

Rationality of Apartment Buyers:

A Micro-Efficiency Approach to the Stockholm Housing Market

Abstract

The assumption that all investors are rational has been greatly debated in modern finance. Due to large increases in prices world-wide within the housing market, there have been talks about bubbles and irrational investor behaviour. Previous research on the topic has been focused on the macro perspective, comparing observed values with some appraised fundamental value. This thesis employs a micro perspective in that market values are taken as given and instead it is tested whether buyers correctly capitalise the monthly fee into the purchasing price. A unique dataset, including 10 768 registered sales of tenant-ownership apartments in the municipality of Stockholm during the period January 2005 to April 2006, is used. Based on extensive regression analysis, the results indicate that the market is in fact not rational.

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1 Introduction

Housing presents a significant share of a household's monthly expenditure – be it rent payments to a landlord or servicing debt for tenures. The large impact of housing prices on personal net worth naturally creates a lot of discussion, and during the last years the significant increase in housing prices world-wide has received a lot of attention in the media. Lowered interest rates in the 2000's have driven up prices and in 2003 many countries showed price-to-rental ratios and price-to-average income ratios at levels not seen since their data began in 1975. (Castles in Hot Air, 2003) Swedes have also seen the price of housing, especially tenant-ownership¹, increase drastically lately. Only during 2005, the average price paid for an apartment² increased by 22 per cent, driven by the large cities: Stockholm up 26 per cent, Malmö up 18 per cent and Göteborg up 32 per cent. (Bostadsrätterna rekorddyra 2005, 2006) As a comparison, consumer price index increased 0.9 per cent. (Statistics Sweden, 2006)

This high increase in prices has led to discussions of a housing bubble. Case and Shiller searched for how many times the term “housing bubble” appeared in major newspapers in the English language around the world 1980–2003. Their study showed that the term scarcely appeared prior to 2002, when it peaked at a significantly higher level. Replacing the term “bubble” with the more neutral word “boom” yielded similar results. (Case & Shiller, 2003) One sign of a bubble is dramatically increasing prices, and despite last years' heavy increase in apartment prices, two-thirds (66 per cent) of the Swedish households believe that prices will continue to rise in the coming twelve-month period. (SEB, 2006)

The question of whether we are experiencing a housing bubble or not raises the issue of homebuyers' rationality. A bubble can only take place in a market with irrational investors. The purpose of this study is to investigate the rationality of apartment-buyers in the Stockholm region. More specifically, based on the modern theories of finance, the ability of investors to correctly capitalise the cash-flows is tested. Unlike previous research, which has been focused on building models predicting the correct market prices,

¹ Sw: "bostadsrätt"

² In Sweden all owner-occupied apartments are in the form of tenant-ownership, and thus the terms will be used interchangeably throughout this paper.

this paper employs a different approach assuming that there is a given value of housing and based on that tests whether the cash-flows are correctly capitalised into the transaction price. This approach is made possible by the unique nature of tenant-ownership, where part of the apartment is financed through the tenants' association's debt and part by the tenant's equity, giving a structure similar to the financing of a corporation.

The thesis is organised in the following way: *Section 2* presents previous research, the theoretical model development and the hypothesis of this paper. Thereafter, in *Section 3* the data and the regression models are described. The results from these regressions are presented in *Section 4*. In *Section 5* we subsequently check the results for robustness by relaxing some of the initial assumptions. Having done this we select the final model in *Section 6* and continue with further tests to answer the paper's hypothesis using this model in *Section 7*. Analysis of the results is found in *Section 8*. In *Section 9* suggestions for further research are presented and finally *Section 10* concludes the thesis.

2 Theoretical Framework and Hypothesis

2.1 On Market Efficiency

In a letter written to behavioural finance researchers John Campbell and Robert Shiller, MIT professor Paul Samuelson put forward his view that the stock market shows “micro efficiency” but not “macro efficiency”. Micro efficiency refers to the relative pricing of individual securities while macro efficiency refers to the overall price-level of a market. Samuelson reasoned that arbitrageurs who spot aberrations from micro efficiency can make money from these occurrences by essentially buying undervalued stock and short-selling overvalued, thus creating a self-financing arbitrage position. This will in turn effectively wipe out any persistent micro inefficiency. Simultaneously, and in no contradiction to the previous statement, there may be considerable macro inefficiencies, in the sense of long waves in the time series of aggregate indices of security prices below and above various definitions of fundamental values. Unlike micro inefficiencies, macro inefficiencies cannot be traded away by taking offsetting positions, as there in for example

an overvalued market are no long positions to be taken to offset the hypothetical short position in the overvalued index. (Shiller, 2000)

As described in the introduction, most research on the area has been focused on macro-efficiency, i.e. if the housing-market is correctly valued relative to some assumed “correct” price. One popular approach has been to run regressions based on macro-economical variables such as demography and per capita income and see how well these explain the changes in housing prices. As an example, Case, Quigley and Shiller found that while in some US states per-capita income was a good predictor with R^2 as high as 0.99, in other states it went as low as 0.45. (Case *et al.*, 2003)

As described previously, for a market to be efficient on the micro level, there must be possibilities of arbitraging price differences. According to Case and Shiller the institutional structure of the housing market leads to that exploitation of mispricing is difficult. (Case & Shiller, 1989) First, there is no market for future contracts and there are no short sales meaning that there are no profit opportunities to exploit if the market is expected to decline. Second, transaction costs are high as selling real estate usually incurs a brokerage commission (significantly higher than that in the stock market). Since the product is heterogeneous, buyers also incur high search costs (spending every Sunday visiting apartments for sale has a major alternative cost) and for those buying property to live in there are additional moving costs. (Case & Shiller, 1989)

A related study to this thesis was performed by Berger *et al.* Based on a sample of nearly 300 000 sales of owner-occupied homes (not apartments) in Sweden the authors investigated whether below-market government subsidised interest rates were capitalised into house prices. There was strong evidence of capitalisation, and in the model favoured by the authors the estimated capitalisation coefficient centred on minus unity, indicating full capitalisation. (Berger *et al.*, 1998)

2.1.1 Behavioural Finance

While this is not a thesis within behavioural finance it is important to put forward some explanations of why the housing market might not be efficient. As noted previously, if the

market is efficient, investors should be rational and correctly value an apartment from a financial perspective. However, researchers have found macro inefficiencies that are the results of investors' behavioural biases. Examples of these inefficiencies that are related to the housing market are described below.

It has been found that US investors in housing perceive little risk with their investments; many believe that “real estate prices cannot go down”. Also, prices display large inertia, meaning that if housing prices go up, the conditional expected value of the consequent price level is higher than the previous. It seems that investors extrapolate previous prices to predict the future price changes. Of course, in an efficient market it should not be possible to predict prices based on historical levels. (Case *et al.*, 2003)

In another study on the US housing market it was shown that when demand falls the number of transactions fall sharply. The authors explain this by that sellers do not wish to sell below the nominal price at which they acquired the house. Therefore, when demand falls, which normally would drive down prices, home-owners refrain from selling and thus reduce the supply keeping up prices at an artificially high level. (Case *et al.*, 2003) Similar results have been reported by Engelhardt (2003) and Genovese & Mayer (2001). The fact that homeowners base their views of the current value of the house on past prices, rather than the actual market value, is a sign of irrationality. This can be related to a phenomenon in behavioural finance called *anchoring*.

In his best-selling book *Irrational Exuberance*, Shiller writes that “solid psychological research does show that there are patterns of human behavior that suggest anchors for the market that would not be expected if markets worked entirely rationally.” (Shiller, 2000) It is worth noting that these patterns are not the result of extreme human ignorance. Rather, investors strive to do the right thing, but they have limited abilities and certain natural modes of behaviour that decide their actions. One of these effects is *quantitative anchoring*. In an experiment by psychologists Tversky and Kahneman participants were asked to give a numerical answer (ranging between 1 and 100) to difficult questions (such as the percentage of African nations in the United Nations) after first having spun a wheel of fortune with the numbers 1 to 100. Even though the participants knew that the number

that came up on the wheel of fortune was truly random and that it had no correlation with the correct answer to the subsequent question the experimenters found that the answer was quite substantially influenced by the random number on the wheel. (Tversky & Kahneman, 1974)

According to the theory of *moral anchoring* people are weighing a story, which has no quantitative dimensions, against the observed quantity of financial wealth that they have available for consumption. As an example, those who sell stocks to the general public often tend to tell a story about the stock, describing the history of the company, the nature of the product, and how the public is using the product. The sales call does not as often engage in discussions of quantities or probabilities of future cash-flows. (Shiller, 2000) Looking at advertisements³ about apartments for sale through real estate agents it is clear that what the potential investors get is a story; there are attractive pictures and lavish descriptions about what life would be like in the apartment, but very little focus on the monthly fee and never any information on the apartment's share of the tenants' association's debt. As an example, browsing through the latest advertisements by Swedish real estate agent Notar, one finds descriptions of apartments like "Barbecue party at sunset eight floors up", "Generous and bright turn-of-the-century dream" and "An experience above the ordinary". None of these ads contained any information on the financial situation of the tenants' associations. (Notar Bostad, 2006) It might well be that a buyer decides what "story" she's looking for (e.g. two rooms in a 19th century apartment with a balcony enjoying sun in the morning) and then when she finds that specific object (which is probably quite rare) she will bid whatever she thinks she can afford considering the wealth available for consumption, instead of paying what is the true, financially rational, price.

Related to anchoring is a human tendency to place particular events into mental compartments based on superficial attributes. It has been argued that people put their sources of income into three categories – current wage and salary income, asset income and future income – and spend differently out of the present values of these different incomes. For example, people are reluctant to spend out of future income even if it is

³ Only Swedish advertisements were examined

certain to arrive. (Shiller, 1998) This could lead to that people do not correctly value the price paid for an apartment (which is paid at once) relative to the present value of future monthly fees. Another aspect of mental compartments is the view of risk: individual investors naturally think in terms of having a “safe” part of their portfolio and a risky part. (Shiller, 1998) This type of mental compartments might lead to that buyers of apartments adhere different risks to the loan taken up by themselves to finance the equity part of an apartment and the loan taken up by the tenants’ association.

2.2 Theoretical Model Development

A common view in research is to view housing investment as a stream of future services, discounted to present value. (Poterba, 1984) We will extend this model to cover the financial cash-flows as well. We base our model on the general model for valuing an enterprise:⁴

$$\text{Enterprise value} = EV = \text{market capitalisation} + \text{net debt} = V_{\text{equity}} + V_{\text{debt}} \quad [1]$$

Applying the same model to the valuation of housing, we define $V_{\text{equity}} \equiv \text{purchase price of apartment}$ and $V_{\text{debt}} \equiv \text{apartment's share of total debt of tenants' association}$, where both are the market values. The value of the housing (note that the term *housing* applies to the value of living in the apartment and not to the value of the *building*) should be unaffected by the choice of financing. As an illustration, the tenants face the possibility of repaying the association’s debt replacing it with equity (i.e. their own money) which should not affect the value of the housing.⁵ The reader should note that how the tenant finances her equity share, i.e. through savings and/or bank loans, is not a part of this model.

We subsequently create a new variable called *housing value (HV)* which we define as:

$$HV \equiv \text{value of housing services} - \text{capitalised maintenance costs} \quad [2]$$

We must subtract the capitalised maintenance costs, as in order for the tenant to get access to the value of the housing services, she must pay the maintenance costs (e.g.

⁴ As made popular by Copeland *et al.* (2000)

⁵ For an extensive discussion of how financing affects (or rather does not affect) value, see Nobel laureates Modigliani & Miller (1958).

cleaning, reparations and heating of common space). Therefore, the true *housing value* is the net of the *value of housing services* less the *capitalised maintenance costs*.

As *Equation 1* can be seen as an expression for the market value of an apartment and *Equation 2* as the true value, given efficient markets the enterprise value should be equal to the housing value. Hence,

$$EV = HV \Rightarrow V_{equity} + V_{debt} = \text{value of housing services} - \text{capitalised maintenance costs} \quad [3]$$

Per definition, the market value of debt is equal to the tax-adjusted interest payments capitalised with the after-tax debt interest rate:

$$V_{debt} = \frac{\text{annual interest}}{r_D(1-T)} \quad [4]$$

Regarding the tax rate (T in the equations), tenants' associations have a tax-shield of 28 per cent on interest payments, while private investors enjoy a 30 per cent tax-shield. In light of the small difference, and the fact that tenants' associations probably enjoy slightly cheaper debt than individuals do, we will assume that the after-tax interest cost is equal for tenants' associations and tenants.

The fee paid by the tenant to the tenants' association consists of two parts: one covering the maintenance fees and one covering the interest payments and amortisation of the association's debt. As amortisations are not actual costs, but merely a financial transaction substituting debt for equity, they should ideally be adjusted for. However, for the basic model, we assume that amortisations are equal to zero,⁶ i.e.

$$\text{annual fee} = \text{annual interest} + \text{annual maintenance costs} \quad [5]$$

Substituting [5] into [4], we get

$$V_{debt} = \frac{\text{annual fee} - \text{annual maintenance costs}}{r_D(1-T)} = \frac{\text{annual fee}}{r_D(1-T)} - \frac{\text{annual maintenance costs}}{r_D(1-T)} \quad [6]$$

⁶ This assumption will be tested later on in the thesis in *Section 5.3*

To capitalise the *annual maintenance costs* the WACC (weighted average cost of capital) of the tenants' association should be used. The well-known WACC formula is:

$$WACC = r_E \frac{E}{D+E} + r_D(1-T) \frac{D}{D+E} \quad [7]$$

As the “business” of most tenants' associations is very similar (i.e. providing housing to its members) and varying capital structures can be observed (ranging from all-equity financed to heavy leveraged), assuming rational behaviour the tenants' associations must be indifferent between choice of financing. This implies that:

$$WACC = r_E = r_D(1-T) \quad [8]$$

Hence, to facilitate calculations the after-tax cost of debt is used instead of the WACC to capitalise the *annual maintenance costs*. It is assumed that the maintenance costs will be nominally constant over time. This assumption will be tested in *Section 5.1*.

$$capitalised\ maintenance\ costs = \frac{annual\ maintenance\ costs}{r_D(1-T)} \quad [9]$$

Inserting [9] into [6], we thus get

$$V_{debt} = \frac{annual\ fee}{r_D(1-T)} - capitalised\ maintenance\ costs \quad [10]$$

Subsequently substituting [10] into [3],

$$V_{equity} + \frac{annual\ fee}{r_D(1-T)} - capitalised\ maintenance\ costs = value\ of\ housing\ services - capitalised\ maintenance\ costs \quad [11]$$

It is clear that we can eliminate *capitalised maintenance costs* from [11], and thus our final equation is:

$$V_{equity} + \frac{annual\ fee}{r_D(1-T)} = value\ of\ housing\ services \quad [12]$$

Assuming constant nominal fee,⁷ we define the *capitalised annual fee* as:

$$\text{capitalised annual fee} \equiv \frac{\text{annual fee}}{r_D(1-T)}$$

Hence,

$$V_{\text{equity}} = \text{value of housing services} - \text{capitalised annual fee} \quad [13]$$

The *value of housing services* is not possible to observe directly. Therefore we will use a hedonic model, as described in Rosen’s classical paper from 1974, to approximate it. The hedonic hypothesis is that “goods are valued for their utility-bearing attributes or characteristics” (Rosen, 1974). This means that a good is described by n objectively measured characteristics. Therefore any good is represented by a vector of coordinates $z = (z_1, z_2, \dots, z_n)$, where z_i measures the amount of the i^{th} characteristic contained in each good. In a working market, the price paid of for the good will be $p(z) = p(z_1, z_2, \dots, z_n)$. (Rosen, 1974)

In line with Poterba we believe that apartments can indeed be treated as tied packages of characteristics such as size, location and age. (Poterba, 1984) Therefore we will use the hedonic model $F(X)$, where X is a vector of quality factors, to approximate the *value of housing services*. The literature gives little guidance on the appropriate form of $F(X)$, why different forms will be tested in the thesis. (Berger, 1998)

In mathematical terms, [13] thus becomes:

$$V_{\text{equity}} = F(X) - \gamma CAF, \quad [14]$$

where CAF is the *capitalised annual fee* and γ is the capitalisation coefficient, i.e. representing the extent to which the annual fees are capitalised into the price. $\gamma = 1$ represents full capitalisation. Here it might be in place to stress that in this thesis we take the market values, i.e. the macro-level, as given. What we in effect investigate is whether, given two objects that only differ in question of monthly fee, the difference in the present

⁷ This will be tested in *Section 5.1* by relaxing the assumption regarding constant maintenance costs

value of these monthly fees is correctly reflected in the difference in purchasing price. Another implication of the micro perspective is that expectations about rising or falling overall price levels in the future and possible risk-premiums will already be included in the given market valuation (represented by $F(X)$).

2.3 Hypothesis

The null hypothesis of this thesis is that buyers of apartments in the greater Stockholm area are rational from a financial perspective, in the respect that the price paid correctly reflects the value of the housing services, the apartment's share of the tenants' association's debt and the present value of future maintenance fees. Specifically:

$$H_0: \gamma = 1$$

$$H_1: \gamma \neq 1$$

3 Data and Methodology

3.1 Sample and Data

Sales of owner-occupied houses (as opposed to apartments) and recreational houses are in Sweden registered by law, and this statistics is provided by Statistics Sweden. However, there is no such registration of transactions of apartments, which makes data difficult to obtain. Previous studies on transactions of apartments in Sweden have relied on data provided by individual real estate agents, leading to limited samples. Since 2004, the leading representatives of the Swedish real estate agency industry – including Mäklarsamfundet,⁸ Föreningssparbankens Fastighetsbyrå and Svensk Fastighetsförmedling⁹ – formed the organisation Mäklarstatistik¹⁰ collecting information about all transactions of apartments handled by the associated organisations. Not all real estate agents in Sweden report to Mäklarstatistik, but with around 70 per cent of all

⁸ The Association of Swedish Real Estate Agents

⁹ Two of Sweden's largest real estate agents

¹⁰ Swedish for "Real estate agent statistics"

transactions the database should be considered to give a good representation of the entire Swedish market.

On commission by Mäklarstatistik, the data is processed and handled by a commercial company called Värderingsdata. The CEO of Värderingsdata, Berndt Ringdahl, was very generous to provide us with all the transactions in the municipality of Stockholm in their database during the period 2 January 2005 to 3 April 2006 (i.e. 16 months). This sample included in total 10 768 transactions. For commercial issues, the data had been made anonymous in the respect that it is not possible to identify exactly which apartment an observation refers to (i.e. street name and number have been removed) nor which real estate agent handled the transaction.

The following variables are included in the dataset:

Variable	Description
Parish	The parish in which the apartment is located (total of 28)
Area	The size of the apartment measured in m ²
Rooms	The number of rooms, excl. kitchen, bathroom and hall
Price	The price paid for the apartment in SEK
Monthly fee	The monthly fee to the tenants' association at the time of sale, in SEK
Monthly fee incl. heating	The monthly fee to the tenants' association including cost of heating, if this is not already included in the monthly fee
Balcony	If the apartment has one, or more, balcony(s) [true or false]
Construction year	The year the building was constructed
Elevator	If the building has an elevator [true or false]
Contract date	The date the purchase contract was signed
Admission date	The date from which the acquirer has the right to use the apartment
Postal code	The postal code for the area in which the apartment is located
Floor	The floor on which the apartment is situated
Number of floors	The total number of floors in the building

For the variables Monthly fee incl. heating, Balcony, Elevator, Floor and Number of floors there was a substantial number of missing observations, why we decided to exclude these variables from further testing. Regarding which date to use, we have decided to use the Contract date as it is the beliefs about the interest rate prevailing at the time of signing the contract that are important for determining which discount rate to use. Therefore, the Admission date was also excluded. As there were observations missing also

for Postal code but none for Parish, we chose to approximate the value of the location of an apartment by its parish. For some of the observations there was also data missing for Rooms, Monthly Fee, and/or Building Year. Having eliminated these observations from the sample we were left with 9 812 observations, which must be considered an extensive sample. A summary can be seen in *Table 1*.

Table 1
Description of data set

	Number of observations	Action
Start	10 768	
Parish missing	0	<i>None</i>
Area missing	0	<i>None</i>
Rooms missing	33	<i>Delete observations</i>
Price missing	0	<i>None</i>
Monthly fee missing	36	<i>Delete observations</i>
Monthly fee incl. heating missing	162	<i>Drop variable</i>
Balcony missing	6 769	<i>Drop variable</i>
Construction year missing	930	<i>Delete observations</i>
Elevator missing	1 280	<i>Drop variable</i>
Contract date missing	0	<i>None</i>
Admission date missing	0	<i>Drop variable</i>
Postal code missing	126	<i>Drop variable</i>
Floor missing	2 095	<i>Drop variable</i>
Number of floors missing	2 757	<i>Drop variable</i>
End	9 812	

Hence, we have a sample of 9 812 observations containing the following variables:

- Parish
- Area
- Rooms
- Price
- Construction year
- Contract date
- Monthly Fee

In addition, historical interest rates (3 month, 1 year, 2 years, 3 years, 4 years, 5 years, 7 years and 10 years) since January 1997 were obtained from SBAB (SBAB, 2006a). It is clear that the Price should increase with the Area of the apartment and that it should decrease with the Monthly fee. We believe that the Parish should explain a large part of the unobservable housing value – an apartment is naturally more attractive if it, *ceteris paribus*, is located close to the city centre than in the outskirts. Rooms are important to include in the model since it is known that studios and two-room apartments are sold for higher prices per square metre than larger apartments, *ceteris paribus*. Therefore we expect the coefficients of dummy variables related to the number of rooms to have positive

values for few rooms, and then fall as the number of rooms increase. Regarding construction year, the effect is unclear: older buildings usually claim a premium for their charm and uniqueness, while at the same time new buildings claim a premium for modern solutions, material choices and higher standard.

3.2 Model Specification

3.2.1 Additive Form

We first assume that $F(X)$ has additive form, i.e. $F(X) = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n$, where β_i is the coefficient of the quality variable x_i . It is not plausible, however, that e.g. the building year adds the same *absolute* value to all apartments regardless of size. Therefore we have chosen to use the price and capitalised annual fee per square metre instead of the absolute price and CAF. Continuing with the same example, this means that we assume that the age of the building adds the same value per area for all apartments in the sample. This seems reasonable also for the quality variable Number of rooms (a studio apartment is expected to have a higher per square meter price than a three-room apartment). Having said that, it would be unreasonable to expect that the quality variables building year and number of rooms would have the same *absolute* effect on the price per square metre on an apartment close to the city centre as one located in the suburbs, *ceteris paribus*. To arrive at a reasonable model we therefore make one regression, based on the additive model, for each parish.

To conclude, the additive form of the hedonic model assumes that for a given geographical region, the quality variables Building year and Number of rooms will yield the same *absolute* change in value per square metre for all apartments.

3.2.2 Multiplicative Form

A perhaps more economically intuitive form is the multiplicative. A multiplicative form implies that the coefficients calculated for the quality variables will represent the corresponding effect on housing value expressed as percentages. This is because, *ceteris paribus*, the marginal value of for example an additional room is different in absolute terms between more and less attractive locations, whereas the relative marginal value

could be argued to be the same. Hence we assume that $F(X)$ has multiplicative form, i.e. $F(X) = \alpha \cdot x_1^{\beta_1} \cdot x_2^{\beta_2} \cdot \dots \cdot x_n^{\beta_n}$, where β_i is the coefficient of the quality variable x_i . As the multiplicative form of the hedonic model represents relative changes in value, it is reasonable to assume that the beta parameters are constant across the different parishes. Therefore we can run one regression on the whole sample, introducing dummy variables for each region, as opposed to dividing the data set according to parish as in the additive model. This gives the benefit of being able to run the regression on a considerably larger number of observations.

We rearrange [14] into a form better suited for calculating logged values:

$$V_{equity} = F(X)/(1 + \gamma\lambda),$$

$$\text{where } \lambda \equiv \frac{CAF}{V_{equity}}$$

Taking the logs of this multiplicative form of the model thus yields

$$\ln V_{equity} = \ln \alpha + \beta \ln X - \ln(1 + \gamma\lambda), \quad [15]$$

where α is the constant term implicit in F , $\ln X$ is a vector of the hedonic quality variables and β is a coefficient vector.

In order to get an expression where γ lies outside the logarithmic term $\ln(1 + \gamma\lambda)$, and thus becomes a coefficient in the regression model, we approximate the term using a Taylor expansion. The general formula for Taylor-expansions is:

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)(x-a)^2}{2!} + \dots + \frac{f^n(a)(x-a)^n}{n!}$$

An approximation for the expression $\ln(1+x)$ using the first order Taylor expansion can be found below:

$$\ln(1+x) \approx \ln(1+x_0) + \frac{1}{1+x_0}(x-x_0)$$

$$\lim_{x_0 \rightarrow 0} \Rightarrow \ln(1+x) \approx \ln(1+x_0) + \frac{1}{1+x_0}(x-x_0) = x \quad [16]$$

Applying the same calculations as in [16] to approximate the expression $\ln(1 + \gamma\lambda)$ we get:

$$\ln(1 + \gamma\lambda) \approx \gamma\lambda \quad [17]$$

Applying the same calculations as in [16] to approximate the expression $\ln(1 + \lambda)$ we get:

$$\ln(1 + \lambda) \approx \lambda \quad [18]$$

Substituting [18] into [17] yields:

$$\ln(1 + \gamma\lambda) \approx \gamma \ln(1 + \lambda) \quad [19]$$

It should be noted that expression [19] is exactly true (as opposed to approximately true) when $\gamma = 1$, since $\gamma = 1 \Rightarrow \ln(1 + 1 \cdot \lambda) = 1 \cdot \ln(1 + \lambda)$. This is important since under the null, full capitalization of the annual fee, i.e. $\gamma = 1$, is assumed.

Hence, the multiplicative form of the hedonic model that we will use is:

$\ln V_{equity} = \ln \alpha + \beta \ln X - \gamma \ln(1 + \lambda)$, which under the null will give exactly the same results as [15], and otherwise give approximately the same results.

3.3 Regression Models

3.3.2 Choice of Interest Rate

As the monthly fee is discounted with an interest rate in perpetuity, the choice of interest rate has a major impact on the value of the capitalised annual fee. We have chosen two “extreme” approaches to selecting the interest rate to use. The first is a naïve martingale¹¹ approach where the prevailing three month interest rate (the “spot-rate” for homebuyers) at the time of signing the contract is assumed to hold for eternity. The second approach uses the longest possible fixed interest rate, namely that for ten years, available at the time of signing. These two approaches should cover in the extremes of buyers’ expectations as they are at opposite ends of the yield curve.

¹¹ The conditional expected value of the next observation, given all of the past observations, is equal to the last observation

3.3.2 Dummy Variables

The effect on price per square meter by the number of rooms is greatest for small apartments. We argue that for larger, “family” apartments whether there are three or five rooms does not affect the square meter price. However, there might be some differences for very large, luxury apartments. Therefore we constructed the following dummy variables:

Ro1: Value of 1 if one room

Ro2: Value of 1 if two rooms

Ro3to5: Value of 1 if three, four or five rooms

Apartments with six rooms or more are captured by the omitted dummy variable, i.e. when *Ro1*, *Ro2* and *Ro3to5* all have the value zero.

We do not include the construction year as an explanatory variable directly as it would imply that the year as a number *per se* affects the house value. Rather, it is the period under which the building was constructed that should have an effect as different periods represent different building styles that have varying perceived values. The construction years were therefore divided into periods, with assigned dummy variables. We argue that houses constructed prior to 1920 (i.e. including national romanticism and prior styles) are seen as “old” and should receive the same premium. Newer buildings were divided into 20-year periods. Hence, the following dummy variables were constructed:

Pre1920: Value of 1 if Construction year < 1920

y20to40: Value of 1 if $1920 \leq \text{Construction year} < 1940$

y40to60: Value of 1 if $1940 \leq \text{Construction year} < 1960$

y60to80: Value of 1 if $1960 \leq \text{Construction year} < 1980$

Buildings constructed in 1980, or later, are represented when the dummy variables above all have the value zero.

Finally, dummy variables for each parish were constructed. For the interested reader the general area in which the parish is located is also provided. The 28 parishes are:

Parish	Area	Parish	Area
Adolf Fredrik	City	Katarina	City
Bromma	Västerort	Kista	Västerort
Brännkyrka	Söderort	Kungsholm	City
Domkyrkoförsamlingen	City	Maria Magdalena	City
Engelbrekt	City	Matteus	City
Enskede	Söderort	Oscar	City
Essinge	City	Skarpnäck	Söderort
Farsta	Söderort	Skärholmen	Söderort
Gustav Vasa	City	Sofia	City
Hedvig Eleonora	City	Spånga	Västerort
Hägersten	Söderort	S:t Göran	City
Hässelby	Västerort	Vantör	Söderort
Högalid	City	Vällingby	Västerort
Johannes	City	Västerled	Västerort

All parishes contained more than 100 observations apart from Domkyrkoförsamlingen (29) and Skärholmen (63). We chose Skärholmen as the omitted parish among the dummy variables.

3.3.3 Additive Form

As described in *Section 3.2.1* regressions were run for the data corresponding to each parish separately (using the dummy variables to identify which observations to include in each regression). The regressions run were (using the three month and ten year interest rates, respectively):

$$P_Area_i = \alpha_i + \beta_1 Ro1_i + \beta_2 Ro2_i + \beta_3 Ro3to5_i + \beta_4 pre1920_i + \beta_5 y20to40_i + \beta_6 y40to60_i + \beta_7 y60to80_i + \gamma_i CAF3mo_i + u_i$$

$$P_Area_i = \alpha_i + \beta_1 Ro1_i + \beta_2 Ro2_i + \beta_3 Ro3to5_i + \beta_4 pre1920_i + \beta_5 y20to40_i + \beta_6 y40to60_i + \beta_7 y60to80_i + \gamma_i CAF10yr_i + u_i$$

P_Area is the price paid per square meter. CAF is the capitalised annual fee per square meter, and calculated as described in *Section 2.1*. It should be noted that as the CAF should be subtracted from the housing value, under the null we expect γ to centre on *minus* unity when interpreting the regression results. These two regressions were run 28 times each (once for each parish), resulting in 56 regression models.

3.3.4 Multiplicative Form

For the multiplicative form, two regressions were run, one with the three month interest rate and one with the ten year interest rate:

$$\begin{aligned}
 \ln P_Area_i = & \ln \alpha_i + \beta_1 Domkyrkoforsamligen_i + \beta_2 Johannes_i + \beta_3 Adolf_Fredrik_i \\
 & + \beta_4 Gustav_Vasa_i + \beta_5 Matteus_i + \beta_6 Engelbrekt_i + \beta_7 Hedvig_Eleonora_i + \beta_8 Oscar_i \\
 & + \beta_9 Maria_Magdalena_i + \beta_{10} Hogalid_i + \beta_{11} Katarina_i + \beta_{12} Sofia_i + \beta_{13} Kungsholmen_i \\
 & + \beta_{14} St_Goran_i + \beta_{15} Brannkyrka_i + \beta_{16} Vantor_i + \beta_{17} Farsta_i + \beta_{18} Bromma_i + \beta_{19} Essinge_i \\
 & + \beta_{20} Vasterled_i + \beta_{21} Vallingby_i + \beta_{22} Enskede_i + \beta_{23} Skarpnack_i + \beta_{24} Hasselby_i \\
 & + \beta_{25} Hagersten_i + \beta_{26} Spanga_i + \beta_{27} Kista_i + \beta_{28} Ro1_i + \beta_{29} Ro2_i + \beta_{30} Ro3to5_i + \beta_{31} pre1920_i \\
 & + \beta_{32} y20to40_i + \beta_{33} y40to60_i + \beta_{34} y60to80_i + \gamma_i \ln 1plusLambda3mo_i + u_i
 \end{aligned} \tag{20}$$

$$\begin{aligned}
 \ln P_Area_i = & \ln \alpha_i + \beta_1 Domkyrkoforsamligen_i + \beta_2 Johannes_i + \beta_3 Adolf_Fredrik_i \\
 & + \beta_4 Gustav_Vasa_i + \beta_5 Matteus_i + \beta_6 Engelbrekt_i + \beta_7 Hedvig_Eleonora_i + \beta_8 Oscar_i \\
 & + \beta_9 Maria_Magdalena_i + \beta_{10} Hogalid_i + \beta_{11} Katarina_i + \beta_{12} Sofia_i + \beta_{13} Kungsholmen_i \\
 & + \beta_{14} St_Goran_i + \beta_{15} Brannkyrka_i + \beta_{16} Vantor_i + \beta_{17} Farsta_i + \beta_{18} Bromma_i + \beta_{19} Essinge_i \\
 & + \beta_{20} Vasterled_i + \beta_{21} Vallingby_i + \beta_{22} Enskede_i + \beta_{23} Skarpnack_i + \beta_{24} Hasselby_i \\
 & + \beta_{25} Hagersten_i + \beta_{26} Spanga_i + \beta_{27} Kista_i + \beta_{28} Ro1_i + \beta_{29} Ro2_i + \beta_{30} Ro3to5_i + \beta_{31} pre1920_i \\
 & + \beta_{32} y20to40_i + \beta_{33} y40to60_i + \beta_{34} y60to80_i + \gamma_i \ln 1plusLambda10yr_i + u_i
 \end{aligned} \tag{21}$$

$\ln 1plusLambda$ is, as the name implies, calculated as $\ln(1 + \lambda)$, where $\lambda \equiv \frac{CAF}{V_{equity}}$. When

calculating λ we cannot use the observed actual prices as the value of equity as this would result in obvious endogeneity problem as the sales price would be present in both the dependent and explanatory side of the equation. Employing an approach used by Berger *et al.* we handle this issue by estimating the hedonic price equation [20] (or [21]) excluding the capitalised annual fee ($\ln 1plusLambda$) from the explanatory variables. Consequently we calculate λ based on the estimated price from this regression, instead of the actual price, eliminating the problem. (Berger *et al.*, 1998)

4 Results

In this section we focus on reporting the results from our testing. Detailed discussion takes place in *Section 8*. The significance levels reported in the following tables refer to the rejection of a null hypothesis of a coefficient being equal to zero (i.e. not having any

explanatory value). The rejection, or support, of the actual null hypothesis of the thesis (i.e. of full capitalisation) will be discussed later on in *Section 8*.

4.1 Additive Form

As described in *Section 3.2.1* the additive model was regressed for, or “clustered by”, each parish. The result from these regressions, using the three month borrowing rate to capitalize the fee, can be found in *Table 2* below. The statistics reported in *Table 2* contain the R^2 and the capitalisation coefficient together with its respective t -value for each separate regression.

Looking at *Table 2* we find that for 9 out of the 28 different area regressions, that are based on the three month interest rate, we end up with a capitalisation coefficient that is not significant at the 5% level. Furthermore we observe three positive coefficients; as discussed in *Section 2.2* the capitalisation coefficients are expected to be negative. However, none of these three positive coefficients are significant at the 5% level. Looking at the R^2 values they seem to differ quite substantially between the different areas, however all in all they appear to indicate a fairly poor degree of explanation from the additive model. It should however be mentioned that an alternative explanation for the low degree of explanation is that it might be a result of too few observations in each of the separate areas.

Having regressed the additive model using the three month interest rate we then proceeded by running the same regression using the ten year interest rate instead. The results from these regressions can also be found in *Table 2*. Looking at the results we observe seven areas where the capitalisation coefficients are not significant at the 5% level. We also observe three positive capitalization coefficients; however none of them are significant at the 5% level. Looking at the R^2 s they are fairly similar to the R^2 values found for the three month rate. This seems reasonable since the value for the explanatory variable CAF is a linear function of the interest rate and hence a change in the interest rate should not give any large differences in explanatory value when estimating a linear regression. All the change should ideally be captured in the capitalisation coefficient given that the difference between the two different rates was constant over time. However, the

two rates have not been changed at the same time historically, why the relationship between the capitalisation coefficients is not exactly linear.

Table 2
Regression results for additive form clustered by parish

	Three Month Interest Rate			Ten Year Interest Rate		
	Capitalisation coefficient		R ²	Capitalisation coefficient		R ²
Kista (218 observations)	-0.02	(-0.36)	0.14	-0.02	(-0.26)	0.14
Spånga (160)	-0.19**	(-3.31)	0.55	-0.39**	(-3.64)	0.55
Skärholmen (63)	-0.12	(-1.31)	0.11	-0.07	(-0.37)	0.08
Hägersten (702)	-0.16**	(-5.64)	0.27	-0.35**	(-6.96)	0.29
Hässelby (119)	0.12	(1.35)	0.22	0.27	(1.68)	0.23
Skarpnäck (487)	-0.18**	(-3.81)	0.38	-0.40**	(-4.76)	0.39
Enskede (617)	-0.17**	(-6.27)	0.17	-0.36**	(-7.73)	0.20
Vällingby (103)	-0.14**	(-2.9)	0.64	-0.37**	(-4.65)	0.68
Västerled (269)	-0.25**	(-4.87)	0.23	-0.48**	(-5.39)	0.24
Essinge (151)	-0.19**	(-3.02)	0.29	-0.37**	(-3.27)	0.29
Bromma (484)	-0.43**	(-15.4)	0.56	-0.77**	(-16.36)	0.58
Farsta (159)	-0.14*	(-2.62)	0.17	-0.27**	(-2.94)	0.18
Vantör (307)	-0.13**	(-2.75)	0.49	-0.29**	(-3.32)	0.50
Brännkyrka (336)	-0.02	(-0.63)	0.31	-0.06	(-0.85)	0.31
St Göran (946)	-0.23**	(-8.89)	0.18	-0.44**	(-10.06)	0.20
Kungsholm (558)	-0.11**	(-2.83)	0.28	-0.25**	(-3.68)	0.29
Sofia (377)	-0.06	(-1.65)	0.05	-0.16*	(-2.34)	0.05
Katarina (494)	0.03	(0.75)	0.10	0.03	(0.40)	0.10
Högalid (621)	0.02	(0.54)	0.07	0.00	(0.04)	0.07
Maria Magdalena (305)	-0.20**	(-5.77)	0.53	-0.37**	(-6.21)	0.54
Oscar (596)	-0.16**	(-4.08)	0.25	-0.33**	(-4.65)	0.26
Hedvig Eleonora (162)	-0.14*	(-2.06)	0.05	-0.24*	(-2.15)	0.05
Engelbrekt (305)	-0.35**	(-4.53)	0.19	-0.70**	(-5.39)	0.21
Matteus (668)	-0.07*	(-2.11)	0.08	-0.17**	(-2.75)	0.08
Gustav Vasa (212)	-0.08	(-1.34)	0.13	-0.15	(-1.56)	0.13
Adolf Fredrik (161)	-0.17**	(-2.78)	0.09	-0.35**	(-3.28)	0.11
Johannes (203)	-0.17*	(-2.5)	0.18	-0.31**	(-2.70)	0.19
Domkyrkoförsamlingen (29)	-0.19	(-1.63)	0.68	-0.43*	(-2.34)	0.71

Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses

4.2 Multiplicative Form

As described in Section 3.2.2 we also considered a multiplicative form for our model as this is the most intuitive approach. The results from our multiplicative regression can be found below in Table 3.

Table 3
Regression results from multiplicative form

	3 Month Interest	10 Year Interest
Domkyrkoförsamlingen	0.755** (13.1)	0.643** (11.3)
Johannes	0.707** (17.8)	0.588** (14.8)
Adolf Fredrik	0.722** (17.7)	0.604** (14.7)
Gustav Vasa	0.719** (18.1)	0.601** (15.1)
Matteus	0.709** (19.1)	0.590** (15.8)
Engelbrekt	0.691** (18.3)	0.577** (15.2)
Hedvig Eleonora	0.802** (19.6)	0.683** (16.6)
Oscar	0.786** (21.2)	0.664** (17.8)
Maria Magdalena	0.725** (19.2)	0.611** (16.1)
Högalid	0.687** (18.8)	0.574** (15.6)
Katarina	0.730** (19.7)	0.614** (16.5)
Sofia	0.696** (18.6)	0.576** (15.3)
Kungsholm	0.757** (20.3)	0.639** (17.1)
St Göran	0.696** (19.3)	0.581** (16.0)
Brännkyrka	0.171** (4.9)	0.115** (3.4)
Vantör	0.069* (2.0)	0.036 (1.1)
Farsta	0.175** (4.7)	0.120** (3.2)
Bromma	0.311** (9.1)	0.243** (7.1)
Essinge	0.672** (16.6)	0.555** (13.7)
Västerled	0.509** (13.7)	0.410** (11.0)
Vällingby	0.190** (4.7)	0.133** (3.3)
Enskede	0.409** (11.9)	0.329** (9.6)
Skarpnäck	0.296** (8.7)	0.232** (6.8)
Hässelby	0.154** (3.9)	0.102** (2.6)
Hägersten	0.411** (12.0)	0.325** (9.5)
Spånga	-0.008 (-0.2)	-0.015 (-0.4)
Kista	0.057 (1.6)	0.050 (1.4)
Rol	0.137** (4.2)	0.149** (4.6)
Ro2	0.071* (2.2)	0.084* (2.6)
Ro3to5	0.044 (1.3)	0.051 (1.6)
pre1920	0.115** (9.2)	0.071** (5.7)
y20to40	0.096** (8.8)	0.057** (5.2)
y40to60	0.106** (9.6)	0.061** (5.4)
y60to80	-0.032* (-2.4)	-0.074** (-5.6)
ln1plusLambda	-0.548** (-26.9)	-0.859** (-31.5)
_cons	9.979** (182.8)	10.137** (186.3)
R ²	0.7488	0.7551
Adj-R ²	0.7479	0.7542

*Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses*

What is important to keep in mind when interpreting the coefficients from the multiplicative regression is that they are expressed as logarithms. Hence in order to interpret their impact in term of percent on the dependent variable, in our case the price

per square meter, we need to calculate the exponential values. As an example, we interpret the impact on price by location in the three month interest regression. To compare an apartment situated in Hedvig Eleonora to the base price, which in our case is the price for an apartment situated in Skärholmen, we need to calculate $e^{\text{coefficient}_{\text{Hedvig_Eleonora}}} = e^{0.802} = 2.230$. We can now interpret this as a square meter of apartment space in Hedvig Eleonora being 123 percent more expensive compared to a square meter of apartment space in Skärholmen, *ceteris paribus*. Looking at the coefficients from the regression, based on the three months rate, we find that all the coefficients except three are significant at the 5% level. Looking at the area coefficients we observe the signs and relative size as we initially had expected; the price per square meter rises the more central is the location. Observing the coefficients describing the number of rooms we also find that their relative size is as we had expected; apartment space is more expensive in an apartment with fewer rooms relative to an apartment with more rooms. When looking at the coefficients for the different construction periods they appear to be line with our initial belief. Age is a priced factor, i.e. apartment space in houses built before 1960 is relatively more expensive than newer houses.

Looking at both the adjusted and the standard R²s they appear fairly high indicating that our model has been able to explain a large part of the variation in price per square meter. This together with only a few coefficients not being significant points to the model being fairly good at capturing the underlying relationship.

Having regressed the multiplicative model using the three month interest rate we then proceeded by running the same regression using the ten year interest rate instead. The results from this regression are also found in *Table 3*. Looking at the results we can conclude that they are fairly similar to the result from the three-month regression with regard to the number of significant coefficients and value for normal and adjusted R²s. The biggest difference is found in the size of the capitalization coefficient which is considerably higher using the ten year interest rate compared to the three month. This seems reasonable as we would expect the capitalization coefficient to grow as a result from the lower absolute value of the capitalized fee caused by the increase in interest rate. There is however also a difference in absolute values for the rest of the coefficients as most

of the coefficients when using the three month rate are higher in absolute terms compared to when using the ten year rate. The coefficients' relative relationships seem however to be unchanged and follow our initial beliefs about sign and relative size.

5 Robustness Checks

In this section we will present the results from a number of stress-tests performed on our underlying model. As the regression result to a large extent are dependent upon the choice of model specifications we felt that it was important to verify whether the models were robust to changes in the underlying assumptions. We will thus in this section loosen some of the assumptions from the previous sections to check how this will impact our results.

5.1 Growth in Maintenance Costs

In *Section 2.1* where we derive our underlying model we make a simplifying assumption that we are able to capitalize the annual fee by the after-tax nominal borrowing rate. It is however also mentioned in the same section that the annual fee actually consists of two parts, namely the annual maintenance costs and the tenants' association's interest cost. It can further be argued that while it is correct to capitalise the interest cost with the after-tax nominal borrowing rate,¹² the maintenance cost should in fact when capitalised be adjusted for inflation. To test whether or not this will have a strong impact on our results we have in this section tried to approximate a model where this is taken into consideration. As there was no data on neither debt nor cost structure for the tenants' association in our data-set we chose an alternative way to approximate a reasonable level of maintenance cost per square meter for any given tenants' association. By looking through current housing ads searching for the key-word "debt free tenants' association"¹³ we gathered a sample of apartments where the monthly fee could be argued only went to paying maintenance costs as the interest cost by definition had to be zero. Having gathered this sample we calculated the average monthly fee per square meter to be 32 SEK. We then proceed by using this as our proxy for maintenance costs for any given

¹² The capitalised interest cost is equal to the nominal present value of the outstanding debt; see *Section 2.2*.

¹³ *Sw*: "skuldfri förening"

apartment and hence assumed that the remaining part of the fee went to interest payments.

Now that we had divided each apartment's fee into these two components we then capitalised them individually. The interest part was capitalised using the after-tax nominal borrowing rate and the maintenance cost part was capitalised using the after tax borrowing rate adjusted for inflation. We used both the long ten year and the short three month interest rates to get robust results. Where we used the three month borrowing rate we used the actual inflation rate at the contract date (i.e. a naïve martingale approach) and where we used the ten year rate we used the Swedish Central Bank's inflation target of 2%. (Sveriges Riksbank, 2004) We used our new calculated values for the capitalised annual fee to test all four of our previous regressions. The results from these regressions can be found below in *Tables 4-5*.

Table 4
Regression results for additive form clustered by area using inflation adjusted capitalised annual fee

	Three Month Interest Rate			Ten Year Interest Rate		
	Capitalisation coefficient		R ²	Capitalisation coefficient		R ²
Kista	0.02	(0.76)	0.14	0.03	(0.66)	0.14
Spånga	-0.02	(-0.59)	0.51	-0.10	(-1.76)	0.52
Skärholmen	-0.02	(-0.53)	0.08	-0.03	(-0.56)	0.08
Hägersten	0.01	(0.58)	0.24	-0.08*	(-2.37)	0.25
Hässelby	0.05	(1.30)	0.22	0.09	(1.46)	0.22
Skarpnäck	0.05	(1.60)	0.37	-0.06	(-1.29)	0.37
Enskede	0.04	(1.84)	0.13	-0.04	(-1.23)	0.12
Vällingby	0.01	(0.21)	0.61	-0.07	(-1.45)	0.61
Västerled	-0.03	(-0.85)	0.16	-0.18**	(-3.02)	0.19
Essinge	0.01	(0.2)	0.24	-0.12	(-1.69)	0.26
Bromma	-0.17**	(-7.28)	0.4	-0.32**	(-8.49)	0.42
Farsta	-0.04	(-1.18)	0.14	-0.03	(-0.47)	0.13
Vantör	0.02	(0.81)	0.48	-0.01	(-0.16)	0.48
Brännkyrka	0.03	(1.63)	0.32	0.01	(0.49)	0.31
St Göran	0.00	(-0.02)	0.12	-0.12**	(-3.70)	0.13
Kungsholm	0.02	(0.74)	0.26	-0.02	(-0.45)	0.26
Sofia	0.10**	(3.82)	0.07	0.06	(1.38)	0.05
Katarina	0.16**	(5.91)	0.16	0.17**	(3.74)	0.13
Högalid	0.16**	(6.53)	0.13	0.12**	(2.78)	0.09
Maria Magdalena	-0.03	(-1.10)	0.48	-0.13**	(-2.93)	0.49
Oscar	0.04	(1.33)	0.23	-0.06	(-1.33)	0.23
Hedvig Eleonora	0.00	(0.06)	0.02	0.01	(0.10)	0.02
Engelbrekt	0.04	(0.72)	0.13	-0.14	(-1.62)	0.14
Matteus	0.10**	(4.6)	0.1	-0.03	(-0.79)	0.07
Gustav Vasa	0.07	(1.61)	0.13	0.01	(0.19)	0.12
Adolf Fredrik	-0.02	(-0.32)	0.05	-0.11	(-1.32)	0.06
Johannes	0.02	(0.49)	0.16	0.06	(0.87)	0.16
Domkyrkoförsamlingen	-0.05	(-0.51)	0.64	-0.20	(-1.39)	0.67

*Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses*

Table 5
Regression results from stress-testing multiplicative form

	Inflation adjusted		Optimised Interest
	3 Month Interest	10 Year Interest	
Domkyrkoförsamlingen	1.114** (18.9)	0.876** (14.4)	0.606** (10.6)
Johannes	1.089** (27.4)	0.847** (19.6)	0.554** (13.9)
Adolf Fredrik	1.118** (27.3)	0.874** (19.7)	0.568** (13.9)
Gustav Vasa	1.108** (27.9)	0.869** (20.1)	0.564** (14.2)
Matteus	1.099** (29.7)	0.858** (21.0)	0.554** (14.8)
Engelbrekt	1.048** (27.5)	0.822** (19.9)	0.542** (14.2)
Hedvig Eleonora	1.204** (29.3)	0.950** (21.2)	0.647** (15.8)
Oscar	1.180** (31.9)	0.929** (22.6)	0.629** (16.8)
Maria Magdalena	1.091** (28.7)	0.855** (20.6)	0.575** (15.1)
Högalid	1.051** (28.7)	0.820** (20.4)	0.539** (14.7)
Katarina	1.103** (29.8)	0.864** (21.2)	0.580** (15.6)
Sofia	1.068** (28.5)	0.832** (20.3)	0.539** (14.3)
Kungsholm	1.140** (30.6)	0.894** (21.7)	0.603** (16.1)
St Göran	1.062** (29.4)	0.829** (20.8)	0.547** (15.0)
Brännkyrka	0.299** (8.4)	0.220** (6.1)	0.098** (2.9)
Vantör	0.130** (3.7)	0.090* (2.5)	0.029 (0.9)
Farsta	0.314** (8.2)	0.232** (6.0)	0.100** (2.7)
Bromma	0.490** (13.9)	0.373** (10.4)	0.222** (6.5)
Essinge	1.034** (25.3)	0.806** (18.4)	0.519** (12.8)
Västerled	0.806** (21.4)	0.619** (15.5)	0.377** (10.1)
Vällingby	0.330** (8.0)	0.242** (5.8)	0.118** (3.0)
Enskede	0.635** (18.1)	0.486** (13.3)	0.303** (8.8)
Skarpnäck	0.459** (13.1)	0.349** (9.8)	0.211** (6.2)
Hässelby	0.301** (7.5)	0.215** (5.3)	0.082* (2.1)
Hägersten	0.651** (18.6)	0.498** (13.6)	0.298** (8.7)
Spånga	-0.015 (-0.4)	-0.011 (-0.3)	-0.016 (-0.5)
Kista	0.044 (1.2)	0.041 (1.1)	0.049 (1.4)
Ro1	0.062 (1.8)	0.081* (2.4)	0.153** (4.7)
Ro2	-0.004 (-0.1)	0.022 (0.7)	0.087** (2.7)
Ro3to5	-0.008 (-0.2)	0.012 (0.4)	0.053 (1.6)
pre1920	0.284** (23.6)	0.206** (15.9)	0.059** (4.7)
y20to40	0.229** (21.6)	0.166** (14.7)	0.046** (4.2)
y40to60	0.252** (23.5)	0.182** (15.6)	0.047** (4.2)
y60to80	0.108** (8.4)	0.054** (4.1)	-0.086** (-6.5)
ln1plusLambda	-0.068** (-4.2)	-0.360** (-13.3)	-1.000** (-32.9)
_cons	9.277** (170.1)	9.760** (150.8)	10.180** (187.7)
Interest add-on	n.a.	n.a.	269bp
R ²	0.7307	0.7350	0.7572
Adj-R ²	0.7298	0.7341	0.7563

*Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses*

5.2 Implicit Interest Rates

Perhaps the most critical assumption throughout our model is the choice of interest rate to capitalise the fee by. It is no surprise that the absolute level of the interest rate will have a strong effect on the capitalisation coefficient in the regression models. We have so far taken this fact into consideration by testing all regressions with both the shortest available borrowing rate, i.e. the three month rate, and by the longest available borrowing rate, i.e. the ten year rate. We will however in this section go about testing the robustness of the results with regards to the interest rate in another fashion. Rather than testing different interest rates we will instead take our hypothesis of full capitalisation, i.e. a capitalisation coefficient of -1 , as given and then back-solve the appropriate interest rate.

For the additive form this is fairly straight forward to do as the relationship between the dependent variable price per square meter and the capitalisation coefficient is strictly linear. If we get a capitalisation coefficient of x using the rate r we can simple solve for the implicit market interest rate by multiplying r with $1/x$ as this will increase/decrease the rate enough to decrease/increase the capitalised annual fee sufficiently to arrive at a capitalisation coefficient of -1 . The interest rates were back-solved using the average interest rates¹⁴ during the estimation period. When we back-solved the interest rate from the multiplicative regression we did it through a trial and error process were we added/subtracted a constant term to/from the three month borrowing rate and then adjusted this new rate for taxes in such a way that we reached a capitalisation coefficient of -1 . The back-solved implicit interest rates can be found above in *Table 5* for the multiplicative form, expressed as an add-on to the three month rate, and below in *Table 6* for the additive form, expressed as an absolute value.

¹⁴ Average three month rate was 2.72% and average ten year rate was 4.51% (SBAB, 2006a)

Table 6
Implicit interest rates for the additive model clustered by area

	Three Month Interest		Ten Year Interest	
	Capitalisation Coefficient	Implicit Interest Rate	Capitalisation Coefficient	Implicit Interest Rate
Kista	-0.02	136%	-0.02	226%
Spanga	-0.19	14%	-0.39	12%
Skarholmen	-0.12	23%	-0.07	64%
Hagersten	-0.16	17%	-0.35	13%
Hasselby	0.12	n.a.	0.27	n.a.
Skarpnack	-0.18	15%	-0.40	11%
Enskede	-0.17	16%	-0.36	13%
Vallingby	-0.14	19%	-0.37	12%
Vasterled	-0.25	11%	-0.48	9%
Essinge	-0.19	14%	-0.37	12%
Bromma	-0.43	6%	-0.77	6%
Farsta	-0.14	19%	-0.27	17%
Vantor	-0.13	21%	-0.29	16%
Brannkyrka	-0.02	136%	-0.06	75%
St_Goran	-0.23	12%	-0.44	10%
Sofia	-0.11	25%	-0.25	18%
Kungsholm	-0.06	45%	-0.16	28%
Katarina	0.03	n.a.	0.03	n.a.
Hogalid	0.02	n.a.	0.00	n.a.
Maria_Magdalena	-0.20	14%	-0.37	12%
Oscar	-0.16	17%	-0.33	14%
Hedvig_Eleonora	-0.14	19%	-0.24	19%
Engelbrekt	-0.35	8%	-0.70	6%
Matteus	-0.07	39%	-0.17	27%
Gustav_Vasa	-0.08	34%	-0.15	30%
Adolf_Fredrik	-0.17	16%	-0.35	13%
Johannes	-0.17	16%	-0.31	15%
Domkyrkoforsamlingen	-0.19	14%	-0.43	10%

5.3 Amortisations

Another problem also discussed in *Section 2.2* is the fact that the observed fee might, besides maintenance and interest cost, also contain amortisations of the association's debts. As these are not actual costs, but merely a financial transaction substituting debt for equity, they should therefore be adjusted for. As we could not observe their actual size we in this section want to test for how influential they might be to the end results. We will do this by assuming that investors fully capitalise the actual, amortisation adjusted, annual fee by the three month interest rate and from this derive the implicit

amortisations. The amortisations are expressed as a fraction of the actual non-adjusted annual fee. Specifically:

$$1 - \text{amortisation coefficient} = \frac{\left[\frac{\text{annual fee}}{(1 - T) \cdot \text{implicit market interest rate}} \right]}{\left[\frac{\text{annual fee}}{(1 - T) \cdot r_{3mo}} \right]} \quad [22]$$

where the *implicit market rate* is that which was back-solved in the previous section. The average implicit amortisation coefficient for the multiplicative model was equal to 49.79%. This would mean that around half of the monthly fee consists of amortisations of the association's debt.

6 Final Choice of Model Form

The first part of this thesis focused on developing an economically and econometrically sound model that we could use to test the behaviour of buyers of apartments. The *a priori* favoured model was the multiplicative form because it, as pointed out in *Section 3.2.2*, assumes relative rather than absolute changes in value. It is intuitive that the effects of the factors included in our regression should have a multiplicative effect on value. As an illustration, the marginal value of an extra room should be affected both by the location and the construction year of the building. To some extent, we control for this by clustering the additive form of the regression by location, but this of course leads to fewer observations. Furthermore, this approach is not theoretically optimal as we would have to cluster on all the explanatory variables, which would lead to an almost infinite number of regressions with small data samples, if we wanted to control for all possible multiplicative effects. However, the effect of the capitalised annual fee is additive, and therefore it was important to test if the whole model could be regressed using the additive approach.

When regressing the additive model, as presented in *Section 4.1* the results indicated that it was not an appropriate form, as suspected. First of all, there is no reason to suspect that the rationality of buyers should differ greatly between parishes. However, this is what we see with even neighbouring parishes exhibiting large differences in capitalisation

coefficient.¹⁵ Furthermore, there are large differences in the significance of the capitalisation coefficients between the different areas, and many are not significant even at the 5% level. The explanatory power measured as R^2 is generally low indicating that the model fails to explain the differences in price per area between apartments. Looking at the value of the capitalisation coefficients they do not only differ between areas but also seem unexpectedly low. This led us to back-solve the implicit interest rates, as explained in *Section 5*, which at levels up to 226% are unrealistically high.

Proceeding to the multiplicative model, with the results presented in *Section 4.2*, we observe few coefficients that are not significant. In fact, most coefficients are significant even at the 1% level (and less). In particular, with p -values of 0.000 (see *Appendix 12.3-4*), the capitalisation coefficients are highly significant. A sign of that the model is economically correct is that the coefficients have the expected signs, which is the case in the multiplicative form of the regression. In addition to the many significant coefficients we observe a high R^2 indicating that the model is able to explain a lot of the variation in price per area between apartments. It should be noted that the models cannot be compared directly, since the additive model does not explicitly include location, which should explain much of the variation in price, as an explanatory variable. Nonetheless, considering the *a priori* economical theory and the econometrical testing we conclude that the appropriate form for the regression model is the multiplicative form.

Having chosen the multiplicative form, we now interpret the results from the stress-testing (*Section 5*). One of our concerns from *Section 2.2* was that we did not allow for that the maintenance costs could grow with inflation (see *Section 5* for discussion). If investors do expect the maintenance fees to grow and we did not include it in our model it would lead to non-linear measurement errors, which would make the regression results unreliable. When introducing the inflation adjusted maintenance cost into the capitalised annual fee (see *Table 5*) the significance of the capitalisation coefficients decreases (drop in t -values from -26.9 and -31.5 to -4.2 and -13.3, respectively). They are however still significantly different from zero at the 1% level. Based on the drop in t -values and R^2 we

¹⁵ As an example Hedvig Eleonora and Engelbrekt are neighbouring parishes both located in the same section of the city, namely Östermalm, but the capitalisation coefficient for Engelbrekt is more than twice as high as that for Hedvig Eleonora; see *Table 2*

conclude that including an inflation-adjusted part into the capitalised annual fee does not improve the model.

7 Further Testing

Like in the *Results* section, in this section we only present the results from the further testing. Comments and analysis follow in *Section 8*. We now move away from the assumption that all investors on the market are rational. It has been showed in studies within behavioural finance that investors do have varying skills in analysing financial valuations and that financial wealth is a good proxy for these skills. This can be explained by that individuals that have a large net worth to invest have faced more investment situations than those with lower net worth, and therefore these high net worth individuals have had more practice to improve their analytical skills. There may also be a reverse causal effect where those who have superior valuation skills make superior investments and thus increase their financial wealth. Related to this topic investors have a learning curve – the more familiar they are with a certain type of transaction the more likely they are to value it correctly.

Based on these views of heterogeneous investor skills we have run the multiplicative form of the regression model clustered on number of rooms. The results are presented in *Table 7* below. We have decided to divide the observations into three groups: apartments with one room, with two rooms and with three rooms or more. We believe that buyers of single room apartments will to a greater extent be first-time-buyers, who are expected to have lower financial skills. Also, apartments with only one room have a lower total price than large apartments and therefore the average financial wealth ought to be lower for buyers of single-room apartments than for buyers of multi-room apartments. Also by dividing the data into these three groups we get roughly the same number of observations in each cluster. We also considered clustering the data per parish to capture investor sophistication through wealth effects. However, as it is likely that buyers of apartments with equal number of rooms across parishes have more characteristics in common (including age and experience from previous transactions) than buyers of apartments with varying number of rooms within a parish, it was decided that number of rooms was the

better proxy for financial sophistication.¹⁶ It should be noted that we only chose to present the results from using the three month interest rate and not the ten year rate. Instead, we proceeded to back-solve the implicit interest rate, as described in *Section 5*, for each cluster of data. These results are presented in *Table 8*. For comparison, the regression results using the ten year rate can be found in the *Appendix 12.9-11*.

Table 7

Regression results from multiplicative form clustered by number of rooms with three month rate			
	1 Room	2 Rooms	3 Rooms or More
Domkyrkoförsamlingen	1.198** (7.8)	0.773** (8.0)	0.444** (4.6)
Johannes	1.183** (8.3)	0.662** (11.3)	0.457** (6.8)
Adolf Fredrik	1.193** (8.4)	0.704** (11.5)	0.480** (6.7)
Gustav Vasa	1.163** (8.2)	0.709** (12.0)	0.480** (7.1)
Matteus	1.184** (8.5)	0.681** (12.3)	0.455** (7.2)
Engelbrekt	1.143** (8.1)	0.629** (11.3)	0.487** (7.5)
Hedvig Eleonora	1.293** (9.1)	0.760** (12.7)	0.534** (7.2)
Oscar	1.250** (9.0)	0.749** (13.6)	0.557** (8.9)
Maria Magdalena	1.248** (8.9)	0.697** (12.3)	0.463** (7.4)
Högalid	1.146** (8.3)	0.651** (12.0)	0.448** (7.0)
Katarina	1.187** (8.5)	0.686** (12.4)	0.514** (8.1)
Sofia	1.144** (8.2)	0.665** (11.8)	0.476** (7.6)
Kungsholm	1.219** (8.7)	0.726** (13.2)	0.503** (7.8)
St Göran	1.125** (8.1)	0.662** (12.4)	0.513** (8.3)
Brännkyrka	0.560** (4.1)	0.073 (1.4)	0.108 (2.0)
Vantör	0.490** (3.6)	0.034 (0.7)	-0.037 (-0.7)
Farsta	0.467** (3.3)	0.062 (1.1)	0.160** (2.7)
Bromma	0.624** (4.5)	0.291** (5.7)	0.172** (3.1)
Essinge	0.987** (7.0)	0.706** (12.0)	0.544** (7.0)
Västerled	0.768** (5.5)	0.436** (7.9)	0.458** (7.3)
Vällingby	0.663** (4.6)	0.109 (1.8)	0.075 (1.2)
Enskede	0.796** (5.8)	0.334** (6.6)	0.317** (5.7)
Skarpnäck	0.710** (5.1)	0.323** (6.4)	0.040 (0.7)
Hässelby	0.382** (2.6)	0.133* (2.2)	0.063 (1.1)
Hägersten	0.836** (6.1)	0.336** (6.6)	0.292** (5.3)
Spånga	0.322* (2.2)	-0.155** (-2.6)	0.034 (0.6)
Kista	0.264 (1.8)	0.089 (1.6)	0.055 (1.1)
pre1920	0.216** (7.6)	0.166** (8.8)	-0.014 (-0.6)
y20to40	0.192** (7.3)	0.125** (7.9)	0.016 (0.7)
y40to60	0.203** (7.5)	0.116** (7.2)	-0.002 (-0.1)
y60to80	0.132** (4.3)	-0.008 (-0.4)	-0.164** (-7.6)
ln1plusLambda	-0.148** (-4.7)	-0.489** (16.8)	-0.890** (21.1)
_cons	9.316** (64.2)	10.021** (48.6)	10.548** (28.9)
R ²	0.6841	0.7491	0.7633
Adj-R ²	0.6798	0.7472	0.7608

Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses

¹⁶ Tests of the regression clustered by parish supported this view

Table 8

Regression results with optimised interest rates from multiplicative form clustered by number of rooms

	1 Room	2 Rooms	3 Rooms or More
Domkyrkoförsamlingen	0.994** (6.4)	0.597** (6.2)	0.399** (4.2)
Johannes	0.961** (6.7)	0.490** (8.3)	0.411** (6.1)
Adolf Fredrik	0.966** (6.7)	0.530** (8.6)	0.434** (6.1)
Gustav Vasa	0.937** (6.5)	0.534** (8.9)	0.434** (6.4)
Matteus	0.959** (6.7)	0.505** (9.0)	0.409** (6.5)
Engelbrekt	0.923** (6.4)	0.459** (8.2)	0.441** (6.8)
Hedvig Eleonora	1.068** (7.4)	0.585** (9.6)	0.487** (6.6)
Oscar	1.022** (7.2)	0.572** (10.2)	0.510** (8.2)
Maria Magdalena	1.024** (7.2)	0.525** (9.1)	0.420** (6.8)
Högalid	0.925** (6.5)	0.485** (8.8)	0.404** (6.3)
Katarina	0.968** (6.8)	0.515** (9.2)	0.468** (7.4)
Sofia	0.922** (6.5)	0.484** (8.4)	0.430** (6.8)
Kungsholm	0.997** (7.0)	0.551** (9.8)	0.457** (7.1)
St Göran	0.905** (6.4)	0.493** (9.1)	0.468** (7.6)
Brännkyrka	0.402** (2.9)	-0.015 (-0.3)	0.090 (1.6)
Vantör	0.358* (2.6)	-0.022 (-0.4)	-0.044 (-0.8)
Farsta	0.308* (2.2)	-0.031 (-0.6)	0.143* (2.4)
Bromma	0.453** (3.3)	0.181** (3.6)	0.150** (2.7)
Essinge	0.766** (5.3)	0.530** (8.9)	0.500** (6.4)
Västerled	0.567** (4.0)	0.283** (5.1)	0.420** (6.7)
Vällingby	0.488** (3.3)	0.031 (0.5)	0.057 (0.9)
Enskede	0.608** (4.3)	0.212** (4.1)	0.287** (5.2)
Skarpnäck	0.547** (3.9)	0.219** (4.4)	0.019 (0.4)
Hässelby	0.223 (1.5)	0.049 (0.8)	0.045 (0.8)
Hägersten	0.641** (4.6)	0.206** (4.0)	0.261** (4.7)
Spånga	0.228 (1.6)	-0.166** (-2.9)	0.035 (0.7)
Kista	0.158 (1.1)	0.074 (1.4)	0.056 (1.1)
pre1920	0.164** (5.6)	0.105** (5.5)	-0.030 (-1.3)
y20to40	0.146** (5.5)	0.071** (4.4)	0.002 (0.1)
y40to60	0.157** (5.7)	0.052** (3.1)	-0.021 (-1.0)
y60to80	0.089** (2.9)	-0.073** (-3.3)	-0.179** (-8.3)
ln1plusLambda	-1.000** (-8.0)	-1.000** (-21.0)	-1.000** (-22.1)
_cons	9.609** (64.3)	10.260** (150.6)	10.613** (130.1)
Interest add-on	1563bp	348bp	39bp
R ²	0.690	0.758	0.766
Adj-R ²	0.685	0.756	0.764

Note: * denotes significance at the 5% level; ** denotes significance at the 1% level; t-values are found within parentheses

Using equation [22] described in Section 5.3 we also back-solved the implicit amortisation coefficients for the three clusters above. The average implicit amortisation coefficient for one room apartments was 85.20%, for two room apartments 56.22% and for apartments with three or more rooms 12.56%.

8 Analysis

Having rejected the additive form of the model (see *Section 6*) the analysis will be based on the results from the tests of the multiplicative form model. We can confirm the real estate market cliché that there are only three things that matter for the value of an apartment: location, location and location. Looking at *Table 3* we find that the area coefficients are not only highly significant, but, remembering that they represent the logged changes in value, they also have a huge impact on the price per area compared to the other quality variables. As expected, the posh district Östermalm demands the highest prices, with the parishes Hedvig Eleonora and Oscars topping the list. The other quality variables are also significant and affect the value, albeit not to the same extent as location. As expected, the price per square meter decreases as the number of rooms increases, and older buildings enjoy a certain “charm” premium – except for the period 1960-1980.

8.1 Overall Market Rationality

Content with the model, we proceed to answering the hypothesis of rationality. A key factor in testing this rationality is the interest rate used to capitalise the tenants’ association’s debt and the future maintenance costs, which together form the capitalised monthly fee. As derived in *Section 2.2*, the interest rate that should be used in the capitalisation is the nominal after-tax borrowing rate, which should be equal for both the tenants and the tenants’ association. Not knowing the loan structure for each tenant and tenants’ association we cannot tell their actual borrowing rate. Therefore we tested using both the lowest (three month) and the highest (ten year) interest rates available in the market. If investors are rational, full capitalisation should be observed using an interest rate at, or between, these two extremes. The results in *Table 3* show that this is not the case; even when using the ten year rate the capitalisation coefficient is statistically significantly lower than -1 , indicating undercapitalisation.¹⁷ Knowing this we proceeded to back-solve the implicit interest rate prevailing in the market. As shown in *Table 5*, the implicit interest rate was found to be 269 basis points above the three month interest rates. As a comparison, based on the average loan structure among SBAB’s customers, presented in the *Appendix 12.1*, we have calculated the average actual borrowing rate to

¹⁷ See *Appendix 12.4* for confidence interval

be around 24 basis points above the three month interest rate.¹⁸ If we want to be able to conclude that investors are rational we must be able to explain this large difference.

As it seems that investors are in fact not rational, we wanted to expand our testing. A popular approach within behavioural finance is to compare groups with varying degrees of financial sophistication. (Anderson, 2004) This means that we moved away from the normal assumption of a homogenous population, with respect to the ability to make financially rational decisions. As described in *Section 7*, we divided the investors into three groups: buyers of apartments with one, two and three rooms or more, respectively. When we tested this, we found that there were indeed large differences between the three groups. Firstly, there are differences in the explanatory power of the regressions, with R^2 increasing as the number of rooms increase. Secondly, the sizes of the capitalisation coefficients vary greatly, being close to zero for one room apartments, close to minus one for the three rooms or more apartments and between these two for the two room apartments. We also note a much smaller t -value for the capitalisation coefficient for the single room apartments, however significant at the 1% level. The lower t -value and R^2 in the regression for the one room cluster lead us to conclude that the capitalised annual fee lacks the same explanatory power as for the other clusters.

A possible explanation for the differences in capitalisation coefficients between the clusters is that the investors in each group face different borrowing costs. Therefore, using the same method as described in *Section 5*, we back-solved the implicit interest rates. As seen in *Table 8*, for apartments with three rooms or more the buyers have an implicit borrowing cost at 39 basis points above the three month interest rate. Compared to the estimated actual add-on of around 24 basis points, this seems reasonable. Continuing on to the two room apartments, the implicit rate lies at 348 basis points above the base rate, while it for the single room apartments is as high as 1563 basis points above the three month rate. It is hard to argue that buyers of apartments with one room should face a nominal interest rate around 18%, while the average SBAB customer faces a nominal interest rate of around 3%.

¹⁸ We assumed that the loan structure among SBAB's customers has remained constant during the estimation period and subsequently calculated the average of the difference between a weighted average of the different length interest rates and the three month rate

One of the assumptions in the model development (*Section 2.2*) was that of no amortisations. The impact of this assumption was tested in *Sections 5* and *7* where we calculated the implicit amortisation, as a ratio of the yearly fee, under the assumption that investors fully capitalise the amortisation-adjusted monthly fee at the three month interest rate. The implicit amortisation coefficient was calculated to range from 12.56% for apartments with three rooms or more to 85.20% for single room apartments, with a total sample coefficient of 49.79%. Although we do not know the actual average amortisation coefficient, we feel that these implicit levels are much higher than the true level. Furthermore, we see no reason why there should be large differences between apartments with different number of rooms, as implied from these calculations. Therefore we are confident that the results from our non-amortisation adjusted models would not have been greatly affected had we been able to adjust the monthly fee for amortisations.

Our null hypothesis was that investors are rational and fully capitalise the monthly fee into the price. From the results based on the whole sample of apartment transactions in the municipality of Stockholm we can reject this hypothesis at the 2.5% significance level, even for the highest possible borrowing rate in the market.¹⁹ The underlying model has been shown to be robust to assumptions concerning amortisations and the growth of maintenance costs, which makes us confident in the results.

Another indication of that the market is irrational is that when dividing the data into clusters based on number of rooms there are large differences in implicit interest rates, significance of capitalisation coefficients and explanatory power (measured as R^2) of the regressions. If the market was efficient, there should be no large differences between different groups of apartments. Furthermore, as it is reasonable to assume that the group of people that buy an apartment with a specific number of rooms share certain characteristics unique within the group,²⁰ it can be argued that the results are due to the heterogeneity among investors and that the mispricing therefore is systematic.

¹⁹ Based on the 95% confidence interval found in the *Appendix 12.4*

²⁰ Examples of such characteristics are age, occupation, financial wealth, experience from similar transaction, marital status and urgency to find housing

8.2 Market Rationality by Segments

The market for apartments with three rooms or more has an implicit borrowing rate which is close to the actual average borrowing rate, implying that investors in this market capitalise the monthly fee correctly. The high significance of the coefficients coupled with the high explanatory power means that we cannot reject the null of rational investors. Having said that, both the market for apartments with two rooms and the market for apartments with one room showed unrealistic levels of implicit borrowing rates, leading us to conclude that these markets are not rational. Due to the extreme levels of implicit borrowing rates, especially for single room apartments but also for apartments with two rooms that exhibit higher implicit borrowing rate than for the group including all apartments, we are confident in rejecting the null of rational investors. This is also supported by that we can reject the null of full capitalisation for one and two room apartments at the 2.5% significance even at the ten year interest rate, i.e. highest available borrowing rate in the market (see *Appendix 12.9 & 12.11*).

To conclude, we have rejected the hypothesis of rationality for the market as a whole and for the sub-categories single room apartments and two room apartments. We could however not reject that the market for apartments with three rooms or more is rational. In *Section 7* we discussed that the number of rooms can be seen as a proxy for investor sophistication. The logic behind this is that buyers of single room apartments are often first time buyers with little or no experience from similar transactions, are possibly in an urgent situation to buy an apartment as it is probable that they do not already own an apartment in Stockholm, and are not accustomed to making financial decisions. Buyers of apartments with two rooms could potentially share many of the same characteristics, but it could also be the case that they are already in the market with experience from first buying a single room apartment. Also, the higher absolute price for two room apartments than one room apartments means that these buyers are likely in a later stage of life and have more experience from financial decisions. Finally, the buyers of apartments with three rooms or more are likely older persons with greater experience from making informed financial decisions. As they most likely already have a place to live in, they are not as urgent to buy an apartment and can take the time to make rational decisions drawing from their past experience of buying apartments.

Despite the fact that we reject the hypothesis of rationality of the market as a whole, it can still be argued that our findings are in line with the study by Berger *et al.* They found that the buyers of owner-occupied houses did fully capitalise below-market government subsidies interest rates, a financial decision related to that investigated in this thesis. We put forward that buyers of owner-occupied houses share many of the characteristics of buyers of apartments with three rooms or more: they are seldom first-time buyers, and thus have experience from similar transactions and other financial decisions and they probably already have a place to live. As we could not reject the null of rationality of buyers of apartments with three rooms or more, our findings are in line with those of Berger *et al.* (Berger *et al.*, 1998)

8.3 Alternative Explanations

In the analysis possible explanations to the results observed have been discussed. One of these was measurement error in the capitalised fee due to possible growth of maintenance costs and amortisations that are embedded in the observed fee. However, when tested for, the results were robust for these possible errors. Another issue was the interest rate used, which was solved by using the two extremes of the interests available in the market as well as back-solving the implicit market rate. However, there is one topic which has not yet been touched upon, and it is that of credit rationing among different types of investors. Credit rationing is a wide subject, but in the setting of this thesis it refers to investors not being able to borrow as much as desired when buying property. Previous research has shown that this phenomenon can be very influential in real estate markets. One of the leading articles on the subject is “The down-payment constraint and UK housing market: Does the theory fit the facts?” (Benito, 2005) Even if the literature mainly focuses on macro-effects such as price developments, it is still an interesting topic to discuss in light of our findings.

Those who are expected to be affected mostly by credit rationing are first-time buyers, as they do not have large capital reserves in the form of prior savings or investments in apartments. This is also supported by the findings of Benito. (Benito, 2005) An investor

who is rationed and can only borrow up to a certain fixed amount will favour buying apartment with, *ceteris paribus*, higher monthly fee as this apartment should have a lower purchasing price. In effect, this means that the rationed investor chooses to finance the apartment with the tenants' association's debt as she cannot raise more money herself. This creates an excess demand for apartments with high fees, which should drive up the prices of these. In effect, this could be translated into an undercapitalisation of the monthly fee. Looking at our results, undercapitalisation is especially pronounced for buyers of single and two room apartments. As we have argued previously, a large part of these investors constitutes of first-time buyers. Hence, what we observe as undercapitalisation might be an effect of credit rationing rather than irrational investors.

The logic for rationing the credit to an investor is that the lender does not judge that the borrower will be able to afford more than the specified amount of loans. The reasoning behind that investors are able to circumvent this restriction by implicitly taking up more loans through the tenants' association is contingent on lenders not taking this possibility into account. Therefore, if the lenders fail to consider this aspect, while it might mean that our results overestimate the undercapitalisation, it stills means that the market is irrational. However, it seems bold to assume that bankers are this naïve, why we are confident in our previous conclusions about undercapitalisation.

9 Further Research

The final model presented in this thesis does have a high explanatory power. However, given a more detailed dataset it would probably be possible to improve the model further. Firstly, we believe that the variables we were forced to drop – such as presence of elevator, balcony and the apartment's floor number – do hold some explanatory value. Other variables that would have been interesting to include are the condition of the apartment, potential need for renovation and the physical status of the building. Furthermore, in this thesis we have made some fundamental assumptions that could have been avoided had we had access to data about the individual buyers and the tenants' associations. It would naturally also be interesting to expand the analysis to other markets than Stockholm, as well as other time periods.

Another angle for further research would be to examine the results more deeply, applying a behavioural finance perspective. Popular methods in previous research have included sending out surveys to investors in order to understand their behavioural biases. In this thesis we also touched upon the possibility of credit rationing. It would be interesting to study this issue further by looking at the behaviour of the lenders and the actual financial situation of the buyers.

10 Conclusions

The question we set out to answer in this thesis was whether or not the market for apartments is rational from a micro efficiency perspective. The hypothesis was that buyers of apartments fully capitalise the monthly fee into the purchasing price. After having found indications of that the market as a whole was not rational, we expanded the study by looking at different investor groups separately. The result from this was that we could not reject the null hypothesis of rationality among buyers of apartments with three rooms or more. However, there were strong indications of that the market for one room and two room apartments was irrational. Specifically, we found evidence of large undercapitalisation of the monthly fee as the implicit capitalisation rate among these buyers was significantly higher than both the actual average loan rate and the highest available borrowing rate in the market. The results were shown to be robust for changes in the underlying assumptions.

The conclusion of irrational buyers contradicts classical theories about market efficiency. We therefore discussed possible explanations for this phenomenon. As previously mentioned the hypothesis was rejected due to evidence of undercapitalisation and because there were large discrepancies between the different investor groups. One theory brought up was that of credit rationing, where rationed investors circumvent their capital restrictions by favouring apartments in tenants' associations with high debt. We put forward that first-time buyers are more likely to suffer from credit rationing, and that these are overrepresented among the buyers of one and two room apartments. The excess demand for one and two room apartments with high level of debt would drive up the prices of these relative to those with low levels of debt. This would lead to that it appears

as if the buyers undercapitalise the monthly fee. The implications of credit rationing in this setting is contingent on lenders being irrational, which in itself would be a market inefficiency.

We do not believe that credit rationing would explain the large apparent undercapitalisation. Rather we conclude that it is a result of heterogeneous investor sophistication between different investor groups. Buyers of apartments with three rooms or more have more experience and are therefore able to make better financial decisions. For the other investor groups, lack of experience results in the market for apartments with one or two rooms being irrational.

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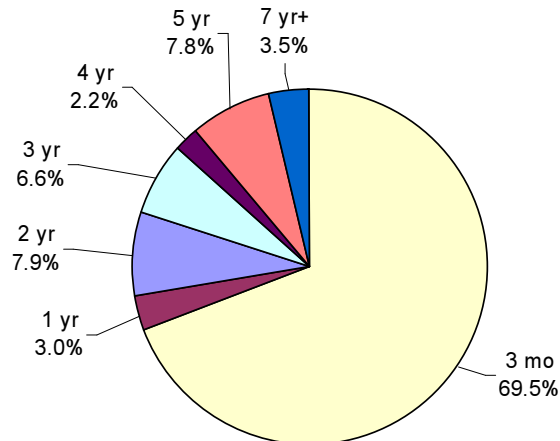
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12 Appendix

12.1 Graph of Average Loan Structure

Average loan structure by SBAB's clients



(SBAB, 2006b)

12.2 Regression of multiplicative form excluding capitalised fee

Source	SS	df	MS	
Model	1703.5934	34	50.1056881	Number of obs = 9812
Residual	629.299389	9777	.064365285	F(34, 9777) = 778.46
Total	2332.89279	9811	.237783384	Prob > F = 0.0000
				R-squared = 0.7302
				Adj R-squared = 0.7293
				Root MSE = .2537

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	1.168719	.0573761	20.37	0.000	1.05625 1.281188
Johannes	1.144822	.0373963	30.61	0.000	1.071518 1.218127
Adolf_Fred-k	1.177021	.03854	30.54	0.000	1.101475 1.252568
Gustav_Vasa	1.16475	.0373166	31.21	0.000	1.091601 1.237898
Matteus	1.156	.0344505	33.56	0.000	1.08847 1.22353
Engelbrekt	1.100077	.0359153	30.63	0.000	1.029676 1.170479
Hedvig_Ele-a	1.264066	.0384584	32.87	0.000	1.188679 1.339452
Oscar	1.23912	.0342309	36.20	0.000	1.17202 1.30622
Maria_Magd-a	1.146223	.0356717	32.13	0.000	1.076299 1.216147
Hogalid	1.104736	.0342738	32.23	0.000	1.037552 1.17192
Katarina	1.157649	.0346252	33.43	0.000	1.089777 1.225522
Sofia	1.123073	.035037	32.05	0.000	1.054393 1.191753
Kungsholm	1.196638	.0346531	34.53	0.000	1.128711 1.264565
St_Goran	1.115644	.0337155	33.09	0.000	1.049555 1.181733
Brannkyrka	.3167448	.0355366	8.91	0.000	.2470857 .3864039
Vantor	.1374853	.0357327	3.85	0.000	.0674418 .2075289
Farsta	.331414	.0382501	8.66	0.000	.256436 .406392
Bromma	.5151734	.0346853	14.85	0.000	.4471831 .5831638
Essinge	1.088391	.0387395	28.10	0.000	1.012453 1.164328
Vasterled	.8496663	.0362867	23.42	0.000	.7785368 .9207958
Vallingby	.3472396	.0411854	8.43	0.000	.2665077 .4279714
Enskede	.6666088	.0342375	19.47	0.000	.5994962 .7337214
Skarpnack	.4826751	.0345902	13.95	0.000	.4148712 .550479
Hasselby	.3223667	.0401437	8.03	0.000	.2436767 .4010566
Hagersten	.6858531	.0339672	20.19	0.000	.6192703 .7524358
Spanga	-.0173443	.0377767	-0.46	0.646	-.0913945 .0567058
Kista	.0398263	.0364649	1.09	0.275	-.0316523 .111305
Ro1	.0548652	.0340448	1.61	0.107	-.0118696 .1216
Ro2	-.0111556	.0337775	-0.33	0.741	-.0773664 .0550553
Ro3to5	-.011852	.0338326	-0.35	0.726	-.0781709 .0544669
pre1920	.307488	.0105988	29.01	0.000	.2867121 .3282639
y20to40	.2472766	.0095974	25.77	0.000	.2284638 .2660895
y40to60	.2731107	.0094613	28.87	0.000	.2545646 .2916568
y60to80	.1258801	.0121103	10.39	0.000	.1021415 .1496187
_cons	9.161146	.0469536	195.11	0.000	9.069107 9.253185

12.3 Regression of multiplicative form using three month interest rate

Source	SS	df	MS	Number of obs =
Model	1746.82961	35	49.9094175	9812
Residual	586.063174	9776	.059949179	F(35, 9776) = 832.53
Total	2332.89279	9811	.237783384	Prob > F = 0.0000
				R-squared = 0.7488
				Adj R-squared = 0.7479
				Root MSE = .24485

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.7552086	.0574738	13.14	0.000	.6425481 .8678692
Johannes	.7065218	.0396094	17.84	0.000	.6288793 .7841644
Adolf_Fred-k	.7221601	.0408693	17.67	0.000	.6420478 .8022723
Gustav_Vasa	.7191759	.0396519	18.14	0.000	.64145 .7969017
Matteus	.7091576	.0371787	19.07	0.000	.6362796 .7820355
Engelbrekt	.6912441	.0378571	18.26	0.000	.6170363 .765452
Hedvig_Ele-a	.8019361	.0409107	19.60	0.000	.7217426 .8821296
Oscar	.78568	.0371005	21.18	0.000	.7129553 .8584047
Maria_Magd-a	.7251283	.0378289	19.17	0.000	.6509757 .7992808
Hogalid	.6871113	.0365503	18.80	0.000	.615465 .7587575
Katarina	.7303594	.0370108	19.73	0.000	.6578106 .8029083
Sofia	.6958712	.0373686	18.62	0.000	.622621 .7691214
Kungsholm	.7567818	.0372385	20.32	0.000	.6837866 .8297769
St_Goran	.6963118	.0360909	19.29	0.000	.6255662 .7670575
Brannkyrka	.1707504	.034724	4.92	0.000	.1026841 .2388167
Vantor	.0686341	.0345803	1.98	0.047	.0008496 .1364186
Farsta	.1748184	.0373723	4.68	0.000	.101561 .2480757
Bromma	.311167	.0343254	9.07	0.000	.2438822 .3784519
Essinge	.6722898	.0404704	16.61	0.000	.5929596 .7516201
Vasterled	.5088059	.0372489	13.66	0.000	.4357903 .5818215
Vallingby	.1902645	.0401749	4.74	0.000	.1115134 .2690156
Enskede	.4089996	.0344064	11.89	0.000	.3415561 .4764432
Skarpnack	.2957959	.0341001	8.67	0.000	.2289527 .3626391
Hasselby	.1542181	.0392448	3.93	0.000	.0772902 .231146
Hagersten	.4112122	.0343394	11.97	0.000	.3438998 .4785245
Spanga	-.0083525	.0364593	-0.23	0.819	-.0798203 .0631152
Kista	.0570134	.0351975	1.62	0.105	-.011981 .1260078
Ro1	.1368954	.0329978	4.15	0.000	.072213 .2015779
Ro2	.0712177	.0327421	2.18	0.030	.0070364 .1353991
Ro3to5	.0439587	.0327174	1.34	0.179	-.0201742 .1080917
pre1920	.1146648	.0124972	9.18	0.000	.0901676 .1391619
y20to40	.0956624	.0108472	8.82	0.000	.0743996 .1169252
y40to60	.1056279	.0110575	9.55	0.000	.083953 .1273029
y60to80	-.0318381	.01308	-2.43	0.015	-.0574777 -.0061986
ln1plusLam-o	-.5481858	.0204125	-26.86	0.000	-.5881985 -.5081732
_cons	9.979011	.0545971	182.78	0.000	9.871989 10.08603

12.4 Regression of multiplicative form using ten year interest rate

Source	SS	df	MS	Number of obs =
Model	1761.54337	35	50.3298106	9812
Residual	571.349415	9776	.058444089	F(35, 9776) = 861.16
Total	2332.89279	9811	.237783384	Prob > F = 0.0000
				R-squared = 0.7551
				Adj R-squared = 0.7542
				Root MSE = .24175

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.643094	.0571648	11.25	0.000	.5310392 .7551487
Johannes	.5883831	.0397756	14.79	0.000	.5104147 .6663515
Adolf_Fred-k	.6042616	.0409822	14.74	0.000	.5239279 .6845952
Gustav_Vasa	.6007646	.0398148	15.09	0.000	.5227193 .6788098
Matteus	.5899803	.0374268	15.76	0.000	.5166161 .6633446
Engelbrekt	.5767972	.0380448	15.16	0.000	.5022216 .6513728
Hedvig_Ele-a	.6826522	.0410355	16.64	0.000	.6022142 .7630902
Oscar	.6643999	.0373776	17.78	0.000	.5911322 .7376677
Maria_Magd-a	.6106802	.0380087	16.07	0.000	.5361753 .6851851
Hogalid	.5738093	.0367548	15.61	0.000	.5017623 .6458564
Katarina	.6144025	.0372324	16.50	0.000	.5414194 .6873856
Sofia	.5755724	.0376427	15.29	0.000	.501785 .6493599
Kungsholm	.6389867	.0374699	17.05	0.000	.565538 .7124354
St_Goran	.5814639	.036331	16.00	0.000	.5102476 .6526803
Brannkyrka	.1154165	.0344609	3.35	0.001	.047866 .182967
Vantor	.0364569	.0342003	1.07	0.286	-.0305828 .1034966
Farsta	.1195267	.0370642	3.22	0.001	.0468733 .1921802
Bromma	.243298	.0341605	7.12	0.000	.1763363 .3102597
Essinge	.553268	.0406112	13.67	0.000	.4757205 .6349332
Vasterled	.4096061	.0372948	10.98	0.000	.3365007 .4827116
Vallingby	.132707	.0398323	3.33	0.001	.0546275 .2107864
Enskede	.3285398	.0343458	9.57	0.000	.2612149 .3958648
Skarpnack	.2218991	.0339092	6.84	0.000	.1654299 .2983682
Hasselby	.1015883	.0388899	2.61	0.009	.025356 .1778205
Hagersten	.3251333	.0343345	9.47	0.000	.2578305 .3924361
Spanga	-.0148613	.0359973	-0.41	0.680	-.0854234 .0557008
Kista	.0501458	.0347487	1.44	0.149	-.0179688 .1182603
Ro1	.1493297	.0325795	4.58	0.000	.0854672 .2131921
Ro2	.0836902	.032327	2.59	0.010	.0203227 .1470578
Ro3to5	.0514901	.0323016	1.59	0.111	-.0118277 .1148078
pre1920	.0712863	.0125805	5.67	0.000	.046626 .0959466
y20to40	.0572164	.0109575	5.22	0.000	.0357374 .0786954
y40to60	.0610353	.0112535	5.42	0.000	.0389762 .0830945
y60to80	-.0736931	.0131657	-5.60	0.000	-.0995006 -.0478856
ln1plusLam-r	-.8585225	.0272644	-31.49	0.000	-.9119663 -.8050787
_cons	10.13677	.0544223	186.26	0.000	10.03009 10.24345

12.5 Regression of multiplicative form using three month interest rate with inflation adjustment

Source	SS	df	MS	Number of obs = 9812
Model	1704.70074	35	48.7057355	F(35, 9776) = 757.96
Residual	628.192043	9776	.064258597	Prob > F = 0.0000
Total	2332.89279	9811	.237783384	R-squared = 0.7307
				Adj R-squared = 0.7298
				Root MSE = .25349

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	1.114168	.0588154	18.94	0.000	.9988773 1.229458
Johannes	1.088565	.039747	27.39	0.000	1.010652 1.166477
Adolf_Fred-k	1.118306	.0410235	27.26	0.000	1.037892 1.198721
Gustav_Vasa	1.10786	.0397245	27.89	0.000	1.029991 1.185728
Matteus	1.099196	.037042	29.67	0.000	1.026586 1.171806
Engelbrekt	1.04764	.0380439	27.54	0.000	.9730657 1.122213
Hedvig_Ele-a	1.204106	.0410514	29.33	0.000	1.123637 1.284576
Oscar	1.18029	.0370223	31.88	0.000	1.107719 1.252862
Maria_Magd-a	1.090922	.0380503	28.67	0.000	1.016336 1.165509
Hogalid	1.050729	.0366334	28.68	0.000	.9789204 1.122538
Katarina	1.102692	.037043	29.77	0.000	1.03008 1.175304
Sofia	1.068159	.0374238	28.54	0.000	.9948008 1.141518
Kungsholm	1.1395	.0372598	30.58	0.000	1.066463 1.212537
St_Goran	1.061996	.0360814	29.43	0.000	.9912686 1.132723
Brannkyrka	.2993595	.0357533	8.37	0.000	.2292757 .3694433
Vantor	.1303786	.0357441	3.65	0.000	.0603128 .2004445
Farsta	.3136532	.0384571	8.16	0.000	.2382693 .389037
Bromma	.4897994	.0351914	13.92	0.000	.4208169 .5587819
Essinge	1.034317	.0408404	25.33	0.000	.9542611 1.114372
Vasterled	.8061323	.0377428	21.36	0.000	.7321485 .8801161
Vallingby	.3297183	.0413671	7.97	0.000	.2486302 .4108064
Enskede	.6347764	.035058	18.11	0.000	.5660554 .7034974
Skarpnack	.4592803	.035018	13.12	0.000	.3906378 .5279227
Hasselby	.3014714	.040425	7.46	0.000	.2222301 .3807128
Hagersten	.6506321	.0349835	18.60	0.000	.5820571 .719207
Spanga	-.0154492	.0377482	-0.41	0.682	-.0894433 .058545
Kista	.0444549	.0364517	1.22	0.223	-.0269979 .1159077
Ro1	.0615043	.0340541	1.81	0.071	-.0052488 .1282574
Ro2	-.0037734	.0337963	-0.11	0.911	-.0700211 .0624743
Ro3to5	-.0076721	.0338196	-0.23	0.821	-.0739654 .0586212
pre1920	.2836929	.0120418	23.56	0.000	.2600883 .3072974
y20to40	.2287452	.0105776	21.63	0.000	.208011 .2494794
y40to60	.251927	.0107428	23.45	0.000	.2308688 .2729851
y60to80	.1077152	.0128671	8.37	0.000	.0824929 .1329374
ln1plusL-o_i	-.0678249	.0163385	-4.15	0.000	-.0998518 -.035798
_cons	9.276511	.054528	170.12	0.000	9.169625 9.383398

12.6 Regression of multiplicative form using ten year interest rate with inflation adjustment

Source	SS	df	MS	Number of obs = 9812
Model	1714.78399	35	48.9938284	F(35, 9776) = 774.89
Residual	618.108791	9776	.063227168	Prob > F = 0.0000
Total	2332.89279	9811	.237783384	R-squared = 0.7350
				Adj R-squared = 0.7341
				Root MSE = .25145

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.8758991	.0609775	14.36	0.000	.7563705 .9954277
Johannes	.8467042	.0433117	19.55	0.000	.7618044 .931604
Adolf_Fred-k	.8740766	.0444702	19.66	0.000	.7869057 .9612475
Gustav_Vasa	.868532	.043171	20.12	0.000	.7838879 .9531361
Matteus	.8575	.0408568	20.99	0.000	.7774122 .9375878
Engelbrekt	.8216844	.0412916	19.90	0.000	.7407444 .9026242
Hedvig_Ele-a	.9498548	.044841	21.18	0.000	.8619572 1.037752
Oscar	.9290175	.0411627	22.57	0.000	.8483301 1.009705
Maria_Magd-a	.8548493	.041589	20.55	0.000	.7733262 .9363725
Hogalid	.8195797	.0401665	20.40	0.000	.740845 .8983144
Katarina	.8639657	.0408047	21.17	0.000	.7839801 .9439513
Sofia	.8324642	.041025	20.29	0.000	.7520468 .9128816
Kungsholm	.8942513	.0411853	21.71	0.000	.8135196 .9749829
St_Goran	.8285717	.0397776	20.83	0.000	.7505994 .906544
Brannkyrka	.2199603	.0359645	6.12	0.000	.1494624 .2904581
Vantor	.0900948	.0355941	2.53	0.011	.0203231 .1598666
Farsta	.2323521	.0386347	6.01	0.000	.1566201 .3080842
Bromma	.3730827	.0359982	10.36	0.000	.3025188 .4436465
Essinge	.8062228	.0438641	18.38	0.000	.72024 .8922055
Vasterled	.6185312	.0399411	15.49	0.000	.5402385 .6968239
Vallingby	.2418067	.0415818	5.82	0.000	.1602977 .3233157
Enskede	.4858608	.0365522	13.29	0.000	.4142109 .5575108
Skarpnack	.3493091	.0357186	9.78	0.000	.2792932 .4193249
Hasselby	.2149278	.0405985	5.29	0.000	.1353463 .2945092
Hagersten	.4975333	.0365205	13.62	0.000	.4259456 .569121
Spanga	-.0111883	.0374441	-0.30	0.765	-.0845865 .0622099
Kista	.0412209	.0361412	1.14	0.254	-.0296233 .112065
Ro1	.0813744	.0338012	2.41	0.016	.0151171 .1476318
Ro2	.0219477	.0335699	0.65	0.513	-.0438561 .0877516
Ro3to5	.0119559	.0335799	0.36	0.722	-.0538676 .0777794
pre1920	.2062745	.0129703	15.90	0.000	.18085 .231699
y20to40	.1659306	.0113079	14.67	0.000	.1437648 .1880964
y40to60	.1816781	.0116261	15.63	0.000	.1588884 .2044677
y60to80	.0542773	.0131542	4.13	0.000	.0284924 .0800622
ln1plusL-r_i	-.3597614	.0270421	-13.30	0.000	-.4127695 -.3067534
_cons	9.759617	.0647249	150.79	0.000	9.632743 9.886491

12.7 Regressions of multiplicative form clustered by number of rooms, using three month interest rate – three rooms or more

Source	SS	df	MS	Number of obs =
Model	776.854411	32	24.2767004	F(32, 3024) =
Residual	240.857084	3024	.079648507	Prob > F =
				R-squared =
				Adj R-squared =
				Root MSE =
Total	1017.7115	3056	.333020777	

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.4441377	.0958865	4.63	0.000	.2561283 .632147
Johannes	.4567053	.0675857	6.76	0.000	.3241867 .5892239
Adolf_Fred-k	.4803695	.0715298	6.72	0.000	.3401175 .6206215
Gustav_Vasa	.4800478	.0678769	7.07	0.000	.3469582 .6131374
Matteus	.4553626	.0633809	7.18	0.000	.3310886 .5796366
Engelbrekt	.4865231	.0647538	7.51	0.000	.3595571 .6134891
Hedvig_Ele-a	.5338935	.0741985	7.20	0.000	.3884089 .679378
Oscar	.5565748	.0623328	8.93	0.000	.4343558 .6787939
Maria_Magd-a	.4632418	.0623195	7.43	0.000	.341049 .5854346
Hogalid	.448184	.0638406	7.02	0.000	.3230087 .5733594
Katarina	.513931	.0636546	8.07	0.000	.3891203 .6387416
Sofia	.4757959	.0627574	7.58	0.000	.3527443 .5988474
KungshoIm	.5025017	.0640556	7.84	0.000	.3769047 .6280987
St_Goran	.5133042	.0616477	8.33	0.000	.3924285 .6341799
Brannkyrka	.1076998	.0552397	1.95	0.051	-.0006114 .216011
Vantor	-.0374364	.0536091	-0.70	0.485	-.1425503 .0676775
Farsta	.1604577	.0591614	2.71	0.007	.044457 .2764584
Bromma	.1722471	.0550836	3.13	0.002	.0642421 .2802522
Essinge	.5444531	.0779225	6.99	0.000	.3916667 .6972395
Vasterled	.4580357	.0629885	7.27	0.000	.334531 .5815404
Vallingby	.0752824	.0638637	1.18	0.239	-.0499383 .2005031
Enskede	.3166403	.0554617	5.71	0.000	.2078938 .4253867
Skarpnack	.0402604	.0544504	0.74	0.460	-.0665032 .147024
Hasselby	.0632497	.0601666	1.05	0.293	-.0547219 .1812213
Hagersten	.2917711	.055129	5.29	0.000	.183677 .3998653
Spanga	.0344743	.0538553	0.64	0.522	-.0711224 .1400709
Kista	.0548369	.0523597	1.05	0.295	-.0478274 .1575011
pre1920	-.0142673	.023111	-0.62	0.537	-.0595821 .0310475
y20to40	.016101	.0219332	0.73	0.463	-.0269044 .0591064
y40to60	-.0015185	.0215569	-0.07	0.944	-.0437862 .0407492
y60to80	-.1637784	.0215494	-7.60	0.000	-.2060313 -.1215255
ln1plusLam-o	-.8902995	.042193	-21.10	0.000	-.9730293 -.8075696
_cons	10.54809	.0818426	128.88	0.000	10.38762 10.70856

12.8 Regressions of multiplicative form clustered by number of rooms, using three month interest rate – two rooms

Source	SS	df	MS	Number of obs =
Model	667.068581	32	20.8458932	F(32, 4305) =
Residual	223.419461	4305	.051897668	Prob > F =
				R-squared =
				Adj R-squared =
				Root MSE =
Total	890.488042	4337	.205323505	

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.7729647	.0962797	8.03	0.000	.5842068 .9617226
Johannes	.6620755	.0585686	11.30	0.000	.5472509 .7769
Adolf_Fred-k	.7035388	.0613659	11.46	0.000	.58323 .8238476
Gustav_Vasa	.7090287	.059247	11.97	0.000	.5928741 .8251832
Matteus	.6809081	.055467	12.28	0.000	.5721642 .789652
Engelbrekt	.6287744	.055621	11.30	0.000	.5197285 .7378202
Hedvig_Ele-a	.7596078	.0600547	12.65	0.000	.6418697 .877346
Oscar	.7492648	.0550271	13.62	0.000	.6413833 .8571462
Maria_Magd-a	.6965668	.0566938	12.29	0.000	.5854177 .807716
Hogalid	.6514218	.0544597	11.96	0.000	.5446527 .7581908
Katarina	.6862823	.0552106	12.43	0.000	.578041 .7945236
Sofia	.6651513	.0563998	11.79	0.000	.5545787 .7757239
KungshoIm	.7256459	.0551488	13.16	0.000	.6175258 .833766
St_Goran	.6616436	.0535233	12.36	0.000	.5567104 .7665768
Brannkyrka	.0725358	.0516534	1.40	0.160	-.0287315 .1738032
Vantor	.0340063	.0523148	0.65	0.516	-.0685576 .1365703
Farsta	.0623495	.0564127	1.11	0.269	-.0482486 .1729475
Bromma	.2908707	.0507941	5.73	0.000	.1912881 .3904534
Essinge	.7061124	.0588123	12.01	0.000	.59081 .8214148
Vasterled	.4356469	.0549528	7.93	0.000	.3279111 .5433826
Vallingby	.1088605	.0600151	1.81	0.070	-.0088001 .226521
Enskede	.3343268	.0509912	6.56	0.000	.2343578 .4342957
Skarpnack	.3234918	.0504064	6.42	0.000	.2246693 .4223143
Hasselby	.1330747	.0614503	2.17	0.030	.0126005 .2535489
Hagersten	.3363934	.0511116	6.58	0.000	.2361883 .4365986
Spanga	-.1548372	.059267	-2.61	0.009	-.2710312 -.0386433
Kista	.0890352	.0552449	1.61	0.107	-.0192732 .1973437
pre1920	.1663219	.018816	8.84	0.000	.1294328 .2032109
y20to40	.1251627	.0157544	7.94	0.000	.094276 .1560494
y40to60	.115933	.0161193	7.19	0.000	.084331 .1475351
y60to80	-.0077417	.0220844	-0.35	0.726	-.0510385 .0355551
ln1plusLam-o	-.4892395	.0291816	-16.77	0.000	-.5464506 -.4320285
_cons	10.0207	.0674404	148.59	0.000	9.888486 10.15292

12.9 Regressions of multiplicative form clustered by number of rooms, using three month interest rate – one room

Source	SS	df	MS	Number of obs =
Model	182.162715	32	5.69258484	F(32, 2384) = 161.30
Residual	84.1352107	2384	.035291615	Prob > F = 0.0000
Total	266.297926	2416	.110222651	R-squared = 0.6841
				Adj R-squared = 0.6798
				Root MSE = .18786

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	1.198258	.1536624	7.80	0.000	.8969325 1.499584
Johannes	1.183014	.1418308	8.34	0.000	.9048894 1.461138
Adolf_Fred-k	1.192905	.1416059	8.42	0.000	.915221 1.470588
Gustav_Vasa	1.163148	.1411309	8.24	0.000	.8863962 1.4399
Matteus	1.184306	.139418	8.49	0.000	.9109134 1.4577
Engelbrekt	1.143156	.1406779	8.13	0.000	.8672924 1.41902
Hedvig_Ele-a	1.293295	.1417694	9.12	0.000	1.015291 1.571299
Oscar	1.249743	.1396915	8.95	0.000	.9758138 1.523673
Maria_Magd-a	1.248305	.1400733	8.91	0.000	.9736272 1.522983
Hogalid	1.145782	.1389225	8.25	0.000	.8733603 1.418203
Katarina	1.187402	.1392089	8.53	0.000	.9144185 1.460385
Sofia	1.144233	.1393272	8.21	0.000	.8710179 1.417448
Kungsholm	1.219307	.1395118	8.74	0.000	.94573 1.492884
St_Goran	1.124825	.1387957	8.10	0.000	.8526528 1.396998
Brannkyrka	.5601858	.1380772	4.06	0.000	.2894221 .8309496
Vantor	.4897016	.1379536	3.55	0.000	.2191803 .7602229
Farsta	.4666172	.1399393	3.33	0.001	.1922018 .7410326
Bromma	.6237743	.1382904	4.51	0.000	.3525923 .8949562
Essinge	.9873281	.1411027	7.00	0.000	.7106314 1.264025
Vasterled	.7675798	.1395551	5.50	0.000	.4939179 1.041242
Vallingby	.6634442	.1454428	4.56	0.000	.3782368 .9486516
Enskede	.7955076	.1383753	5.75	0.000	.5241593 1.066856
Skarpnack	.7104178	.138128	5.14	0.000	.4395544 .9812812
Hasselby	.3822179	.1451195	2.63	0.008	.0976445 .6667913
Hagersten	.836465	.1377953	6.07	0.000	.566254 1.106676
Spanga	.3219757	.1457955	2.21	0.027	.0360767 .6078748
Kista	.2643352	.1441493	1.83	0.067	-.0183358 .5470061
pre1920	.2160461	.0284804	7.59	0.000	.1601973 .271895
y20to40	.1917482	.0262835	7.30	0.000	.1402073 .243289
y40to60	.2025872	.0269359	7.52	0.000	.1497671 .2554073
y60to80	.1319935	.0305891	4.32	0.000	.0720095 .1919775
ln1plusLam-r	-.1481526	.0317043	-4.67	0.000	-.2103235 -.0859818
_cons	9.316006	.1450914	64.21	0.000	9.031488 9.600524

12.10 Regressions of multiplicative form clustered by number of rooms, using ten year interest rate – three rooms or more

Source	SS	df	MS	Number of obs =
Model	786.561277	32	24.5800399	F(32, 3024) = 321.57
Residual	231.150219	3024	.076438564	Prob > F = 0.0000
Total	1017.7115	3056	.333020777	R-squared = 0.7729
				Adj R-squared = 0.7705
				Root MSE = .27648

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.3045479	.0946423	3.22	0.001	.1189781 .4901178
Johannes	.3147139	.0672617	4.68	0.000	.1828306 .4465972
Adolf_Fred-k	.3399462	.0710474	4.78	0.000	.2006402 .4792522
Gustav_Vasa	.3385809	.0675584	5.01	0.000	.2061159 .4710459
Matteus	.3143654	.0631975	4.97	0.000	.190451 .4382797
Engelbrekt	.3460024	.0645591	5.36	0.000	.2194183 .4725865
Hedvig_Ele-a	.3933839	.0735501	5.35	0.000	.2491707 .5375972
Oscar	.4140664	.0622117	6.66	0.000	.2920849 .5360478
Maria_Magd-a	.3291105	.0621165	5.30	0.000	.2073157 .4509052
Hogalid	.3155954	.0634823	4.97	0.000	.1910325 .4399784
Katarina	.3732079	.06348	5.88	0.000	.2487397 .4976761
Sofia	.332401	.0627095	5.30	0.000	.2094433 .4553586
Kungsholm	.3608371	.0638678	5.65	0.000	.2356084 .4860658
St_Goran	.3745576	.0615128	6.09	0.000	.2539465 .4951688
Brannkyrka	.0505381	.0543519	0.93	0.353	-.0560324 .1571086
Vantor	-.0610147	.0525578	-1.16	0.246	-.1640674 .0420381
Farsta	.1056184	.0581599	1.82	0.069	-.0084184 .2196553
Bromma	.1021779	.0543163	1.88	0.060	-.0043227 .2086786
Essinge	.4047041	.0772873	5.24	0.000	.2531631 .556245
Vasterled	.3379988	.0625867	5.40	0.000	.2152821 .4607155
Vallingby	.0134561	.0628022	0.21	0.830	-.1096832 .1365954
Enskede	.2234411	.0549396	4.07	0.000	.1157185 .3311638
Skarpnack	-.0276002	.0536749	-0.51	0.607	-.1328431 .0776428
Hasselby	.0063839	.0591498	0.11	0.914	-.109594 .1223617
Hagersten	.1931833	.054695	3.53	0.000	.0859402 .3004263
Spanga	.0361487	.0527584	0.69	0.493	-.0672972 .1395946
Kista	.0549989	.0512875	1.07	0.284	-.0455621 .1555619
pre1920	-.0594534	.0228461	-2.60	0.009	-.1042489 -.0146579
y20to40	-.0269357	.0217712	-1.24	0.216	-.0696236 .0157522
y40to60	-.0620411	.021738	-2.85	0.004	-.1046638 -.0194184
y60to80	-.2135301	.0215401	-9.91	0.000	-.2557648 -.1712955
ln1plusLam-r	-1.333326	.0548492	-24.31	0.000	-1.440871 -1.22578
_cons	10.72624	.0801503	133.83	0.000	10.56908 10.88339

12.11 Regressions of multiplicative form clustered by number of rooms, using ten year interest rate – two rooms

Source	SS	df	MS	Number of obs =
Model	671.834612	32	20.9948316	F(32, 4305) =
Residual	218.653431	4305	.050790576	Prob > F =
				R-squared =
				Adj R-squared =
Total	890.488042	4337	.205323505	Root MSE =

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.659822	.0959507	6.88	0.000	.4717091 .8479348
Johannes	.5476348	.0591215	9.26	0.000	.4317262 .6635435
Adolf_Fred-k	.5897409	.0618048	9.54	0.000	.4685717 .7109102
Gustav_Vasa	.5942438	.0597767	9.94	0.000	.4770507 .7114369
Matteus	.564982	.0561431	10.06	0.000	.4549125 .6750515
Engelbrekt	.5189755	.0561738	9.24	0.000	.4088458 .6291052
Hedvig_Ele-a	.6437094	.0605784	10.63	0.000	.5249445 .7624742
Oscar	.631478	.0557627	11.32	0.000	.5221543 .7408017
Maria_Magd-a	.58585	.0572232	10.24	0.000	.473663 .698037
Hogalid	.5422046	.0550322	9.85	0.000	.4343132 .650096
Katarina	.5733641	.0558383	10.27	0.000	.4638922 .6828359
Sofia	.5465611	.0571141	9.57	0.000	.4345881 .6585342
Kungsholm	.6112183	.055803	10.95	0.000	.5018157 .720621
St_Goran	.5507191	.0541657	10.17	0.000	.4445265 .6569117
Brannkyrka	.015666	.0514195	0.30	0.761	-.0851427 .1164748
Vantor	-.0032881	.0518748	-0.06	0.949	-.1049895 .0984132
Farsta	.0022813	.0561378	0.04	0.968	-.1077777 .1123403
Bromma	.2195481	.0507776	4.32	0.000	.1199979 .3190984
Essinge	.5918514	.0593619	9.97	0.000	.4754716 .7082312
Vasterled	.3384043	.0552812	6.12	0.000	.2300245 .446784
Vallingby	.0555521	.0596132	0.93	0.351	-.0613206 .1724247
Enskede	.2552915	.0510962	5.00	0.000	.1551166 .3554664
Skarpnack	.2569159	.0503246	5.11	0.000	.1582537 .3555781
Hasselby	.0808872	.0610261	1.33	0.185	-.0387553 .2005298
Hagersten	.2522444	.0513018	4.92	0.000	.1516665 .3528223
Spanga	-.1641501	.0586186	-2.80	0.005	-.2790727 -.0492274
Kista	.0805089	.0546387	1.47	0.141	-.0266111 .1876289
pre1920	.1246358	.0190438	6.54	0.000	.0873002 .1619714
y20to40	.0888351	.0160076	5.55	0.000	.0574519 .1202183
y40to60	.0745976	.0164867	4.52	0.000	.0422751 .1069201
y60to80	-.0510253	.0222885	-2.29	0.022	-.0947223 -.0073284
ln1plusLam-r	-.7660428	.0392435	-19.52	0.000	-.8429803 -.6891052
_cons	10.18315	.0681833	149.35	0.000	10.04948 10.31683

12.12 Regressions of multiplicative form clustered by number of rooms, using ten year interest rate – one room

Source	SS	df	MS	Number of obs =
Model	182.710661	32	5.70970815	F(32, 2384) =
Residual	83.5872648	2384	.035061772	Prob > F =
				R-squared =
				Adj R-squared =
Total	266.297926	2416	.110222651	Root MSE =

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	1.134227	.1539807	7.37	0.000	.832277 1.436177
Johannes	1.107082	.1425655	7.77	0.000	.8275173 1.386648
Adolf_Fred-k	1.114093	.1424137	7.82	0.000	.8348254 1.393361
Gustav_Vasa	1.085163	.1419275	7.65	0.000	.8068486 1.363477
Matteus	1.106593	.1402362	7.89	0.000	.8315952 1.38159
Engelbrekt	1.06809	.1414216	7.55	0.000	.7907682 1.345412
Hedvig_Ele-a	1.215401	.1425555	8.53	0.000	.9358556 1.494947
Oscar	1.170835	.140537	8.33	0.000	.8952481 1.446423
Maria_Magd-a	1.171673	.1408469	8.32	0.000	.8954777 1.447868
Hogalid	1.070696	.1396763	7.67	0.000	.7967959 1.344595
Katarina	1.112025	.1399578	7.95	0.000	.8375738 1.386477
Sofia	1.067902	.1401215	7.62	0.000	.7931294 1.342675
Kungsholm	1.143177	.1402838	8.15	0.000	.8680859 1.418268
St_Goran	1.049649	.1395476	7.52	0.000	.776002 1.323296
Brannkyrka	.5109452	.138187	3.70	0.000	.2399661 .7819244
Vantor	.4492886	.137883	3.26	0.001	.1789056 .7196715
Farsta	.4182275	.1400113	2.99	0.003	.143671 .692784
Bromma	.5702223	.1384875	4.12	0.000	.2986539 .8417906
Essinge	.9114659	.1418485	6.43	0.000	.6333066 1.189625
Vasterled	.7014414	.1400526	5.01	0.000	.4268039 .9760788
Vallingby	.6068743	.1456712	4.17	0.000	.3212191 .8925295
Enskede	.7350179	.1387389	5.30	0.000	.4629565 1.007079
Skarpnack	.6594826	.1382708	4.77	0.000	.3883392 .9306261
Hasselby	.3346248	.1451265	2.31	0.021	.0500377 .6192119
Hagersten	.7728666	.1382534	5.59	0.000	.5017573 1.043976
Spanga	.2963698	.1454611	2.04	0.042	.0111264 .5816131
Kista	.2332314	.1438931	1.62	0.105	-.0489371 .5153998
pre1920	.1943178	.0287541	6.76	0.000	.137932 .2507035
y20to40	.1740505	.0264912	6.57	0.000	.1221023 .2259987
y40to60	.1853054	.0271312	6.83	0.000	.1321023 .2385086
y60to80	.1149153	.0307004	3.74	0.000	.054713 .1751175
ln1plusLam-r	-.2689521	.0438568	-6.13	0.000	-.3549535 -.1829507
_cons	9.428587	.1465542	64.34	0.000	9.141201 9.715974

12.13 Regression of multiplicative form for whole sample with back-solved interest rate (three month rate + 268.82bp)

Source	SS	df	MS	Number of obs = 9812
Model	1766.39733	35	50.4684951	F(35, 9776) = 870.93
Residual	566.495456	9776	.057947571	Prob > F = 0.0000
				R-squared = 0.7572
				Adj R-squared = 0.7563
Total	2332.89279	9811	.237783384	Root MSE = .24072

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.6063517	.0570577	10.63	0.000	.4945069 .7181966
Johannes	.5543586	.0397584	13.94	0.000	.4764238 .6322933
Adolf_Fred-k	.5684571	.040975	13.87	0.000	.4881377 .6487764
Gustav_Vasa	.5640508	.0398324	14.16	0.000	.485971 .6421306
Matteus	.5543528	.0374498	14.80	0.000	.4809435 .6277622
Engelbrekt	.5417038	.0380653	14.23	0.000	.4670879 .6163197
Hedvig_Ele-a	.6472497	.0410197	15.78	0.000	.5668425 .7276568
Oscar	.628648	.0374003	16.81	0.000	.5553356 .7019603
Maria_Magd-a	.5746293	.0380401	15.11	0.000	.5000629 .6491958
Hogalid	.5388731	.0367833	14.65	0.000	.4667703 .610976
Katarina	.5796086	.0372513	15.56	0.000	.5065884 .6526289
Sofia	.5390049	.0376822	14.30	0.000	.46514 .6128698
Kungsholm	.6033866	.0374945	16.09	0.000	.5298897 .6768835
St_Goran	.5465445	.0363624	15.03	0.000	.4752667 .6178224
Brannkyrka	.0984895	.034364	2.87	0.004	.0311289 .1658501
Vantor	.0291219	.0340639	0.85	0.393	-.0376504 .0958943
Farsta	.1003781	.0369654	2.72	0.007	.0279183 .1728378
Bromma	.2219289	.0340948	6.51	0.000	.155096 .2887618
Essinge	.5193124	.0406192	12.78	0.000	.4396903 .5989345
Vasterled	.3772277	.0373012	10.11	0.000	.3041096 .4503457
Vallingby	.1184804	.0396912	2.99	0.003	.0406774 .1962834
Enskede	.3026024	.0343159	8.82	0.000	.2353361 .3698688
Skarpnack	.2111512	.0338409	6.24	0.000	.144816 .2774864
Hasselby	.082314	.0387815	2.12	0.034	-.0062943 .1583337
Hagersten	.2983059	.034312	8.69	0.000	.2310474 .3655644
Spanga	-.0161015	.035844	-0.45	0.653	-.0863631 .0541601
Kista	.0489213	.0346003	1.41	0.157	-.0189025 .1167451
Ro1	.1526245	.0324391	4.70	0.000	.089037 .2162119
Ro2	.0871695	.0321882	2.71	0.007	.024074 .150265
Ro3to5	.0527011	.0321615	1.64	0.101	-.010342 .1157443
pre1920	.0594743	.0125654	4.73	0.000	.0348435 .0841051
y20to40	.0461315	.0109661	4.21	0.000	.0246356 .0676275
y40to60	.0471523	.0113004	4.17	0.000	.0250011 .0693035
y60to80	-.0855967	.0131643	-6.50	0.000	-.1114015 -.0597919
ln1plusLam-s	-1.000006	.0303757	-32.92	0.000	-1.059548 -.9404631
_cons	10.1799	.0542441	187.67	0.000	10.07357 10.28623

12.14 Regression of multiplicative form for one room apartments with back-solved interest rate (three month rate + 1562.6bp)

Source	SS	df	MS	Number of obs = 2417
Model	183.602519	32	5.73757873	F(32, 2384) = 165.41
Residual	82.6954064	2384	.03468767	Prob > F = 0.0000
				R-squared = 0.6895
				Adj R-squared = 0.6853
Total	266.297926	2416	.110222651	Root MSE = .18625

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.9944965	.1555881	6.39	0.000	.6893944 1.299599
Johannes	.9614352	.1446812	6.65	0.000	.6777212 1.245149
Adolf_Fred-k	.966374	.1446075	6.68	0.000	.6828045 1.249944
Gustav_Vasa	.9367151	.1441679	6.50	0.000	.6540077 1.219423
Matteus	.9589626	.142489	6.73	0.000	.6795474 1.238378
Engelbrekt	.9234543	.143528	6.43	0.000	.6420016 1.204907
Hedvig_Ele-a	1.068027	.144736	7.38	0.000	.7842052 1.351848
Oscar	1.02153	.1428476	7.15	0.000	.7414113 1.301648
Maria_Magd-a	1.023548	.1431056	7.15	0.000	.7429242 1.304173
Hogalid	.9254072	.1418529	6.52	0.000	.6472393 1.203575
Katarina	.9676022	.1420914	6.81	0.000	.6889666 1.246238
Sofia	.921694	.142323	6.48	0.000	.6426043 1.200784
Kungsholm	.997393	.1424632	7.00	0.000	.7180284 1.276758
St_Goran	.9047346	.1417121	6.38	0.000	.6268429 1.182626
Brannkyrka	.401705	.1390732	2.89	0.004	.1289881 .6744218
Vantor	.3581506	.1382678	2.59	0.010	.0870131 .6292881
Farsta	.3077272	.1409076	2.18	0.029	.0314131 .5840413
Bromma	.4532715	.1396329	3.25	0.001	.1794571 .727086
Essinge	.7661372	.1439702	5.32	0.000	.4838175 1.048457
Vasterled	.566626	.1418117	4.00	0.000	.2885391 .844713
Vallingby	.4879516	.1467349	3.33	0.001	.2002104 .7756929
Enskede	.6075441	.1402505	4.33	0.000	.3325186 .8825697
Skarpnack	.5467515	.1392747	3.93	0.000	.2736395 .8198636
Hasselby	.2225584	.145991	1.52	0.128	-.063724 .5088408
Hagersten	.6410107	.1399351	4.58	0.000	.3666037 .9154177
Spanga	.2275738	.1452371	1.57	0.117	-.0572302 .5123778
Kista	.1576419	.1438343	1.10	0.273	-.1244114 .4396951
pre1920	.1636369	.0290797	5.63	0.000	.1066128 .220661
y20to40	.1462668	.0268557	5.45	0.000	.0936039 .1989297
y40to60	.1573135	.0275048	5.72	0.000	.1033777 .2112492
y60to80	.0893383	.0308763	2.89	0.004	.0287912 .1498855
ln1plusLam-s	-1.00003	.1252739	-7.98	0.000	-1.245687 -.7543734
_cons	9.608591	.1495275	64.26	0.000	9.315374 9.901808

12.15 Regression of multiplicative form for two room apartments with back-solved interest rate (three month rate + 347.69bp)

Source	SS	df	MS	Number of obs =
Model	674.546815	32	21.079588	4338
Residual	215.941227	4305	.050160564	F(32, 4305) = 420.24
Total	890.488042	4337	.205323505	Prob > F = 0.0000
				R-squared = 0.7575
				Adj R-squared = 0.7557
				Root MSE = .22397

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.5971702	.0957277	6.24	0.000	.4094945 .7848458
Johannes	.4902444	.0592459	8.27	0.000	.3740919 .6063969
Adolf_Fred-k	.5301082	.0619269	8.56	0.000	.4086996 .6515168
Gustav_Vasa	.5335725	.0599549	8.90	0.000	.4160299 .6511151
Matteus	.5047779	.0563681	8.96	0.000	.3942675 .6152884
Engelbrekt	.4594097	.0564023	8.15	0.000	.3488322 .5699873
Hedvig_Ele-a	.5847184	.0607024	9.63	0.000	.4657103 .7037265
Oscar	.5715862	.0559849	10.21	0.000	.461827 .6813454
Maria_Magd-a	.5251234	.0574532	9.14	0.000	.4124855 .6377613
Hogalid	.4845356	.0552356	8.77	0.000	.3762454 .5928258
Katarina	.5147699	.0560432	9.19	0.000	.4048962 .6246435
Sofia	.4839205	.0573818	8.43	0.000	.3714225 .5964184
Kungsholm	.5507352	.0560433	9.83	0.000	.4408615 .6606089
St_Goran	.4925602	.0543936	9.06	0.000	.3859207 .5991998
Brannkyrka	-.0149738	.0512661	-0.29	0.770	-.1154818 .0855342
Vantor	-.0218981	.0516108	-0.42	0.671	-.1230819 .0792857
Farsta	-.031028	.0559685	-0.55	0.579	-.1407552 .0786991
Bromma	.1810088	.0507322	3.57	0.000	.0815475 .2804701
Essinge	.5296123	.059592	8.89	0.000	.4127812 .6464434
Vasterled	.283208	.0554472	5.11	0.000	.174503 .3919131
Vallingby	.0309552	.0593367	0.52	0.602	-.0853753 .1472857
Enskede	.2118849	.05112	4.14	0.000	.1116634 .3121064
Skarpnack	.2192422	.0502689	4.36	0.000	.1206892 .3177953
Hasselby	.0487587	.0607995	0.80	0.423	-.0704396 .1679569
Hagersten	.2063946	.0513624	4.02	0.000	.1056977 .3070914
Spanga	-.1664122	.058252	-2.86	0.004	-.2806161 -.0522083
Kista	.0739795	.0542942	1.36	0.173	-.0324651 .180424
pre1920	.1046843	.0190665	5.49	0.000	.0673042 .1420645
y20to40	.0707854	.0160737	4.40	0.000	.0392728 .1022981
y40to60	.0517147	.0166668	3.10	0.002	.0190392 .0843902
y60to80	-.0728572	.022334	-3.26	0.001	-.1166432 -.0290711
ln1plusLam-s	-1.000006	.0476791	-20.97	0.000	-1.093481 -.9065302
_cons	10.25986	.0681379	150.57	0.000	10.12628 10.39345

12.16 Regression of multiplicative form for three room or more apartments with back-solved interest rate (three month rate + 38.85bp)

Source	SS	df	MS	Number of obs =
Model	779.8357	32	24.3698656	3057
Residual	237.875795	3024	.078662631	F(32, 3024) = 309.80
Total	1017.7115	3056	.333020777	Prob > F = 0.0000
				R-squared = 0.7663
				Adj R-squared = 0.7638
				Root MSE = .28047

lnP_Area	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Domkyrkofo-n	.3986332	.0955495	4.17	0.000	.2112846 .5859818
Johannes	.4106578	.0675445	6.08	0.000	.2782201 .5430956
Adolf_Fred-k	.434037	.0714529	6.07	0.000	.2939358 .5741381
Gustav_Vasa	.433538	.067851	6.39	0.000	.3004991 .5665768
Matteus	.4094254	.0633909	6.46	0.000	.2851318 .533719
Engelbrekt	.4410742	.0647509	6.81	0.000	.314114 .5680344
Hedvig_Ele-a	.486866	.0740833	6.57	0.000	.3416072 .6321247
Oscar	.5100401	.0623671	8.18	0.000	.3877539 .6323263
Maria_Magd-a	.4202882	.0623014	6.75	0.000	.2981308 .5424455
Hogalid	.4039442	.0638127	6.33	0.000	.2788235 .5290648
Katarina	.46807	.0636671	7.35	0.000	.3432349 .5929052
Sofia	.4295505	.0628006	6.84	0.000	.3064144 .5526866
Kungsholm	.4565125	.0640602	7.13	0.000	.3309064 .5821185
St_Goran	.4678904	.0616774	7.59	0.000	.3469565 .5888243
Brannkyrka	.0902681	.0549696	1.64	0.101	-.0175136 .1980497
Vantor	-.0438371	.0532863	-0.82	0.411	-.1483181 .0606439
Farsta	.1430277	.0588621	2.43	0.015	.0276139 .2584416
Bromma	.1503341	.0548565	2.74	0.006	.0427743 .2578939
Essinge	.5003374	.0777551	6.43	0.000	.3478792 .6527956
Vasterled	.4195788	.0629008	6.67	0.000	.296246 .5429115
Vallingby	.0566466	.0635386	0.89	0.373	-.0679366 .1812299
Enskede	.2869468	.0553234	5.19	0.000	.1784714 .3954222
Skarpnack	.018917	.0542218	0.35	0.727	-.0873983 .1252324
Hasselby	.0450956	.0598639	0.75	0.451	-.0722825 .1624737
Hagersten	.2608574	.0550119	4.74	0.000	.1529928 .3687219
Spanga	.0350271	.0535208	0.65	0.513	-.0699136 .1399679
Kista	.0558372	.0520338	1.07	0.283	-.0461881 .1578624
pre1920	-.0299365	.0230714	-1.30	0.195	-.0751738 .0153008
y20to40	.001922	.0219048	0.09	0.930	-.0410279 .0448719
y40to60	-.0209813	.0216409	-0.97	0.332	-.0634137 .0214512
y60to80	-.1794702	.0215585	-8.32	0.000	-.221741 -.1371995
ln1plusLam-s	-1.000005	.0452349	-22.11	0.000	-1.088699 -.9113109
_cons	10.6126	.0815972	130.06	0.000	10.45261 10.77259