

HOUSING PRICES AND EDUCATION LEVEL

A study on the effects of the number of highly educated residents on regional housing prices in the Netherlands

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Date: 7-8-2018

Abstract

This focus of this research was to find whether the number of highly educated residents has a significant effect on regional housing prices in the Netherlands. The model used to conduct the statistical analysis was based on a model of house price determinants constructed by Alan K. Reichert (1990). His model was extended with a variable for the number of highly educated residents per region. The study finds that the number of highly educated residents has a significant positive effect on housing prices, at a ten percent significance level.

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I. Introduction

The last years the number of highly educated people in the Netherlands has increased. With the increasing number of highly educated people that enter the labour market, the share of highly educated people in the workforce has increased as well. This can be noticed in all areas of labour. For example, in 2016, the number of people with a HBO- or WO-diploma in an economic firm had increased to 44 percent, from 29 percent in 2003 (Centraal Bureau voor de Statistiek (CBS), 2017). Next to that, housing prices in the Netherlands have been increasing, causing sales of houses to fall (Centraal Bureau voor de Statistiek (CBS), 2018).

There may be a relationship between the number of highly educated residents in a region and housing prices. With more highly educated residents, there is a firmer economic support for public services such as education and public transport (Lakens, 2016). Moreover, the higher the 'academic level' in a city, the more residents are willing to pay for housing (Bouman, 2015). This extra economic support for public services and higher 'academic level' increases the chance of 'high quality' jobs, which is good for the residential image of a region. This increases a region's popularity, resulting in a higher demand for housing in that specific region (Lakens, 2016). Therefore, it would be interesting to research if there actually is a significant relationship between the numbers of highly educated residents on regional housing prices. Education level could be a relevant factor for the level of housing prices, but has not been taken into account in previous studies.

Most research on housing prices has been conducted for the United States or the United Kingdom; other areas or countries have almost been neglected in previous research. The focus of this research is unique, as it analyzes factors of housing prices in the Netherlands.

The research question constructed for this paper therefore sounds as follows:

"Does the number of highly educated residents affect regional housing prices in the Netherlands?"

The model used in this paper is based on a model introduced by Reichert (1990). Reichert emphasized the importance of both macro- and microeconomic factors in conducting research on housing markets. He shows that regional housing prices react uniformly to macro-economic factors, such as mortgage rates. On the other hand, local, microeconomic factors such as employment rate and population shifts often have a unique impact on housing prices. His model is extended with a variable that measures the number of highly educated residents per region.

This paper is organized as follows: Section II, the literature review, presents an overview of previous studies on determinants of housing prices. Section III describes the data and methodology that was used to conduct the regression analysis, after which section IV discusses the results that were obtained from the statistical analysis. Section V provides a summary of the paper and the conclusion that is drawn from the research. Section VI finalises this paper with a discussions of possible shortcomings of this study and recommendations for further research.

II. Literature Review

Grigsby (1978) was the first to draw attention to the fact that there are two different approaches to research on housing prices. He identified a gap in assumptions and techniques between theoretical- and policy-analysis of housing research. McAvinchey and Maclennan (1982) add to Grigsby's identified gap that in the realm of technical economic analysis 'macro' and 'micro' analysis of housing market phenomena have been pursued independently from each other. They stress the importance of restricting macro-economic models of housing-price inflation to national level issues, while also developing less aggregated models which would take into account micro-economic analyses of housing-price. That is, the study of house price inflation could become an appropriate basis for the development of a micro-economic basis for macro-housing studies (McAvinchey & Maclennan, 1982).

In his paper "The impact of Interest Rates, Income and Employment upon Regional Housing prices" (Reichert, 1990), Reichert analyzes the determinants of new housing prices at a regional level using a combination of macro- and microeconomic factors, tying together the differences in macro- and microeconomic factors. This research was unique in its kind and will therefore be of great importance for this paper, as it provides a good insight of the variables that influence regional housing prices.

In the literature review section, firstly, microeconomic research on housing prices will be discussed. After that, Reichert's research will be discussed, as well as why Reichert's model is used as a basis for this paper.

Theoretical framework

As is pointed out by Reichert (1990), the cyclical nature of the U.S. housing market has been well documented in the academic literature.

Employment Rate and Mortgage rate

John Baffoe-Bonnie (1998) analyses the effect of four different macroeconomic variables; money supply, mortgage rate, consumer price index and employment growth. He analysis the effect of these variables on both the national and regional level, and finds that the housing market is very sensitive to shocks in employment growth and mortgage

rate. His research reveals that the economic variables have a different impact on the dynamic behaviour of housing prices in different regions. Therefore, economic aggregates alone cannot explain the fluctuations in real estate values on a regional level. (Baffoe-Bonnie, 1998)

Employment rate and population

Bartik (1991) examined how growth shocks in a small local area, such as a metropolitan area, affects housing prices. He finds that shocks in local employment permanently increase housing prices. In fact, these housing price effects are large enough to significantly affect the return to owning property. His study also reveals that population and employment growth directly influence housing appreciation, although the impacts of these factor vary widely (Jud & Winkler, 2002). (Bartik, 1991)

Quality of Housing

Both Gardner et al. (1987) and Bowen et al. (2001), among others, have used hedonic pricing models to find how certain characteristics of an area affect the local housing prices. These characteristics include, but are not limited to, residential quality and accessibility (Kain & Quigley, 1970), externalities in or from local surrounding environment (Ridker & Henning, 1968), job availability (Bender & Hwang, 1985). For example, Gardner et al. (1987) find that the announcement by Chrysler/Mitsubishi to locate their Diamond Star automobile plant in Bloomington, Illinois increased the local housing prices with 10 to 15 percent (Bartik, 1991).

Income

McAvinchey and MacLennan (1982), as stated before, highlight the importance of micro-economic research for the housing market. They show that income, and especially changes in income, can have a strong significant effect on local housing prices. They state that income has an effect on the mortgage that a buyer might receive, causing a positive effect on housing prices. Sign, significance and impact may differ between regions, which is another reason why macro-economic research on the housing market may not be sufficient.

Painter et al. (2001) find that the endowment differences (income, education, and immigrant status) largely explain the homeownership gap between Latinos and whites. They find that Latinos have a lower rate of homeownership compared to whites, which can be attributed to relatively lower levels of income and education. This result suggests that policies that lead to higher levels of training and human capital investment among Latino households would substantially increase homeownership rates (Painter, Gabriel, & Myers, 2001). This higher homeownership rate would imply more demand for homeownership, and therefore higher housing prices.

Reichert's model of house prices

As stated before, Reichert's model was unique as it was the first model that analyzes determinants of housing prices using a combination of macroeconomic and microstructural factors. Reichert used his model to identify significant differences in regional housing prices for the United States. The ultimate goal of his research is not to find the optimal model for each specific region that he identified, but to observe how an appropriate set of supply and demand factors behaves across a variety of regions (Reichert, 1990).

Important to note is that Reichert performed a Durbin-Watson test to test for multicollinearity. He found that, in general, multicollinearity is of little impact on the results that were obtained. Thus, the independent variables are not intercorrelated, whilst the model does include important factors to determine local housing prices.

The results of his study are in line with the general conclusion of McAvinchey and Maclennan (1982) with their study on the British housing market: A combination of both local and national factors simultaneously work together to influence housing prices (Reichert, 1990). Regional housing prices react uniformly to certain national economic factors, such as mortgage rates. On the other hand, local factors such as population shifts, employment and income trends often have a unique impact on housing prices (Reichert, 1990).

General conclusions from literature review

From the research on housing prices before this study, we can conclude that a combination of macroeconomic factors, such as mortgage rates, together with regional factors such as employment rate, population and housing quality, is key to conducting research on the housing market. This is in line with what Reichert concluded from his study, which rejects the hypothesis of a single national housing market in favour of one that allows for broad national trends to be superimposed upon unique regional markets (Reichert, 1990). Reichert's model catches accurately a variety of factors, both macroeconomic and microstructural, that influence regional housing prices. His model provides a good basis to conduct further research on regional housing prices, thus also for this paper.

III. Data and Methodology

In order to find the effect of the number of highly educated residents on regional housing prices, a model needs to be constructed to test this effect. This model should include several control variables that may also influence regional housing prices. This section will explain how the data for the model was obtained, how the model was constructed and how the regression analysis was done.

The Model

As was explained in the 'Literature Review' section, the model constructed by Reichert was used as a basis for this research. Therefore, the dependent variable housing prices is a regression function existing of the independent variable 'Number of highly educated residents (Edu)' and a number of control variables, similar to those used by Reichert. The model can be written as:

$$\ln HP = \beta_0 + \beta_1 \ln Edu + \beta_2 \ln Pop + \beta_3 \ln ER + \beta_4 \ln MR + \beta_5 \ln GDP + \beta_6 \ln WOZ + \beta_7 PrInd + \varepsilon$$

By using the natural logarithm, the regression coefficients of the variables are to be interpreted as elasticities. When conducting research on prices, interpretation of elasticities is more meaningful, as it represents the percentage change in prices rather than absolute change. Next to that, taking a natural logarithm increases the level of fit of the model, the R-squared, as was also shown by Anas and Eum (1984) in their model for housing prices.

HP, the dependent variable, measures the average real housing price per region in a specific period.

Edu, the independent variable, represents the education level per region, which is based on the number of highly educated residents in a region. In this case, highly educated residents will be defined according to the CBS definition of high education; "Everyone of whom the highest obtained education level is HBO, WO bachelor, WO master or doctor is highly educated" (Centraal Bureau voor de Statistiek (CBS), 2018).

The various control variables in the model are defined as follows. *Pop* is measured as the total resident population during each period for each region. Population growth puts direct pressure on the demand for housing services, especially if the majority of the population growth is in the home-buying age group. Hence, changes in population should be directly related to housing prices (Reichert, 1990).

ER represents the average employment rate in each region. Reichert found that a region's employment rate "proved to be the best predictor of short-run fluctuations in both national and regional housing prices and showed little correlation with other variables in the model" (Reichert, 1990), which is why it is an important control variable in the model.

MR measures the real mortgage interest rate during each period. A rise in mortgage rates increases the cost of home ownership relative to other consumption. Furthermore, rising interest rates increase the opportunity cost associated with real estate investments (Reichert, 1990). A higher mortgage rate is therefore expected to have a negative influence on housing prices.

GDP was used to define the level of income in a region.

WOZ represents the *COST/QUAL* variable that Reichert used in his model. Municipalities in the Netherlands calculate the 'WOZ-waarde' (Real estate valuation) each year, based on data such as build year and type of residence. Therefore, the WOZ-value is a good representation of the cost/quality ratio that Reichert uses.

PrInd measures the acceleration in regional housing prices, and hence, provides a measure of a region's speculative investment potential. This can be calculated using data on the housing prices per region in each time period. The CBS use the 'Prijsindex bestaande koopwoningen' (Price index for existing real estate) to measure the change in price for existing real estate (Wal, 2014).

Data

As this research focuses on the regional housing market in the Netherlands, a set of panel data has to be constructed consisting of multiple regions within the Netherlands over a period of time. The regions were defined following the mapping introduced by

the ‘Coördinatie Commissie Regionaal OnderzoeksProgramma’; COROP-regions (Coordination Committee Regional Research Programme). The COROP-regions were constructed following the nodal principle, in which the commuter flow plays an important role. The COROP-regions are therefore very useful to define regions for this research, as tenure choice partly depends on a trade-off between migrating and commuting (Cameron & Muelbauer, 1998). If the commuter flow is not taken into account, the results may be distorted, as there can be some inter-regional effect on housing prices: Strong demand for highly educated people in region X could influence housing prices in region Y, if commuting between region X and Y is relatively cheap/short. COROP-regions take care of this effect, as commuter flow was taken into account when the regions were defined.

The data for each variable was obtained from the CBS – Statistics Netherlands using the online data archive. Table 1 shows some descriptive statistics of the data that will be used for the statistic analysis of this paper. The data was collected over an 18-year period ranging from 2000-2018. However, due to missing values in the data, the time range was reduced to a 10-year period, resulting in 400 observations for each variable. Thus, the variable ‘Year’ has a minimum of 2003 and a maximum of 2012; the 10-year period that was used for the analysis.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Year	400	2007.5	2.876	2003	2012
lnHP	400	12.298	.187	11.747	12.894
lnEdu	400	10.89	.853	8.517	12.81
lnPop	400	12.674	.717	10.794	14.161
lnER	400	4.184	.041	4.055	4.265
lnWOZ	400	12.175	.285	11.277	12.785
lnGDP	400	9.216	.851	7.067	11.353
lnMR	400	2	.034	1.946	2.041
PriceIndex	400	102.591	6.569	86.4	122.2

The data for the ‘Population’ variable represents the number of residents per region in absolute numbers. As was explained before, the ‘Education’ variable was defined as the number of highly educated residents per region. Therefore, data for the ‘education’ variable is also represented in absolute numbers. The variables ‘Employment rate’ and ‘Mortgage rate’ are percentage variables. ‘WOZ-value’ and ‘GDP’ were represented in

thousands of Euros, and the 'Prince Index' variable is an index of the growth of housing prices, with 2015 as the base level. For all variables, the natural logarithm was taken, which resulted in the descriptive statistics as shown in table 1.

Methodology

For the regression analysis, 3 models will be constructed. The first model will be a very basic regression model, consisting of the dependent variable $\ln\text{HP}$ and the independent variable $\ln\text{Edu}$. This model is constructed to see if there is even any statistical relationship between the number of highly educated residents and housing prices. If there is no statistically significant relationship at this stage, it is very unlikely that the two variables have a statistically significant relationship once control variables are added to the model.

Because the first model is very basic and without any control variables, more extensive models need to be created to check whether there is a significant relationship between house prices and number of highly educated residents. Thus, for model two, various control variables have to be added. In this model, variables for regional determinants of housing prices will be added. These variables include the dependent variable, $\ln\text{Edu}$, and three control variables; population, employment rate, WOZ-value and regional GDP. This model will catch whether there is a significant regional effect that number of highly educated residents has on house prices. However, as was explained in the literature review, housing prices are affected by both regional and national economic factors. Therefore, model two needs to be extended with some national-economic control variables.

Model three is therefore constructed, which includes all variables, both regional and national. To this model, two more variables were added compared to model 2, namely the mortgage rate and the price index for existing real estate. This model resembles the effects on housing prices the best of all three models and is therefore the most important for the regression analysis. Sign and significance of the independent variable, the number of highly educated residents, will represent whether or not there is a significant effect on housing prices and if this effect is positive or negative.

As the analysis is done with a set of panel data with different regions over a 10-year period, fixed effects need to be taken into account. Fixed effect regression methods are used to analyze longitudinal data. These methods control for all stable characteristics of variables, whether measured or not. This is important, as some variables may have a fixed effect over time. For example, house prices and/or the number of highly educated residents may have a stable growth over time, which is different for each region. If this characteristic is not taken into account, results may be biased, as the over time effect differs between regions and thus generates different results for each region. The fixed effect method takes into account this over-time-difference, to make sure that certain time-invariant, regional characteristics are not distorting the results.

IV. Results

Regression results for the three different models are represented in table 2. The models were constructed by firstly applying a simple regression of housing prices and education level and then adding more control variables to eventually come to model 3, which shows the regression results for the effect of education level on housing prices including all control variables. Model 3 appears to fit the data reasonably well, as the R-squared has a value of 0.914. All models were regressed with fixed effects taken into account.

Table 2: Regression results

	(1)	(2)	(3)
	lnHP	lnHP	lnHP
lnEdu	0.355*** (0.031)	-0.142*** (0.035)	0.033* (0.018)
lnPop		-0.149 (0.157)	0.169** (0.079)
lnER		0.921*** (0.150)	0.245*** (0.090)
lnWOZ		0.198*** (0.017)	0.108*** (0.013)
lnGDP		0.024 (0.029)	0.005 (0.014)
lnMR			-0.458*** (0.074)
PriceIndex			0.007*** (0.000)
_cons	8.434*** (0.337)	9.247*** (1.949)	7.622*** (1.002)
Obs.	400	400	400
R-squared	0.269	0.652	0.914

The result of model one shows that there is definitely a significant relationship between the number of highly educated residents and house prices. The effect is significant at a one percent significance level, with a positive sign and a coefficient of 0.335. However,

as the model only includes one variable, the R-squared is relatively low, meaning that the model has a low goodness-of-fit measure. This was to be expected, thus model 2 and 3 need to be analysed.

In model 2, the effect of the number of highly educated people on housing prices is still significant at a one-percent significance level. However, the sign seems to have switched from positive to negative. Next to that, although not significant, population has a negative effect on house prices as well. The flip in sign of these coefficients is most likely caused by the fact that the macro-economic variables are not yet included in the model. As can be seen later in model 3, mortgage rate is a very strong determinant of house prices and strongly negative. The time period of the data includes data from years during the European financial crisis. Generally, real housing prices decline average 35 percent of six years (Reinhart & Rogoff, 2009). Therefore, it may seem that the number of highly educated residents and population decrease housing prices. However, comparing the results of model 2 to model 3, the sign flips again and one can now see that the negative sign was most likely caused by the omission of the mortgage rate variable.

In model 3 the effect of the number of highly educated residents on housing prices is significant at 10% significance, with a coefficient of 0.033. As all variables consist of a natural logarithm, the effect needs to be interpreted as a percentage. Therefore, according to the model, a 1 percent increase in the number of highly educated residents is expected to increase housing prices by 0.033 percent. As could be expected, the effect of the number of highly educated residents in a region has a positive effect on housing prices. This is in line with what Painter et al (2001)(Painter, Gabriel, & Myers, 2001) discovered. They found that the difference in homeownership between different racial groups could largely be explained by the difference in education. They found that the higher the education level of a certain group is, the higher the homeownership rate is. Thus, the more highly educated residents in a region, the higher the homeownership rate is and therefore the higher housing prices will be.

Model 3 also shows that all control variables, apart from GDP, are significant for at least a 5 percent significance level. The employment rate has the strongest positive impact on housing prices, with an estimated coefficient of 0.245. To illustrate, if employment rate increases from 60 to 62 percent, a relative increase of 3.3 percent, then the housing price is estimated to increase by 3.3×0.245 percent, which equals a 0.8 percent increase in housing prices.

In model 3, mortgage rate is the only (control) variable that has a negative impact on housing prices. The negative sign of the mortgage rate makes sense, as a rise in mortgage rates increases the cost of home ownership relative to other consumption items. Next to that, opportunity costs associated with real estate investments also increase with a higher mortgage rate(Reichert, 1990).

Population and WOZ-value have a relatively lower, but still positive significant impact on housing prices. As population increases in a region, demand for housing within that region naturally increases as well, causing housing prices to increase. The WOZ-value is a representation of real estate value adjusted for the quality. Therefore, if the WOZ-value increases, housing prices increase with it.

When comparing the results to the results obtained by Reichert, the sign and magnitude of the coefficients seem to be in line with the coefficients obtained by Reichert. Both in his results and in the results presented in this paper, 'Population, 'Employment Rate' and 'Mortgage Rate' have the strongest effect on housing prices. 'Mortgage Rate' is the only variable in the model with a negative sign. The only difference compared to Reichert's results, is that he finds a strong and significant impact of income, whereas the effect of income was not significant for this research.

Overall, the model appears to be a good representation of factors that influence housing prices. The independent variable that is studied, the number of highly educated residents, has a significant impact on regional housing prices and is therefore a factor that should be taken into account in housing price estimation.

V. Conclusion

The central question in this paper was “Does the number of highly educated residents affect regional housing prices in the Netherlands?”. To answer this question, a model was constructed based on the model proposed by Reichert in his paper “The impact of Interest Rates, Income, and Employment upon Regional Housing Prices”. His model was extended with a variable that measured the number of highly educated people per region, following the CBS definition of high education; “Everyone of who the highest obtained education level is HBO, WO bachelor, WO master or doctor is highly educated” (Centraal Bureau voor de Statistiek (CBS), 2018).

The results of the ordinary least squares regression showed that the number of highly educated residents has a positive effect on housing prices, with a coefficient of 0.033. This result was significant at a 10 percent significance level. This finding suggests that a rise of 1 percent in the number of highly educated residents in a region results in a 0.033 percent increase in regional housing prices. Even though the impact is relatively small compared to other variables such as mortgage rate and employment rate, this is still a variable that needs to be taken into account when conducting research on regional housing prices.

The results of this study is in line with Reichert’s conclusion, which suggests that housing policy and research should take into consideration both national and regional factors (Reichert, 1990). Sign and magnitude of the coefficients for the variables in this research are also comparable to those obtained by Reichert.

This research is relevant for further Dutch policy analysis on housing prices, as the Dutch economy is knowledge-based (CBS, 2017). The number of highly educated people will rise, which will therefore cause an increase in housing prices in the Netherlands. Policy on housing prices needs to take into account this effect when conducting research on housing prices.

VI. Discussion

A shortcoming of this research could be that the research was only conducted over a 10-year period. The effect of highly educated residents was significant, but only at the 10 percent significance level. Therefore, further research needs to be conducted to find whether the effect of the number of highly educated residents has an effect on housing prices that is significant at a 1 or 5 percent significance level. To do this research, more data needs to be collected on the Dutch housing market, over a longer period of time.

Data collected for this model could be distorted, as the economic/euro crisis affected housing prices in the European Union, and therefore also in the Netherlands. Again, more research needs to be conducted over a different or longer period of time to test the effect of the number of highly educated residents on housing prices.

Factors that influence housing prices have mostly only been researched in the United States and the United Kingdom. This study adds to general housing price research, as it was conducted for data in the Netherlands. However, factors that influence house prices may vary across countries, thus more research needs to be conducted to find more evidence for the different economic variables that impact housing prices.

As was mentioned in the results section, the data used for this model included the years of the European economic crisis. House prices decreased drastically during that crisis, which might have distorted the data and thus the results for this research.

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