results are very sensitive. The group of higher income households could remain about 10% of the total households. In this scenario are dwellings not transferred from the social market to the commercial housing market, besides the initial separation. It results in a larger social housing market, compared to the basic scenario. The commercial housing market has a constant range of approximately 5000 dwellings.

**Feasibility result**

Besides the normal simulation is also a simulation provided with a 80% rent rate of maximum rent for new tenants.

![Figure H.13: partial liberalisation, loan to value and interest coverage ratio](image)

Figure H.13 shows that the simulation with a 98% rent of maximum rent provides in a good financial result. When the rent is decreased to 80% the loan to value and interest coverage ratio remains more or less equal. It seems that the result of the simulation is feasible for the housing association.

### Allocation of households based on quality

<table>
<thead>
<tr>
<th>Goal</th>
<th>Place households with a lower income in dwellings with a low quality and households with a medium income in the other dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted instruments</td>
<td>New household allocation: from: 0.67,0.67,0.67,0.67,0.5,0.5,0.5,0.5 to 1,1,0,0,0,0,5,0</td>
</tr>
</tbody>
</table>

**Structure social housing market**

In this simulation the dwellings are strictly assigned to the associated households based on quality of the dwelling. Households with a lower income are given the dwellings with a low quality. Housing allowance is only granted to the lower income group in dwellings with a lower quality. The medium income households are assigned the other dwellings. It is desired to find a better balance between lower and middle income groups.
Figure H.14: allocation based on quality, lower and middle income group

Figure H.14 shows that the objective is reached to make more place for the lower income group, but the total number of households with a lower income does still decline and the number of middle income households almost doubles.

Feasibility result
The financial results of the scenario are negligible.

Allocation of households: preference for low income

Goal
The new households with a lower income are strongly preferred above the households with a middle income

Adjusted
New household allocation: from: 0.67,0.67,0.67,0.67,0.5,0.5,0.5,0.5 to 1,1,0.8,0.8,0.8,0.8,0.8

Structure social housing market
In the simulation is given a great preference for low income households.

Figure H.15: preference for low income households, lower income group

Figure H.15 shows that the added preference for low income households has only a very small result for the number of household. The difference is considered to be very small compared to the previous simulation. Besides the real number of households the percentage is taken into account. It is noticed that the in the first 15 years the share of the lower income group increases. The increase in percentage stops when the higher income group is almost disappeared out of the social housing market.
Social housing on the move

It should be taken into consideration that the seize of the lower income group is dependent on how many households do make an improvement in income and are transferred towards the middle income group. Therefor the sensitivity is shown in figure H.16, which shows that 50% of the outcomes are in a range of 5000 households.

**Feasibility result**
The financial results of the scenario are negligible.

**Combination partial liberalisation and household allocation**

**Goal**
Combination of two other scenarios, to increase the lower income group and avoid to many dwellings are transferred to commercial assets

**Adjusted instruments**
Maximum rent: not higher than liberalisation rent
New rent rate remains 98% or 80%
Initial high income group F&H dwellings to commercial assets New household allocation: from: 0.67,0.67,0.67,0.67,0.5,0.5,0.5,0.5 to 1,1,0,0,0,0,0.5,0

**Structure social housing market**
In the scenario are two previous scenarios combined. It results in a lower income group with much more households compared to the basic scenario.

Figure H.17 shows that the increase of the lower income group is not from the middle income group, but from the higher income group. It should still be mentioned that the total seize of households in the lower income groups declines slowly. In the first ten years the decrease is low, but becomes more in the last 20 years of simulation. It is suggested that this could be the result of the constant income improvement rate in
the model, but also the demolish of older dwellings and dwellings with less quality. It is not simulated that after a period of 30 years the dwellings with an average age becomes old dwellings.

Figure H.18: combination, number of movements and percentage realised movements

Figure H.18 shows that the movement in the social housing market is higher and the percentage of realised movements is constantly a bit higher. The percentage of realised movements shows that the result is not only dependent on the number of social dwellings in the portfolio, although the improvement is considered to be small.

Feasibility result
The financial results can be compared with the results of the partial liberalisation scenario. A rent level of 80% of the maximum rent will generate enough financial income for an acceptable loan to value and interest coverage ratio.

Sell commercial combined

Goal
Combination of two other scenarios, to increase the lower income group and avoid to many dwellings are transferred to commercial assets

Adjusted instruments
Maximum rent: not higher than liberalisation rent
New rent rate remains 98% or 80%
Initial high income group F&H dwellings to commercial assets New household allocation: from: 0.67,0.67,0.67,0.67,0.5,0.5,0.5,0.5 to 1,1,0,0,0,0,0,0.5
Sell rate commercial to 1

Structure social housing market
The choice is made for the housing association to sell all the commercial assets. It will not be possible to sell all the property to tenants or households, but it can be sold to a third party who rent the dwellings on the commercial market.

Figure H.19: combined and selling, number of dwellings
The result is that the housing portfolio of the housing association becomes much smaller, but contains only dwellings on the social housing market. It represents a complete separation of both types of rental housing market.

**Feasibility result**

When the commercial dwellings are sold immediately, it gives a large financial income at the moment of selling, although the financial revenues from rent in the future will disappear.

Figure H.20: combined with selling, loan to value and interest coverage ratio

The loan to value and the interest coverage ratio shows in figure H.20 the result of selling the commercial dwellings (with a discount rate of 10%). Both values are much lower, although it is shown that the difference becomes smaller at the end of the simulation. When the financial situation is less positive as represented in the simulation, selling dwellings could be a solution for the housing association.