

# How economic and demographic drivers influence residential development in the Netherlands

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## 1. Abstract

Residential development in The Netherlands has been a very prominent topic of discussion in recent years as well as over the past two decades. Currently, the amount of housing stock is insufficient to fulfil the needs of the population of the country. This shortage has led to an incremental national housing plan, that will be put into action in the coming decade. However, although the relevant drivers of housing supply are well understood in general terms, empirical analyses at the local scale are scarce. A more comprehensive outlook on the reasons behind residential development is necessary, as a surplus of knowledge in this field could lead to a better overall understanding. In order to obtain more insight of the drivers behind housing development, this study analyses the key demographic and economic factors, by examining municipal differences in realised housing development. This is measured in the amount of building permits granted per municipality. In specific, regression analysis is used to assess drivers of the amount of building permits, which results in the finalization of a model. The analysis on building permits originates from 2012-2019 CBS (Centraal Bureau voor Statistiek) data. The results indicate that GDP per capita, developable land, population development and age structure significantly contribute to the amount of building permits granted per municipality. Population development per municipality explains about 90% of the variance of the amount of building permits granted. This somewhat contrasted the expectations of the results, as theory suggested GDP and amount of developable land would have a larger explanatory impact than measured. Using the Life Cycle Theory, a relationship between age and residential development was to be expected. The outcomes of this study may inform policy makers who seek to implement drivers for residential development in their planning process.

## 2. Introduction

### 2.1 Background

The Netherlands currently resides in a housing crisis. There is a shortage of about 390,000 houses throughout the country, as researched by Atlas (Berg, 2022). This shortage leads demand to cause high housing rents and prices. In the Randstad areas (Rotterdam, Amsterdam, Utrecht and The Hague), the residential demand has increased to a ratio of 150 households per 100 homes.

To counteract this, the Dutch government has construed a national housing plan (VRO, 2022). Throughout the country, at total of 900,000 houses will be built, averaging a yearly amount of 100,000 (NOS, 2022). This is a major shift in the government's attitude towards housing development, as previous administrations advocated for market forces to restore balance on the housing market (Obbink, 2020). Appropriate policy decision making requires empirical knowledge on the drivers behind residential development.

### 2.2 Past Research

Within the residential development research space, several subjects have been studied extensively. Research by Saiz (2010) has for example established the most favourable land characteristics related to residential development. Many studies focus on the drivers behind house prices (Geng, 2018; Anundsen and Heebøll, 2016; Álvarez-Román & García-Posada, 2021) and its impact on local economies. Other studies consider the effect of varying policy conditions on the supply of houses (Green et al., 2005) or the supply of houses in more general terms (Gyourko, 2009). Relevant to this research are the drivers behind the realization of dwellings, specifically the economic and demographic factors. These have been researched quite considerably. Research by Van der Heijden et al. (1991), Glaeser et al. (2006) and Broitman and Komen (2015) describe the importance of economic characteristics on the supply of houses. Demographic determinants have been studied by Thompson (1937), Zhang et al. (2020) and Green and Hendershott (1996). In general, the main drivers behind residential development are understood. However, an empirical analysis on the comparative strength of these drivers on a local scale has not been done yet. Therefore measuring the performance of the key demographic and economic factors on a specific region would be a unique approach.

The aim of this study is to find the most relevant economic and demographic drivers related to residential development and to discover which drivers have the most significant impact on the realization of houses. Since empirical analyses on the local scale are missing, the performance of the key drivers are measured on municipal level in the Netherlands. Presumably, this will provide more insight into the importance of key factors influencing residential development.

## 2.3 Research and Relevance

The main question that aims to be answered is: *How is the number of building permits granted per municipality in The Netherlands related to the key economic and demographic features of those areas?*

In line with for example Saiz (2010), regression analysis is applied to measure the significant influence of multiple factors on a particular subject. Another paper by (Green et al., 2005) also uses regression analysis in the context of explaining numbers of building permits. In this case, the number of building permits per municipality is used to measure the amount of realised houses and is therefore the subject of investigation. The data on building permits originates from the Dutch statistics bureau (CBS) and spans from 2012-2021. This data is used because its source is trustworthy and it's recently collected. Municipal data is relevant because decision making on residential development is often carried out on this governmental level.

The outcomes of this study can be used with regards to the Dutch housing plan for the coming years. The congruent presence of economic and demographic factors in higher numbers of granted building permits, may improve the understanding of the construction of housing in the future. This way, stakeholders of all sorts will have a better understanding of where and in which size, housing development takes place. This is potentially useful to governmental planners, who could for example anticipate residential growth in areas in which these factors are more present and shape their planning accordingly.

This paper is organized the following way. Section three discusses the theoretical framework. After that, section four explains the methods of research and data collection. The results of the research are presented in section five and is followed by a conclusion in section six. Finally, a discussion is included in section seven.

## **3. Theoretical framework**

### 3.1 Land Significance

A study by Saiz (2010) highlights the criteria for 'developable land', or land that has the capabilities to host residential development. This is highlighted as an incremental factor for housing development, as higher the amount of developable land there is, higher is the total number of construction within an area. Saiz' (2010) definition of undevelopable land, is land that is either flooded by water, and/or sloped 15 degrees and up. Relevant to the Netherlands, some adaptations in the definition are required. Land that is sloped 15 degrees and up can be dismissed as this is very rare throughout the country. Reviewing the available data, developable land is the sum of all agricultural terrain, semi-constructed terrain and recreational terrain within a municipality.

### 3.2 Economic Determinants

A study done by Van der Heijden et al. (1991) shows how the spatial distribution of non-subsidized housing construction was mainly the result of a couple factors. Research showed that municipality size, political preference and the average income of inhabitants was positively associated with the construction of new dwellings. In fact, in more right wing and higher income municipalities, more non-subsidized dwellings were built. This was over the period of 1984-1988, which was a time in which the Dutch government loosened its housing policies to increase private investments. The study

by Van der Heijden et al. (1991) also highlighted how city size was not necessarily an indicator for non-subsidized construction. The municipality size is also part of the total amount of developable land per municipality and is incorporated in the research through that variable. The political preference per municipality would be more of a socio-economic or political factor and is therefore not included in the research. However, this is an interesting connection and would be worth investigating in a different study.

The importance of regional economic performance on residential development was also noticed by Glaeser et al. (2006). This research found that a relationship between a region's economy and the amount of man-made structures exists. Broitman and Komen (2015) continued this thought and used GDP as a means of explaining residential stock increases. This study was based around how housing stock differs in urban and peri-urban areas within The Netherlands. The results present a positive correlation between high GDP (Gross Domestic Product) and substantial residential stock increases. This was done at municipal level, by aggregating COROP GDP data to the respective municipalities. Furthermore, Broitman and Komen (2015) mention how the results also show a soft link between population dynamics and housing stock. This subject was only touched upon briefly, but did show insight in a possible relationship, relevant to this research. The link between GDP and residential development was also made in a study done by Hoang (2020). The author found that income growth rate and gross regional domestic product both have a positive impact on rural housing development. One of the better known connections between economic performance and residential prices, is the bid-rent theory by Alonso (1964). This theory builds on the assumption that, as distance from CBD's (Central Business Districts) increases, price and demand for real estate changes.

Another topic that was frequently discussed across several studies, was the influence of housing prices on the amount of residential development (Geng, 2018). Especially the relative building costs compared to the housing prices seems to be an important factor for residential development (Lerbs, 2014). However, both housing prices and construction costs have heavily differed across the period of 2012-2019 in The Netherlands. It is therefore a difficult factor to include into an analysis that includes multiple variables. However, this relationship is definitely worth investigating.

### 3.3 Demographic Determinants

A link between population growth and housing demand has been established for quite some time. Thompson (1937) describes population growth along with immigration as one of the most impactful factors for housing development. Family size is also one of the more pronounced demographic factors, as a lower family sizes mean smaller houses and less residential development (Thompson, 1937). However, the decline in family size was a lot more present 100 years ago, than it is today. Especially over the course of 2012 to 2019, family size has remained quite levelled throughout the country, with low differences between municipalities (CBS, 2022). For the analysis, population development is used, as this number is more in line with the number of building permits.

As for age structure differences, Mankiw and Neil (1990) found that persons after the age of 40, generally demand less housing than younger people. Furthermore, according to Zhang et al. (2020), using the Life Cycle Theory, a higher ODR (Old Age Dependency Rate) would imply a decrease in housing demand compared to other regions. As the Life Cycle Theory implies that people within older age categories are less likely to invest high amounts of money. Another study by Green and Hendershott (1996) established that the willingness to pay for houses decreases for people of 70 years and older. Applying the rules of demand and supply, this would result in a lower supply for housing in a region with a higher degree of people of 70 years and older. If people are not willing to pay for houses, no houses will be built. A study from the Dutch CBS (1999) highlights how people

over 55 are a lot less likely to move than the younger population. Only 15% of elderly people had intentions of moving, compared to 32% of the younger population.

### 3.4 Expectations

- Regional GDP has a strong, positive relationship with the amount of houses built per municipality. This refers back to the findings of Broitman and Komen (2015) and Hoang (2020), which have both shown GDP to be a driver for residential development.
- The amount of developable land per municipality is positively associated with the number of realised houses per municipality. This is underpinned by the paper by Saiz (2010), which highlights the link between developable land and housing supply.
- Demographic indicators such as the rate of people over 65 and the population development per municipality have a significant impact on the respective housing supply. This links back to studies done by Mankiw and Neil (1990), Zhang et al. (2020) and Thompson (1937). The Life Cycle Theory is also applicable.

## **4. Methodology**

### 4.1 Selected Variables

In order to answer the research question: *How is the number of building permits granted per municipality in The Netherlands related to the key economic and demographic features of those areas?*, a quantitative study is conducted. Based on literature study, a handful of variables are selected as the most promising in determining the outcome of the test value.

These are: *The total number of developable land per municipality, The GDP per capita per COROP region, The net population development per municipality and The percentage of the population of 65 and up per municipality.*

The regression model is operationalised as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Where  $Y$  is the number of building permits,  $\alpha$  is the constant term,  $\beta_i$  is the regression coefficient for variable  $X_i$ ,  $X_1$  is the amount of developable land per municipality,  $X_2$  is the GDP per capita per COROP region,  $X_3$  is the net population development per municipality,  $X_4$  is the percentage of the population of 65 and up per municipality and  $\epsilon$  is the model's error term.

As limited by the intervals of the data sets required for the analysis, the model is based on the years from 2012 to 2019. As for the data sets themselves, these all originate from the CBS, with the exception of the GDP variable which originates from the EU Stat database. The data collection process provided four different independent variables that are tested against the dependent variable in a multiple regression analysis in order to discover whether or not a linear relationship exists. This method of statistical analysis was chosen for a couple of reasons. Firstly, four independent variables are tested against the dependent variable, which leaves out all single test statistics. Secondly, since the aim of this research is based around finding the variables with the most predictive value on building permits, regression analysis is most suitable. Regression is based around linear relationships,

formulated as an equation. It measures how much of the independent variables impact the outcome of the dependent variable, which is exactly the aim of this study.

#### 4.1.1 Developable Land

As for the *total number of developable land per municipality*, the dataset used is based on the 2022 municipal borders, but with the 2012 numbers of land use indicators. This means that these numbers are aggregated to the 2019 municipal borders in order to make sense, as this is the municipal layout congruently used throughout the whole research. In practice, this implicates the combined usage of a 2012 CBS dataset, along with the benchmark CBS *Bodembestand* dataset. Municipal mergers after 2019 are 'un-merged' to their 2019 composition and the respective data extracted from the 2012 CBS dataset. An example of this process is as follows. The municipality of Maashorst arose in 2022 through a merger with the municipalities of Landerd and Uden. Subsequently, only Maashorst is mentioned in the *Bodembestand* dataset. However, in the analysis, the municipal borders of 2019 are used. This means that Landerd and Uden still existed by then. In order to incorporate those municipalities in the analysis, the 2012 CBS dataset was consulted and filled in the necessary gaps. The reason the 2012 CBS dataset was not used for the entire variable, is because of the bigger difference in accurate municipal borders. As for the composition of the total developable land, the total agrarian terrain, semi-constructed terrain and recreational terrain are added up per municipality<sup>1</sup>.

#### 4.1.2 Straightforward Variables

The *GDP per capita per COROP region* is an average of the yearly data from 2012 to 2019. These values are then appointed to the municipalities falling within the borders of the respective COROP region. This means that all municipalities within the same COROP region share the same GDP value. A measurement on municipal level does not exist and this is therefore the best option to include GDP into the analysis. Furthermore, the *net population development per municipality* and the *number of building permits* are both additions of the yearly and quarterly values of the period from 2012 to 2019, while of course also taking into account the municipal changes over those eight years. The *net population development* implied in a variety of cases a minus number of people, as a lot of municipalities declined in population size between the years from 2012 to 2019.

#### 4.1.3 Age Structure

Finally, the *percentage of the population of 65 and up per municipality* is included. Adding this variable means taking into account something important. Because all other variables are likely to have a positive relationship with the amount of building permits granted, this variable has to be transformed to fit the positive effect. Naturally, a higher rate of elderly people is linked to lower amounts of housing development, and therefore has a natural negative effect on the amount of building permits granted in that region. In order to fabricate a positive effect on higher rates of elderly people, the percentages were subtracted from 100. So, a rate of 22% would be 78% after

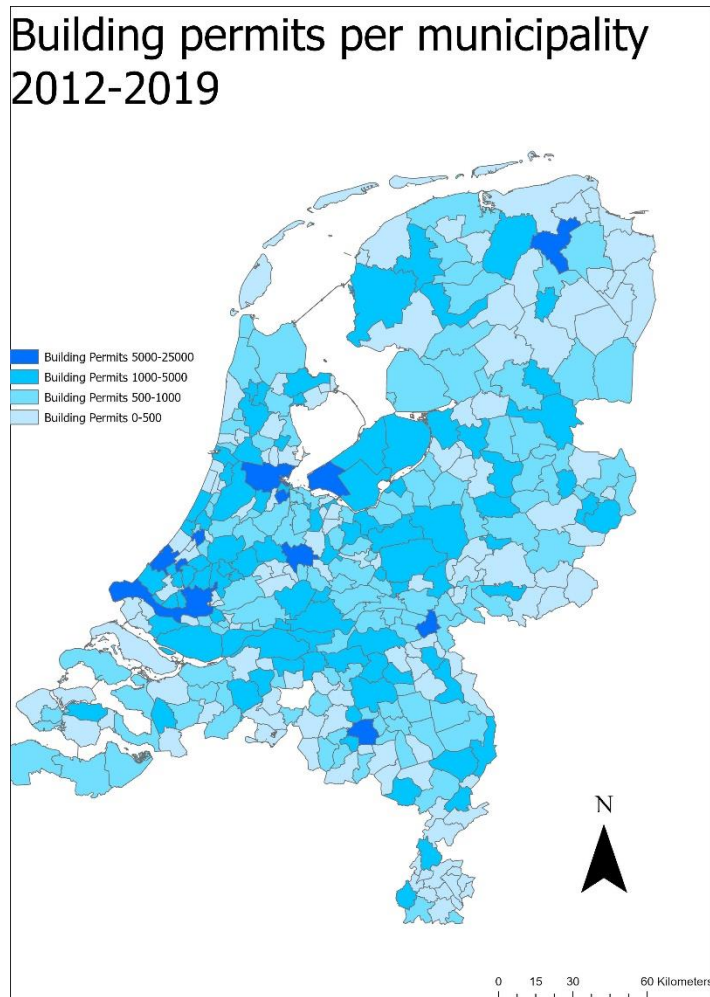
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<sup>1</sup> As a sidenote, an anomaly in the data must be mentioned. For the municipality of Sint Anthonis, no data was available at all. This municipality merged into the municipality of Land Van Cuijk and its value could therefore be deducted from looking at the other co-merging municipalities. By subtracting all the merging municipalities of Land Van Cuijk from the value of Land Van Cuijk, there were some residual values left. These were assigned to Sint Anthonis, as that would be the destination of the remaining values.



transforming the data. This way, higher percentages mean lower rates of elderly people and therefore maintain a potential positive relationship with the dependent variable.

Figure 1



#### 4.2 Summary

In total, five different variables are collected to be subjected to a statistical analysis. The data is collected through firstly importing the several data sets into Excel. Subsequently, the data is checked and in some cases cleaned up or altered as mentioned in the sections above. In Figure 1, a map is shown of the total amount of realised houses per municipality in the period of 2012-2019. Something that stands out in the data is the large disparity between lower ranking and higher ranking municipalities. A couple municipalities such as Amsterdam, Utrecht and Den Haag have large percentual differences with the rest of the data set. These outliers are always something to consider in statistical analysis, as they may impact the results of the study.

Table 1 shows the descriptive statistics for the Dutch municipalities in 2019. It is noticeable that almost for every variable, the standard deviation is rather high. This indicates that the data is spread out and not closely centred around the mean.

Table 1

#### Descriptive statistics for municipalities (N=355)

Variable	Mean	Std. Deviation
Total building permits 2012-2019	1,142.09	2,105.26
GDP per capita per COROP region 2012-2019	38,853.12	10,650.97
Total developable land per HA (2012)	6,788.26	7,278.98
Net population development 2012 - 2019	1,908.55	6,118.62
100 - % people over 65 (2019)	78.78	3.26

## 5. Results

In the tables below, the results of the multiple regression are shown. The model with the four variables is significant, including the variables on their own. This means that there is a significant linear relationship between the independent variables on one hand and the dependent variable on the other hand. This model shows how the number of building permits per municipality in the Netherlands significantly relates to GDP per capita, the total number of developable land, the net population development and the percentage of people over 65. The model's *adjusted R square* is remarkably high. The *adjusted R square* is the total percentage of variance of the dependent variable, explained by the independent variables. Linear regression identifies the equation that produces the smallest difference between the observed values and the fitted values. For this model, 91.7% of the total variability of the dependent variable is explained<sup>2</sup>. The variable responsible for this high number, is the net population development per municipality. Running a single regression with only this variable as the designated independent variable, the explained variance comes down to 90%. This is high, but at the same time not illogical. As the population development is a sum of population change in and out of the municipalities, a strong relationship with the amount of residential development is expected. Figure 2 (next page) highlights the relationship between the number of building permits and the net population development.

**Table 2**

### Regression Results

R Square	Adjusted R Square	Model Significance	Variables	Standardised Coefficients	Significance
0.957	0.917	<0.001	GDP per capita	-0.050***	0.003
			Total developable land	0.005***	<0.001
			Net population development	0.930***	<0.001
			100 - % people over 65	0.086***	<0.001

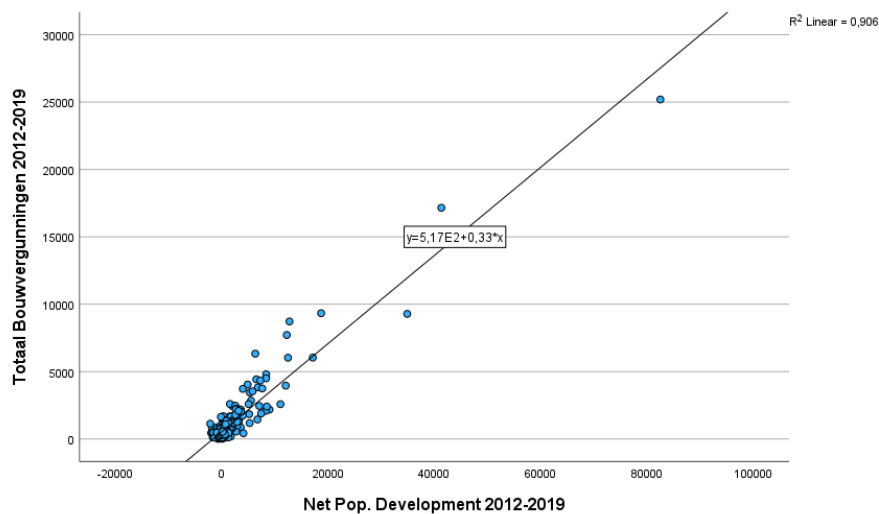
\*\*\* Significance at 5%

Comparing the standardised coefficients, it is noteworthy how dominant the effect of the net population development is on the number of building permits. Standardised coefficients can be used to measure the independent changes to the dependent variable. The value of 0.930 says that an increase by one of its standard deviations (6,118.62), the expected increase in building permits will be 0.930 of its standard deviation. Therefore, a population change of 6,118.62 will have an expected change of (0.930 \* 2,105.26) 1,957.89 building permits. What stands out, is that the standardised coefficients for GDP per capita and the total number of developable land are quite low. This implies that the economic drivers did not contribute to the model as much as the demographic drivers did. Running a single regression with total developable land as the independent variable, results are insignificant. This means that on its own, the number of developable land per municipality does not have a significant relationship with the number of building permits granted per municipality. The percentage of elderly people per municipality also significantly contributed to the model, having the second highest associated standardised coefficient.

<sup>2</sup> High R square values are often associated with *multicollinearity* effects between two independent variables. After conducting cross examination between the independent variables, no such effect was found. However, a degree of *heteroskedasticity* was found to be present in the dataset, which can be expected because of the outliers in the dataset. This effect limits the explanatory power of the model.

Figure 2

### Scatterplot net population development



## 6. Conclusion

This paper combines the presence of different known drivers of residential development into a local, empirical study by testing different variables in statistical analysis. By measuring the key demographic and economic drivers behind residential development, their comparative strength in influencing the supply of houses is examined. By focusing on all 355 municipalities throughout the Netherlands, the significance of these key drivers is measured on the total amount of realised houses. CBS and EU stat data is collected in order to supply the dataset with accurate and trustworthy input. Multiple regression analysis is used to measure the combined and comparative performance of the different key drivers behind residential development. The findings show that a model combining GDP per capita, net population development, total amount of developable land and the percentage of people over 65, has a significant relationship with the total number of building permits granted per municipality. The results display that demographic drivers have a stronger relationship with housing supply in The Netherlands than economic drivers. Especially the net population development per municipality seems to have a very strong influence on the total number of realised houses. On the other hand, contrasting theoretical underpinnings (Saiz, 2010), the total number of developable land has a weak relationship with the total number of housing supply. The findings from this study may have implications for municipal land use planners or developers who are responsible for finding suitable locations for residential development. By taking into account the importance and comparative strength of key drivers behind residential development, their decision making may alter. This study shows that higher rates of elderly people or large amounts of emigration in a municipality should signal lower interest in residential space, even though economic regional performance may be in an upward trend. Further research into this topic may include analysis combining the key drivers from this study with socio-economic variables such as political preference and building cost of houses. Relevant to the Netherlands, the influence of high nitrogen areas on realised houses would also be a topic worth investigating.

## 7. Discussion

### 7.1 Synergy between different results

As mentioned before, the demographic drivers both have stronger relationships with the amount of building permits granted per municipality than both the economic drivers. Net population development really stands out in the analysis as the main explanatory variable. This means that for municipalities in the Netherlands, population development is a better indicator for residential development than GDP per capita or total amount of developable land. The significance of the rate of elderly people on housing supply is not a surprise, especially in the Netherlands. As throughout the country, rates of elderly people differ quite largely (CBS, 2022), a difference in effect can be measured comprehensively. If the rates would roughly be the same, a relationship with housing supply would mean a lot less.

### 7.2 How insights relate to the literature

Reviewing the expectations, established in the theoretical framework, a few notions can be made. The relationship between GDP on one hand and the number of building permits on the other, is expected to be strong, as the theoretical underpinnings underlined. However, reviewing the final model, the GDP Per Capita has the lowest significance level with a p value of 0.003. A possible explanation for this, could be the scope of the measurement level. The GDP data is measured on COROP/NUTS 3 level, and is therefore not the most accurate per municipality. This still contrasts the findings from Broitman and Komen (2015), who also aggregated COROP GDP data to municipalities in their research. These findings were admittedly used to explain residential stock and not building permits, which could explain the difference in results. This because residential stock does not necessarily imply yearly or quarterly stock increases, whereas for amounts of building permits, it does.

As for the Amount Of Developable Land per municipality, the expectation did not match outcome. For the model, the associated standardised coefficient is the lowest compared to the other variables. Also, running a single regression, results are insignificant on their own. Saiz (2010) elaborates on the importance of developable land, and how the availability of this is necessary to accommodate for residential development. However, his description of developable land is different from the one used in this paper, mainly due to its inaccurate application for the Netherlands. According to Saiz, developable land is all land excluding water and land sloped 15 degrees and up. Working with the available data, this paper describes developable land as all agrarian, semi-constructed and recreational terrain. This difference could explain why the results for the amount of developable land did not match the expectations.

As for the demographic drivers, the results matched, or even exceeded the expectations. Theory by Thompson (1937) exemplifies how long population dynamics have been associated with the supply of houses. The net population development variable shows just how, also in this study, these two are related. The rate of elderly people also significantly contributed to the model. Using the Life Cycle Theory as a theoretical basis, a relationship with housing stock was to be expected. Furthermore, a study by Green and Hendershott (1996), established a link between people in their 70's and housing stock. In the respective study, the willingness to pay for a house decreased with 70 year olds, compared to the younger population. Another study by the Dutch CBS (1999) also established evidence that people over 55 had less of an interest in buying homes.

### 7.3 Limitations and scope

Due to the nature of the data, some limitations must be stated. Reviewing the means and standard deviations for the variables, it is noticeable that the data is not centred around the mean. In fact, a closer look at the municipalities show a number of outliers. Municipalities like Amsterdam, The Hague and Utrecht deviate a lot from the other cases for many of the variables. As limited by the time intervals of the available data, this study only focuses on the period of 2012-2019. This is a period in which residential development was not as high as in other time spans (Obbink, 2020). In fact, the total number of realised houses between 2012 and 2019 comes down to 404,960. To put this in perspective, the same amount of houses developed in eight years' time is now projected to be developed in three to four years (VRO, 2022). This difference may have an impact on the final results.

### **References**

1. Alonso, W. (1964). *Location and Land Use: Toward a General Theory of Land Rent*. Amsterdam University Press.
2. Álvarez-Román, L., & García-Posada, M. (2021). Are house prices overvalued in Spain? A regional approach. *Economic Modelling*, 99, 105499. <https://doi.org/10.1016/j.econmod.2021.105499>
3. Anundsen, A. K., & Heebøll, C. (2016). Supply restrictions, subprime lending and regional US house prices. *Journal of Housing Economics*, 31, 54–72. <https://doi.org/10.1016/j.jhe.2016.02.001>
4. B. Aalbers, M., Hochstenbach, C., Bosma, J. and Fernandez, R. (2020). The Death and Life of Private Landlordism: How Financialized Homeownership Gave Birth to the Buy-To-Let Market. *Housing, Theory and Society*, 38(5), pp.541-563.
5. Berg, N. (2022). Atlas voor gemeenten 2022 - Wonen - Atlas Research. [online] Atlas Research. Available at: <<https://atlasresearch.nl/atlas-voor-gemeenten-2022-wonen/>> [Accessed 30 September 2022].
6. Broitman, D., & Koomen, E. (2014). Regional diversity in residential development: a decade of urban and peri-urban housing dynamics in The Netherlands. *Letters in Spatial and Resource Sciences*, 8(3), 201–217. <https://doi.org/10.1007/s12076-014-0134-y>
7. *CBS Statline*. (n.d.). <https://opendata.cbs.nl/statline/>
8. *Database*. (n.d.). Eurostat. <https://ec.europa.eu/eurostat/web/main/data/database>
9. Geng, N. (2018). Fundamental Drivers of House Prices in Advanced Economies. IMF Working Papers, 18(164), 1. <https://doi.org/10.5089/9781484367629.001>
10. Glaeser, E. L., Gyourko, J., & Saks, R. E. (2005). Urban growth and housing supply. *Journal of Economic Geography*, 6(1), 71–89. <https://doi.org/10.1093/jeg/lbi003>
11. Green, R. K., Malpezzi, S., & Mayo, S. K. (2005). Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources. *American Economic Review*, 95(2), 334–339. <https://doi.org/10.1257/000282805774670077>
12. Green, R., & Hendershott, P. H. (1996). Age, housing demand, and real house prices. *Regional Science and Urban Economics*, 26(5), 465–480. [https://doi.org/10.1016/0166-0462\(96\)02128-x](https://doi.org/10.1016/0166-0462(96)02128-x)

13. Gyourko, J. (2009). Housing Supply. *Annual Review of Economics*, 1(1), 295–318.  
<https://doi.org/10.1146/annurev.economics.050708.142907>
14. Hoang, Q. V. (2020). Determinants of the result of new rural development program in Vietnam. *Journal of Economics and Development*, 22(1), 81–90. <https://doi.org/10.1108/jed-12-2019-0076>
15. Koomen, E., Dekkers, J., & van Dijk, T. (2008). Open-space preservation in the Netherlands: Planning, practice and prospects. *Land Use Policy*, 25(3), 361–377.  
<https://doi.org/10.1016/j.landusepol.2007.09.004>
16. Lerbs, O. W. (2014). House prices, housing development costs, and the supply of new single-family housing in German counties and cities. *Journal of Property Research*, 31(3), 183–210.  
<https://doi.org/10.1080/09599916.2014.893249>
17. Mankiw, N., & Weil, D. N. (1989). The baby boom, the baby bust, and the housing market. *Regional Science and Urban Economics*, 19(2), 235–258. [https://doi.org/10.1016/0166-0462\(89\)90005-7](https://doi.org/10.1016/0166-0462(89)90005-7)
18. *Netherlands Journal of Housing and the Built Environment* Vol. 14, No. 3, Social Housing Management: Between Economic Efficiency and Social Profile (1999), pp. 323-325
19. NOS. (2022). Kabinet komt met nationaal bouwplan, vanaf 2024 100.000 woningen extra. [online] Available at: <<https://nos.nl/artikel/2420767-kabinet-komt-met-nationaal-bouwplan-vanaf-2024-100-000-woningen-extra>> [Accessed 28 September 2022].
20. Obbink, H. (2020, September 9). Zo kwam Nederland aan een tekort van 331.000 woningen. *Trouw*. <https://www.trouw.nl/economie/zo-kwam-nederland-aan-een-tekort-van-331-000-woningen~b04d8d53/?referrer=https%3A%2F%2Fwww.google.com%2F>
21. Saiz, A. (2010). The Geographic Determinants of Housing Supply\*. *Quarterly Journal of Economics*, 125(3), pp.1253-1296.

22. Shahab, S., Hartmann, T., & Jonkman, A. (2020). Strategies of municipal land policies: housing development in Germany, Belgium, and Netherlands. *European Planning Studies*, 29(6), 1132–1150. <https://doi.org/10.1080/09654313.2020.1817867>
23. Thompson, W. S. (1937). Population Growth and Housing Demand. *The ANNALS of the American Academy of Political and Social Science*, 190(1), 131–137. <https://doi.org/10.1177/000271623719000115>
24. VRO. (2022, March). *Programma woningbouw*. open.overheid.nl. <https://open.overheid.nl/repository/ronl-7cf320fe661a5079d9b9c431d6fa3a96c8d558ff/1/pdf/programma-woningbouw.pdf>
25. Zhang, Y., Jin, H., Xiao, Y., & Gao, Y. (2020). What are the Effects of Demographic Structures on Housing Consumption?: Evidence from 31 Provinces in China. *Mathematical Problems in Engineering*, 2020, 1–14. <https://doi.org/10.1155/2020/6974276>



### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,957 <sup>a</sup>	,917	,916	610,994

a. Predictors: (Constant), GDP Per Capita Per COROP Region 2012-2019 , Total Developable Land Per HA (2012), Net Pop. Development 2012-2019, 100-% People Over 65 (2019)

### Model Summary

### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3592,280	875,874		-4,101	<,001
	Total Developable Land Per HA (2012)	,017	,005	,059	3,744	<,001
	Net Pop. Development 2012-2019	,320	,006	,930	53,167	<,001
	100-% People Over 65 (2019)	55,718	11,317	,086	4,923	<,001
	GDP Per Capita Per COROP Region 2012-2019	-,010	,003	-,050	-3,013	,003

a. Dependent Variable: Totaal Bouwvergunningen 2012-2019

### Model Table

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,006 <sup>a</sup>	,000	-,003	2108,206

a. Predictors: (Constant), Total Developable Land Per HA (2012)

### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.
		B	Std. Error			
1	(Constant)	1153,916	153,099		7,537	<,001
	Total Developable Land Per HA (2012)	-,002	,015	-,006	-,113	,910

a. Dependent Variable: Totaal Bouwvergunningen 2012-2019

*Single regression Total Developable Land*

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,952 <sup>a</sup>	,906	,905	647,590

a. Predictors: (Constant), Net Pop. Development 2012-2019

### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1420937575,0	1	1420937575,0	3388,244	<,001 <sup>b</sup>
	Residual	148038608,12	353	419372,828		
	Total	1568976183,1	354			

a. Dependent Variable: Totaal Bouwvergunningen 2012-2019

b. Predictors: (Constant), Net Pop. Development 2012-2019

*Single regression Net Population Development*

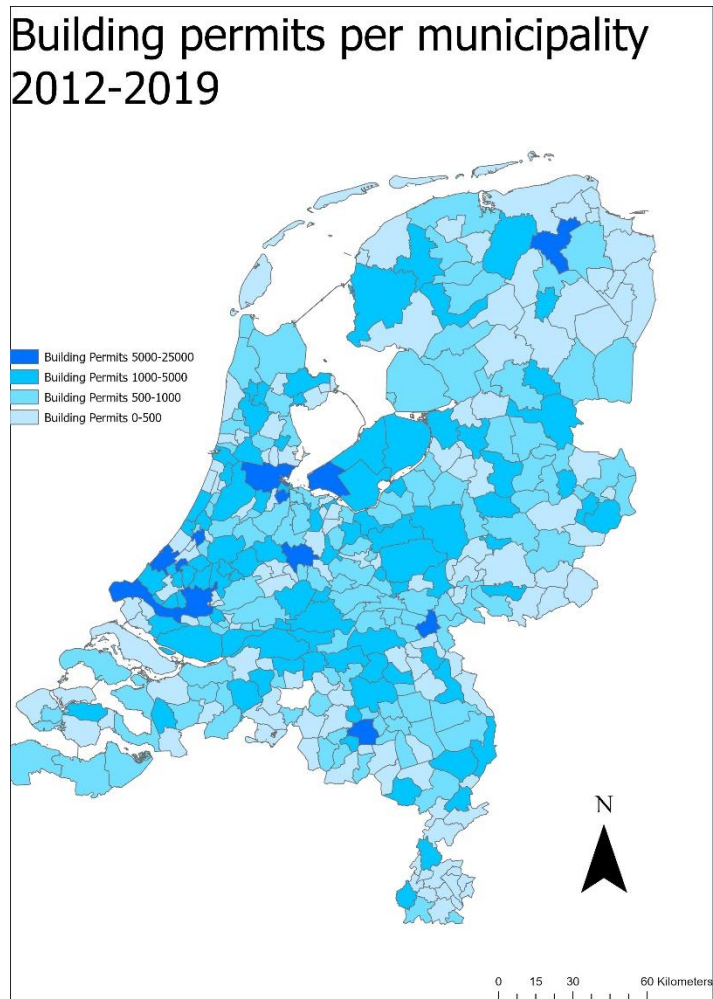


Figure 1

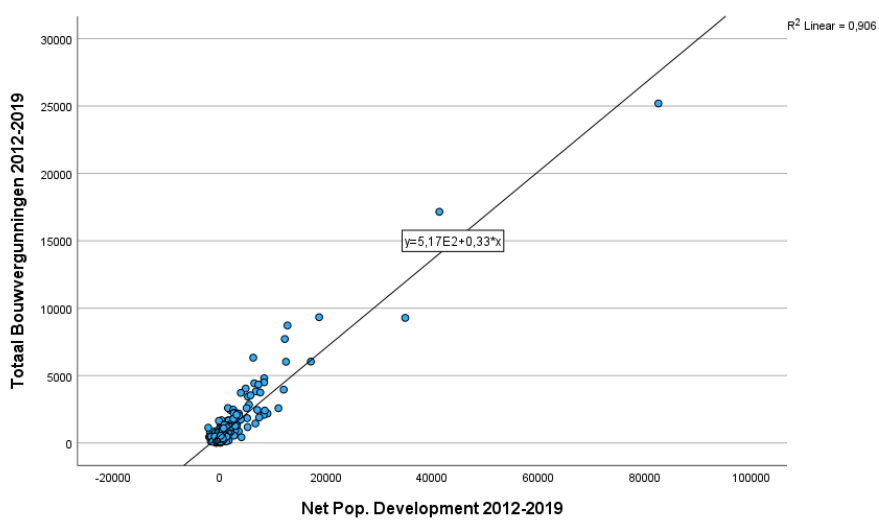


Figure 2

**Table 1**

**Descriptive statistics for municipalities (N=355)**

Variable	Mean	Std. Deviation
Total building permits 2012-2019	1,142.09	2,105.26
GDP per capita per COROP region 2012-2019	38,853.12	10,650.97
Total developable land per HA (2012)	6,788.26	7,278.98
Net population development 2012 - 2019	1,908.55	6,118.62
100 - % people over 65 (2019)	78.78	3.26

**Table 2**

**Regression Results**

R Square	Adjusted R Square	Model Significance	Variables	Standardised Coefficients	Significance
0.957	0.917	<0.001	GDP per capita	-0.050***	0.003
			Total developable land	0.005***	<0.001
			Net population development	0.930***	<0.001
			100 - % people over 65	0.086***	<0.001

\*\*\* Significance at 5%