

An analysis of the interaction between new construction and pricing of housing in Sweden 1991-2009

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Abstract: This thesis analyses the effect of new construction of housing on housing prices in Sweden from 1991 to 2009. This is done by analyzing the links between house prices, net migration, supply of housing, income, unemployment rate and new construction of houses in 288 Swedish municipalities from 1991 to 2009. A quantitative approach using a Heckman Sample Selection model and panel-data from Statistics Sweden (SCB) and the Swedish public employment agency (AMS) is used to investigate the effect of new construction on house prices in Sweden. Through empirical analysis it is found that the effect of new construction of houses on the price of houses is statistically significant and positive. This surprising result contradicts theory as construction of new housing is generally believed to decrease housing prices. It is therefore suggested that the variable used to measure new construction captures effects other than solely new construction or is correlated with omitted variables explaining increases in housing prices. Nevertheless, the literature review points to some policy implications such that reducing the market imperfections in the Swedish construction industry, loosening the stiff administrative process involved in construction projects and perhaps aiming new construction projects at the lower end of the market. The conclusions drawn are therefore in line with Glaeser, Gyourko and Saks (2005) that regulations and a tedious administrative process may serve to keep new construction of housing at a low level. It is believed that this study sheds some light on an undeveloped aspect in academic literature: the effect of new construction of housing on housing prices.

Keywords: Price formation of housing, new construction of housing, panel-data analysis, Swedish housing market

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TABLE OF CONTENT

Preface	2
List of tables	2
List of graphs	2
1. Introduction	3
2. Determinants of housing prices	5
2.1 Economic Theory	5
2.2 Previous research	8
2.3 Construction of new housing and property prices.....	12
3. The case of Sweden	14
3.1 Housing prices in Sweden 1991-2009	14
3.2 Housing construction in Sweden	17
4. Methods	21
4.1 Methodology	21
4.2 The model	23
5. Data	26
5.1 Source material	26
6. Results	32
6.1 Empirical results	32
6.2 Sensitivity analysis	35
7. Discussion of the regression results.....	38
7.1 Discussion and policy implications	38
8. Conclusion.....	40
List of references	41
Appendix.....	48

Preface

Many thanks to my supervisor, Åsa Hansson, for helping me write this thesis.

List of tables

Table 1: A table summarizing previous research on the formation of housing prices.

Table 2: A table showing the expected signs on the explanatory variables using the price of housing as the dependent variable.

Table 3: Table showing the results from the GLS 'fixed effects' model using $\ln(\text{housingprice})$ as dependent variable.

Table 4: Table showing the results from the selection equation using the binary variable construction as dependent variable.

Table 5: Table showing the results from the GLS 'fixed effects model' using $\ln(\text{housingprice})$ as dependent variable and different lags on $\ln(\text{weightedconstruction})$.

List of figures and graphs

Figure 1: A figure showing a supply and demand diagram when housing supply increases ceteris paribus.

Figure 2: A figure showing a supply and demand diagram when supply and demand increases resulting in an unchanged average price of houses.

Graph 1: Annual growth in price index of houses in Sweden 1992-2010 and annual growth in consumer price index in Sweden 1992-2010. Annual percentage change.

Graph 2: Growth in housing construction in Sweden 1975-2009. Annual percentage change.

Graph 3: New construction of housing per person in Sweden, Norway and Denmark 1991-2010. Number of new houses per person.

Graph 4: Annual growth in price index of houses in Sweden 1991-2010 and growth in housing construction in Sweden 1991-2010. Annual percentage change.

1. INTRODUCTION

Many people invest a large share of their current and future income in housing. In fact, in the past decade households in Sweden have increased their total debt as a proportion of disposable income from 100% in latter part of the 1990s to 167% in 2009.¹ A fall in housing prices could therefore have severe consequences for many individuals as well as for the Swedish economy as a whole.

There is a growing concern for the sustainability of the high prices on the Swedish property market. In April 2011 the Swedish Central Bank (Riksbanken) published a report analysing the likelihood and consequences of a fall in housing prices. The IMF and the European Commission echo the concern of the Swedish Central Bank as in June 2011 reports were published by the two supranational organisations arguing for a likelihood of a cooling down of the housing market in Sweden. In addition to this in July 2011 *The Economist* published an article stating that housing prices in Sweden are overvalued.

Due to the importance of housing prices to the domestic economy there is a large body of research on the determinants of housing prices. A significant proportion of this research emphasize the importance of macroeconomic conditions such employment levels, income levels and interest rates on the formation of property prices. In the report published by the Swedish Central Bank (Riksbanken) in April 2011, Peter Englund points to low levels of construction of new housing playing a role in driving up housing prices in Sweden. The idea of limited construction of housing providing impetus to soaring property prices is also analysed in a paper by Glaeser, Gyourko and Saks (2005). According to Glaeser et al. (2005) building restrictions play a key role in the high housing prices in expensive regions of the US. Nevertheless, the importance of levels of new construction for housing price formation appears to be underdeveloped in academic literature. This thesis therefore aims to shed some light on the part played by new construction of housing on the increasing property prices in Sweden from 1991 to 2009. This is done by using a Heckman Sample Selection model with a ‘fixed-effects’ specification panel-data analysis on data from 288 municipalities in Sweden from 1991 to 2009. It is found that construction of new houses has a positive and statistically significant effect on house prices during the period of time considered. Whilst this result can

¹ Sveriges Riksbank, *Finansiell stabilitet 2010:2* (Stockholm: Sveriges Riksbanks publikationer, 2010), p.40

be taken as providing some insight on the interaction between house construction and price formation of houses some caution is needed as the dataset is not complete.

To provide thorough analysis of the impact of new construction of houses on house prices in Sweden from 1991 to 2009 this study is separated into seven parts. Section two examines previous research on the interaction between new construction and housing prices. The third part outlines the development of construction of new houses and house prices in Sweden from 1991 to 2009. The fourth part summarizes the statistical model used. The fifth section analyses the data collected to run the panel-data regression. The sixth part summarizes the results and conducts sensitivity analysis. The seventh part discusses the results and argues that perhaps the variable used for new construction captures effects other than solely construction of new housing or is correlated with omitted variables. Nevertheless, from the literature review it is appears as if the market for housing in Sweden is restricted. Hence some policy implications can be drawn from the literature review such as loosening the stiff administrative procedure involved in the construction of new housing and addressing market imperfections in the construction industry in Sweden. Finally, I conclude by pointing to some limitations of this study and giving suggestions for future research.

2. DETERMINANTS OF HOUSING PRICES

In order for the effect of construction of new housing on property prices to be understood, an overview of determinants of housing prices is needed. This section therefore highlights some of contributions to understanding price formation of housing and outlines how new construction is believed to contribute to housing prices. For the analysis to be coherent, this section is separated into three parts. Firstly, a theory of housing prices is developed through the prism of economic theory. Secondly, a literature review is provided. Finally, the links between new construction and the formation of housing prices according to economic theory are developed.

2.1 ECONOMIC THEORY

The effect of new construction on housing prices can be understood by using standard economic theory.

The impact of new construction on the stock of housing can be grasped by the following identity from standard macroeconomic theory where H represents the stock of housing.²

$$H_{t+1} = H_t(1 - \delta) + I_t^H \quad (\text{Equation 1})$$

δH_t is the decline of the physical stock of housing that would occur in the absence of new construction and I_t^H is investment made in new housing. According to the identity above even in a situation when the housing stock is fixed, some construction is needed to prevent depreciation of the stock of housing. As there is no data on the decline of the physical stock of housing in Sweden it is difficult to assess whether construction has been enough to counterbalance δH_t . However, as will be shown in *Section 3.2* (please see page 18) construction of new housing in Sweden is at a lower level than neighboring countries. This points to the replacement ratio in Sweden being rather low.

² Peter Birch Sørensen, and Hans Jörgen Whitta-Jacobsen, , *Introducing Advanced Macroeconomics – Growth and Business cycles*, (New York: McGraw Hill, 2010), p.412

In the short-run the stock of housing is pre-determined. In the long-run, however, if construction occurs above the rate of depreciation of the physical stock of housing the stock of housing is changed. This is best understood by using a simple demand and supply diagram. The elasticity of the supply and demand curve in the long-run is determined by a variety factors. When illustrating different situations in *Figure 1* and *Figure 2* below the same slope of the curves is used as Sullivan (2009) in his textbook on Urban Economics.

Figure 1. A figure showing a supply and demand diagram when housing supply increases ceteris paribus.

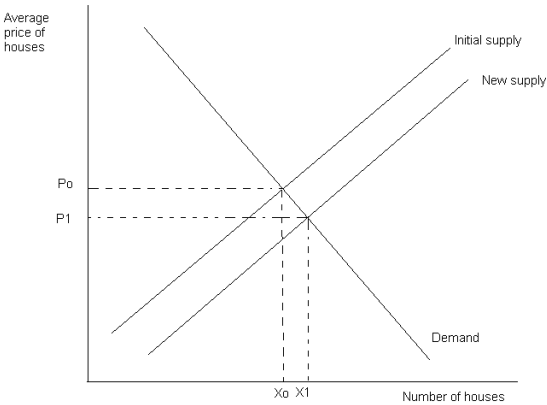
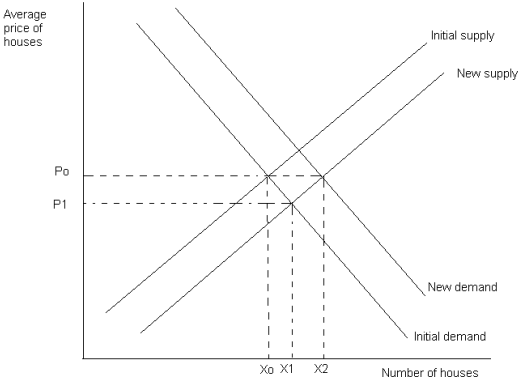


Figure 2. A figure showing a supply and demand diagram when supply and demand increases resulting in an unchanged average price of houses.



As illustrated by *Figure 1* (see page 6) increasing the supply of houses shifts the supply curve from ‘initial supply’ to ‘new supply’ and if demand remains constant the price of houses will

decrease. By the same token, a decrease in the supply of houses will lead to an increase in the price of houses. As shown by *Figure 2* (see page 6) increasing construction of new houses shift the supply curve from ‘initial supply’ to ‘new supply’. In this case if demand also increases the demand curve shifts from ‘initial demand’ to ‘new demand’. The lesson to be learnt from *Figure 2* is that if demand increases at the same rate as supply housing prices will remain unchanged.

Finally, economic theory can help us understand the price of housing through the perspective of the individual. The price of a good can be expressed in the following form:

$$P_0 = \sum_{i=1}^{\infty} \frac{B_i - C_i}{(1+r)^i} \quad (\text{Equation 2})$$

The price of a house can therefore be thought of as being determined by the sum of the discounted benefits minus costs of owning a property. The benefits of owning a particular property can be features of the dwelling such as location and quality. The costs of a property can be viewed as being factors such as the cost of borrowing money and user costs of the property. According to this final identity the price of a property can be thought of as reflecting the values individuals operating on the market attributes to a house and not only the outcome of demand and supply factors.

According to economic theory if new construction of housing increases, a decrease in the price of housing is predicted. This is made clear by the demand and supply diagrams above. Nevertheless, the level of construction needs to be at a certain minimum level in the economy at all times to prevent the stock of housing from declining. It can therefore be argued that when new construction increases above the physical decline of the stock of housing the price of housing decreases. Economic theory offers a toolbox by which the mechanisms of the effect of new construction on house prices can be understood. However, it is also important to turn to previous research to grasp the complex nature of housing prices.

2.2 PREVIOUS RESEARCH

In addition to economic theory it is also useful to consider empirical work. In this section I will summarize some of the main contributions to the understanding the housing prices.

There exists a large body of work on housing price formation. A significant proportion of this research focuses on the impact of the macroeconomic environment such as interest rates on housing prices. The principal contributions of previous research are summarized in *Table 1* (please see page 8-10).

Table 1. A table summarizing previous research on the price formation of housing.

AUTHOR	COUNTRY	METHOD	DATA	RESULT
Boelhouwer (2000)	Netherlands	Literature review and data analysis.	Data on nominal price development of owner-occupied dwellings and the development of real house prices.	In the medium term there should be a decline in the sales price for dwellings in the Netherlands.
Hort (1998)	Sweden	Error-correction on panel-data in Sweden 1967-1994 for twenty urban areas.	Real house price changes, real construction cost changes, real user cost changes, change in expected inflation, total real income changes, unemployment rate, and real house prices.	Price fluctuations are explained by the development of demand in this period.
Kearl (1979)	USA	Simulation	-	Inflation has an important effect on the mortgage payments on houses.
Larsen (2010)	Norway	Engel-elasticities of housing expenditure 1986-	Cross-section of the Norwegian Consumer	Elasticity is close to unity for all years. Therefore when

		1998.	Expenditure Survey.	income or total consumption rise by 1% then housing expenditure also increases by 1%.
Rahman (2010)	Australia	Literature review.	A number of papers.	There is reduced affordability of buyers in Australia. Increasing supply of housing at the lower end of the market should be the focus of future policy development.
Riddel (2004)	USA	Error-correction model on the US housing market 1967-1998.	US house price index, income per household, rent index, stock of housing, apartment vacancy rate, construction cost index, age-adjusted households, rate on conventional mortgages, user cost of housing, rate on 3-month treasury bill.	Demand for housing is negatively correlated to interest rate and influenced by high levels of employment.
Wigren et al. (2007)	Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden and the UK.	Panel-data is used to estimate an error-correction model 1976-1999.	Data on GDP, interest rate, property price index, construction price index, housing stock, population, household size, share of the population in the age 0-29 years and	The relationship between housing stock and macroeconomic determinants are robust across all countries. A shock takes four years before being incorporated into the housing stock.

			price level of housing relative to the US collected from a variety of sources.	
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Table 1 highlights the importance of macroeconomic conditions for housing prices, by using panel-data analysis Wigren et al. (2007) points to the relationship between housing stock and macroeconomic determinants such as the interest rate being robust across the countries analyzed. Riddell (2004) uses an error-correction model to show that the demand for housing is negatively correlated to the interest rate. Riddell also points to unemployment being an important determinant of housing prices. Larsen (2010) points to the importance of income for the development of housing prices. In fact, Larsen (2010) argues that the elasticity of income to housing expenditure is close to unity in Norway. Rahman (2010) supports Larsen by arguing that there is reduced affordability of buyers in Australia. Kearl (1979) emphasizes the importance of inflation on mortgage payments of houses. Boelhowuer (2000) and Hort (1998) are concerned by the fluctuations in housing prices. Hort argues that the price fluctuations are explained by the development of demand in Sweden during the 1990s. Boelhowuer on the other hand argues that the price of dwellings in the Netherlands is likely to decrease in the years to come.

Table 1 indicates that there is rich literature on the influence of macroeconomic conditions on housing prices. The body of research on endogenous factors and housing prices is however, less developed. Apart from the economic theory outlined in *Section 2.1* (please see pages 5-7) the influence of new construction of housing on property prices has been analyzed by Glaeser, Gyourko and Saks (2005). Glaeser et al. (2005) note that property prices in expensive regions (in particular regions close to a coast) of the US have increased drastically and argue that changes in building regulations in the US have resulted in little construction of new housing in these areas. By constructing a theoretical model Glaeser et al. (2005) point to the idea that building restrictions in the US play a key role in the formation of housing prices. According to Glaeser et al. (2005) a low level of construction yields high housing prices. This idea is developed further in *Section 2.3* (see pages 12-13) below.

Although there is little research on the effect of new construction of property on housing prices the report published by the Swedish Central Bank (Riksbanken) in April 2011 suggests that the level of new construction of housing in Sweden is low. In fact, Jansson and Persson (2011) argue that there may be reasons to question if fundamental factors such as new construction are at an appropriate level.³ This can be related to *Equation 1* on page 5 where a minimum level of construction is needed to counterbalance the decline in the physical stock of housing. In the same report Englund (2011) writes that the increase in housing prices has not been met by rising construction activity.⁴ Englund makes an important point as it is a general belief that high property prices leads to more construction. However, the point made by these scholars i.e. that the high property prices have not been met by increases in new construction in Sweden appears to be justified when examining the construction of new housing in Sweden in an international context (see page 18 for further explanation). According to these authors', the low levels of construction of new housing may have contributed to increasing housing prices in Sweden.

³Per Jansson and Mattias Persson "Riksbankens utredning om risker på den svenska bostadsmarknaden – sammanfattning", in *Riksbankens utredning om risker på den svenska bostadsmarknaden* (Stockholm: Sveriges Riksbanks publikationer, 2011), p.17

⁴ Peter Englund, "Svenska huspriser i ett internationellt perspektiv", in *Riksbankens utredning om risker på den svenska bostadsmarknaden*, (Stockholm: Sveriges Riksbanks publikationer, 2011), p. 25

2.3 CONSTRUCTION OF NEW HOUSING AND PROPERTY PRICES

As highlighted by Glaeser et al. (2005) and Englund (2011) (see Section 2.2 above) the level of new construction plays a role in housing price formation. From economic theory and previous research it appears as if new construction above the decline of the physical stock of housing serves to decrease aggregate house prices. It can however, in line with Glaeser et al. (2005) be argued that in Sweden the housing market has several distinct features which may result in new construction having a positive effect on the price of the new units of housing but not on existing houses.

According to the theoretical model by Glaeser et al. (2005) the impact of new construction on housing prices has changed over time.⁵ To illustrate this idea Glaeser et al. (2005) examine the economy of the USA. Due to a low level of construction in the years prior to 1950s the quality of new housing was higher than older units. However, as pointed out by Glaeser et al. (2005) in recent decades there is empirical evidence linking reductions in construction to rising housing prices.⁶ Glaeser et al. (2005) therefore point to the idea that the influence of new construction on average housing prices is not straightforward as it depends on the trajectory of construction activity in the past.

Applying the reasoning of Glaeser et al. (2005) to Swedish housing prices it appears as if new construction does not necessarily result in lower average housing prices. Sweden has for the past decades had low levels of new construction (please see *Section 3.2* for further explanation). This has in part been due to the economic turbulence of the early 1990s and other factors such as the long administrative process involved in new construction. The fact that Sweden has had a relatively low level of construction for a longer period of time may result in the new units of housing being of higher quality and hence a higher price can be charged for them. This however, does not increase the overall prices as a higher price cannot be charged for already existing units of housing.

As pointed out in a report by Olander (2005) and Kalbro, Lind and Lundström (2009) there is a long administrative process involved in construction of new housing in Sweden. Due to this

⁵ E.L., Glaeser, J Gyourko, and R.E. Saks, "Why Have Housing Prices Gone Up?", *American Economic Review*, 95(2) (2005), p.333

⁶ *Ibid.*, p. 333

long process it can be argued that contractors have to weigh the benefits of constructing with the costs of construction. This can result in contractors wanting to charge an extra premium for the administrative process and so charge a higher price for the housing unit. In addition to the long administrative process the cost of building material has risen since the early 1990s.⁷ Consequently it can be argued that in order for a building project to be profitable newly constructed housing units have to be highly priced. There is little data available on the price charged for new units of housing⁸ but it may well be as pointed out by Glaeser et al. (2005) that new houses are more expensive than older houses. This, however, does not increase aggregate house prices.

In addition to the features of the Swedish housing market described above it is also important to point to the fact that it is mostly in the three largest metropolitan areas of Sweden (Malmö, Göteborg and Stockholm) where new construction occurs.⁹ According to the *Swedish National Board of Housing, Building and Planning* (Boverket) construction is concentrated around metropolitan areas.¹⁰ In these areas the average price of housing is high and as these areas are expanding there is an increased demand for units of housing. Therefore due to a steadily increasing demand in these areas it is possible for higher prices to be charged for a new unit of housing.

The idea that new construction serves to decrease house prices is established both in the literature and in economic theory. To shed some more light on the effect of new construction on housing price in Sweden an empirical model is needed. Before turning to the empirical model, however, the development of housing prices and new construction of housing in Sweden from 1991 to 2009 needs to be outlined.

⁷ Statistics Sweden (SCB), *Building costs in Sweden 2000-2009* accessed via <http://www.ssd.scb.se/Databaser/Makro/SaveShow.asp>

⁸ Statistics Sweden (SCB) only publishes data for 30% of the new housing stock.

⁹ Linda Nohrstedt, "Här byggs det mest i Sverige" *Byggvärlden*, 14/02/2008 accessed via <http://www.byggvarlden.se/nyheter/byggprojekt/article89322.ece>

¹⁰ Swedish National Board of Housing, Building and Planning (Boverket), *Regionala analyser av bostadsmarknaden – hur vi går vidare*, February 2009 accessed via http://www.boverket.se/Global/Webbokhandel/Dokument/2009/regionala_analyser_av_bostadsmarknaden.pdf

3. THE CASE OF SWEDEN

Before developing an empirical model to quantify the effect of new construction on property prices, the development of the housing market in Sweden needs to be traced. This section does so by drawing on data from a variety of sources and by highlighting the different trajectories taken by construction of new housing and housing prices in Sweden 1991 to 2009.

3.1 HOUSING PRICES IN SWEDEN 1991-2009

Housing prices in Sweden have increased steadily over the past twenty years. To get a better idea of the relationship between construction of new housing and housing prices it is necessary to briefly outline the development of the price of housing in Sweden.

Firstly, it is important to establish the different forms of dwellings in Sweden. This thesis examines owner-occupied housing and so the rental section of the Swedish housing market is not discussed. In Sweden it is possible to either own a house or own the right to occupy an apartment (bostadsrätt). It is also possible to own an apartment (ägarrätt) but this form of dwelling is new in Sweden and only a fraction of the Swedish population resides in this form of housing. In 2002, 57% of the Swedish population (in the age group 16-84) resided in houses whilst 43% of the population lived in apartments. Approximately half of the households own their housing.¹¹

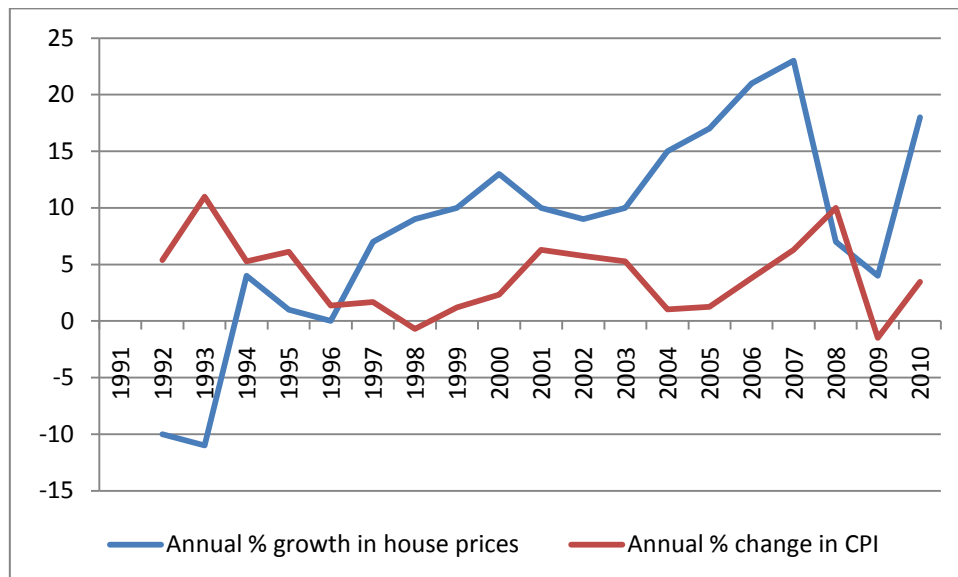
During the past twenty years the price of apartments (bostadsrätter) and houses have increased in Sweden. Information on the prices of apartments (bostadsrätter) is not available¹² and I will therefore illustrate the increase in the price of housing by analyzing the price of houses in Sweden. As shown in *Graph 1* (please see page 15) the price of houses have increased sharply for the past ten years. As revealed by *Graph 1* the price of houses has increased faster than the Consumer Price Index in Sweden. House prices only decreased during the early 1990s as Sweden suffered through economic turbulence partly due to generous lending by banks giving momentum to speculative behavior on the real estate market. However, shortly after the economic crisis housing prices continued to rise. From 1994 to 2009 housing prices grew at

¹¹ Statistics Sweden (SCB), *The proportion of the population residing in a particular dwelling ("Så bor vi i Sverige)* accessed via http://www.scb.se/Pages/PressRelease____112581.aspx

¹² In Sweden the selling price of apartments is not documented in any public record.

an average rate of 10%. In the mid-2000s the price of houses increased by around 20% annually. Even during the global financial crisis of 2008 house prices continued to increase in Sweden. This dramatic increase in the prices of houses fuels the worries of analysts as the long-term sustainability of this high level of pricing is questionable. This worry is nicely summarized by Larsen (2010) who writes that the “*juxtaposition of the size of the mortgages and future growth in income*”¹³ must be considered as increases in housing prices leads to larger mortgages.

Graph 1. Annual growth in price index of houses in Sweden 1992-2010 and annual growth in consumer price index in Sweden 1992-2010. Annual percentage change.



Source: Consumer Price Index (CPI) - Statistics Sweden (SCB)¹⁴

House price index – Statistics Sweden (SCB)¹⁵

¹³ ER Larsen, What May Eventually Limit Rising House Prices? Evidence from Engel Elasticities and Budget Shares of Housing, *Housing, Theory and Society*. 27(1), (2010), p. 95

¹⁴ Statistics Sweden (SCB), *Consumer Price Index (CPI), total annual averages, Shadow Index, 1980=100* by period accessed via <http://www.ssd.scb.se/databaser/makro/SaveShow.asp>

¹⁵ Statistics Sweden (SCB), *Price index for permanent houses (1990=100) after 1990-2010 (fastighetsprisindex för permanenta småhus (1990=100). År 1990-2010)* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&omradekod=BO&huvudtabell=FastpiPSLanAr&omradetext=Boende,%20byggande%20och%20bebyggelse&tabelltext=Fastighetsprisindex+f%F6r+permanent+sm%20hus+%281990%3D100%29+efter+1%E4n%2E+%C5r&preskat=O&prodid=BO0501&delta bell=+&deltabellnamn=Fastighetsprisindex+f%F6r+permanent+sm%20hus+%281990%3D100%29+efter+1%E4n%2E+%C5r&innehall=FastpiPS&starttid=1990&stoppid=2010&Fromwhere=M&lang=1&langdb=1>

Graph 1 above shows the evolution of aggregate prices in Sweden. However, increases in the price of housing for the past twenty years have been unevenly distributed across Sweden. The price of housing in Stockholm is about three times the national average whilst in scarcely populated regions (such as Norrbotten) housing prices are around a fifth of the national level.¹⁶ Analysis of the interaction between the price of housing and construction therefore needs to use regional levels as the unit of analysis. Disaggregating housing prices at the level of municipalities allows for the relationship between new construction and the price of housing to be closely studied.

¹⁶ Z Yang ,Z., S Wang, and R Campbell, Monetary policy and regional price boom in Sweden, *Journal of Policy Modelling*, 32 (2010), p.866

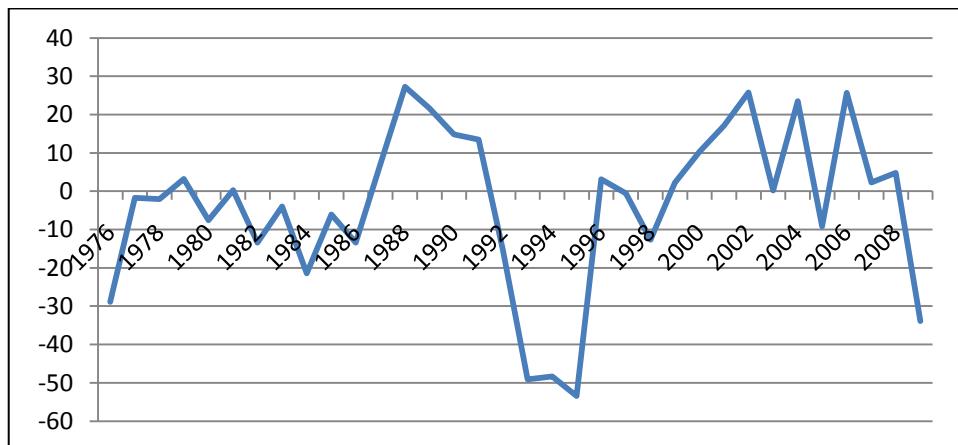
3.2 HOUSING CONSTRUCTION IN SWEDEN

Having briefly outlined the evolution of housing prices in Sweden I will briefly point to the trajectory taken by construction of new housing in Sweden for the past two decades.

To provide a backdrop to this discussion I will begin by briefly outlining the existence of building cycles. The presence of building cycles in Sweden is described by Schön (2006). According to Schön Sweden exhibits long-swings (building cycles). Long-swings are cycles of 15-25 years and occur due to economic restructuring and demographic changes. Sweden fits into the pattern of building cycles as long-swings have occurred in the period 1850 to 2000. The political agenda of the 1960s gave rise to increased levels of construction as large blocks of housing close to cities were built resulting in a cycle of 30 years. Sweden returned to the cyclical pattern of 20-year cycles with the increased construction at the end of the 1980s and with construction sharply decreasing in the mid 1990s to then increase again throughout the 2000s. This pattern can be seen in *Graph 2* (please see page 18). It is important, however, to note that even though Sweden fits nicely into the pattern of building cycles the amount of new construction varies between cycles. For example, the level of construction during the 1960s was higher than the building activities during the long-swing of the 1980s.

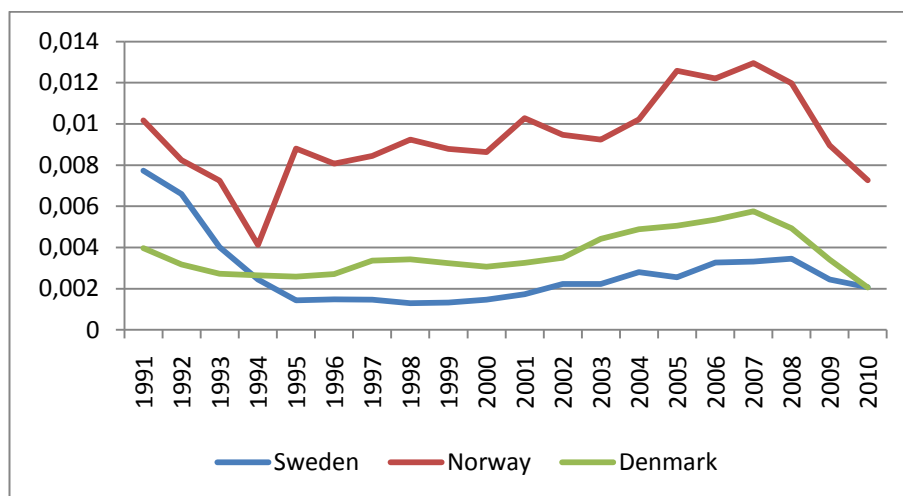
From *Graph 2* it can be seen that housing construction has not increased steadily during the past twenty years. Following the economic turbulence of the 1990s there was a sharp decrease. Construction of new housing grew during the 2000s and then plunged as the global recession of 2008 took hold. In addition, *Graph 3* reveals that construction of new houses in Sweden is at a low level compared to neighboring countries. The comments by Englund (2011) and Jansson and Persson (2011) (see page 10-11) therefore appear to be well established in empirical reality as the level of housing construction is at a low level in Sweden.

Graph 2. Growth in housing construction in Sweden 1975-2009. Annual percentage change.



Source: Statistics Sweden (SCB)¹⁷

Graph 3. New construction of housing per person in Sweden, Norway and Denmark 1991-2010. Number of houses per person.



Source: Statistics Sweden (SCB)¹⁸, Statistics Norway (Statistisk Sentralbyrå)¹⁹, Statistics Denmark (Statistikbanken)²⁰

¹⁷Statistics Sweden (SCB), *Completed apartments in newly constructed houses after region type of house and point in time in Sweden 1975-2010 (Färdigställda lägenheter i nybyggda hus efter region hustyp och tid i Sverige)* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=LghReHustypAr&delta bell=R1&deltabellnamn=F%E4rdigst%E4llda+1%E4genheter+och+rumsenheter+i+nybyggda+hus+i+rikt+efter+hustyp%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat=O&inne hall=AntLgh&starttid=1975&stoptid=2010&ProdId=BO0101&fromSok=&Fromwhere=S&lang=1&langdb=1>

¹⁸ Statistics Sweden (SCB), *Completed apartments in newly constructed houses by municipality, type of house and period in Sweden 1975-2010 ("Färdigställda lägenheter i nybyggda hus efter region hustyp och tid i Sverige")* accessed via

The comment by Englund (2011) that the increase in housing prices has been met by surprisingly little new construction is clear in *Graph 4* (see page 20) . It can be seen in *Graph 4* that the trajectories taken by housing prices and new construction of housing are different. In the period of time considered the price of housing has increased continuously whilst the level of new construction of housing has fluctuated from 1992 to 2010.

<http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=LghReHustypAr&deltabell=R1&deltabellnamn=F%E4rdigst%E4llda+1%E4genheter+och+rumsenheter+i+nybyggda+hus+i+riket+efter+hustyp%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat=O&innehall=AntLgh&starttid=1975&stoptid=2010&ProdId=BO0101&fromSok=&Fromwhere=S&lang=1&langdb=1> and

Statistics Sweden (SCB), *Population in Sweden 1749-2010 ("Befolkningsutvecklingen i riket. År 1749-2010")* accessed via

<http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=tanss&xu=C9233001&omradekod=BE&huvudtabell=BefUtv1749&omradetext=Befolkning&tabelltext=Befolkningsutvecklingen+i+riket%2E+%C5r&preskat=O&prodid=BE0101&deltabell=+&deltabellnamn=Befolkningsutvecklingen+i+riket%2E+%C5r&innehall=Doda&starttid=1749&stoptid=2010&Fromwhere=M&lang=1&langdb=1>

¹⁹ Statistics Norway (Statistisk Sentralbyrå), *Population of Norway from the census* accessed via

http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=0&tilside=selecttable/MenuSelS.asp&SubjectCode=02 and

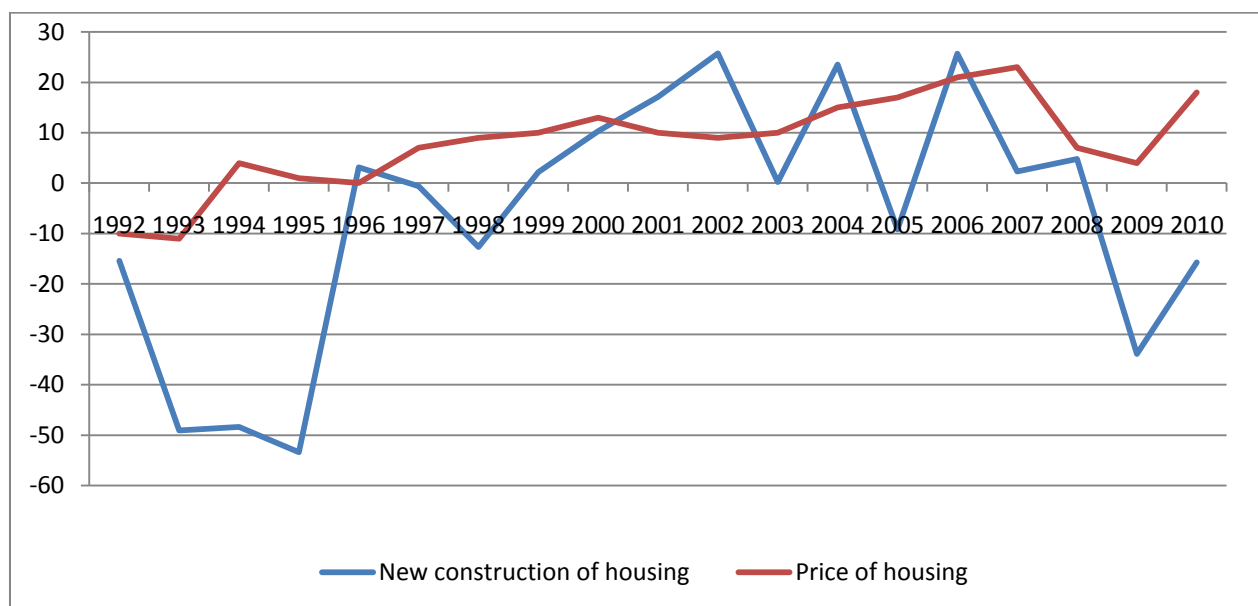
Statistics Norway (Statistisk Sentralbyrå), *New Buildings completed by type of building case, year of commencement and time* accessed via

http://statbank.ssb.no/statistikkbanken/Default_FR.asp?Productid=10.09&PXSid=0&nvl=true&PLanguage=0&tilside=selecttable/MenuSelP.asp&SubjectCode=10

²⁰ Statistics Denmark (Statistikbanken) , *New Buildings completed by type of building case, year of commencement and time* accessed via <http://www.statistikbanken.dk/statbank5a/default.asp?w=1366>

Statistics Denmark (Statistikbanken) , *The population of Denmark from the census* accessed via <http://www.statistikbanken.dk/statbank5a/default.asp?w=1366>

Graph 4. Annual growth in price index of houses in Sweden 1992-2010 and growth in housing construction in Sweden 1992-2010. Annual percentage change.



Source: Growth in price index of houses in Sweden 1992-2010 - Statistics Sweden (SCB)²¹

Growth in housing construction in Sweden 1992-2010 – Statistics Sweden (SCB)²²

To gain better understanding of the effects of new construction of housing on the housing prices in Sweden from 1991 to 2009 a good methodology is required.

²¹ Statistics Sweden (SCB), *Price index for permanent houses (1990=100) by county 1990-2010* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&omradekod=BO&huvudtabell=FastpiPSLanAr&omradetext=Boende,%20byggande%20och%20bebyggelse&tabelltext=Fastighetsprisindex+f%F6r+permanent+sm%E5hus+%281990%3D100%29+efter+1%E4n%2E+%C5r&preskat=O&prodid=BO0501&deltabell=+&deltabellnamn=Fastighetsprisindex+f%F6r+permanent+sm%E5hus+%281990%3D100%29+efter+1%E4n%2E+%C5r&innehall=FastpiPS&starttid=1990&stopptid=2010&Fromwhere=M&lang=1&langdb=1>

²² Statistics Sweden (SCB), *Completed apartments in newly constructed houses by municipality, type of house and period in Sweden 1975-2010* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=LghReHustypAr&deltabell=R1&deltabellnamn=F%E4rdigst%E4llda+1%E4genheter+och+rumsenheter+i+nybyggda+hus+i+rikt+efter+hustyp%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat=O&innehall=AntLgh&starttid=1975&stopptid=2010&Prodid=BO0101&fromSok=&Fromwhere=S&lang=1&langdb=1>

4. METHODS

In order to shed some light on the interaction between house prices and construction of new houses a coherent method is needed. This section outlines the methodology used to understand the formation of housing prices in terms of new construction. First, the methodology used is outlined. It is argued that an econometric model is required to deduce the impact of new construction on housing prices in Sweden for the period of time considered. Next, an overview is given on the process by which an appropriate model is selected. Finally, details on model specification are given.

4.1 METHODOLOGY

A coherent methodology is needed to analyze the interaction between housing prices and new construction of housing. As mentioned in Section 2.3 (see page 13) a quantitative method is believed to yield an answer to the research question. This section gives details on the method used to shed some light on the interaction between price of housing and new construction in Sweden from 1991 to 2009.

As stated above econometric techniques are needed to examine the links between construction of new housing and housing prices. Conducting analysis on the aggregate level using Sweden as a unit of analysis would in my opinion not provide a coherent answer to the research problem as the property market differs between different regions of the country. For example, in the Northern parts of Sweden housing prices are significantly lower compared to Stockholm. The fundamentals of housing prices also vary between regions. Flows of migration tend to be stronger to regions with high levels of employment such as Stockholm whereas sparsely populated areas such as the Northern parts of Sweden suffer from a weak inflow of migration. Using the aggregate level as the unit of analysis is therefore not adequate. It is believed that housing prices need to be disaggregated and analyzed using the municipalities as the unit of analysis. To conduct analysis on municipality level panel-data techniques is preferable.

Panel-data regression is a way of pooling data and allows for the analysis of data in several different dimensions. Marno Verbeek (2008) points out panel data has several advantages as

*“the availability of repeated observations on the same units allows economists to specify and estimate more complicated and more realistic models than a single cross-section or a single time series would do.”*²³ Verbeek also argues that *“estimators based on panel data are quite often more accurate than from other sources”*²⁴ as data varies over two dimensions (individuals and time). Panel-data analysis can be broadly classified into two broad categories: fixed-effects and random-effects model. A fixed-effects model is a linear regression model in which the intercept varies over individual units. In fixed-effects models each unit is given a separate intercept functioning as a dummy variable. A random-effects model is different from a fixed-effects model as it does not assume individual effects. A fixed-effects model controls for omitted variables that differ between cases but are constant over time. As already noted many scholars believe that housing prices are formed by macroeconomic conditions and as the focus of this thesis is to shift analysis to internal factors influencing property prices, a fixed-effects model appears to be appropriate. In a fixed-effects model determinants of housing prices such inflation and interest rates are controlled for as they do not differ between the municipalities.²⁵ In addition, variables such as the distance to a large city or industrial area are controlled for as they do not vary over time. A fixed-effects model therefore allows for analysis of internal factors varying between the municipalities.

²³ Marno Verbeek, *A guide to modern Econometrics*, (West Sussex: John Wiley&Sons, 2008), p.355

²⁴ Marno Veerbek,, op.cit., p.357

²⁵ Interest rates do vary across households. For the purpose of this thesis it is assumed that the variation in interest rates of households across municipalities is very small.

4.2 THE MODEL

As already pointed out in the theoretical section variables that are not constant over time need to be controlled for. From the literature review (see page 8-10) it appears as if the most important factors are income, net migration, unemployment rate, and the already existing stock of houses. According to theory the expected signs of the variables are summarized in *Table 2*. An overview of the data is available in *Section 5* (see pages 26-31).

Table 2. A table showing the expected signs on the explanatory variables using the price of housing as the dependent variable.

Variable	Expected effect on housing prices
CONSTRUCTION/POPULATION	-
STOCK/POPULATION	-
NET MIGRATION TO MUNICIPALITY/POPULATION	+
INCOME	+
UNEMPLOYMENT	-

Due to the prospect of endogeneity an instrumental variable needs to be used. This is due to the idea that high housing prices can induce higher level of construction activity as well as construction activity can result in changes in housing prices. Whilst it is possible to deal with endogeneity by taking the first differences of the variables, an instrumental variable is more appropriate in this case. By taking differences of the variables information that may be of interest is lost. It is difficult to quantify how long it takes for new construction to have an impact on price of housing. Drawing on the theoretical overview in *Section 2.2* (see page 8-10) it appears as if there should be a lag of at least four years. Wigren et al. (2007) (see page 9-10) argues that it takes four years for a shock of supply or demand to influence the prices of housing. A number of lags are therefore experimented with and the most significant lag on construction is chosen.

Due to the measure of construction used (number of new houses constructed) and the variable net migration a regression using a log-linear transformation is not possible. An initial

regression is run in the following form using GLS ‘fixed-effects’ (please see the Appendix for details of diagnostic tests). In this regression ‘housing’ represents the price of houses in Sweden 1991-2009, ‘construction’ represents the construction of new houses per adult person in a municipality, ‘migration’ is the net migration per adult person in a municipality, supply is the stock of housing per adult person in a particular municipality, and ‘income’ is the income per year per adult person and ‘unemployment’ is the percentage of people in a municipality lacking employment.

$$\begin{aligned}
 \text{housing}_{it} = & \\
 & \alpha_i + \\
 & \beta_1 \text{construction}_{it(-4)} + \beta_2 \text{migration}_{it} + \beta_3 \text{supply}_{it} + \beta_4 \text{income}_{it} + \beta_5 \text{unemployment}_{it} + \varepsilon_{it}
 \end{aligned}$$

(Regression 1)

For the purpose of this thesis we have the following cross-sectional and time dimension.

i= municipality 1...municipality 288 (cross-sectional dimension)
t= 1991,..., 2009 (time-dimension)

The variable ‘migration’ is highly insignificant (p-value is 0.70). The regression above is run again without ‘migration’ as an explanatory variable. Regressing housing on the remaining explanatory variables does not change the co-efficients of the independent variables. Hence it is possible to exclude migration from the regression.

The measure of construction (number of houses) constructed has a number of zeros. To enable the use of a log-linear model a Heckman Sample Selection model can be used. Heckman’s two-stage procedure is a way to deal with the problem of selection bias. By using a Heckman Sample Selection model it is possible to “*take the sample selection phenomenon into account.*”²⁶ As construction only occurs in some municipalities some observations in which construction is zero in a given year are not included in the sample when a log-linear regression is run. Using a sample selection model deals with this issue as a probit sample selection equation is first estimated and the regression of interest is run including an error term. As the quantitative software used in this thesis (Eviews) does not have a function for

²⁶ Peter Kennedy, *A guide to Econometrics*, (Victoria: Blackwell publishing, 2008), p.265

the Heckman two stage procedure using panel-data the regressions are run manually by first running a probit regression and then including the error term as an additional variable in the ‘fixed-effects’ regression.

For the purpose of this study, it is apparent that migration has an impact on construction in a municipality. This can be seen from the fact mentioned on page 13 that construction activity is high in the expanding regions in Sweden. According to the laws of demand and supply, the stock of houses municipality is bound to have an effect on the construction of new housing. In addition, income and unemployment ought to have an effect on the number of houses constructed as high levels of income attract people to a municipality as well as it enables residents to spend more on housing. The effect of income on both housing prices and construction of new housing has been developed by scholars such as Larsen (2010) (please see page 8-9). Using this line of reasoning the selection equation below (*Regression 2*) is estimated using a ‘fixed-effects’ probit model. Construction is given the value 1 if construction occurs and 0 otherwise.

$$construction_{it} = \alpha_i + \beta_1 migration_{it} + \beta_2 supply_{it} + \beta_3 income_{it} + \beta_4 unemployment_{it} + \varepsilon_{it}$$

(Regression 2)

The final regression is then run using GLS ‘fixed-effects’ in the following form:

$$\ln(housing_{it}) = \alpha_i + \beta_1 \ln(construction)_{it(-4)+} + \beta_2 \ln(supply)_{it} + \beta_3 \ln(income)_{it} + \beta_4 \ln(unemployment)_{it} + \beta_5 (errorcorrection)_{it} + \varepsilon_{it}$$

(Regression 3)

Before presenting the results of the regressions it is important to first outline the accuracy of the data used.

5. DATA

For the Heckman Sample Selection model to be consistent a good dataset is needed. This section therefore gives details on the metrics of the data, the data collection process and the data sources.

5.1 SOURCE MATERIAL

As already mentioned in *Section 3.1* (see page 14) due to the Swedish legal system data is only available for houses. The purchasing price of an apartment (bostadsrätt) is not public and therefore not available for analysis. The regressions in this thesis are therefore only representative for houses.

As stated in *Section 4.2* above (please see page 23) data for number variables is needed in order to investigate the effect of new construction on house prices in Sweden 1991 to 2009. This section describes the data collected and emphasizes that whilst the data collected can be used to shed some light on the effect of house construction on prices, the results from the regressions cannot be considered as being definite.

The following variables are needed to run the regressions using a ‘fixed-effects’ specification on the panel-data.

Dependent variable:

- Price co-efficient of houses in a municipality in a given year.

Explanatory variables:

- Construction of new houses per person in a municipality per year (variable of interest)
- Unemployment in a municipality in a given year (control variable)
- Net migration per person to a municipality in a given year (control variable)
- Average income per person per year of a person in a municipality (control variable)
- Supply of houses per person in a municipality in a given year (control variable)

Data is collected from several sources. In this section each source is examined separately and some problems with the data collected are highlighted.

In the data collection process it was noticed that the number of municipalities differ for the period of analysis. In 1997 two new municipalities were formed (Nykvarn and Knivsta) and one municipality switched region (Hedeby). Therefore to make the analysis as coherent as possible Nykvarn and Knivsta are removed from the sample and close attention is given to the identification codes to link Hedeby in the two time periods. Therefore the number of municipalities analyzed is 288 instead of 290. It is worth mentioning that although every effort is made to link the identification codes of Hedeby there may be some discrepancies in the data.

1. Dependent variable: Price co-efficient of houses

The price of houses is measured by the co-efficient of the purchase price of the house. The price co-efficient is believed to be an appropriate measure of prices of housing as the selling price is divided by the tax assessment value of the house. Whilst it is true to say that in theory the tax assessment value is supposed to be equal to 75% of the house price this does not hold in reality. The tax assessment value is based on an estimate of the value of the house two years before the tax assessment value is set. As the tax assessment value is not updated every year and is based on an estimate of the price of the house a discrepancy between the actual price of the house and tax assessment value is inevitable. Features of the house such as quality are controlled for by this variable. This data is collected from *Statistics Sweden* (SCB).²⁷ As already mentioned two municipalities are removed (Knivsta and Nykvarn) and data is therefore collected for 288 municipalities. The raw data collected from *Statistics Sweden* (SCB) does not take into account the changes made in the taxation systems in the past twenty years. Therefore the price coefficients are re-calculated using a set of conversion co-

²⁷ Statistics Sweden (SCB), *Statistics on house prices in Sweden (prisstatistik för småhus på kommunnivå)* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=FastprisSHRegionAr&deltabell=K1&deltabellnamn=F%F6rs%E5lda+sm%E5hus+efter+kommun%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat=O&innehall=Antal&starttid=1981&stopptid=2009&P rodid=BO0501&fromSok=&Fromwhere=S&lang=1&langdb=1>

efficients supplied by *Statistics Sweden*²⁸ to yield a comparable time-series over the period of time considered. The panel is not balanced as there are a few observations missing.

This data is collected from a reliable source and is comparable over time. It is therefore believed that the data on this variable is suited to tackle the research question.

2. Variable of interest: construction of new houses

Data for the construction of new houses is collected from *Statistics Sweden* (SCB).²⁹ The data is readily available and again two municipalities are removed yielding 288 cross-sections. This data is believed to be reliable for the purpose of this thesis but it does have one flaw: *Statistics Sweden* publishes the data using apartments as the metric. According to the description of the data most houses (småhus) contain only one apartment but a very small number of houses contain two apartments. However, according to the data description the number of houses with two apartments is small and according to *Statistics Sweden* this data can be taken measuring construction of new houses. Again there are a few observations missing for this variable. The metric is the number of houses constructed. As the construction of new houses needs to be put in proportion to the adult population of a municipality the number of constructed houses is divided by adult the population of a municipality and henceforth referred to as ‘weighted construction’.

$$\text{Weighted construction} = \frac{\text{construction of new houses in a municipality}}{\text{adult population of municipality in a given year}}$$

Although this data is not perfect it does come from a reliable source and is therefore judged as being appropriate for analysis of the effect of new construction on the price of houses.

²⁸ Statistics Sweden (SCB), *Conversion co-efficients (omräkningstal för taxeringsförändringar)* accessed via <http://www.ssd.scb.se/databaser/makro/Produkt.asp?produktid=BO0501>

²⁹ Statistics Sweden (SCB), *Number of houses constructed (färdigställda småhus på kommunnivå)* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=LghReHustypAr&delta bell=K1&deltabellnamn=F%E4rdigst%E4llda+1%E4genheter+och+rumsenheter+i+nybyggda+hus+efter+komm un+och+hustyp%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat= O&innehall=AntLgh&starttid=1975&stopptid=2009&ProdId=BO0101&fromSok=&Fromwhere=S&lang=1&langdb=1>

3. Control variable: rate of unemployment in a municipality

As mentioned in the theoretical overview in *Section 2.2* (please see page 8-10) labour market conditions are important for house prices. It is believed that if unemployment increases it becomes difficult to finance large mortgages and house prices therefore decrease. Unemployment is therefore included as a control variable as it varies between municipalities.

Data for unemployment is collected from the statistics department of the *Swedish Public Employment Service* (AMS). The data for 1996 to 2009 is readily available³⁰ but the data for 1991 to 1996 is fetched from the archives.³¹ The identification codes for the data from *Swedish Public Employment Service* are different from the identification codes from *Statistics Sweden* but every effort was made to link the two datasets. Again data is collected for 288 municipalities. There is some data missing for some of the cross-sections for a few years. However, there are few missing observations and as *Swedish Public Employment Service* is regarded as being a reliable source to represent the unemployment rate. The metric is the unemployment rate in percent.

This data is not perfect as there are some observations missing but it is believed to be the best data source available for this variable.

4. Control variable: net migration to a municipality

As mentioned in *Section 2.2* by Wigren et al. (please see page 9-10) changes in the population of a municipality are believed to provide thrust to rising house prices. Instead of changes of population in a municipality data is therefore collected on net migration to a municipality (immigration to a municipality-migration from a municipality). This data is again collected from *Statistics Sweden* (SCB).³² Again every effort is made to link the identification codes to the rest of the dataset and data is collected for 288 municipalities. This data does, however,

³⁰ Swedish Public Employment Service (AMS), *Unemployment in Sweden 1996-2009* accessed via <http://www.arbetsformedlingen.se/Om-oss/Statistik-prognoser/Tidigare-statistik>.

³¹ Swedish Public Employment Service (AMS), *Unemployment in Sweden 1991-1996* sent to me by the Swedish Public Employment Service (AMS)

³² Statistics Sweden (SCB), *Net migration to a municipality* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=tanss&xu=C9233001&huvudtabell=Flyttningar&deltabell=K&deltabellnamn=Flyttningar+efter+kommun%2C+%E5lder+och+k%F6n%2E+%C5r+1968%2D1996&omradekod=BE&omradetext=Befolkning&preskat=O&innehall=Emigranter&starttid=1968&stoptid=1996&Prodid=BE0101&fromSok=&Fromwhere=S&lang=1&langdb=1>

have the same Achilles heel as the data on unemployment: there are a few observations missing. The metric is the number of people migrating to a municipality in a given year. Again net migration needs to be put in proportion to the population of a municipality and is therefore divided by the population of the municipality.

$$\text{Weighted migration} = \frac{\text{net migration to a municipality}}{\text{adult population of municipality in a given year}}$$

This source of data is believed to be reliable although there are some missing observations.

5. Control variable: average income per person

Income is pointed out as providing impetus behind rising house prices in many of the sources examined in the theoretical section please see *Section 2.2* (pages 8-10). It is therefore important to control for this variable. The data is again collected from *Statistics Sweden* (SCB). Data is collected for all 288 municipalities for all years. The metric is thousands of SEK per person.

This source is believed to be reliable and therefore this dataset is well-suited to provide an answer to the research question.

6. Control variable: supply of houses in a municipality

A municipality with a high stock of housing already satisfying demand might choose to construct fewer new units of houses. Controlling for the number of houses available is therefore believed to be important. Again data is collected from *Statistics Sweden* (SCB) on the stock of houses in a municipality (bostadsbeståndet).³³ The data collected is for both the number of houses (småhus). The metric is the number of houses in a municipality. This variable is again weighted by the population of a municipality.

³³Statistics Sweden (SCB), *Supply of houses (bostadsbeståndet på kommunnivå)* accessed via <http://www.ssd.scb.se/databaser/makro/Visavar.asp?yp=bergman&xu=scb&huvudtabell=BostadsbestandK&deltabell=K1&deltabellnamn=Kalkylerat+bostadsbest%20E5nd+efter+kommun+och+hustyp%2E+%C5r&omradekod=BO&omradetext=Boende%2C+byggande+och+bebyggelse&preskat=O&innehall=Bostadsbestand&starttid=1990&stopptid=2009&ProdId=BO0104&fromSok=&Fromwhere=S&lang=1&langdb=1>

$$\text{Weighted supply} = \frac{\text{supply of houses in a municipality}}{\text{adult population of municipality in a given year}}$$

Again as this data is collected from a reliable source it is thought to represent the supply of houses in a municipality.

7. Variable used to weight variables of interest: adult population

As already mentioned the variables are weighted by the adult population of a municipality. The population of a municipality is collected from the census conducted by SCB.³⁴ It is true that the number of households would be a more appropriate measure to weight the variables but there are numerous definitions of what constitutes a household. It is therefore believed that it is more appropriate to divide the variables by the adult population. For the purpose of this thesis the adult population is defined as the population of a municipality over the age of eighteen. Data is available for all years (1991-2009) and as it is collected from a renowned source it is believed to be reliable.

Having carefully examined sources of the data it is time to turn to the results of the regression analysis.

³⁴ Statistics Sweden (SCB), *Population of municipalities in Sweden on 1st of January 1968-2010* accessed via <http://www.ssd.scb.se/databaser/makro/Produkt.asp?produktid=BE0101>

6. RESULTS

This section gives an overview of the results from the Heckman Sample Selection model and outlines some of the main findings.

6.1 EMPIRICAL RESULTS

The regressions are run using the method and specifications described in *Section 4.2* (see pages 23-25) and the results are displayed in *Table 3* and *Table 4* below correct to 3 significant figures.

Table 3. Table showing the results from the GLS ‘fixed effects model’ using $\ln(\text{housingprice})$ as dependent variable.

Variable	1	2
Constant	-9.81**** (3.10)	-5.42**** (1.82)
$\ln(\text{weightedconstruction}(-4))$	0.0170**** (0.00684)	
$\ln(\text{weightedsupply})$	-0.730 (0.755)	-0.569 (0.468)
$\ln(\text{income})$	1.67**** (0.347)	1.27**** (0.205)
unemployment	-0.0297** (0.0151)	-0.0326**** (0.00807)
Error correction term	0.0131 (0.0108)	
Adjusted R ²	0.811	0.769
N	3598	5455

Note: unemployment is in percentage points

Numbers in parentheses are white standard errors

**** denotes statistical significant at the 1% level, *** denotes statistical significance at the 2% level, ** denotes statistical significant at the 5% level, * denotes statistical significant at the 10% level

Table 4. Table showing the results from the selection equation using the binary variable construction as dependent variable.

Variable	3
Constant	0.880**** (0.141)
Weighted migration	0.000191** (0.0000930)
Weighted supply	0.0000633**** (0.00000574)
Income	-0.0000109 (0.000692)
Unemployment	-0.0451**** (0.00997)
McFadden R ²	0.0473
N	5422
Number of observations with construction=1	4623
Number of observations with construction=0	799

Note: unemployment is in percentage points

**** denotes statistical significant at the 1% level, *** denotes statistical significance at the 2% level, ** denotes statistical significant at the 5% level, * denotes statistical significant at the 10% level

The most significant lag on construction is found to be -4 years. Running ‘fixed effects’ regressions with and without construction confirms the importance of this variable. Running a regression with construction and the error correction term yields an adjusted R² of 0.811 whilst without construction and the error correction term the adjusted R² is only 0.769. Whilst it is true that R² increases as the number of explanatory variables increases, the fact that R² increases by 4.20% points to construction being an important variable. Including construction as a variable and the error correction term results in the regression 4.20 % more of house prices being explained. The adjusted R² of both the regressions is nevertheless high and it can therefore be argued that the model explains house prices well.

The error correction term is not significant but running a regression without the error correction term confirms the importance of the error correction term. Running a regression

without the error correction term results in a change in the magnitude of the co-efficients on the explanatory variables. Hence without the error correction term the regression suffers from omitted variable bias.

It is interesting to note that all the explanatory variables except for $\ln(\text{weighted supply})$ are statistically significant at the 5% level in both the first (1) and second regression (2). However, running a regression without $\ln(\text{weighted supply})$ changes the co-efficients on the explanatory variables. Therefore $\ln(\text{weighted supply})$ needs to be included in the regressions.

The co-efficient on construction is positive. This means that increasing construction by 1% will yield an increase of 0.0170% in the price of houses four years later. This is a surprising result and the implications of this will be discussed in *Section 7* (please see pages 38-39) below. The signs are as expected on all the explanatory variables. 1% increases in unemployment yields a -0.0297% decrease in house prices. The most important variables for house prices appear to be the stock of already existing houses (increasing the supply of housing by 1% may induce a 0.730% decrease in house prices) and the level of income (if income per person rises by 1% may be coupled by an increase in house prices by 1.67%). Some would argue that the change in stock is equal to new construction but the fact is that the stock of houses can be changed through depreciation of houses and transformation of already existing houses. A larger house can be transformed to several smaller units altering the stock of houses and depreciation of houses can result in houses disappearing from the existing stock of houses. These results are further discussed and put into context in *Section 7* (see pages 38-39) below.

6.2 SENSITIVITY ANALYSIS

It is important to determine how sensitive the results are to the regression method used. Therefore a sensitivity analysis is needed.

The regression is first re-run using OLS and ‘fixed-effects’. Again the co-efficient of new construction of houses is of the same magnitude, positive and statistically significant. The co-efficients on the other variables are of the same sign and similar magnitude as when GLS is used. Some of the co-efficients are, however, less significant and the adjusted R^2 is less. The fact that the co-efficients are of similar magnitude and the same sign re-enforces the results obtained from the GLS regression as they appear to be robust to the method used. In addition, different lags are tried. The results using the lags and GLS are displayed in *Table 5* below. The fact that the co-efficients on the lags are all positive and the co-efficients on the other variables are of a similar magnitude and the same sign does not contradict the results obtained in the regressions and presented in *Table 3* (see page 32).

Table 5. Table showing the results from the GLS ‘fixed effects model’ using ln(housingprice) as dependent variable and different lags on ln(weightedconstruction)

Variable	1	2	3
Constant	-9.81**** (3.10)	-10.1**** (3.86)	-13.0**** (3.49)
ln(weightedconstruction(-4))	0.0170**** (0.00684)		
ln(weightedconstruction(-5))		0.00284 (0.0121)	
ln(weightedconstruction(-6))			0.000671 (0.0115)
ln(weightedsupply)	-0.730 (0.755)	-0.845 (0.936)	-0.741 (0.822)
ln(income)	1.67**** (0.347)	1.66**** (0.426)	1.91**** (0.393)
unemployment	-0.0297** (0.0151)	-0.0331** (0.0169)	-0.0318* (0.0166)
Error correction term	0.0131 (0.0108)	0.198** (0.0092)	0.0174* (0.0096)
Adjusted R ²	0.811	0.779	0.751
N	3598	3355	3101

Note: unemployment is in percentage points

Numbers in parentheses are white standard errors

**** denotes statistical significant at the 1% level, *** denotes statistical significance at the 2% level, ** denotes statistical significant at the 5% level, * denotes statistical significant at the 10% level

A possible explanation of the results is that the variable ‘new construction’ also picks whether a municipality is expanding or not. The three largest metropolitan areas (Malmö, Göteborg and Stockholm) and the municipalities where most construction occurs are removed and a new regression is run. The co-efficient on new construction decreases slightly but is still positive. The co-efficient of the rest of the variables are of similar magnitude and size and the adjusted R² decreases. It therefore appears as if the results are confirmed even in municipalities that are not expanding.

It can also be argued that the municipality dummies in the ‘fixed effects’ regression have high explanatory power. A regression is therefore run using ‘random effects’ specification. In this regression the signs on the explanatory variables remain the same but the adjusted R^2 decreases from 0.811 to 0.599. This adjusted R^2 is nonetheless high and so it appears as if the explanatory variables do explain the house prices well.

The regressions run in this sensitivity analysis do not appear to contradict the results obtained from the regression analysis presented in *Table 3*. Therefore the results can be taken as shedding some light on the influence of new construction of houses on house prices.

7. DISCUSSION OF THE REGRESSION RESULTS

The surprising results need to be put in context. This section therefore discusses the results and suggests some policy implications.

7.1 DISCUSSION AND POLICY IMPLICATIONS

It is important to place the results from the regression into a context and relate them to the theoretical discussion.

According to the regressions new construction of houses has a positive effect on the price of houses. The sign and magnitude of the co-efficient on new construction contradicts theory. When conducting sensitivity analysis the co-efficient of new construction is positive even when the expanding municipalities are removed. This point to the idea that perhaps the variable used for new construction captures subjective factors that cannot be controlled for using available data sources such as the depreciation of the housing stock. As highlighted in both *Section 2* and *Section 3* construction needs to be at a certain level to maintain stable housing prices. As already mentioned there is no data available on the depreciation of the housing stock. Hence as the depreciation of the housing stock cannot be controlled for in the regressions; the results of the regression cannot be considered as being definitive.

The co-efficients on the explanatory variables confirm economic theory. In fact the regression point to the idea that increasing income per person by 1% may induce an increase in house prices by 1.67%. This adds further weight to the results of scholars such as Larsen (2010) who points to the elasticity of housing expenditure with respect to income being close to unity. The idea that the signs and magnitudes on the other variables are in line with theory points to the idea that the data used for each variable is appropriate.

Nevertheless, some policy suggestions can be made from the literature review of this study. As pointed out in *Section 2.2* (see page 13) it is likely profitable to build expensive housing. It may also be the case as pointed out by a variety of sources that the market for contractors in Sweden suffers from competition problems. According to a report by the *Swedish Competition Authority* (Konkurrensverket) the construction industry in Sweden is

characterized by weak competition and is dominated by a few large actors.³⁵ According to this report the barriers to entry are high and so it is difficult for new actors to establish themselves on the market. This view of the industry is confirmed in a report by *PwC* claiming that the construction industry is vulnerable to corruption and market imperfections.³⁶ It can therefore be argued that the market for new construction in Sweden is rather complex and has room for improvement.

The factor that migration is not statistically significant in the initial regression (*Regression 1*) points out that changes in population are not being an important factor for housing prices. It can therefore be argued that other factors are more important. As highlighted by many commentators such as Kalbro, Lind and Lundström (2009) and Olander (2005) there are difficulties in the long administrative process. In addition, as pointed out by *Swedish Competition Authority* (KKV) the construction industry is characterized by cartels and high barriers to entry making it difficult for new firms to break ground. Hence loose statements often heard in the media of the need for more construction ought to be placed in context.³⁷ Perhaps what is needed is a thorough analysis of the construction industry and a loosening up of the rigid administrative structure so that the level of construction can be at an appropriate and sustainable level in Sweden.

Although the regression results of this study are inconclusive, the theoretical discussion does point to the need for further analysis of the market for new construction in Sweden.

³⁵Swedish Competition Authority (Konkurrensverket), *Konkurrensproblem i bygg-och-anläggningsbranschen* accessed via http://www.kkv.se/t/Page___525.aspx

³⁶ Thorbjörn Spängs "Svågerpolitik i byggbranschen hotar konkurrensen", *Dagens Nyheter*, 07/03/2011 accessed via <http://www.dn.se/ekonomi/svagerpolitik-i-byggbranschen-hotar-konkurrensen?rm=print>

³⁷ For example see "Nils Åkesson "SEB: Därför dröjer boprissmällan" , *Dagens Industri*, 28/03/2011

8. CONCLUSION

By conducting a panel-data analysis this thesis points to the idea that construction of houses has a positive effect on house prices in Sweden from 1991 to 2009. This result contradicts theory and the sensitivity analysis does not shed light on the reasons for the discrepancy between empirical reality and theory. It may be that the results are vulnerable to some variable not included in the regression such as the depreciation of the housing stock or some subjective factor which is difficult to measure. It is, however, possible to point to some problems with the market for new construction in Sweden including an industry susceptible to market imperfections and low levels of competition. According to some scholars the administrative process is tedious and making construction of new houses difficult.

The results of this study cannot be considered as being definitive. The data is not perfect and whilst every effort has been made to link the codes of the municipalities there may still be problems. To better understand the impact of new construction of houses on house prices more research is needed. For example, a dataset giving details on newly constructed houses in Sweden for a longer time period is welcome. *Statistics Sweden* (SCB) currently only has data for 30% of newly constructed houses and only for a short period of time. In addition, zooming on micro data and examining individual newly constructed houses may well serve to yield a more holistic picture of the impact of new construction on house prices.

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APPENDIX

Potential Problem	Diagnostic Test	Result from Diagnostic Test	Measure taken
Heteroskedacity	A Breusch-Pagan test usually used but not supported by software (Eviews).	-	Eviews manual recommends using 'co-efficient covariance method' ³⁸
Autocorrelation	Durbin-Watson.	D-statistic does not lie within the acceptable range of the d-statistic.	GLS is used and the data program is modified by adjusting the standard errors using 'cross-section weights'.
Multicollinearity	A correlation matrix is constructed.	No correlation over 0.37 in addition to this no warning signs of multicollinearity (no low level of statistical significance and high adjusted R ²)	No measure taken.
Normality	Bera-Jarque usually used but as the sample is large normality is assumed.	-	Sample large enough to assume normality.
Stationarity	Levin, Lin and Chu (2002) panel unit root test is used using Parzen kernel method.	The null hypothesis of all panels being non-stationary can be rejected at the 1% level. Hence at least one panel is stationary.	At least one panel is stationary. Cointegration needs to be tested for.
Cointegration	KAO test using Parzen kernel method is used.	Null hypothesis of no cointegration can be rejected at the 1% level.	Variables are assumed to be cointegrated.
'Fixed Effects' vs. 'Random Effects' specification	Hausman test.	Null hypothesis can be rejected at the 2% level.	The idea that a 'fixed-effects' estimator is suitable for this dataset is not rejected.

³⁸ Eviews (Quantitative Micro Software) (2007), *Eviews manual for Eviews version 6*, p.485

