The Effect of Market Power on Housing Prices

Eldar Arasli & Vilmer Lunneblad

Abstract: In this paper we wish to examine whether market power of housing suppliers is predictive of the price of housing in the municipality of Stockholm. This is, in part, done by developing a measure of market power - market concentration - and regressing measures of price on it. The regression analysis shows that there is no significant connection between market power and price. Moreover, we find that the descriptive data shows strong signs of departure from perfect competition and indicates the presence of market power. This study concludes that market power does not necessarily have an effect on price.

Bachelor's thesis in Economics, 15 credits

Spring Semester 2020

Supervisor: Andreas Dzemski

Department of Economics

School of Business, Economics and Law

University of Gothenburg

Preface

We extend our gratitude to Professor Andreas Dzemski for his advice and guidance in this thesis process.

Layout of the Paper

The research question of this thesis is: Is market power predictive of the price of housing? To answer this we firstly establish, with the available data and reports, the state of Stockholm's housing market and, hence, if it might contain any market power. Secondly, the theoretical framework for price formation - the interaction of supply and demand, the essentials of a oligopoly model and the definition of market power - are explained. Thirdly, we describe the variables in our data set and the regression equations that will be used. This includes developing our measure of market power. Fourthly, some general descriptive statistics are presented, a regression analysis is conducted and the results are presented. Finally, with the descriptive statistics, statistical modelling and the data analysis, we attempt to conclude if the market power of housing developers is predictive of housing prices.

Background

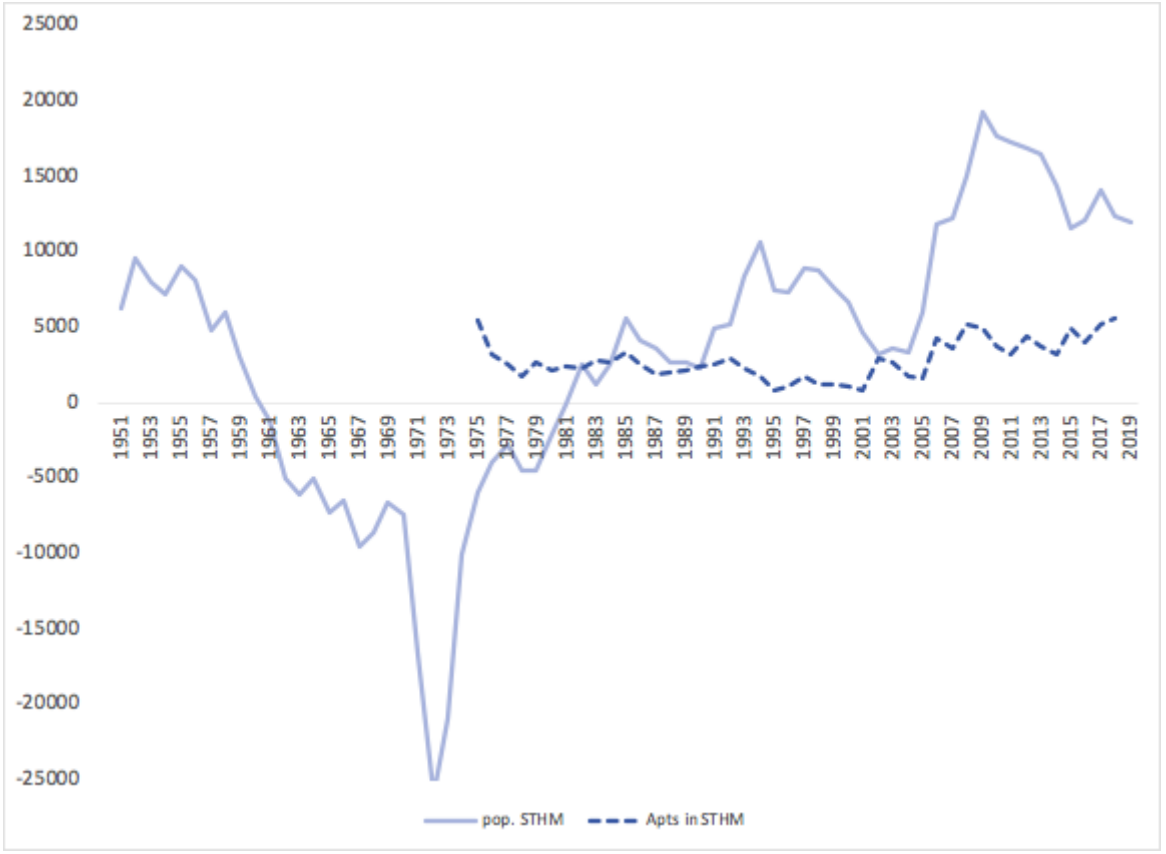
Initially, we will review data on supply, demand and price on the market in order to introduce the supply-side approach of this paper and to establish the singular importance of the relationship between market power and price.

A market that suffers from imbalances can be characterised by a lack of supply (Perloff, 2018) and today, Stockholms housing market is widely regarded as such (Bildsten & Wilden, 2017).

The notion of a lack of supply is supported by a report from Deutche Bank (2019) that ranks Stockholms housing market as one of the least accessible in the world. When supply is constricted it puts an upward pressure on price (Perloff, 2018). This can suggest the absence of perfect competition and the presence of market power.

If one were to compare the number of annually constructed square meters to the population rise, the population has continuously surpassed supply since 1984, from within a decade of the end of the building boom of the 70's (SCB, 2020).

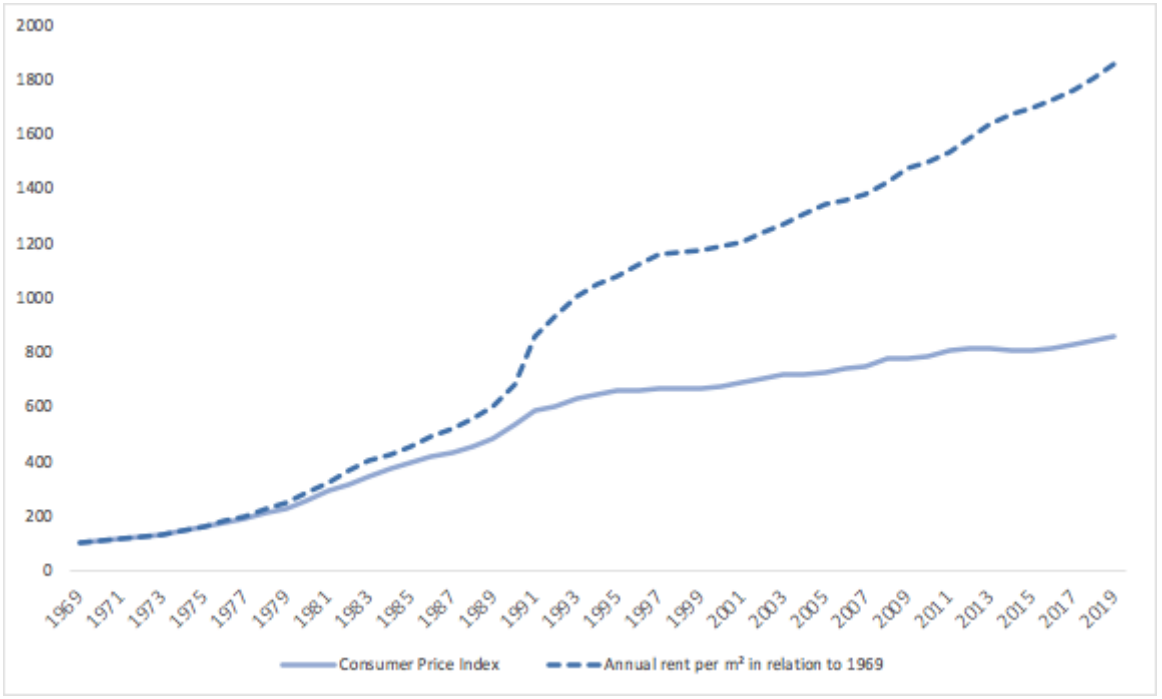
Figure 1.3: *Annual Population Change vs m^2 Built of Apartments in Stockholm 1950-2019*



Data from SCB. Own calculations. SCB ("2019, Helåsrstatistik - kommun, län, riket enligt indelning 1 januari 2019"), SCB (2019, "Tabeller i Statistikdatabasen. 08-May-2019 Nybyggnad, år. Färdigställda lägenheter i nybyggda hus efter region, lägenhetstyp, och hustyp". År 1975 - 2019)

According to SCB, the Swedish statistics agency, housing prices have risen steadily for decades (SCB, 2019).

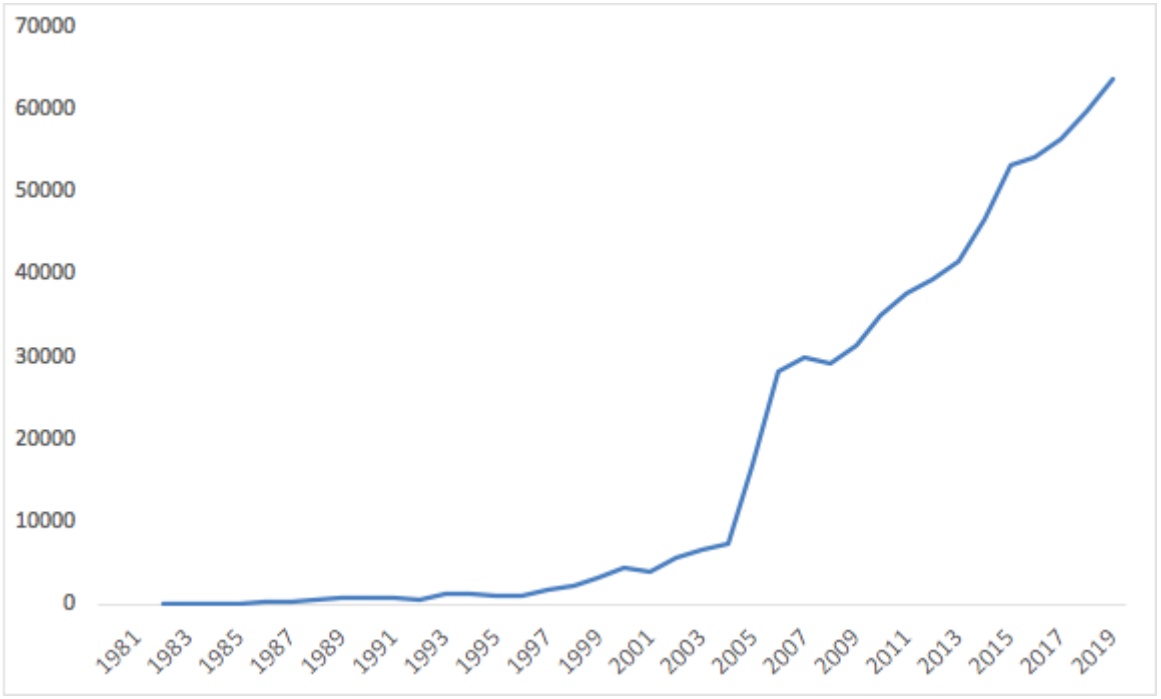
Figure 1.1: *CPI vs Annual Rent per m^2, (1969=100)*



Data from SCB. (SCB, 04-10-2019. “Hyror och den allmänna prisutvecklingen 1969-2019”).

The number of municipalities reporting a shortage of housing in 2019 was 84%, only slightly lower than the previous year, at 88%. Three of 289 responders report a small surplus, yet these are in low-populated regions and, moreover, report an expected shortage in three years' time. Though three municipalities report a small surplus in housing, no municipality reports a balanced market in three years (SCB, 2019). The shortage is a national issue but it most strongly affects inhabitants of Sweden’s largest metropoles, including Malmo, Gothenburg and Stockholm; their regions within which half of Sweden’s population lives (Boverket, 2019, p.11-25). The average time spent in Stockholm's housing queue is a decade, 8-12 years. The housing queue in Sweden’s largest metropole, Stockholm has risen, nearly without interruption for four decades. Over 686 000 people are registered in Stockholm’s housing queue. The total population of Stockholm is ca. 974 000 inhabitants (Bostadsförmedlingen, 2020).

Figure 1.2: *Number of Active* Members in Stockholm’s Housing Queue*



*The total number of members in Stockholm Housing Queue: 687 000. This is 71% of the population in the municipality of Stockholm. OBS: One does not need to be an inhabitant of Stockholm to enter the queue. Data from Bostadsförmedlingen (2020).

We can - based on these reports from SCB (2019), Boverket (2019, 11-25) and Bildsten & Willden (2017) - establish that Stockholms housing market suffers from low supply.

Finally, we note the social issues that accompany a lack of housing. It is a leading factor in increased social segregation (Bildsten & Welin, 2017). It can lead to higher crime rates and increased religious extremism (Polismyndigheten, 2017). Moreover, housing trends in Stockholm are highly representative of the entirety of the Swedish housing market (Reid, Nicol & Allen, 2019) and this is a global issue that is present in other large metropoles (Williams, 2016), adding to the urgency of this research.

Theory - General

Marginal Cost and Supply

Here we wish to expound on the relationship between the firm's cost and supply in perfect competition, and how they differ when market power is introduced. The marginal cost curve of the firm is its supply curve. This is because the marginal cost curve graphs the firm's cost of producing one more unit of housing.

In perfect competition we assume (1) an absence of entry/exit barriers for firms, (2) a homogenous product, (3) no transaction costs, (4) that consumers have complete information (Perloff, 2018). By way of price competition, all firms construct an equal quantity at equal cost, for an equal revenue, at an equal profit of zero. Any deviations from this rule indicate market power, which we will now define as: the ability to raise the price above marginal cost, without exiting the market. As we assume a market with rational actors, in failure of at least one of the perfect competition assumptions, we expect firms to seize the opportunity to raise their price above marginal cost. The more firms that enter the market, the fiercer the price competition is and the closer the price - in figure 3.2 imagined as a horizontal ray above LRS - will be to the supply curve (LRS). Generally, the fewer firms on the market, the greater the vertical distance between the supply curve and the price; commonly known as markup.

The Equilibrium Model

In order to understand how market power would affect price we must establish a theoretical framework for the interaction of supply, demand and price. In this study we use the model described by Sorensen (2013) to explain the relationship between supply and demand in the short- and long run on the housing market. In figure 3.2 from Sorensen (2013, p.9) the horizontal and vertical axes represent the stock of- and price of housing, respectively. The short run supply curves are assumed to be vertical, and denoted SRS, meaning the housing stock is constant at any given point in time. The long run supply curve is denoted LRS and appears as a horizontal line.

Figure: 3.2 Dynamic Market Equilibrium Model

Figure from Sorensen (2013, p.10)

An adjustment to equilibrium from disequilibrium, due to an exogenous positive demand shock - for instance due to higher income, lower property tax, maintenance cost or interest rate - will raise the demand curve at every point on the curve and cause a shift rightward from D_0 *to* D_1. Though the short run housing stock is fixed, developers recognize a profit opportunity and raise prices from E_0^* *to* E_1. In the long run, suppliers will raise construction so SRS shifts outward until the price stabilizes at E_1^*, where demand and LRS intersect, and price exactly equals marginal cost of construction.

In the case of a negative demand shock, for instance due to the opposite shift-variable changes described above, the exact reverse movements would follow.

Adjustments due to exogenous shocks can hence have profound effects on the long term equilibrium. How this fact applies to supply-side variables is of particular interest in this paper.

Suppose that a supply shock, such as a long-term cost increase, were to occur. This would raise the LRS curve, and, in turn, result in a new equilibrium - to which the SRS would

accordingly adjust - with a higher price and lower supply, assuming no other changes, say, to demand (i.e. ceteris paribus). A negative supply-side shock would result in the reverse shifts.

If profit is introduced to the model, this manifests as an imagined horizontal ray above LRS, emerging from the price-axis. This would have the exact same effect on the relationship between supply, demand and price as the cost increases, resulting in a higher equilibrium price and lower quantity produced, ceteris paribus. A negative supply-side shock would produce the opposite shifts.

Finally, if the rate of construction were to fail to offset the depreciation of the stock of housing, the stock of housing falls and we imagine the SRS curve to shift leftward and, in the long run, the LRS curve to shift upward, ceteris paribus. This would provide the same result as a markup or cost increase. A negative supply-side shock would cause the opposite movements.

Oligopoly

We will here define an oligopoly as a market where there are fewer firms than required for the price ray to be exactly aligned with marginal cost (the supply curve). We define a monopoly as the most extreme version of an oligopoly, where one single firm supplies the market and thus has the power to freely set the price.

In addition, a greater number of firms on the market does not necessarily decrease markup. Any oligopoly market, with 2 or more firms (but less than that of a perfectly competitive market) can facilitate different levels of competition. The market structure of the oligopoly in large part dictates the level of competition - the price and quantity produced - and we will briefly mention that the ones most commonly discussed in the literature are: Cartel, Cournot, Bertrand and Stackleberg - all resulting in different levels of markup (Pepall, Richards, Norman, 2014, p.9).

In summary, in failure of perfect competition we enter an oligopoly wherein the particular market structure in large part dictates if- and the extent to which market power is applied. If so, the price rises and the supplied/demanded quantity of housing falls accordingly.

Assumptions of the Dynamic Equilibrium- and Perfect Competition Model

Our model simplifies the real market in ways that might systematically affect the data in our later analysis. We explain some of these simplifying assumptions in this section. An assumption in the equilibrium model is that the price adjusts instantaneously to changes in fundamental variables. Yet, the housing price has been shown to react slowly to short-run demand/supply shocks. Finally, the fundamental variables and their forecasts change constantly. We may therefore regard the actual market, as opposed to our modeled one, as in perpetual adjustment toward equilibrium (Sorensen, p.20, 2011).

Furthermore, housing is a heterogenous good and buyers need time to evaluate characteristics such as size, location and variety. In addition, limited information means buyers need time to know of price changes and compare prices. “[...] it takes time for prices to adjust to the market-clearing level even if [...] the housing stock is held fixed.” (Sorensen, p.20, 2011). Transaction costs are often non-zero and include expenses for real-estate brokers etc. Finally, entry/exit barriers are often considerable, especially as the housing market is a particularly capital-intensive market with high fixed costs (McKinsey, 2020, p.4, 5).

This might introduce a certain measurement error (as discussed in the Discussion). Moreover, it might mean that unobserved variables break the exogeneity assumption of our regression (as discussed in the Method).

Theory - Variables

In order to evaluate the correlation between market power and the price of housing, we wish to account for the fundamental factors that affect the price of housing. We proceed to

motivate the inclusion of the specific variables in our data set and to describe how these factors that are, according to the literature, correlated with the price of housing.

Supply-Side Variables

The supply-side contains our variables of interest: the Construction Price Index, the Factor Price Index and the Herfindahl Hirschman Index. These factors also comprise the distinguishing feature of our statistical model and remain our main focus.

Cost

Cost is represented in the regression through the Factor Price Index (henceforth Factor PI) and the Construction Price Index (henceforth Construction PI). Both belong to our variables of interest. We include these variables because we expect them to be positively correlated with price. If costs rise, price likewise rises. We wish to control this. Both indices measure the costs of construction. The Factor PI is an average of factor prices, such as labour, transportation and materials. The construction PI sums the total cost to the developer, including the contractor's fees and any profit from sale. There is no theoretical basis for selecting one over the other. Therefore we include both in our data set.

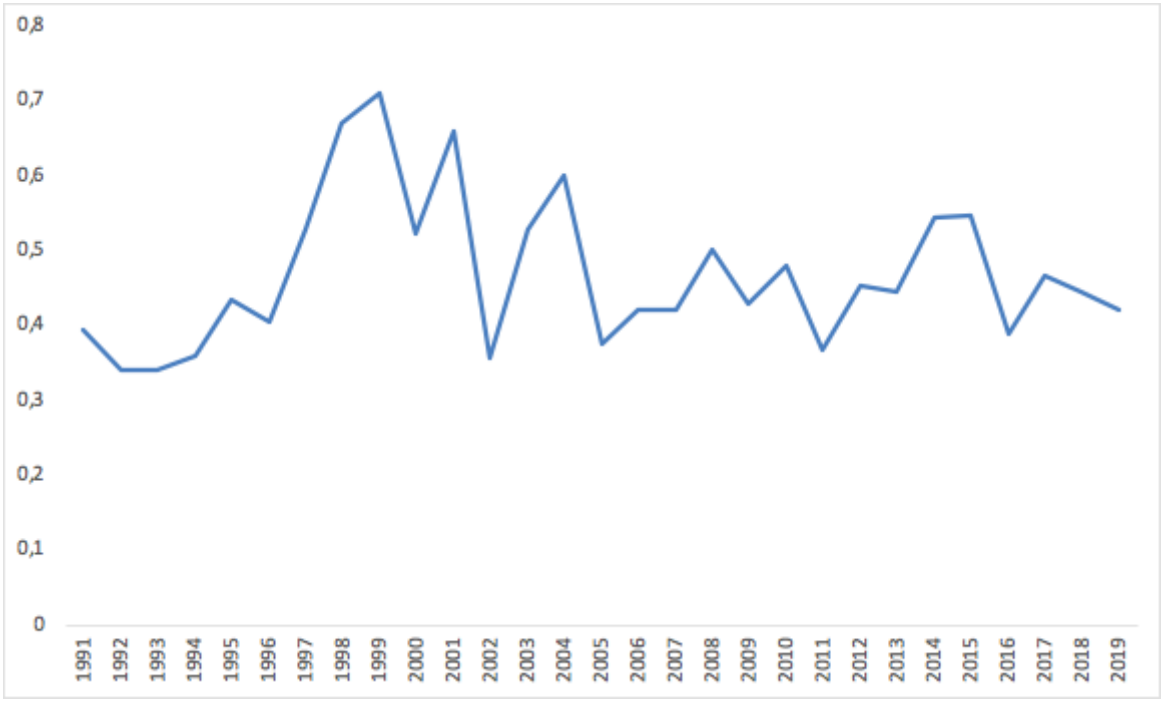
There are variables that capture various complicated processes that result in shifting costs. There are institutional aspects (regalation, planning processes, permits, appeals etc.) and fundamental aspects (factor prices such as labour and materials and taxation etc.) that affect these variables (Riksbanken, 2011, p.14).

Furthermore, *market power* might be correlated with cost, in two major ways: competition costs and productivity costs. High market power could decrease short-term costs associated with competition (advertisement etc.), but it could also increase long-term costs associated with productivity by diminishing incentives to raise it. The net effect of market power on costs may be positive (Konkurrensverket, 2018, p.42). Therefore, we expect market power to be positively correlated with price, through costs. Some of the estimated causal effect of cost on price might therefore, rightfully, be attributed to market power - though it is difficult to estimate how much.

Herfindahl Hirschman Index

The Herfindahl Hirschman Index (henceforth "the HI") is designated as our third and final variable of interest. We wish to quantify market power: deviations from the ideal, total competition market and resulting markup. To this end we employ the HI, as described by Richards and Norman (2014, p.49), which measures market power by market shares. That is, market concentration acts as a proxy for market power. As mentioned, the time series we use to calculate the HI contains the volume produced by developer 1991-2019. The index is calculated, simply, by summing the square of each group's share of the total production This results in a value between 0 and 1. A market with an HI nearing 1 approaches a monopoly and one with an HI nearing 0 approaches perfect competition. The calculated index is displayed in figure 5.3.1.

Figure 5.3.1: *HI - Index*



Own calculations. Data from SCB. 2020-04-15. (Färdigställda lägenheter i nybyggda hus efter region, hustyp och ägarkategori. År 1991 - 2019)

The time trends of our measure of market concentration exhibits some time trends. The HI rose violently between 1991 and 2019, notably reaching 0.7 in 1998 and 0.6 in 2004, but

generally returned to a level of about 0.4. The behaviour of the HI may be interpreted as indicating that inequality in market shares reached its peak before the new millennium and successively decreased since.

Theoretically, market power's correlation with price should occur through markup as a deliberate and, according to our assumptions, logical decision by the profit maximizing firm. (Cumbersome market conditions could also raise operating costs and entry barriers, preventing new firms from entering and supplying from reaching equilibrium level.) Therefore, market power should be positively correlated with price, be it through lower supply or higher markup.

Due to limited access to data we are compelled to pragmatically study producers in three groups - TIC's, state-owned firms and private firms - as if they were individual producers. This preserves our (somewhat diminished) ability to measure deviations from a perfect competition market.

Furthermore, the HI uses market concentration as a proxy for market power and the extent to which market concentration captures market power (defined here as markup) is debatable. If one producer's market share were to exceed that of another, we observe a departure from perfect competition -which by our assumptions would afford all suppliers an equal market share - and invites the possibility of market power. We infer market power through the structure of the market. Yet, we are not observing market power. Rather, we quantify the conditions that enable market power - for rational, profit maximizing firms - but not how market power is *used* by firms. For instance, the markets for large aircrafts or microchips are commonly described as oligopolies, being dominated by a few, large firms, but they still facilitate such fierce competition as to resemble competitive markets. Hence, the *application* of market power is lost in our measure.

Finally, by imposing a structure on a piece of the total, finite real-estate available, a developer exerts market power by laying claim to this diminishing and increasingly rare resource (Konkurrensverket, 2018, p.30). This expression of market power is not captured to any meaningful extent by our HI, which measures market shares. The HI might be correlated to

the claiming of developable land. Suppose that a developer raises its rate of construction. This would conceivably raise the rate of land usage. Therefore, the HI could reasonably be thought to capture ownership of this resource to some extent, but not nearly all of it. Therefore, this one crucial dimension of competition is lost to us.

Stock of Housing

The stock of housing is represented in our regression by stock of apartments and stock of houses. The stock of housing is a variable that is universally included in fundamental analysis of the housing price, in previous research (though it does not belong to our variables of interest) (Jarlman, 2014). Theoretically, it has a clear negative relation to price, as raising the supply puts downward pressure on price. This, as the total demand per unit falls and every unit of housing is less precious.

Demand-Side Variables

In this section we develop an understanding for the effect of demand-side fundamental factors on the housing price because it is highly relevant to distinguish their effect on price from demand-side effects when we regress price on supply-side factors.

Disposable Income and Unemployment

A crucial fundamental factor, almost universally used in house-price modelling is the disposable income or unemployment (Frisell & Yazdi, 2010). These are believed to be positively correlated with price, because they have a decisive importance for whether one is able to afford housing. Both variables have been shown to possess high explanatory power and have been used in previous studies (Sorensen, 2013). Therefore, we include both in our regression model.

Interest Rate

The interest rate is represented in our regression by the Interest Rate variable. Although this fundamental factor is, in the literature, commonly included due to its crucial effect on demand, it has a negative relationship with *both* demand and supply.

The interest rate has a similar effect on the housing sector as it has on all non-financial sectors of the economy. If it falls, borrowing becomes cheaper, temporarily raising the purchasing power of consumers and therefore raising demand. Simultaneously, the interest rate affects the supply-side by affecting loan costs for construction in a very capital intensive sector, as a lower interest rate makes loans for production cheaper (McKinsey, 2020). Hence, a lower interest rate stimulates construction and demand for it.

Population

The population is accounted for by the Live Births variable. The population has an, intuitively, positive relationship with price, by creating a surplus demand that puts upward pressure on price (Konkurrensverket, 2018, p.47). Capozza (*et al.*, 2002) used a specific age group that had a high propensity to purchase housing. Other studies have used the total population of major metropolitan areas. In this study, we choose to use live births, as was done in a recent study by Jarlman (2014, p.25), the rationale being that expanding households raise demand for housing.

Outcome Variables

The data set contains two outcome variables, “House Price” and “Apartment Price” representing the price of single household Dwellings and multiple-apartment dwellings, respectively.

The two outcome variables Apartment Price and House Price, are chosen because they contain different weaknesses. Though most inhabitants in Stockholm live in multiple-household dwellings, the Swedish system for rent-setting is an unusual system dependent on a complex relationship between public negotiations and user-cost, according to Lindén and Gustafsson (2014, p.7). This may create a separation between the price and market forces of demand and supply. But, as described in the theory section, our model assumes a reasonably well functioning market and rational actors. Because of this, the price of newly built single-household dwellings, House Price, might yield a more accurate picture of how- and what affects the housing price, as it is more directly determined by the market forces. For this reason, both House Price and Apartment Price are used as outcome variables.

Expected Sign

We proceed to display the expected sign of each variable of interest and control variable (together henceforth "regressors"), in table 5.2, for the purpose of later analysis. Note that a clear distinction is made between variables of interest and control variables and that all variables of interest are expected to have a positive relationship to the price of housing.

Table 5.2: *Expected Sign of Variables in Dataset*

Variables of Interest	**Sign**
HI	+
Construction PI	+
Factor PI	+
Control Variables	**Sign**
Stock of Apartments	-
Stock of Houses	-
Interest Rate	-
Live Births	+
Unemployment	-
Mean Income	+

PI = Price Index

Data

Details and Sources

Here, the source and contents of the data is explained in detail. This data is summarized in table 5.1 and consists exclusively of time series data, annually 1998-2018. The columns present the variable name, the units of measurement, the source of each time series and the column “Explanation” offers a brief explanation of the data in each variable.

Table 5.1: *Description of Variables in Data Set*

Name	**Explanation**	**Unit**	**Source**
House Price	The final price of newly built houses in the County of Stockholm.	kr/m^2 (nominal)	SCB
Apartment Price	The final price paid by a developer to raise apartment housing in Greater Stockholm, including land, materials, utilities, management, wages etc.	kr/m^2 (nominal)	SCB
Construction PI	The total cost of raising housing. Nationwide.	index (1968=100)	SCB
Factor PI	Average of factor prices used in construction. Nationwide.	index (1968=100)	SCB
HI	The summed squares of market shares of developers in the Municipality of Stockholm.	index (0 to 1)	SCB
Stock of Apartments	The number of apartments in multiple household dwellings in the Municipality of stockholm.	# of units	SCB

Stock of Houses	Number of single household dwellings in the Municipality of Stockholm.	# of units	SCB
Interest Rate	The national interest rate as calculated and provided by the Swedish central bank.	% rate	Riksbanken
Live Births	The number of live babies born in the municipality of Stockholm.	# of units	SCB
Unemployment	The share of the total workforce not employed, in Sweden.	% rate	SCB, World Bank
Mean Income	The national mean disposable income, including capital income. Nationwide.	1 000 kr (Deflated to 2018)	SCB

PI = price index

(X=100) = Base year for index

House Price

The House Price variable consists of the "Försålda permanenta småhus (län, riksområden, riker) Kvartal: 1998K1 - 2020K1" quarterly time series published by SCB (2019). This measure corresponds to the purchasing price of single-household dwellings in the County of Stockholm. This measure is in nominal krona per square meter of floor area (in square meters).

Apartment Price

The Apartment Price variable is comprised of the time series "Totalt produktionspris/lägenhetsarea", published by SCB (2018) and is supposed to represent the final price, from the developer's perspective, paid of multiple apartment housing in the municipality of Stockholm, 1994-2018. This price includes the price paid for land: real-estate cost, landscaping, interest on purchase of land, administrative fees, municipal fees, roads, razing costs and possible profit or loss. The measure also includes construction costs: cost of

construction, cost of selling, housing services provided to tenants, and possible profit or loss. Value added tax is included. The units of the measure are: krona per square meter of floor area, in nominal monetary units.

Construction PI

The Construction PI is a measure of the total cost of erecting dwellings in Sweden. The measure is from the developer's perspective. It is a time series published by SCB (2018) and called "Byggnadsprisindex för bostäder (BPI), inkl mervärdesskatt efter hustyp och indexslag. Kvartal 1968K1 - 2018K4" The measure is an index with base year 1968 (1968=100). The measure takes into account the developer's- and contractor's expenses, incl. wages, management, materials, machines, transport, fuel, any profit/loss & the contractor's other costs. Excludes real-estate cost but includes VAT.

Factor PI

The factor PI is published by SCB, (named "Faktorprisindex (FPI) för bostäder inkl. löneglidning, 1968=100, efter hustyp och kostnadsslag. Kvartal 1975K1 - 2020K1") is a nationwide measure of the average price of production factors in the construction of dwellings. The base year is 1968 (1968=100). The measure includes production factors such as materials, labour, machines, transport, fuel, management fees and contractor's other costs.

The HI

The data used for the HI is from the time series "Färdigställda lägenheter i nybyggda hus efter region, hustyp och ägarkategori. År 1991 - 2019" is an annual time series published by SCB on multiple- and single household dwellings. It represents the construction volume of categories of developers', in the Municipality of Stockholm. The measure is in numbers of housing units. From this data the HI is calculated (see theory section) and inserted into the data set.

Stock of Apartments and Stock of Houses

A time series published annually by SCB: “Antal lägenheter efter region, hustyp och upplåtelseform (inklusive specialbostäder). År 1990 - 2019”, 1990-2019 and represents the total number of single- and multiple household dwellings in the Municipality of Stockholm.

Interest Rate

The variable Interest Rate represents the official interest rate, as an annual average, calculated and published by Riksbanken annually, 1994-2019.

Live Births

This variable is from an annual time series published by SCB: “Levande födda efter region, moderns ålder och barnets kön. År 1968 - 2019”. This represents the number of live born children in the Municipality of Stockholm, 1968-2019.

Unemployment

This variable is the percentage share of the total labour force, 15-74, unemployed. The time series is annually published by SCB and named: “Arbetslösa samt därav heltidsstuderande 15-74 år (AKU) efter kön och ålder. Kvartal 2005K2 - 2020K2”. Long-term unemployed people, pensioners or severely ill individuals are excluded from the labour force. Students are included in the labour force.

Mean Income

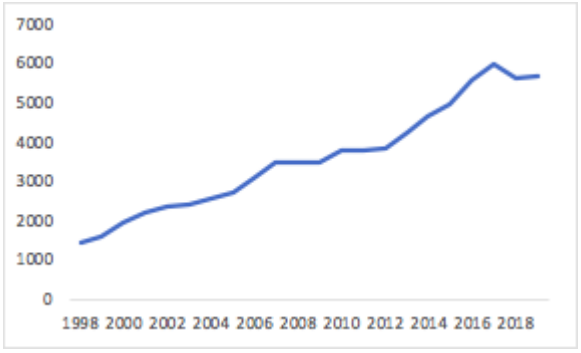
This variable is from a time series published by SCB: ”Disponibel inkomst per ke decilgrupper 1991–2018”. The data shows the annual, mean disposable income across Sweden. The measure is in thousands of krona, deflated to 2018’s prices. It includes capital income - note, not capital profit.

Non-Stationarity of the Data

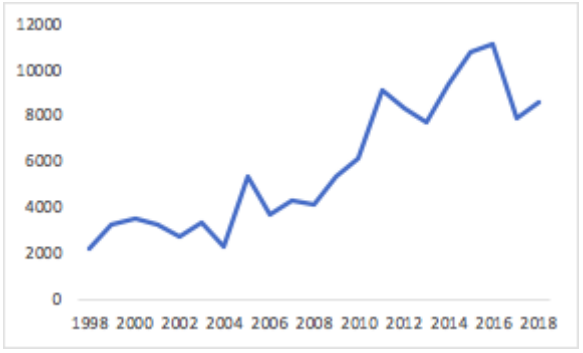
By graphing and visually inspecting the time series, some curious behaviour emerges. Certain variables exhibit a non-predictable (random) movement, such as trend, random walk or cyclical behaviour (see appendix 2). This can result in inconsistent and misleading results. Below, a few selected variables are graphed: House Price, Apartment Price, Interest Rate and Disposable Income. All appear to exhibit a trend, random walk or cycle.

Figure 5.5: *Selected Variable Graphs*

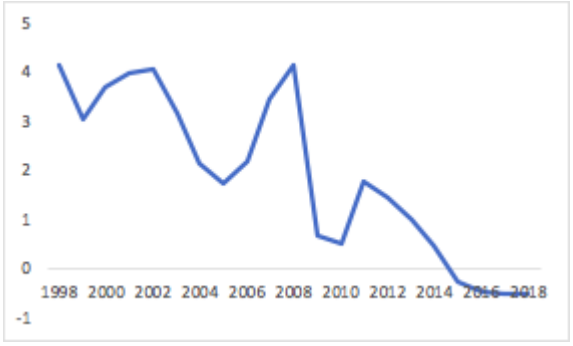
House Price



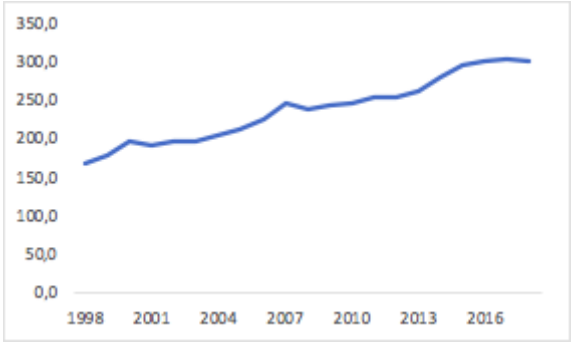
Apartment Price



Interestrate



Disposable Income



House price exhibits a clear trend. Apartment prices appear to have a trend and random walk. Interestrate appears to have a trend and perhaps a cycle. Disposable Income appears to have a trend. In the method section it is explained how the regression model is adjusted to accommodate for this errant behaviour.

Method

In this section we develop our regression model that will be used in the following regression analysis, the purpose of which is to decisively determine whether and how market power affects price.

The Regression Model

We now proceed to present the final regression equation that will be used in the regression analysis below. This is equation 1.4. Our three variables of interest: the HI, the construction PI and Factor PI, are explicitly shown.

$$log(P_{t+1}) = \beta_0 + \beta_1 D.log(HI_t) + \beta_2 D.log(Factor\ PI_{t+1}) + \beta_3 D.log(Construction\ PI_{t+1}) + \\ + \gamma_1 D.X_{1,\,t+1} + ... + \gamma_n D.X_{n,\,t+1} + \varepsilon \qquad (1.4)$$

In the remaining part of this section, we develop the 3 regression equations that are used: equation 1.2, 1.3 and 1.4. Variables that affect the price in the long run and the short run are incorporated into our equations and therefore they model the long-term price of housing.

$$P_{t+1} = \beta_0 + \beta_1 D.(HI_t) + \varepsilon \qquad (1.2)$$

Our starting point is the simple regression, 1.1, in which we regress price on our market power index. Note that the regressor is lagged by one period (year), because we assume that market power has a delayed effect on price. All control variables are excluded and are hence subsumed into the unobserved component: ε. (We make a clear distinction between variables of interest and control variables, but all regressors are treated the same way in a regression.)

We cannot be reasonably ascertained that market power will predict price unless we control for other influences on price. Problematically, we are here not able to clearly distinguish the estimated causal effect of our regressor from market trends and various unobserved factors. This results in errant and inconsistent regression results.

Moreover, any estimates would contain heavy omitted variable bias (OVB). Suppose that we were to regress price on the HI without any control variables. The omitted variable Interest Rate can be assumed to have a negative relationship with the HI because, as it falls, developers' ability to borrow for construction increases and their production does likewise, raising their ability to claim market shares. Interest Rate should also be negatively correlated with our outcome variable price, as a falling interest rate makes mortgages more affordable, raises demand and puts upward pressure on price. Interest Rate is therefore negatively correlated with our outcome variable (Price) and regressor (the HI). The nature of OVB is such that a positive bias is imposed on the estimated causal effect of the HI, if we were to run this regression. Therefore we introduce control variables into equation 1.2 and attain equation 1.3.

$$P_{t+1} = \beta_0 + \beta_1 D.(HI_t) + \beta_2 D.(Factor\ PI_{t+1}) + \beta_3 D.(Construction\ PI_{t+1}) + \\ + \gamma_1 D.X_{1,\,t+1} + ... + \gamma_n D.X_{n,\,t+1} + \varepsilon \qquad (1.3)$$

These control variables are denoted $\gamma_1 X_{1,\,t+1} + ... + \gamma_n X_{n,\,t+1}$ and contain all demand-side variables and the housing stock variables (Stock of Houses and Stock of Apartments). Our variables of interest are explicitly shown. In order to clearly distinguish the estimated causal effect of our variables of interest (the HI, Construction PI and Factor PI), and in order to minimize the OVB, we want to add as many control variables as possible. However, we also want to avoid breaking our full rank assumption. It follows that we add as many regressors as possible without any regressors being perfectly collinear with any other. This has been taken into account when assembling the data set (presented in table 5.1).

Furthermore, some of our variables contain non-stationarity unpredictable movement such as "random walk". This is established by a simple visual inspection, (see Data section). Graphs of all variables in our data set (see appendix. 2) indicate such stochastic processes as trends and random walk. These may be removed by using differences rather than levels. That is, rather than regressing on the value of the regressor in periods t , $t+1, \ldots, t+n$, we regress on the *difference* of the value it assumes in these time periods; such that variable X in periods

t to t+n which is $x_t, x_{t+1}, \ldots, x_{t+n}$ becomes $(x_{t+1} - x_t), (x_{t+2} - x_{t+1}), \ldots, (x_{t+n} - x_{t+n-1})$. This operation is denoted "D." and is applied to the outcome variable and regressors of all 3 regression models: 1.2, 1.3 and 1.4. An exception to this is the variable Interest Rate, which will not be differentiated, as its definition is already a difference between time periods.

Finally, we suspect that the relation of some outcome variables to the regressors (control variables and variables of interest) might be non-multiplicative. A correlation test is made to determine whether a log-specification be appropriate. (see appendix 3) In such a test, the variables of interest that appear to have a stronger correlation to the outcome variable House Price, once both are loged, are the Factor PI and the HI. When repeating the correlation test, the variable of interest that exhibits a stronger correlation to the outcome variable Apartment Price, both once logged, is Construction PI. This means a final iteration of our regression will be log-specified, as shown in equation 1.4.

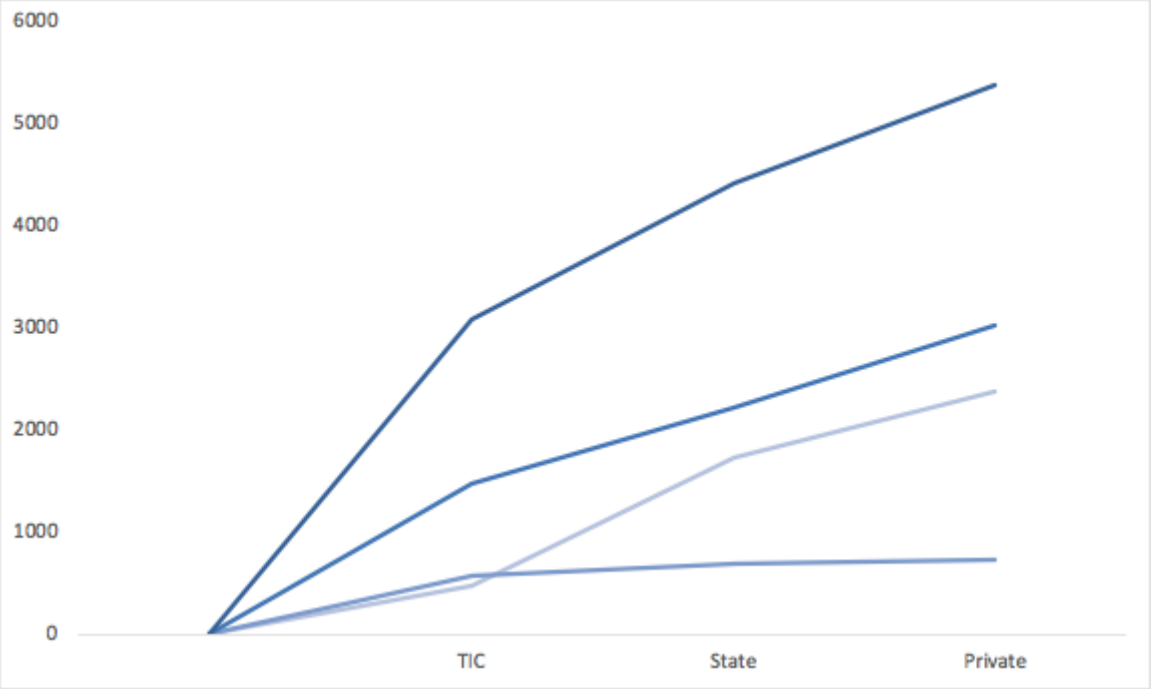
Descriptive Statistics

We expound on the available data in order to provide material for the later discussion, before proceeding to the formal data analysis which will attempt to determine the relationship between market power and price.

A closer enquiry into the demand side of Stockholm's housing market tells us *who* the producers are and may provide an indication about the state of competition of the market. The market concentration curves that are plotted in figure 5.1 are intended to provide an image of how production is concentrated among developers. Each curve contains the volume produced by private-, state-owned- and TIC-developers, respectively. The curves turn progressively darker as they present the production of more recent years. We see that in 2001 state-owned construction firms produced more housing than cooperatives and in 2011 private firms produced more than state owned firms, though the difference was small. But, this relationship has changed dramatically in recent years, as we see in 2019's market concentration curve. Here, a clear difference emerges as the largest production quantity results from cooperatives followed by state-owned firms that are, in turn, followed by private firms. Note, that every

producer should produce an equal volume in a perfectly competitive market and that this data indicates a departure from this.

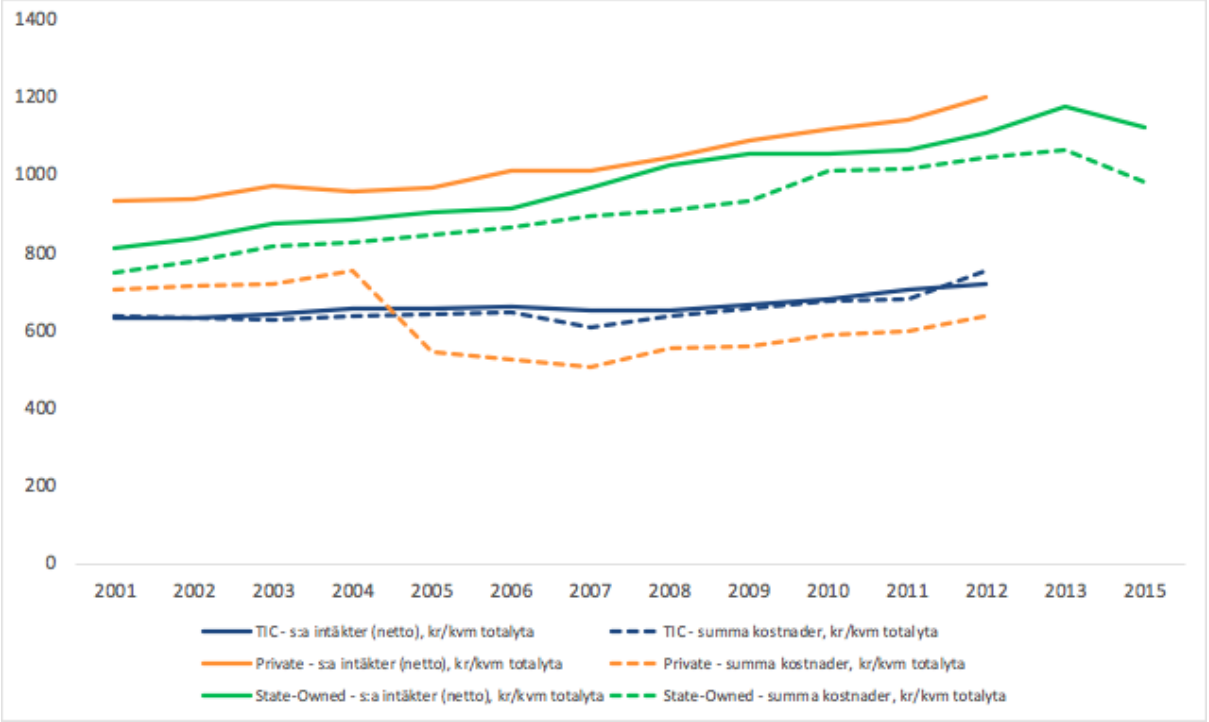
Figure 5.1: *Market Concentration Curves for Developers in Stockholm: 1991, 2001, 2011 and 2019*



Own calculations. Data from SCB (2020-04-15. Färdigställda lägenheter i nybyggda hus efter region, hustyp och ägarkategori. År 1991 - 2019).

Finally, the revenues and costs of these producers offer a perfectly lucid comparison of the current state of affairs to the ideal market situation, where the revenue and cost of every producer equals each other and the same goes for profit which should equal zero. In figure 5.6 we plot the available revenue- and cost data in a (now discontinued) time series published by SCB between 2001 and 2015. The time series in figure 5.6 contain too few data points to regress on, yet they are informative. TIC's, state-owned firms, and private firms are colour coded as blue, green and orange, respectively. Each category of developer receives two plots: revenue (solid) and costs (dashed).

Figure 5.6: *Revenue vs Costs per m^2 by Developer in Greater Stockholm 2001-2015*



Data from SCB 2015 ("Intäkter och kostnader för flerbostadshus efter region, nybyggår/värdeår, årsintervall, fastighetsägarkategori och intäkts-/kostnadsslag. (Urvalsundersökning, se fotnoter). År 2003 - 2015"), SCB 2013 ("Bostadshyror i nybyggda hus efter region, hustyp, byggherre, upplåtelseform och lägenhetstyp. År 1997 - 2013")

This data, once plotted, reveals that the price-cost difference (markup) among firms differ greatly. State-owned firms and TIC's exhibit a near-zero profit whereas private firms exhibit a striking cost-price difference. Even though the costs of TIC's and private firms are roughly equal, the former har far higher revenues. Graph 5.6 constitutes the perhaps clearest illustration of market power, exactly in accordance with our definition: a price that exceeds the marginal cost of production. This graph also informs us that market power is unevenly distributed among firms, private firms achieving the most by a considerable margin.

Results

In the following section the supply-side variables are regressed on. Table 5.1 summarizes the results of OLS-model 1.2, 1.3 and 1.4 applied to both measures of price. The aspects of the regressions of foremost importance are, in order, the significance and sign of the regressions. Moreover, the estimate will be described to have the "wrong" sign if the sign contradicts the

expected one presented in table 5.2 and "right" if otherwise. The magnitude of each estimate, as explained in the method section, is illusive because of measurement differences. Ergo, it is assigned less importance than significance and sign.

Table 5.1: *Regression Table*

Outcome Variable	$House\ Price_{t+1}$			$Apartment\ Price_{t+1}$		
Column	1	2	3	4	5	6
Model	1.2	1.3	1.4	1.2	1.3	1.4
	estim. coeff. (std. err.)					
$D.HI_t$	-168.1318 (360.5657)	-551.5957 (316.4976)	-0.0165 (0.0302)	4116.395* (2170.598)	3817.185 (3615.384)	0.3177 (0.3500)
$D.Construction\ PI_{t+1}$	-	0.5182 (1.1462)	0.1769 (0.3729)	-	-2.9876 (11.9782)	-1.4609 (3.2037)
$D.Factor\ PI_{t+1}$	-	-1.6369 (1.6723)	0.0691 (0.5837)	-	-1.4436 (16.1161)	0.7087 (5.5539)
Control Variables	No	Yes	Yes	No	Yes	Yes
Logs on var's of interest and outcome variable	No	No	Yes	No	No	Yes

* = p-value ≤ 0.1
** = p-value ≤ 0.05
*** = p-value ≤ 0.01

Own calculations. Data from SCB, Riksbanken and The World Bank.

The results of regression with model 1.2 on outcome variables House Price and Apartment Price, produce columns 1 and 4, respectively. The results in column 2 and 5 are from regression with model 1.3, which incorporates control variables. Finally, column 3 and 6 present the results of model 1.4, which is identical to model 1.3, but with log-specified outcome variables and regressors.

The HI is not significant once control variables are introduced. Hence, the regression analysis does not provide evidence that market power is predictive of the price of dwellings. Surprisingly, the regression consistently yields the wrong sign for the HI for single-household dwellings (column 1-3), indicating a negative relationship between market concentration and the price of single-household dwellings. Likewise, the HI is not significant for

multiple-household dwellings (column 4-6), although it has the right sign. Contrary to what was expected, the relationship between the HI and the price for single-household dwellings is not stronger than that of multiple-household dwellings.

The regression does not show a strong or positive relationship between the Construction PI and single-household dwellings (column 2, 3). This relationship is not significant, though it has the right sign indicating a positive relationship. The relationship is not significant for multiple-household dwellings either and it has the wrong sign (column 2, 3).

The Factor PI is not significant for multiple- or single-household dwellings, but both the Construction PI and Factor PI attain the right sign once logs are introduced. The logs do, however, dramatically decrease the magnitude of the estimated coefficient of the Factor PI for multiple-household dwellings (column 6) and especially for single-household-dwellings (column 3).

Finally, log specifications, though shown to strengthen the correlation for some variables of interest with outcome variables, do not raise the significance of the causal effects once implemented, as seen in column 3 and 6.

Finally, in table 5.2 the results are presented from a T-test and an F-test conducted, respectively, on the significance of the HI and the joint significance of the Construction PI and Factor PI. This is done for the model 1.4. (That is, the columns with control variables *and* log-specified outcome variables and variables of interest.) Neither the Construction PI nor the Factor PI is significant for the outcome variable House Price or Apartment Price. The HI is not significant at 10% level for Apartment Price or House Price. According to this test we may not with certainty state that the HI has a non-zero effect on multiple- or single-household dwellings. This affirms, to some extent, our regression results.

Table 5.2: *T-test and F-test for Variables of Interest*

Outcome Variable	**Regressor**	**P-value**	**Sign**
House Price	HI	0.5961	-

	Construction PI & Factor PI	0.8664	+ & +
Apartment Price	HI	0.3806	+
	Construction PI & Factor PI	0.8979	– & +

Own calculations. Data from SCB.

Discussion

We have found that the effect of market power on prices has remained unsatisfyingly explored in the literature. This thesis therefore sets out to study this possible correlation. There is a well documented, unsatisfied demand on Stockholm's housing market, as reported by state agencies and organizations such as Boverket (2019), Nybyggarkommisionen (2014) and Bostadsförmedlingen (2019). This issue, though recently arrested in ascent, is expected to increase in the future. The implications are extensive. This confirms the urgency of this research, it suggests the absence of perfect competition and suggests the presence of market power.

In our regression analysis, we do not receive conclusive evidence that market power affects the housing price. With control variables, the market concentration index has no significant estimated effect on multiple-household dwellings or single-household dwellings. This contradicts our expectations. It also contradicts the literature which suggests fundamental factors to be more significant for single-household dwellings, which the market powers can more freely affect than multiple-household dwellings. Though insignificant, the HI attains the right sign for single-household dwellings when control variables are introduced - though it remains the wrong sign for multiple-household dwellings - and this is consistent with the positive relationship indicated in the literature. Furthermore, although theory suggests a positive relationship between cost and price, the cost indices are not significant once control variables are introduced. Finally, though our correlation tests suggest otherwise, no variables of interest are more significant once logged. But, it corrects the sign for the Factor PI for both price measures.

Overall, the regressions indicate a surprisingly low connection between the cost indices and price; significance is consistently nonexistent or low. This contradicts the numerous previous results that ascribe rising costs as the result for rising prices. Another strange result is the consistently low or nonexistent connection between our market power index and price. This suggests market power might not be a major cause of rising housing prices.

There are various plausible explanations for the deviations of our results from what the theory has led us to expect. Firstly, endogeneity might be introduced into the regression by the various factors subsumed into the unobserved factor, such as legislation or home-ownership trends. Thus, the validity of the exogeneity assumption is precarious as various factors in the unobserved component are feasible, through either supply or demand, systematically correlated with the regressors.

The HI might not be an adequate measure of market power. The descriptive statistics (figure 5.6) clearly records markup, but the HI might not be sufficiently reflective of this. Therefore, this study also shows how difficult it might be to infer market power through market structure.

Certain oversimplifications made in the assumptions of the equilibrium model might lead us to neglect various unobserved factors that might systematically influence regressors and distort the results. Transaction costs are rarely zero, consumers often lack perfect information of prices, the commodity of housing is not homogenous and entry-barriers are non-zero.

In addition, the measurement error of some regressors is probably quite contained than that of others, as variables such as Interst Rate or Unemployment, or Stock of Apartments are direct measures. However, variables such as the Factor PI, Construction PI and Live Births are either reported values or proxies of real-world factors, which might introduce some bias to these variables - especially as the variation in the measurement error might be large compared to the variation in the variable itself.

Furthermore, the quality of the data complicates attempts to establish causality. This is especially applicable to our principal variable of interest: the HI. The data used for this time series is, low resolution as we cannot see the market shares of individual firms. This almost certainly results in a much higher HI as every firm's market share is combined into its group's (larger) market share. Crucially, the HI might misrepresent the variation of market shares among individual firms. Suppose that each group consists of one large firm and many small ones, yet all groups' total market share is roughly equal. The variation *within* each group is lost in our data.

Generally, the time series used for the variables differ in key ways, as detailed in the theory section. They coincide in a limited time span and they are of differing units of measurement, as some variables are in real terms, some nominal and others in non-monetary units. However, although we do not expect the estimated causal effects to be accurate, we do expect the regression to accurately detect correlation between the regressors and the outcome variables. In addition, our treatment of the data incurs a trade-off in that differencing the observations mitigates errant behaviour, such as the random walk, yet cuts in half the number of already sparse observations.

Sources

Online Sources

Bostadsförmedlingen. *Bostadskön i siffror.* Retrieved on 2020-04-13 from: https://bostad.stockholm.se/statistik/statistiktjansten/. (Bostadsförmedlingen, 2020)

Bostadsförmedlingen. *Hur lång tid tar det att få en bostad genom oss*? Retrieved on 2020-04-23 from: https://bostad.stockholm.se/statistik/hur-lang-tid-tar-det/.

Boverket. (2019). *Bostadsmarknadsenkäten 2019 – en sammanställning av de texter som publicerats på boverket* (24-May-2019). Retrieved on 2020-04-23 from: https://www.boverket.se/contentassets/44b828c304f24b46ba69a1f293c24a97/bostadsmarknadsenkaten-2019.pdf

Lars Frisell och Masih Yazdi. (2010). *Prisutvecklingen på den svenska bostadsmarknaden – en fundamental analys. Riksbanken*. Retrived on 2020-05-17 from: http://archive.riksbank.se/Upload/dokument_riksbank/kat_publicerat/artiklar_pv/2010/pov_2010_3_frisell_yazdi.pdf?fbclid=IwAR28NtLjlzRW5WDbYt6yshCpjCDReY-oxTNhjg2jPUl43-3tOIJWLAt2CD8

Jansson, P. Persson, M. (2011). *Riksbankens utredning om risker på den svenska bostadsmarknaden - sammanfattning. Riksbanken*. ISBN: 978-91-89612-50-1. Publisher: Åtta.45 Tryckeri AB. 103 37 Stockholm. Retrieved on 2020-04-29 from: http://archive.riksbank.se/Upload/rapporter/2011/ruth/ruth.pdf#page=111

Jarlman, A. (2014-06-28). *Byggkostnaders betydelse för dynamiken på bostadsmarknaden - en analys av byggkostnaderna inverkan på husprisutvecklingen i svenska storstadsområden. Lund Universitet, Ekonomihögskolan*. Retrieved on 2020-05-13 from: http://lup.lub.lu.se/luur/download?func=downloadFile&recordOId=4461259&fileOId=4461280.

Konkurrensverket. (2018). Project leader: John Söderström. Bättre konkurrens i bostadsbyggandet. Rapport: 2018:7. ISSN: 1401-8438. Retrieved from: http://www.konkurrensverket.se/globalassets/publikationer/rapporter/rapport_2018-7.pdf.

Lindén, A., Gustafsson, R.(2014). *Det svenska hyressättningssystemet Boverket*. ISBN: 978-91-7563-133-2. Dnr: 20110-297/2014. Karlskrona. Retrieved from: https://www.boverket.se/globalassets/publikationer/dokument/2014/det-svenska-hyressattningssystemet.pdf.

McKinsey & Company. (2020-06) *The next new in construction - How disruption is reshaping the world's largest ecosystem.* Retrieved from: https://www.mckinsey.com/~/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/The%20next%20normal%20in%20construction/The-next-normal-in-construction.pdf

Polismyndigheten. (2017). *Utsatta områden - Social ordning, kriminell struktur och utmaningar för polisen*. Hämtat 2020-05-27 från, https://polisen.se/sok/ .

Reid, J., Nicol, C., Allen, H. (2019-05-19). *Mapping The World's Prices 2019. Deutsche Bank*. Retrieved on 2020-05-17 from: https://www.dbresearch.com/PROD/RPS_EN-PROD/PROD0000000000494405.pdf.

Riksbanken. *Sök räntor och valutakurser. Organization number: 202100-2684. 103 37 Stockholm.* Retrieved on 2020-04.23 from: https://www.riksbank.se/sv/statistik/sok-rantor--valutakurser/.

SCB. *Försålda permanenta småhus efter region (län, riksområden, riket). Kvartal 1998K1 – 2020K1*. Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0501__BO0501B/FastprisPSRegKv/

SCB. *Pris per kvm för nybyggda ordinära flerbostadshus efter region och brutto-/nettopris. År 1994 – 2018.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0201__BO0201A/PrisPerAreorFH02/.

SCB. *Årshyra per lägenhet, kr.2003-2014*. Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0406BO0406A/Bhudef1ny/.

SCB. (2019-11-21). *Byggnadsprisindex (BPI). Byggnadsprisindex för bostäder (BPI), inkl mervärdesskatt efter hustyp och indexslag. Kvartal 1968K1 - 2018K4*. Retrieved on 2020-04-15 from: https://www.scb.se/hitta-statistik/statistik-efter-amne/priser-och-konsumtion/byggnadsprisindex-samt-faktorprisindex-for-byggnader/byggnadsprisindex-bpi/.

SCB. *Faktorprisindex för byggnader (FPI).* Retrieved on 2020-04-15 from: https://www.scb.se/hitta-statistik/statistik-efter-amne/priser-och-konsumtion/byggnadsprisindex-samt-faktorprisindex-for-byggnader/faktorprisindex-for-byggnader-fpi/.

SCB. *Lägenheter i nybyggda hus efter region och hustyp. Kvartal 1975K1 - 2019K4.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0101__BO0101C/LagenhetNyKv16/

SCB. *Antal lägenheter efter region, hustyp och upplåtelseform (inklusive specialbostäder). År 1990 – 2019.*Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0104__BO0104D/BO0104T04/.

SCB. 08-May-2019. *Hitta statistik. Statistikdatabasen. Boende, byggande och bebyggelse. Nybyggnad av bostäder. Färdigställda bostäder och rumsenheter i nybyggda hus efter region och hustyp. År 1975-2019.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0101

SCB. 04-10-2019. *Hyror och den allmänna prisutvecklingen 1969-2019.* Retrieved on 2020-04-15 from: https://www.scb.se/hitta-statistik/statistik-efter-amne/boende-byggande-och-bebyggelse/bostads-och-hyresuppgifter/hyror-i-bostadslagenheter/pong/tabell-och-diagram/hyror-och-den-allmanna-prisutvecklingen/.

SCB. *Helårsstatistik - kommun, län, riket enligt indelning 1 januari 2019.* Retrieved on 2020-04-16 from: https://scb.se/be0101.

SCB. *Tabeller i Statistikdatabasen. 08-May-2019 Nybyggnad, år. Färdigställda lägenheter i nybyggda hus efter region, lägenhetstyp, och hustyp. År 1975 - 2019.* Retrieved on 2020-04-17 from: https://scb.se/bo0101.

SCB. *Pris per lägenhet för nybyggda ordinära flerbostadshus efter region. Byggherre och brutto-/nettopris. År.1998-2018. Visited 2020-April-29. Statistikdatabasen.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0201__BO0201B/PrisPerLghFH03/.

SCB. 2020-04-15. *Levande födda efter region, moderns ålder och barnets kön. År 1968 – 2019*. Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BE__BE0101__BE0101H/FoddaK/.

SCB. A*rbetslösa samt därav heltidsstuderande 15-74 år (AKU) efter kön och ålder. Kvartal 2005K2 - 2020K1.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__AM__AM0401__AM0401L/NAKUArblheltidstudK/.

SCB. *Indikatorer inkomstfördelning 1975-2018.* Retrieved on 2020-04-15 from: https://www.scb.se/hitta-statistik/statistik-efter-amne/hushallens-ekonomi/inkomster-och-inkomstfordelning/inkomster-och-skatter/.

SCB. *Indikatorer inkomstfördelning 1975-2018.* Retrieved on 2020-04-15 from: https://www.scb.se/hitta-statistik/statistik-efter-amne/hushallens-ekonomi/inkomster-och-inkomstfordelning/inkomster-och-skatter/.

SCB. *Färdigställda lägenheter i nybyggda hus efter region, hustyp och ägarkategori. År 1991 - 2019.* Retrieved on 2020-04-15 from: http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__BO__BO0101__BO0101A/LghReHtypAkAr

Sorensen, P. B. May-2015. *The Swedish Housing Market: Trends and Risks.* Finanspolitiska Rådet. ISSN: 1654-8000. Retrieved from:

http://www.finanspolitiskaradet.com/download/18.11165b2c13cf48416debd71/Underlagsrapport+2013-5+S%C3%B6rensen.pd

Williams, C. (2016-01-16). *Housing is at the root of many of the world's problems*. Special Report. The Economist. Retrieved on 2020-05-19 from: https://www.economist.com/special-report/2020/01/16/housing-is-at-the-root-of-many-of-the-rich-worlds-problems.

World Bank. (2020-06-21) *Unemployment, total (% of total labor force) (modeled ILO estimate) - Sweden.* Retrieved from: https://data.worldbank.org/indicator/SL.UEM.TOTL.ZS?end=2019&locations=SE&start=1991&view=chart.

Written Sources

Perloff, J., M. (2018) *Microeconomics: Theory and Applications with Calculus, Ghobal Edition*. Pearson. 4th ed.

Appendix

1. Vocabulary

Byggherre = Developer
Entreprenör = Contractor
Upplåtelseform = Provision/Tenancy model

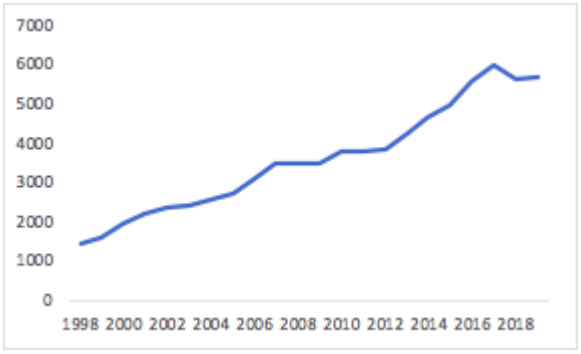
Storstockholm (0100) = Greater Stockholm
Stockholm (0180) = Municipality of Stockholm/STHM
Stockholms region/län = County of Stockholm/STHM

Småhus = Single household dwelling/household
Flerbostadshus = Multiple-apartement, Multiple-household dwelling
TIC (Tenancy in Common) = Bostadsrättsförening

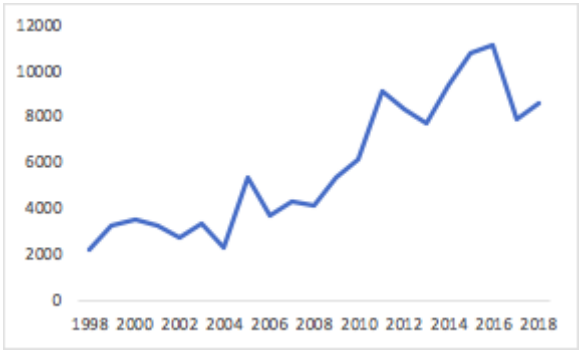
Bostadsrätt = Condominium

2. Variable Graphs

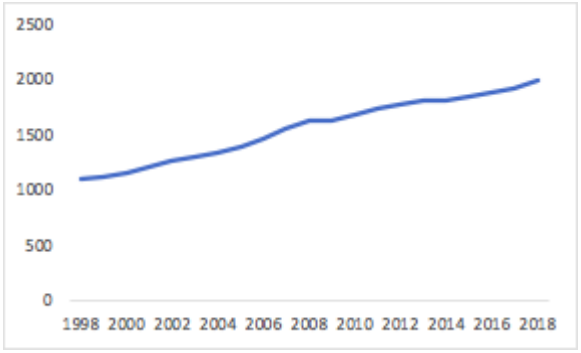
House Price



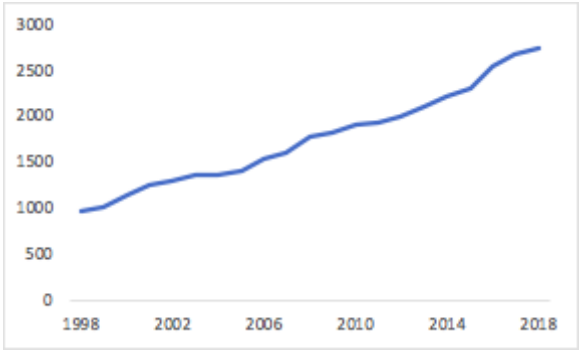
Apartment Price



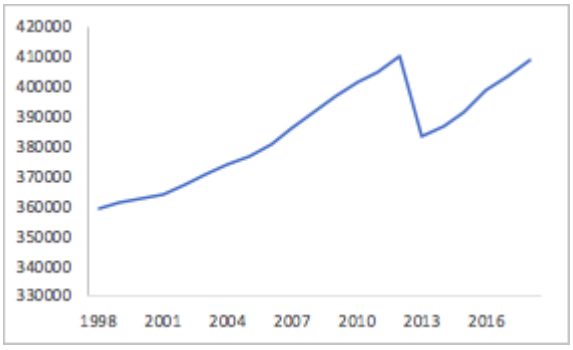
Factor Price Index



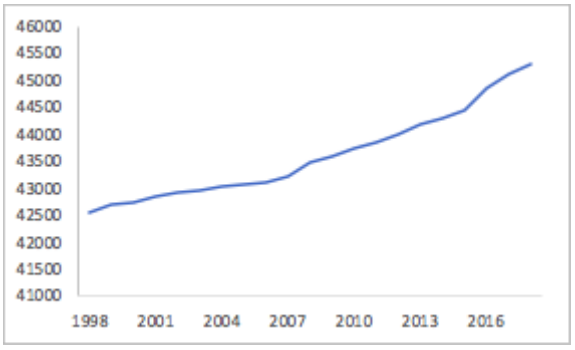
Construction Price Index



Stock Apartments

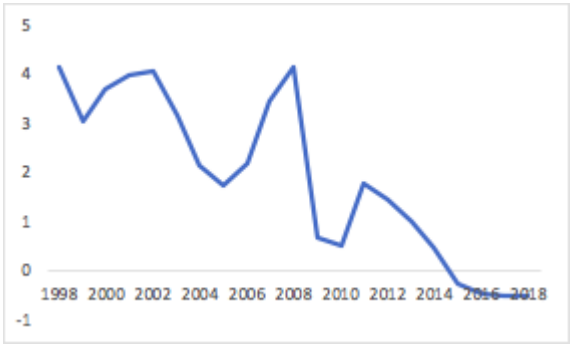


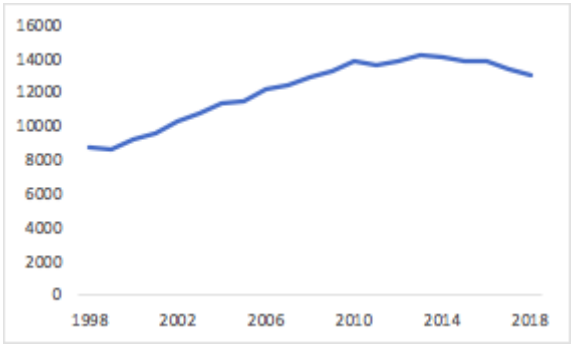
Stock Houses



Interestrate

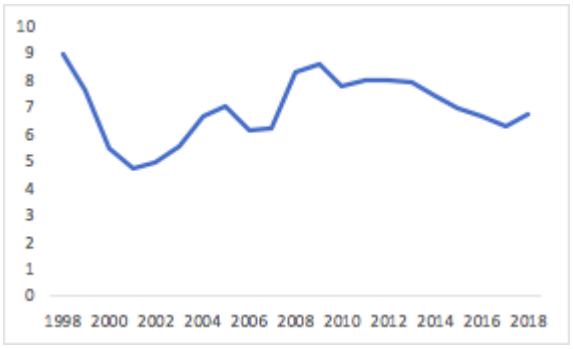
Births

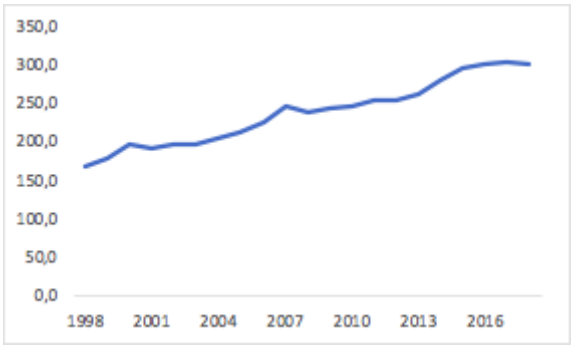




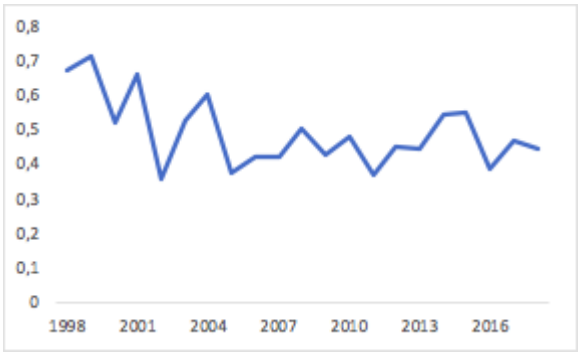
Unemployment

Disposable Income





The HI



3. Correlation Tests

Figure Appendix 3.1: *Correlation Test Between Non-Loged variables*

	houseP	aptP	HI	factorPI	constructPI
houseP	1.000				
aptP	0.8683	1.000			

HI	-0.4598	-0.3954	1.000		
factorPI	0.9657	0.8809	-0.5042	1.000	
constructPI	0.9932	0.8764	-0.4480	0.9754	1.000

Own calculations. Data from SCB.

Figure Appendix 3.1: *Correlation Test Between Loged variables*

	lhouseP	laptP	lHI	lfactorPI	lconstructPI
lhouseP	1.000				
laptP	0.8756	1.000			
lHI	-0.5029	-0.4323	1.000		
lfactorPI	0.9807	0.8963	-0.4879	1.000	
lconstructPI	0.9921	0.8916	-0.4643	0.9862	1.000

Own Calculations. Data from SCB.

l = log([variable])

houseP = House Price

aptP = Apartment Price

HI = the HI

factorPI = Factor PI

constructPI = Construction PI