Who Benefits from Rent Control?

Socio-Economic Determinants of the Rent Subsidy

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Abstract:

A common aim of rent control is to assist low-income households and decrease segregation. We test the income-distributional effects of rent control with a novel dataset that includes characteristics of those who received rental apartments between 2011 and 2016 in central Stockholm, Sweden. In this setting, rental apartments are allocated through a centrally managed que.

To estimate the rent subsidy, we estimate hypothetical market rents by taking the owner-occupied market as a point of deviation. We find that the average rental apartment has a rent that is considerably below market clearing levels, with an average monthly rent subsidy of 4,338 SEK ($502).

From an income-distributional perspective, we find several regressive effects. Individuals who receive rent-controlled apartments have incomes that are on average 30% higher than the metropolitan area average. Within this group, we find that rental apartments in the highest quantile of the subsidy have older tenants with substantially higher incomes compared to tenants who receive less subsidized apartments. The regressive effect is driven by high earners affording higher rents (renting larger apartments) and being able to wait longer in que. The most subsidized apartments have tenants that are on average 13 years older than the least subsidized ones.

Controlling for time in que, we find that renters in the highest quantile of annual income (who on average make 836,008 SEK/$96,648) receive monthly rent subsidies that are 1,034 SEK ($120) higher than renters in the lowest quantile of income (who on average make (250,802 SEK/$28,994).

1. Introduction

During recent years, increasing residential rents have resulted in calls for rent controls. On a national level, Bernie Sanders and Jeremy Corbyn have called for rent control policies in the US and the UK, respectively. The elected coalition in Berlin has attempted to impose a moratorium on rents during 2020. And the mayor of London, Sadiq Khan, has signaled the necessity of similar measures. In short, rent control measures have become a popular policy to combat decreasing housing affordability and segregation.

A large body of research supports improved health and educational outcomes of minority and lower-income residents that live in less segregated neighborhoods (Kain, 1968; Katz et al., 2001; Cutler and Glaeser, 1997). However, for rent control to act as a re-distributional measure and decrease segregation, the mechanism for allocating rent controlled apartment is important (Glaeser, 2003). As rent control will increase demand and limit supply of rental housing, and landlord preferences tend to favor higher-income residents, the desired outcome of rent control might not be achieved. The aim of this study is to analyze the relationship between household characteristics and the rent subsidy in a setting where apartments are allocated through a central housing queue. We use a novel dataset with renter characteristics of those who received rent-controlled apartments in Stockholm, Sweden to test this relationship.

To what extent a rent subsidy is allocated to low-income households is of particular interest. Although allocation through a central housing queue should favor high income households less compared to allocation through connections with landlords or key money for instance, the possibility to gather waiting time may be skewed in favor of high-income households. The argument is simple, waiting for a decade for a rent subsidy demands an alternative housing solution in the meantime. Within the data in this study, the average time in que among those who received a rental apartment is 14.8 years, which increases to 21 years for apartments in the highest quantile of rent subsidy. Possibilities to arrange alternative housing solutions are naturally skewed in favor of high-income households, who can solve their housing needs on the ownership market.

Glaeser and Luttmer (2003) present an argument of the accumulated costs that rent control impose on society. Such costs can be attributed to two distinct sources. First, rent control decreases incentives

to construct new apartments, which implies both consumer and producer surplus will decrease. Second, rent control distorts the allocative properties of the price mechanism, resulting in an inefficient allocation of existing apartments. There is a consensus that rent control comes at a price.

Among the adverse effects attributed to rent control are decreased tenant mobility (Diamond et al. 2019; Munch and Svarer, 2002; Gyourko and Linneman, 1989); adverse effects on housing supply (Diamond et al. 2019; Lindbeck, 1967); misallocation of apartments (Van Ommeren and Van der Vlist, 2016; Glaeser and Luttmer, 2003); affects incentives to maintain rental properties (Lind, 2015; Werczberger, 1988); tenure conversions (Diamond et al. 2019, Kopsch, 2019, Donner and Kopsch, 2018; Werczberger, 1988) and occurrence of black markets (Malpezzi, 1998; Werczberger, 1988). Even in presence of a myriad of negative consequences, rent control is used as a policy measure combating increasing urban rents.

A common purpose of rent control legislation is that households of different income categories can afford to live in all neighborhoods. In a Swedish context, Enström Öst et al. (2014) find that income segregation is significantly lower in the rent-controlled housing market as compared to the owner-occupied housing market. However, when using other measures than income, they find the rental market to more segregated. Their results imply that the Swedish rental market disadvantages young households, immigrant households and households with lower educational levels.

One of the earlies attempts to measure income distribution in relation to rent controls is Johnson (1951), who concludes that there is no evidence that rent control helps low-income households. Johnson (1951) suggests that there may indeed exist households with relatively low incomes renting from landlords with relatively high incomes. However, the opposite relations also exist. Johnson concludes his findings with "Thus if one of the objectives of rent control is to aid low-income people-and I can find no other important objective that rent control does achieve-it does not achieve that objective" (p. 582).

But the literature is ambiguous to this conclusion. Olsen (1972) provides one of the first econometric estimations of the consequences of New York rent control. He concludes that rent control benefits poorer households more than it benefit richer households. Thus, the findings by Olsen (1972) lean

support to the primary aim of rent controls. However, the allocation of benefits through rent control costs twice as much for landlords as the benefit received by tenants.

In relation to allocation of rental apartments through queuing, Van Ommeren and Van der Vlist provide evidence of random allocation of apartments across income groups. In particular, they find that in a sub-sample of public housing apartments in Amsterdam with long queuing times, there is no connections between household income and market value of the apartment. For apartments with short queuing time there is however a positive such relationship, where household with higher incomes receive apartments with higher market values.

With this paper, we will add to the existing literature by analyzing the income-distributional effects of allocations of subsidized rental apartments via a central housing queuing system. A central housing queue, compared to other non-market allocations such as key money or connections with landlords, should be less inclined to favor high income households. The example of Stockholm is interesting since Swedish rental legislation is all-encompassing, thus differing from e.g., Van Ommeren and Van der Vlist who studies public housing only.

The remainder of this paper is structured as follows. We present our empirical strategy, measuring the subsidy implied by rent control and the socio-economic determinants thereof in section 2. Section 3 is devoted to a presentation of the data used. Section 4 presents the results and section 5 concludes.

2. The Empirical strategy

Binding rent controls affects the price of rental housing. Thus, implying a subsidy to the tenants living in rent-controlled apartments. In this paper we are interested in explaining and investigating whether socio-economic factors of renters can help explain the rent control subsidy. To achieve this, we need a quantitative measure of the subsidy. More specifically, the subsidy (S_i) is the amount of rent for apartment *i* that is not paid due to rent control. That is, the difference between the prevailing market level rent (h_i^{market}) and the rent-controlled rent ($h_i^{regulated}$). Or expressed mathematically:

$$S_i = h_i^{market} - h_i^{regulated} \quad (1)$$

Regulated rents are observable in the Swedish context. But since the counterfactual market rents are unobservable, the true subsidy will also be unobservable. Therefore, we will have to provide an estimate of the subsidy ($\hat{s}i$). All that is needed to estimate the subsidy, is an estimate of the counterfactual market rents.

$$\widehat{s_i} = \widehat{h_i^{market}} - h_i^{regulated} \qquad (2)$$

Thus, deriving the dependent variable for the following analysis, demands that we estimate the likely market rent of rent controlled apartments. Here, we follow the approach by Donner et al. (2017) of using transaction data of owner-occupied apartments to estimate hypothetical market rents for each rent-controlled apartment. In the below section, we cover each step of our analysis to estimate hypothetical market rents.

2.1 Estimation of Market Rents in a Rent Controlled Setting

As previously described, the Swedish rent control policy is all-encompassing and applied to virtually all rental apartments (with some temporary market adjustments for new construction). The absence of an unregulated comparable rental sector prohibits estimation of market rents between sectors. Instead, we will make use of the unregulated market for owner-occupied apartments. On a housing market without price controls, we would expect the monthly costs of apartments to converge with respect to tenancy form. Following Donner et al. (2017) we use information from the owner-occupied sector to estimate the household cost function of housing (c_i). This cost consists of two parts. First, the monthly fee, M_i, that is paid to the housing co-operative to cover heating, maintenance and debt-maintenance if the co-operative holds debt. In Sweden, practically all owner-occupied apartments are in co-operative form, which is somewhat different in an international perspective. The monthly fee is included in our transaction data. Second, the cost of capital, which can be estimated from the transaction price, P_i, assuming an annual cost of capital (r-g)[1], where r denotes the annual interest rate and g the expected increase in apartment value. The total monthly cost of a co-operative apartment is therefore as shown in (3);

$$c_i = M_i \frac{(r-g)\times P_i}{12} \qquad (3)$$

[1] See appendix section 7 for the approach of estimating r-g.

In our data set of apartment transactions, we can observe all components of (3) except for *r-g*, which we derive from a small sub-set of newly produced apartments with freely set rents s a point of reference. The estimation of *r-g* is detailed in the appendix (section 7).

The transaction data also includes apartment specific characteristics such as size and location. This allows us to estimate the housing cost function to provide an estimate of the individual cost components, such as size and location. That is, the monthly cost for apartment *i* is a function of the characteristics associated with that apartments:

$$c_i = f(X_i) + \varepsilon_i \quad (4)$$

With X_i representing the physical characteristics of apartment i and ε_i is a statistical error term representing aspects that are important for the price of the apartment but that are not in our data set, and stochastic errors. This cost function would provide an estimation of market rents in a well-functioning rental market where the equilibrium is equal to the housing cost that a tenant is willing to pay. Expressed differently, the market rent (based on the market cost for owner-occupied apartments) is the sum of the estimated implicit cost of individual characteristics associated with the apartment.

To estimate hypothetical market rents, we run econometric models where the dependent variable is the monthly cost of an apartment which is the monthly fee, and the present value of the transaction price, M_i + (r-g) P_i/12.

The independent variables are apartment characteristics; the number of rooms, the living area (in square meters), the number of rooms multiplied with the living area, binary variables indicating neighborhood (parish) and time (quarterly).

As we found that the data is heteroskedastic, we do Box-Cox Transformations of the dependent and independent variables, following Halvorsen and Pollakowski (1981). The econometric specification is as below (5);

$$\frac{c_i^{\theta}-1}{\theta} = a_0 + \beta_1 \frac{living\ area_i^{\lambda}-1}{\lambda} + \beta_2 \frac{rooms_i^{\lambda}-1}{\lambda} + \beta_3 + \frac{(living\ area_i * rooms_1)^{\lambda}-1}{\lambda} +$$

$$\beta_4 * neighborhood_i + \beta_5 * year_i + \varepsilon_i \quad (5)$$

Since we have stated that the free market outcome of both rents and monthly costs of owner-occupied apartments would result in equality between costs ($h_i^{market} = c_i$), we can use the implicit estimated costs ($\hat{f}$) from (5) to impute market rents, such that:

$$\widehat{h_i^{market}} = \hat{f}(X_i) \qquad (6)$$

Since we can observe the same characteristics for rental apartments, i.e. size and location, as for owner-occupied apartments, this approach is possible. And thus, we can compute an estimate of the subsidy for each of the observed rental apartments, using (2).

2.2 Sources of Potential Bias for Estimating Market Rents

Using estimated monthly costs of owner-occupied housing may potentially result in biased results, for several reasons. For one, this approach assumes that rental housing and owner-occupied housing are perfect substitutes to each other. There are however some genuine differences between renting and owning, such as different service levels and different capital risks that speak to the fact that rents are likely to be slightly higher than monthly costs for similar owner-occupied apartments. Thus, market rents may be underestimated.

It is also likely that prices on the owner-occupied market are driven upwards due to the lack of supply of rental apartments and that a de-regulation of the rental market would have a depreciating impact on the owner-occupied market as supply of rental apartments increases. Thus, using prices of owner-occupied apartments as benchmark, may overestimate the market rent. In the longer-term, the subsidy is likely to be overstated as market rents would increase supply of rental apartments and thus drive down rents. Similarly, the current incentives to convert rental apartments to co-operatives that has decreased supply of rental apartment would also decrease (see Donner and Kopsch, 2017 for a review of this conversion process).

It may also be the case that we have unobserved quality differences between rental housing and owner-occupied housing that results in an over- or underestimation of market rents. If rental housing on average holds a lower level of unobserved quality our approach will not take this into account and thus result in an overestimation of market rents. Economic theory typically points towards quality deterioration in presence of rent controls. However, Lind (2015) argues that the Swedish rent control

policy may very well have the opposite impact, that landlords, in order to raise rents, overinvest in quality, which could then imply an underestimation of market rents using our approach.

2.3 Model Specification for Estimating the Determinants of the Rent Subsidy

As we have estimated market rents for all rent-controlled apartments by imputing the estimated equation from (5), we proceed to estimate models that explain the rent subsidy, subsidy $\widehat{s_i} = \widehat{h_i^{market}} - h_i^{regulated}$ as a function of the characteristics of the renter who received the apartment.

The dependent variables are; gender, income (by quartiles), age up to 30, age 31 to 45, age 46 to 65 (i.e. 66 and older is the default age category[2]), time in que (in years), the square of time in que (as we expect a non-linear relationship) and if the renter is from Stockholm. We also include binary variables controlling for location (parish) and time (year).

We run models with the dependent variable (the rent subsidy) based on an *r-g* of 2.65% and 3.0%, which minimized the RMSE and MAPE forecasting errors for newly produced apartments with more freely set rents.[3] As higher interest-rates results in a higher cost-of-capital, our estimated market rents and rent subsidies become higher with the higher estimate of *r-g*. The absolute rent subsidy is estimated as shown in (7) below:

$$\widehat{s_i} = a_0 + \beta_1 * Female_i + \beta_2 * Income_i + \beta_3 * Age_i + \beta_4 * Que\ Time_i + \beta_5 * Que\ Time_i^2 + \beta_6 * From\ Stockholm_i + \beta_8 * Year_i + \beta_9 * Neighborhood_i + \varepsilon_i \quad (7)$$

It is likely that higher income individuals will demand larger and more expensive apartments, with a larger absolute subsidy. We therefore estimate a model where we control for apartment size (in square meters), the number of rooms, and the number of rooms multiplied with the living area. The econometric specification can be seen in (8):

[2] As a robustness test, we have estimated the models with age as a continuous variable, with consistent results (slightly lower R^2).

[3] Some newly produced rental apartments in Sweden are temporarily allowed to set what is known as *presumption rents*, allowing landlords to set rents more freely to cover the cost of construction. See appendix for a description of how r-g is estimated.

$$\widehat{s_i} = a_0 + \beta_1 * Female_i + \beta_2 * Income_i + \beta_3 * Age_i + \beta_4 * Que\ Time_i + \beta_5 * Que\ Time_i^2 + \beta_6 * Size_i + + \beta_7 * Rooms_i + \beta_8 * Size * Rooms_i + \beta_9 * From\ Stockholm_i\ \beta_{10} * Year_i + \beta_{11} * Neighborhood_i + \varepsilon_i \quad (8)$$

3. Data and Swedish Rent Control

3.1 Swedish Rent Control and the Central Stockholm Housing Queue.

Sweden has had different types of rent control regimes since the 1942. The current system of rent control was established in 1968 but has since then undergone several changes. The main result does however remain intact: rents are far below their market levels, especially in Stockholm. Queuing times have increased consistently for decades and now surpass 10 years on average, approaching 20 years plus for inner city apartments (Donner, Englund and Persson, 2017; Kopsch, 2019). In our data, the average time in que is 14.8 years among those who received a rental apartment. The number of queuing people increase at a rate faster than the number of allocated apartments.

Rents for apartments can be set in a few different ways. For the majority of the existing rental housing stock the so-called *user value* system applies. User value was implemented in 1968 as a measure to ensure that apartments with similar characteristics also have similar rents. If a tenant and a landlord disagree regarding the rent, the rent can be tried in court, where the user value will be established looking at other apartments. For newly constructed apartments rents can be set using the user value. However, the rent motivated by user value may not be high enough to cover building costs. For this reason, a supplement to rental legislation in 2006 allows rents for newly constructed apartments to deviate from the user value, to cover expenses, for a period of 15 years. Thereafter, rents are to be tried against user values. It is also common for landlords to set individual rents for newly constructed apartments. Such rents can exist as long as tenants do not choose to try rents in court, at which point individually set rents would be controlled by their user value. Thus, user value is the system that determines rent levels.

Changes to rents over time, for the majority of apartments, is determined by central negotiations between landlords, or a representative of the landlords, and the tenants, or a tenant union[4]. In practice, the abovementioned user values are only applied for the existing housing stock when these negotiations do not result in an agreement. There is also a connection between central negotiations and user value in that the reference apartments used to legally try a user value in court has be an apartment with a central negotiation agreement.

The price control on the Swedish rental market has decreased the supply of rental apartments, primarily via conversions to owner occupied apartments (Donner and Kopsch, 2018; Donner, Englund and Persson, 2017; Kopsch, 2019). The price controls also imply that rental apartments need be allocated via no-market mechanisms, as price is not available. This will result in yet another inefficiency, other than undersupply, through allocation (Glaeser and Luttmer, 2003).

There are a number of ways for prospective tenants to receive a contract for a rental apartment. Connections and nepotism is one. Illustrative examples are the former social-democratic prime minister Göran Persson who received a rent-controlled apartment from a private landlord.[5] The same goes for the current center-right leader of the opposition, Ulf Kristersson.[6] Some landlords have their own waiting queues or allocation methods where they can choose between prospective tenants. The discrepancy between market rents and regulated rents also provides incentives for a black market[7] (Malpezzi and Ball, 1991; Malpezzi, 1998). It is not a far stretch to suggest that such allocations mechanism, black markets and connections, favor households with higher incomes. A portion of vacant rental apartments in Stockholm (circa 20 percent according to Donner et al. 2017) are allocated through the central queuing system (*Bostadsförmedlnignen i Stockholm*, from here on referred to as *the queue*). Both private and public landlords can post their apartments through website of the queue. In our data set consisting of 9943 allocated rental apartments for central Stockholm, we can identify 203 distinct companies.

[4] For the most part by the nationwide organization Hyresgästföreningen who negotiate rents for roughly 90 percent of Swedish rental apartments.
[5] Svärdkrona, Z. Nov 16, 2006 "De susade förbi kön", Aftonbladet.
[6] October 6, 2010. "Nya ministern fick hyresrätt genom kontakter", SVT Nyheter.
[7] Sandberg, S and Aschberg, R. Jun 15, 2017. "Svartmäklare berättar: Enorma belopp och mindre risker än när man säljer knark", Aftonbladet.

Queuing time starts upon registration in the queue. To register, the applicant needs to be 18 years of age and a legal resident of Sweden. There is an annual cost of 250 kronor ($29) to stay in the queue. An individual who has registered in the queue will start building waiting time, which is the currency with which an apartment can be acquired. An individual in the queue will never be offered an apartment, instead one has to actively express interest in posted apartments on the website of the queue. When the apartment has been posted and applicants have expressed their interest a number of households, ordered from highest queuing times, are invited to view the apartment. After viewing, the household can decide whether or not they want the apartment. The individual with longest queuing time who want the apartment and fulfills any income requirements set up by the landlord[8], can then sign a contract. The queue does in practice have unlimited deferral. There is however, at least on paper, possible to lose one's place in the queue. An individual who first expresses interest on the website, is invited to a showing, accepts the offer but then chooses to decline when being offered a contract get a strike. Three strikes result in exclusion from the queue. We do not have data on the frequency of such occurrences, but the authors of this paper have never heard any anecdotes of this happening.

3.2 Data

To analyze the relationship between individual socio-economic characteristics and the rent control subsidy, this study uses three primary data sources which are described below.

First, data with basic characteristics such as size, number of rooms and address of rental apartments that have been mediated through the central que managed by the Stockholm Housing Agency. The dataset includes apartments from both private and public landlord. For those familiar with the Stockholm housing market, there is no reason to believe that there are unobserved differences in quality between properties owned by public and private landlords. This data covers the period of 2011 to 2016.

Second, transactions of owner-occupied co-operative apartments sold through real estate agents. We use this dataset to estimate an equation for market rents which is applied on our dataset with rental apartments, as covered in section 3.1. The difference between the actual rent and the estimated market rent is the rent subsidy.

[8] Most commonly landlords demand the household to have a monthly income at least three times the monthly rent.

Third, based on the rental apartment ID, we merge the dataset with rental apartments with information on all individuals who applied for a rental apartment to analyze the determinants of the rent controls subsidy. This data was also provided from the Stockholm Housing Agency. Using a dataset on data with apartments that are newly constructed and thus are subject to a higher rent closer to market level, we identify such observations and exclude them from the analysis.

Our transaction data includes nearly 40,000 arms-length sales of owner-occupied co-operative apartments done by real estate agents. This data covers sales in the city of Stockholm during the period of 2011 to 2016 and was provided by the company *Mäklarstatistik* that compiles and aggregates housing transactions. The market coverage is above 90%. It should be noted that the Swedish apartment market is somewhat different in an international perspective, as owner-occupied apartments take the form of co-operatives, in which a share in a housing co-operative is owned. The co-operative is responsible all structural repairs and renovations and might also hold debt. Apartment owners pays a monthly fee that covers future renovation needs and debt service.

The dataset with rental apartments mediated through the Stockholm Housing Agency que is structured such that the unit of observations are apartment applications with apartment and applicant characteristics, time in que, and information about whether the application was successful in getting the apartment. Unfortunately, time in que is only available for applications with a positive outcome.

Of 9,943 mediated rental apartments in central Stockholm during the period, we exclude short-term contracts and all special types of contracts (such as senior housing, student housing, housing specifically for youth and short-term contracts) to analyze what is typically considered a "normal" rental apartment by most individuals, i.e. with a right of tenancy and without special requirements. Our way of determining the sample follows previous research analyzing the Swedish rental market (Donner et al. 2017). We also exclude apartments in new development and renovations as these are subject to a different rent structure which allows for higher rents, closer to market rates.

Even though normal rental apartments constitute the vast majority of rental apartments in Stockholm, the remaining sample of mediated apartments numbers 2,375 (out of 9,943), illustrating that the turnover of rental apartments is much lower compared to other forms special rental contracts. This

can be attributed to the shorter-term nature of short-term contracts and student housing, but also a consequence of a lock-in effect caused by low-rents (i.e., those with very subsidized apartments are unwilling to give up their contracts). Another consequence of a-typical rental apartments constituting a majority of mediated apartments while comprising a small fraction of the overall rental stock is that the uninformed individual might believe that rents in general are close to market level.

Table 1 below covers the basic characteristics of size and the number of rooms of the apartments in our analysis which consists of the rental apartments from the rental que data, and owner-occupied co-operative apartments from the transaction data. The statistics are based on transactions of co-operative apartments used in the models that estimate market rents, and the dataset with rental apartments mediated through the central que.

The statistics show us that rental apartments tend to be smaller (on average 57 square meters compared to 62 for co-operatives) and have fewer rooms (1.9 compared to 2.3). This difference tells us that rental apartments will be on the lower end of the market in a given area, compared to owner occupied apartments. The data also tells us that the average transacted apartment sold for 4,427,017 Swedish Crowns (SEK) (approx. $511,794) with an average co-operative monthly fee of 2,888 ($334). This while the average mediated rental apartment has a monthly rent of 7,434 SEK ($859).[9]

[9] When showing values in U.S. dollars, we use the exchange rate of August 18,2020 of 8.65 Swedish Crowns per U.S. Dollar.

Table 1 – Apartment Characteristics by Category. Mean Values with Standard Deviations in Parenthesis.

	Rental Apartments	Co-Operative Apartments
Contract Price (SEK)	N/A	4,427,017
		(2435874)
Co-Operative Monthly Fee (SEK)	N/A	2,888.075
		(1330.138)
Rent (Regulated)	7433.562	N/A
	(2948.049)	
Living Area (Sqm)	57.09263	61.88527
	(22.4046)	(30.77707)
No. of Rooms	1.977684	2.332556
	(.9238753)	(1.062529)
Year of Mediation	2013.107	N/A
	(1.633429)	
Year of Sale	N/A	2013.8
		(1.668852)
No. of Obs.	2,375	39,022

We now shift our attention towards the characteristics of those who received rental apartments in central Stockholm through the que between 2011 and 2016.

In addition to time in que, table 2 shows statistics on gender, age, income and if the renter was already living in central Stockholm. As information on annual income, time in que and age is missing for 733 observations (notably time in que which is missing for 541 observations), our analysis of those who received a rental apartment is of the remaining 1,642 observations.[10]

The average individual who received a rental apartment is 43 years old and has an annual income of 487,761 Swedish Crowns (SEK) ($56,388). The median is 416,700 SEK or $48,173. The average time spent in que was nearly 15 years (with a standard deviation of 6.2 years). There is a slight majority of women (56%), and about 46% was already living in the central parts of Stockholm that we are analyzing. The latter statistic is notable, as it shows that almost half of those who receive rent-

[10] Reassuringly, our estimated market rents are very similar between the full sample of 2,375 mediated apartments and the 1,642 that have information on tenant characteristics. This can be seen in the bottom two lines of table 4.

controlled apartments already had some form of housing in the attractive city center and indicates that the current system has a limited effect on decreasing segregation.

The levels of income for those who received rent-controlled apartments are considerably higher than average incomes for Sweden and the greater Stockholm region (county). Based on official statistics, the average income for the metropolitan area was 323,300 SEK for all individuals between 20 and 64 years of age in 2011 (the median was 290.000 SEK), with the equivalent value for 2016 being 367,200 SEK (with a median of 331,300 SEK) (Statistics Sweden, 2020). The average of averages for 2011 to 2016 is an annual income of 343,700 SEK ($39,734), which is 30% less than the average for those who received a rent-controlled apartment in central Stockholm.

Table 2 – Characteristics of Individuals Receiving a Rental Apartment in Central Stockholm Through the Housing Agency Que During 2011 to 2016. Mean Values with Standard Deviations in Parenthesis.

	Received Rental Apartment
Female	.5572473
	(.4968633)
Age	43.4324
	(11.99977)
Annual Income (SEK)	487,760.9
	(255,584.7)
From Stockholm	.4616322
	(.4986776)
Years in Que	14.79111
	(6.16260)
No. of Obs.	1,642

4. Results

Our results will be presented in sections 5.1 through 5.4, with section 5.1 briefly covering the results from our estimation of market rents and the rent subsidy, 5.2 the impact of rent control across tenant income groups, 5.3 tenant characteristics by quantiles of the rent subsidy, and 5.4 presenting econometric models that explain the rent subsidy with renter characteristics.

4.1 Estimation of Market Rents and the Rent Subsidy

The output from the hedonic Box-Cox models (corresponding to equation 5 above) for estimating market rents is provided in table 3. The dependent variables show their expected signs and are statistically significant (1%). These results provide us with an equation to estimate market rents. Our results from the analysis of the rent subsidy follows in sections 5.2 through 5.3.

Table 3 – Hedonic Box-Cox Models Applied to Transaction Data in Central Stockholm, 2011 to 2016. Dependent Variable is the Transaction Price + the Present Value of Co-Operative Monthly Fees. Coefficient Estimates with the Chi^2 test statistic in parenthesis.

Variable	r-g: 2.65%	r-g: 3.0%
Number of Rooms	-.0020864	-.001943
	(51.814)	(49.792)
Living Area	.0143024	.013235
	(3393.701)	(3308.155)
Number of Rooms*Living Area	.003143	.0028899
	(247.767)	(238.832)
Location Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes
Transformation Parameters:		
Left-hand side parameter λ	.1131605	.1169405
Right-hand side parameter θ	-.2135908	-.218149
Log likelihood	-571498.22	-570954.49
No. of Obs.	39,022	39,022

Binary variables indicating the year of sale and location (parish) are suppressed from the output to save space.

As we apply the equation from Table 3 to estimate market rents for central Stockholm, we find that *r-g* of 2.65% produces an average estimated monthly hypothetical market rent of 10,818 SEK ($ 1,251) while an *r-g* of 3.0% results in an average estimated hypothetical market rent of 11,872 SEK ($ 1,372). This while the average regulated rent is considerably lower at 7,434 SEK ($ 859).[11] These estimates are based on the full sample of 2,375 rental apartments, while our analysis below is focused on those 1,642 observations with renter characteristics. Reassuringly rents and estimated rents are very close when comparing the full sample of rental apartments with those that include renter characteristics, as seen in the last two lines of Table 4.

[11] Using an USD to SEK exchange rate of 8.65 (as of August 2020).

Table 4 shows us regulated rents and estimated market rents by neighborhood, illustrating that rents are significantly below market level across all neighborhoods in central Stockholm. As an example, the average rent for rental apartments mediated 2011 to 2016 in the Högalid neighborhood is 6,621 SEK ($765) while our estimated market rents are 10,378 SEK ($1,200) and 11,396 SEK ($1,317) for an r-g of 2.65% and 3.0%, respectively.

Analyzing these estimates of market rents in greater detail allows us to identify how large the rent subsidy is, i.e., the difference between the estimated market rent and the current regulated. We find average monthly rent subsidies of either 3,384 SEK ($391) or 4,338 SEK ($502), for an r-g of 2.65% or 3%, respectively.

There is considerable geographical spread of the rent subsidy, with the neighborhood Gustav having the smallest difference between rents and hypothetical market rents, and an average subsidy of 2,344 SEK ($271) at an r-g of 2.65% (3,602 SEK or $416 at 3.0%). The Hedvig Eleonora neighborhood has the largest subsidies, which on average is 5,961 SEK ($689) or 7,402 SEK ($856) at 2.65% and 3.0%, respectively.

In the next two sections, we analyze the distributional effects from two perspectives. First, we analyze the subsidy by breaking down the sample by quantiles tenant income levels, telling us how the subsidy varies across different income groups. Second, we answer the question of "who receives the most subsidized apartments?" by breaking down the sample by quantiles of rent subsidy.

Table 4 – Estimated Market Rents and Current Rent Controlled Rents by Zip Codes in Central Stockholm. Mean Values with Standard Deviations in Parenthesis.

Parish (Parish Code)	Rent	Market Rent (2.65%)	Market Rent (3.0%)	Rent Subsidy (2.65%)	Rent Subsidy (3.0%)	No. of Obs.
Stockholms Domkyrkoförsamling (18001)	9224.756	12830.5	14097.67	3605.746	3605.746	78
	(4001.917)	(5886.89)	(6504.781)	(3406.672)	(3897.425)	
S:t Johannes (18004)	5790.136	10104.45	11152.52	4314.313	5362.387	44
	(2463.622)	(4608.954)	(5124.01)	2799.045	3273.123	
Adolf Fredrik (18005)	8630.119	13347.24	14751.23	4717.117	6121.113	42
	(3130.58)	(5513.426)	(6159.405)	4153.485	4723.783	
Gustav Vasa (18006)	9684.142	12028.52	13286.32	2344.381	3602.178	106
	(3432.685)	(3566.77)	(3967.966)	2390.866	2595.138	
S:t Matteus (18007)	6474.301	12119.04	13371.73	5644.74	6897.424	83
	(1703.455)	(3660.098)	(4065.754)	2607.533	2987.482	
Engelbrekt (18009)	6605.504	10126.32	11113.81	3520.815	4508.307	113
	(2442.958)	(3435.972)	(3787.928)	1967.172	2245.159	
Hedvig Eleonora (18010)	7317.429	13279.07	14720.25	5961.645	7402.82	14
	(3161.487)	(6891.831)	(7691.623)	4172.247	4944.833	
Oscar (18011)	5989.655	9350.792	10295.25	3361.137	4305.598	87
	(2594.147)	(4011.861)	(4433.422)	1818.854	2194.074	
Maria Magdalena (18013)	6526.811	10614.15	11650.19	4087.337	5123.375	185
	(2626.84)	(4180.587)	(4630.918)	2282.383	2674.547	
Högalid (18014)	6620.69	10378.15	11396.41	3757.463	4775.717	200
	(2837.233)	(4389.909)	(4838.481)	2561.726	2938.431	
Katarina (18015)	7151.451	11743.39	12932.6	4591.941	5781.149	295
	(2420.405)	(4326.61)	(4795.676)	2764.383	3181.545	
Sofia (18017)	8656.599	11295.35	12335.67	2638.746	3679.068	694
	(2527.374)	(2991.208)	(3281.364)	(1949.949)	(2134.115)	
Västermalm (18019)	6302.164	9030.11	9905.896	2727.947	3603.733	434
	(2907.6)	(3517.536)	(3875.325)	(1970.9)	(2202.891)	
All Parishes	7433.562	10817.75	11871.79	3384.185	4438.232	2,375
	(2948.049)	(3988.832)	(4407.262)	(2491.813)	(2811.452)	
All Parishes (Sample w. Renter Data)	7667.649	10822.1	11879.71	3154.446	4212.057	1,642
	(3075.735)	(4034.743)	(4454.855)	(2300.286)	(2612.917)	

5.2 Breaking Down the Data by Quantiles of Tenant Income

We start our analysis by breaking down the sample by quantiles of renter income – this tells us the level of subsidy tenants with different levels of income receive. Table 5 shows us tenant and apartment characteristics by quantiles of income, with rent and subsidy estimates based on discount rates of 2.65% and 3%. We will focus on discussion on rent subsidy estimates based on an r-g of 2.65%, as the results are consistent, with the difference being higher estimated market rents and subsidies when the discount rate is higher.

Tenants in the highest, fourth, quantile of income on average make 836,008 SEK ($96,648) a year, while those in the first quantile on average make 250,802 SEK ($28,994). This very large difference illustrates that the need, and ability to find housing at market levels varies substantially among those who receive rent-controlled apartments with below market rents.

Table 5 shows us that high earners tend to receive larger rent subsidies than low-earners. At a 2.65% discount rate, the highest quantile of earners receives an average monthly subsidy of 3,309 SEK ($383), compared to 2,845 SEK ($329) for tenants in the first quantile of income. Renters in the third quantile receive highest average subsidy, at 3,402 SEK ($393).

Even as the absolute subsidy is stable across income groups, we find that the percentage rent discount (i.e., market rent in relation to subsidized rent) is higher for lower income tenants, with those in the first quantile of income receiving an average discount of 34% while the fourth quantile of renters receive a 21.9% discount.

We also find that the absolute rent subsidy makes a considerably bigger impact on low earners, with the rent subsidy on average being equal to 14.8% of income among those in the first quantile of income. For those in the fourth quantile of income (who receive a slightly larger subsidy in absolute terms), the subsidy only comprises 4.9% of their annual income. This tells us that even as the absolute subsidy is stable across income groups (ranging from 2,845 SEK/$329 to 3,402 SEK/$393), low-income tenants are more likely to need the subsidy to afford their apartments while higher earners would afford to pay market rents.

As expected, higher earners consume more housing, with the average number of rooms and square meter size increasing with income – as an example, tenants in the fourth quantile of income have an average of 2.6 rooms on 75.5 square meters while those in the first quantile of income on average rent 1.3 rooms on 39.5 square meters. Lower income tenants correspondingly pay lower rents, on average 5,186 SEK ($600) in the first quantile of income and 10,814 SEK ($1,250) in the fourth quantile.

There is a substantial difference in estimated market rents across income groups, which is expected given the above-described differences in apartment characteristics. Those in the first quantile of income received apartments with an average estimated market rent of 8,031 SEK ($928) while tenants in the fourth quantile having apartments with an average estimated market rent of 14,123 SEK ($1,633).

Age, the fraction already living in central Stockholm before receiving a rental apartment, and time in que shows little variation across income levels.

From an income distributional perspective, table 5 tells us that high income tenants on average receive a slightly larger absolute rent subsidy than low-income tenants, and that this subsidy on average makes little difference for high income tenants (as a percentage of income). Lower income-tenants rent smaller and cheaper apartments with larger percentage discounts, while higher income-tenants rent larger and more expensive apartments, with higher estimated market rents.

Table 5 – Apartment and Tenant Characteristics by Quantiles of Tenant Income. Mean Values with Standard Deviations in Parenthesis.

Tenant Income:	Income: Quantile 1	Income: Quantile 2	Income: Quantile 3	Income: Quantile 4
Rent Subsidy (2.65%, SEK)	2845.222	3063.192	3402.002	3308.887
	(1593.434)	(1910.764)	(2439.065)	(2982.417)
Rent Subsidy (3%, SEK)	3631.402	4009.912	4514.59	4696.216
	(1808.865)	(2120.7)	(2715.365)	(3396.296)
% Rent Subsidy (2.65%)	.340362	.3010673	.2822075	.2185183
	(.1169375)	(.1453457)	(.1537683)	(.1497416)
% Rent Subsidy (3%)	.3989727	.3626737	.3451979	.2875434
	(.1072749)	(.134209)	(.1418981)	(.1378907)
Rent Subsidy / Income (2.65%)	.1483518	.1017689	.0823755	.0493971
	(.1189508)	(.0643211)	(.0602354)	(.0450025)
Rent Subsidy / Income (3%)	.1884112	.1331334	.1091508	.0700024
	(.1391338)	(.0716084)	(.0672264)	(.0509126)
Time in Que (Years)	14.38792	15.09337	15.2585	14.42763
	(5.512284)	(5.847047)	(6.515141)	(6.678477)
Annual Income (SEK)	250801.5	364180.4	502240.1	836007.8
	(51346.42)	(28553.39)	(56158.2)	(249164.5)
Tenant Age	43.28502	42.95332	44.09709	43.38875
	(13.86954)	(11.33916)	(11.45011)	(11.12289)
From Stockholm	.4565217	.4226044	.4781553	.4889976
	(.4987087)	(.4945816)	(.5001299)	(.5004912)
Monthly Rent (SEK)	5185.976	6657.57	8035.66	10814.09
	(1381.381)	(1746.671)	(2209.189)	(3291.99)
Est. Market Rent (2.65%)	8031.198	9720.762	11437.66	14122.98
	(2414.329)	(2542.176)	(3219.769)	(4720.422)
Est. Market Rent (3%)	8817.378	10667.48	12550.25	15510.31
	(2657.499)	(2799.281)	(3558.022)	(5241.417)
Apartment Size (Sqm)	39.4686	50.01474	59.8665	75.52078
	(14.23183)	(15.33549)	(17.76391)	(24.83051)
Number of Rooms	1.291063	1.663391	2.042476	2.634474
	(.5614253)	(.6353396)	(.7822649)	(.963302)
No. of Obs.	414	407	412	409

4.3 Breaking Down the Data by Quantiles of Rent Subsidy

As the data illustrates that there is considerable spread in the rent subsidy, it is of interest to analyze tenant characteristics in relation to the absolute rent subsidy. Table 6 shows us tenant and apartment characteristics by quantiles of rent subsidy.

This type of breakdown of the data tells us the characteristics of those tenants that receive the most subsidized apartments. As in section 5.2, we will focus on discussion on rent subsidy estimates based on an r-g of 2.65%, as results based on an r-g of 3% are consistent, with the difference being higher estimated market rents and subsidies (table 6 shows us results based on both estimates).

Apartments in the first quantile of subsidy have an average monthly subsidy of 804 SEK ($93), while the fourth quantile has an average monthly subsidy of 6212 SEK ($718).

One should keep in mind that the subsidy can be driven by either current rents or the estimated market rent, and that some apartments with lower subsidies have comparably high current rents. The U-shaped relationship between current regulated rents and the level of subsidy is a likely contributor to the low subsidies in the first quantile. Current regulated rents are on average 8,352 SEK ($966) in the first quantile of subsidy, which is higher than in the second and third quantiles (6,802 SEK/$786 and 7,045 SEK/$814, respectively) and nearly at the same level as the most subsidized apartments in the fourth quantile (8,471 SEK/$979).

Given that the least subsidized apartments are also comparably expensive, it is no surprise that we find a U-shaped relationship between income and the subsidy. We find that average income is higher among those who received apartments in the first quantile of subsidy compared to the second and third quantiles. Highest average income is seen for those who receive the most subsidized apartments.

The difference in tenant income between the quantiles of subsidized apartments are quite large. Average annual incomes are 519,065 SEK ($60,008), 434,571 SEK ($50,239), and 466,126 SEK ($53,887) for the first, second and third quantiles of subsidy, respectively. Apartments with the largest subsidies, in the fourth quantile, are mediated to tenants with an average annual income of 531,258 SEK ($61,417).

The most subsidized apartments are also those with the highest estimated average market rents (14,683 SEK/$1,697 compared to a range between 8,959 SEK/$1,036 to 10,493 SEK/$1,213 for the other quantiles of rent subsidy), which aligns with these apartments being larger in terms of the number of rooms and square meters (on average 74.6 square meters and 2.6 rooms, compared to 1.5 to 1.8 rooms on 47 to 52 square meters in the first, second and third quantiles).

Tenant age increases with the subsidy, going from on average 37 years in the first quantile and 50 in the fourth. Similarly, more subsidized apartments have a slightly larger fraction of tenants who already were living in the attractive city center - at 50% in the fourth quantile compared to 45% in the first. Even as this difference is not very large, the absolute size of this fraction is. That roughly half of all subsidized apartments are mediated to tenants who already were living in the attractive city center indicates that these tenants either already had a rent-controlled apartment or could afford housing at market clearing prices. As there are almost no rental apartments at market prices available, it is likely that a substantial fraction of these tenants owned an apartment while waiting in the housing que until an attractive rental apartment became available. It is also striking from the often-stated aim of rent control to decrease segregation, as there is a limited effect on segregation when half of all subsidized apartments go to those who were already living in the area.

Not surprisingly, time in que increases with the level of subsidy, with apartments in the first quantile on average requiring 10 years in que while those in the fourth requiring more than 21 years. This pattern is reassuring as it tells us that our estimates of the rent subsidy align with observed market behavior.

The relationship between queuing time, age, and rent subsidy is also likely to play a role in why we find higher income levels among those who receive apartments in the fourth quantile of subsidy (compared to the second and third quantiles), as older individuals and high earners are more likely to have housing that fits their preferences and therefore be able to wait for a highly subsidized apartment, while low earners will have a more urgent need for housing, causing them to wait for shorter time-periods and receive a less subsidized apartment.

This part of our analysis shows several regressive effects of the setting with rent control and allocation through a que. Notably, high-income individuals who could afford market rents receive rental

apartments with the largest subsidies, both in terms of the absolute monthly subsidy and in terms of percentage of rent. As these most subsidized apartments are very attractive, they also require on average 21 years in que, which benefits older tenants – as illustrated by the higher average tenant age of apartments in the higher quantiles of subsidy (50 years vs 37 for the first quantile).

Table 6 – Apartment and Tenant Characteristics by Quartiles of the Apartment Rent Subsidy. Mean Values with Standard Deviations in Parenthesis.

Rent Subsidy:	Rent Subsidy: Quartile 1	Rent Subsidy: Quartile 2	Rent Subsidy: Quartile 3	Rent Subsidy: Quartile 4
r-g: 2.65%				
Rent Subsidy (SEK)	804.5093	2157.586	3448.667	6212.037
	(664.0286)	(343.3901)	(389.4345)	(2124.598)
Rent Subsidy (%)	.1041375	.2580183	.3502549	.4305975
	(.0925992)	(.070936)	(.0904964)	(.0878973)
Rent Subsidy/ Income (%)	.0257585	.0731073	.1092695	.1742292
	(.0254825)	(.0345421)	(.0508755)	(.1138249)
Time in Que (Years)	10.14866	12.8	15.17786	21.04829
	(3.44405)	(4.084289)	(5.157265)	(5.666593)
Annual Income (SEK)	519064.6	434571	466126.3	531258
	(272913.3)	(225072.2)	(233369.2)	(275661.5)
Tenant Age	37.30657	41.54146	45.22141	49.67073
	(10.18911)	(11.51716)	(12.34018)	(10.2395)
From Stockholm	.4476886	.4390244	.459854	.5
	(.497862)	(.4968744)	(.4989931)	.5006109
Monthly Rent (SEK)	8352.294	6802.132	7044.737	8471.283
	(3119.095)	(2664.876)	(2859.979)	(3262.412)
Est. Market Rent (SEK)	9156.804	8959.718	10493.4	14683.32
	(2891.725)	(2693.8)	(2894.048)	(4467.973)
Apartment Size (Sqm)	51.2871	46.48537	52.40146	74.57dddd
	(20.01744)	(17.22655)	(18.05187)	(24.11689)
Number of Rooms	1.751825	1.545122	1.76399	2.565854
	(.8057509)	(.7172606)	(.79266)	(.9187293)
No. of Obs.	411	410	411	410
r-g: 3.0%				
Rent Subsidy (SEK)	1634.542	3032.464	4484.231	7706.025
	(612.3345)	(378.9364)	(447.4319)	(2505.242)
Rent Subsidy (%)	.1949024	.3228502	.4045422	.4731641
	(.096922)	(.0831451)	(.0897558)	(.0873859)
Rent Subsidy/ Income (%)	.0511291	.1029488	.1381809	.2091209
	(.0328778)	(.0507426)	(.0593957)	(.1366981)
Time in Que (Years)	10.23689	12.73325	15.48686	20.72293
	(3.474915)	(4.052344)	(5.253526)	(5.941863)
Annual Income (SEK)	492048.5	435848.5	469498.6	553544.9
	(270448.3)	(220030)	(224144.6)	(287310.9)
Tenant Age	37.1966	41.7335	45.30657	49.51463
	(10.07213)	(11.78275)	(12.09852)	(10.38741)
From Stockholm	.4466019	.4376528	.4501217	.5121951
	(.4977449)	(.4967052)	(.4981123)	(.5004619)
Monthly Rent (SEK)	7724.532	6960.45	7165.53	8819.307
	(3091.948)	(2714.214)	(2807.843)	(3318.256)
Est. Market Rent (SEK)	9359.073	9992.913	11649.76	16525.33
	(2959.114)	(2731.229)	(2900.509)	(4827.377)
Apartment Size (Sqm)	47.39806	47.83863	53.39173	76.12439
	(19.39227)	(17.0148)	(17.64887)	(23.35851)
Number of Rooms	1.61165	1.584352	1.791971	2.639024
	(.7591519)	(.7171564)	(.7776818)	(.8997087)
	412	409	411	410

4.4 Determinants of the Rent Subsidy

To further analyze the income-distributional effects the Swedish model for rent control, we run several econometric models. These can be seen in table 7.

First, we run models that that regresses current rent on tenant characteristics (Model 1), in addition to models that explain estimated market rents (Models 2 and 3).

Model 1 provides us with insight into the process of how renters are sorted and tells us that higher earners are more likely spend more on rent, as the variables that indicate income in the second, third and fourth quantile are all statistically significant. An individual in the highest quantile of income will spend 4,999 SEK more a month in rent compared to someone in the first quantile, all else equal. Similarly, we find that renters already living in central Stockholm pay higher rents, paying approx. 318 SEK more compared to those who are not, all else equal. We find that time in que has a negative impact (with one additional year in que reducing rent with 357 SEK), and that this effect is diminishing (as que^2 is positive). This supports that individuals wait to get cheaper apartments. Being under the age of 30 is also associated with lower rents (642 SEK lower, on average), as is to be expected as young people will have lower incomes and have a lower demand for larger, more expensive apartments. No effect on rent is found in terms of gender or other age brackets. The explanatory power is fairly high, with an R^2 of 0.52.

Models 2 and 3 provides us with insight into the sorting into apartments in respect to estimated market rents. One should keep in mind that the estimated market rent is not the rent paid, and that these models tells us which renters that end up in the most attractive apartments (rather than the most subsidized). Models 2 and 3 explain market rents using r-g of 2.65% and 3%, respectively. We find that income is positively correlated with market rents. The fourth quantile of tenants having apartments with 5,488 SEK (Model 2) or 6,033 SEK (Model 3), higher estimated market rents compared to tenants in the first quantile of income.

Already living in central Stockholm before receiving a rental apartment is associated with higher rent and estimated market rents – perhaps because those who already live in central Stockholm are

comparably pickier and more interested in the most attractive apartments compared to those who don't already live in central Stockholm. Models 2 and 3 have R^2 values of 0.52.

The core of our analysis comes from models 4 and 5, as we model the estimated subsidy as a function of renter characteristics. Models 4 and 5 have R^2 values of 0.58 and 0.59, respectively, which tells us that renter characteristics has a large role in determining the rent subsidy – despite that apartments are allocated purely on time in que.

Time in que is only significant at the 10% level in model 4, showing a marginally declining positive effect on the rent subsidy, as seen by the coefficient estimates for time in que and time in que^2 (which is significant in both models). We find no statistically significant effect of age, gender or if the renter is from Stockholm, on the rent subsidy.

The variables of most interest for understanding the income distributional effects of rent control are those that capture income. We find that income is significant and positively correlated with the rent subsidy. Renters in the fourth quantile of income receive monthly rent subsidies that are either 488 SEK ($56) or 1,034 SEK ($120) higher than those in the first quantile of income, all else equal (when estimating market rents with a discount rate of 2.65% or 3%, respectively). When looking at these numbers, one should keep in mind that the average incomes in the fourth and first quantiles of income are 836,008 SEK ($96,648) and 250,802 SEK ($28,994), respectively.

This effect of income also holds when comparing the third quantiles of income with the first, showing a slightly smaller impact on the monthly subsidy, of 272 SEK ($31) or 535 SEK ($62), for estimates based on discount rates of 2.65% and 3%, respectively.

The results from models 4 and 5 show that higher income tenants receive larger absolute subsidies, while also controlling for time in que, gender, age, location and time. It is interesting to see why this might be. Notably, if it is due to high income individuals consuming more housing (i.e., larger apartments) and therefore receive larger subsidies, or if higher earners receive a larger subsidy regardless of apartment characteristics. To test this, we run models that also control for apartment characteristics (apartment size and the number of rooms).

It is worth keeping in mind that regulated rent is set before the tenant moves in and without regard of who the tenant is – so any potential effect of tenant characteristics on the rent subsidy should be attributable to differences in apartment choice between groups of tenants.

Models 6 and 7 show no effect of income or gender, when controlling for apartment characteristics. An effect of being below 30 years of age is seen, with such tenants receiving slightly larger subsidies.

What models 6 and 7 tells us, when analyzed in conjunction with models 4 and 5, is that the fact that higher income tenants receive larger absolute subsidies is driven by such tenants preferring larger and more expensive apartments, which in turn are associated with larger absolute differences between market rents and regulated rent.

Table 7 – Regression Results. Estimation on Rents, Estimated Market Rents and the Rent Subsidy on Mediated Rental Apartments in Central Stockholm, 2011 to 2016. Coefficient Estimates with T-values Parenthesis.

	Model 1: Rent	Model 2: Market Rent (2.65%)	Model 3: Market Rent (3%)	Model 4: Rent Subsidy (2.65%)	Model 5: Rent Subsidy (3%)	Model 6: Rent Subsidy (2.65%)	Model 7: Rent Subsidy (3%)
Female	208.0856	348.4155	382.3805	140.3299	174.2949	24.80674	21.61178
	(1.91)	(2.44)	(2.42)	(1.86)	(2.02)	(0.42)	(0.35)
Income (Quantile 2)	1295.592	1297.306	1420.234	1.714103	124.6421	-489.3256	-517.1939
	(11.97)	(8.93)	(8.89)	(0.02)	(1.25)	(-6.60)	(-6.73)
Income (Quantile 3)	2438.85	2711.257	2973.962	272.4067	535.1118	-689.7532	-725.4484
	(18.99)	(15.65)	(15.60)	(2.77)	(4.82)	(-7.80)	(-7.75)
Income (Quantile 4)	4999.358	5487.81	6032.952	488.4519	1033.594	-1355.60	-1384.603
	(26.75)	(22.35)	(22.24)	(3.95)	(7.25)	(-12.68)	(-12.41)
Age (up to 30)	-642.1016	-459.8418	-495.7563	182.2598	146.3452	401.4198	433.1088
	(-2.41)	(-1.31)	(-1.28)	(0.95)	(0.67)	(2.63)	(2.75)
Age (31-45)	7.023091	244.5796	273.9011	237.5565	266.8781	205.7974	221.4616
	(0.03)	(0.73)	(0.74)	(1.30)	(1.27)	(1.49)	(1.56)
Age (46-65)	-141.9538	73.44568	86.06448	215.3994	228.0182	238.1623	255.6575
	(-0.59)	(0.22)	(0.23)	(1.16)	(1.07)	(1.72)	(1.79)
Time in Que	-357.3046	-268.2349	-298.1068	89.06976	59.19788	153.0906	145.2236
	(-5.70)	(-3.32)	(-3.34)	(1.90)	(1.12)	(4.00)	(3.67)
Time in Que^2	10.13922	14.22394	15.75028	4.084715	5.611055	.2085283	.4570586
	(5.65)	(5.83)	(5.84)	(2.76)	(3.36)	(0.18)	(0.38)
From Central Stockholm	317.9509	396.109	435.7546	78.15816	117.8037	-66.25907	-69.1238
	(2.96)	(2.80)	(2.79)	(1.06)	(1.39)	(-1.12)	(-1.13)
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size (sqm)						58.98987	74.66234
						(13.08)	(14.84)
No. of Rooms.						-107.9741	-68.49666
						(-1.07)	(-0.64)
R^2	0.5217	0.5195	0.5202	0.5866	0.5822	0.7395	0.7838
No. of Obs.	1,642	1,642	1,642	1,642	1,642	1,642	1,642

Heteroscedasticity robust standard errors are estimated. T-values are shown in parenthesis below the coefficient estimates. Time fixed effects are binary variables indicating the year of the rental contract and location fixed effects are defined as parish.

5. Conclusion

We apply a framework for estimating hypothetical market rents in a setting with regulated rents below market clearing levels. We analyze the income-distributional effects of the rent subsidy in a setting where apartments are allocated through queuing from several perspectives; 1) looking at subsidy levels across tenant income levels, 2) tenant characteristics across levels of rent subsidy and 3) econometric models that explain rents and subsidies.

The overall picture that our analysis shows so far, is that low-income tenants benefit as they receive subsidies that encompass a larger fraction of their overall income compared to higher income tenants, and that this is likely to enable them to live in the attractive city center of Stockholm. In this sense, rent control is progressive from an income distributional standpoint and contributes to decrease segregation. It is also consistent with earlier analysis of the Stockholm rental market and the potential impact of de-regulation (Donner et al., 2017).

However, we find several regressive aspects of this system of rent control. Notably, when we compare renter groups by quantiles of income, we find that high earners on average receive larger absolute rent subsidies than low-earners. This tells us that a large fraction of the total rent control subsidy goes to individuals who could have afforded market rent. Consequently, the impact on segregation decreases. We also find that apartments in the fourth quantile of subsidy have older tenants with higher incomes compared to less subsidized apartments.

That the overall group of tenants have an average income that is substantially above the county average indicates that the system of very long times in que benefits higher income households. The fact that nearly half of all who received a rent-controlled apartment through the central que already where living in central Stockholm adds support to the notion that there is limited impact on segregation as tenants wait for on average nearly 15 years to receive a subsidized in the attractive city center. This benefits higher income individuals who either owns housing or already has a rental apartment as they can wait until a cheap rent controlled one becomes available.

Controlling for time in que (and other characteristics such as age and gender), our econometric models find that tenants in the highest quantile of income (who on average make 836,008 SEK/$96,648)

receive monthly rent subsidies that are 488 SEK ($56) to 1,034 SEK ($120) higher than renters in the lowest quantile of income (who on average make (250,802 SEK/$28,994).

Overall, we find regressive effects of the Swedish system of allocating rental apartments through a que as the largest subsidies go to higher income tenants that can afford market level rents. This effect is driven by high income renters affording higher rents and being able to wait in que for longer time-periods.

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7. Appendix: Determining the Cost of Capital, *r-g*.

As noted above, estimating (4) & (5) requires information on the cost of capital, *r-g*. We estimate an appropriate level for *r-g* by using the relatively freely set rents of a small number of newly produced apartments as a point of reference – these are referred to as presumption rents and is a segment of the market where rent control is less strict for a period of 15 years after construction.

Consequently, we estimate (5) at various levels of *r-g* and use values that minimizes the forecast error when we apply the equation to a subset of our data that covers of new construction with presumption rents. we apply two measures of forecast error; the root mean square error (RMSE), and the median absolute forecast error (MAPE).

We find that RMSE is minimized at *r-g* = 2.65% and MAPE is minimized at *r-g* = 3%.