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Abstract

This paper studies the effect of housing allowance on rents using discontinuities in the Finnish housing allowance system as a quasi-experimental setting. The stepwise dependence of housing allowance on the floor area of the dwelling and the year of construction of the building allows us to isolate the impact of the generosity of housing allowance from other determinants of rents. The discontinuities in the amount of housing allowances at the studied cut-offs are economically and statistically significant. However, our results show that there are no discontinuities in rents of the recipient households at these cut-offs. Instead, differences in the amount of the housing allowance are translated roughly one-to-one into differences in the rent net of housing allowance.

Key words: Housing demand subsidies, housing allowance, incidence, rents

JEL classes: H22

1 Introduction

In most countries, governments subsidize the housing consumption of low-income households through various, often overlapping housing programs. Over the last few decades, the general trend has been towards less construction of social housing and increased reliance on direct subsidies for low-income households. Given this tendency, it is vital to understand the effects of these direct subsidies and to be aware of how the details of the programs affect their efficiency and distributional effects.

A typical feature of housing allowance (henceforth HA) programs is that the subsidy depends on the characteristics of the household, such as income and household size. In addition, the subsidy is typically more generous in more expensive areas and also depends on other unit characteristics related to rent. The aim of these details is to level the out-of-pocket rents (rent net of housing allowance) and non-housing consumption of recipients. However, these differences likely affect the recipient households' willingness to pay for rental housing, and could thereby affect their rents. If the incidence of differences in HA generosity is to a large extent on the landlords, the redistributive goals of the scheme are not achieved.

In this paper, we study whether and to what degree differences in HA generosity for different housing units affect rents. We consider the Finnish HA system where the HA is capped by a rent ceiling which depends in a stepwise manner on the floor area of the unit and the construction year of the building. We test for the existence of a similar stepwise pattern in rents using a regression discontinuity type approach and register data covering the universe of HA recipients in Finland. The discontinuities provide a quasi-experimental setting to isolate the impact of housing allowance from other determinants of rent.

Figures 1 and 2 illustrate our research design and present the main results. The dots correspond to the sample means by 0.5 m^2 bins. The red vertical lines show the floor area cut-offs where the rent ceiling changes, and the black lines represent 2nd order polynomials fitted separately for each interval between the cut-offs. Figure 1 shows that there are clearly visible discontinuities in the amount of HA at the cut-offs. In our econometric analysis, we demonstrate that, for example, crossing the first cut-off implies on average a 15 euro reduction in monthly HA which corresponds to a 6.7% decrease in HA or 1.9% decrease in income (including HA). Figure 2, in turn, shows that the relationship between floor area and

rent does not have a similar stepwise pattern. This suggests that the differences in HA are not capitalized into rents.

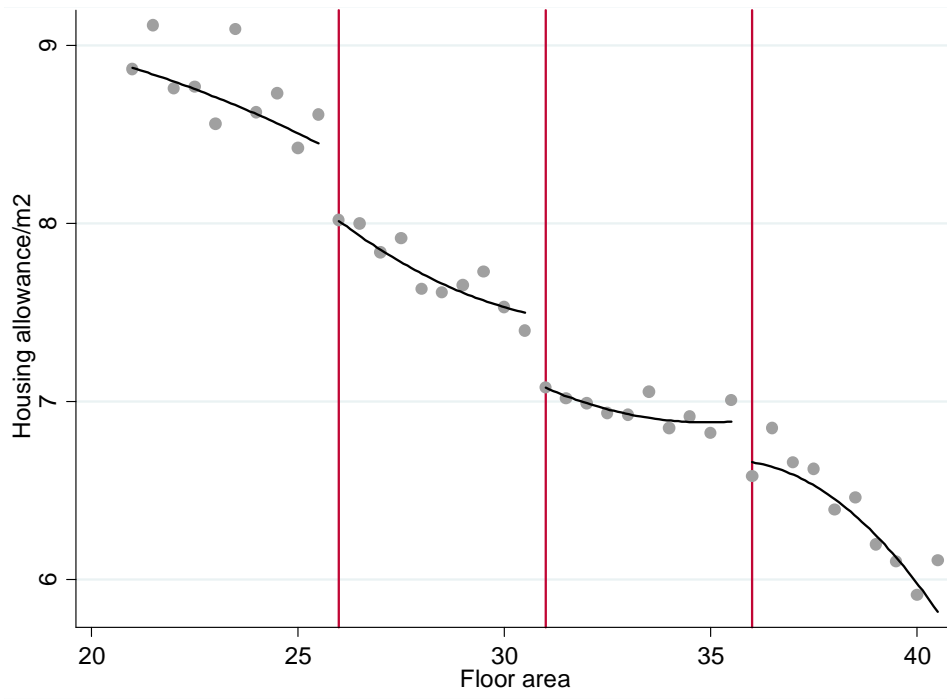


Figure 1. Floor area and monthly HA per square meter.

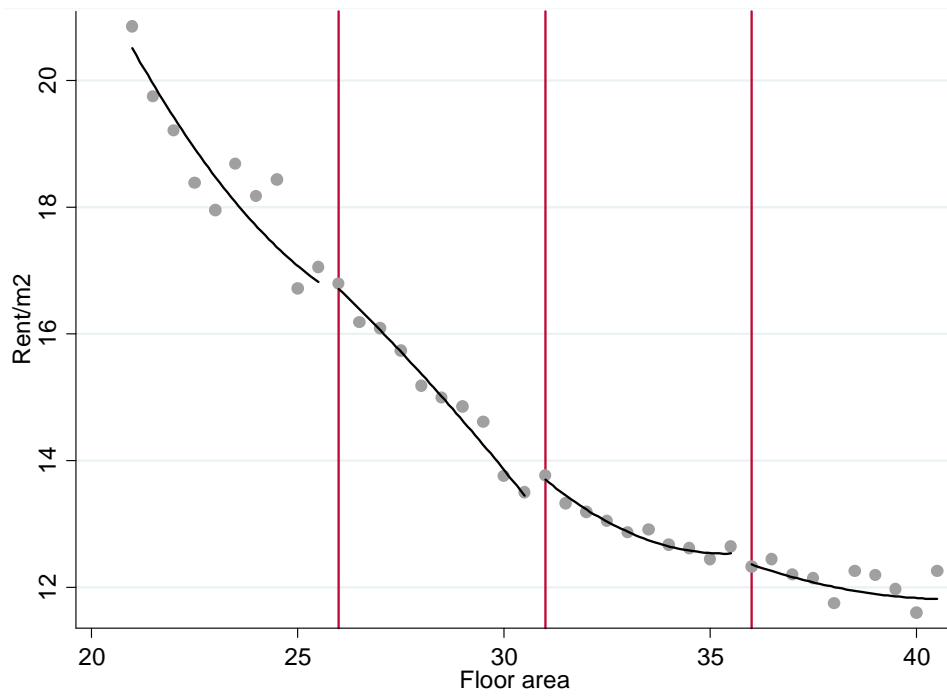


Figure 2. Floor area and monthly rent per square meter.

In an instrumental variables regression, utilizing the discontinuities as instruments, we again find no effect of the HA on the rents of recipient households. The upper limit of the 95% confidence interval for our preferred estimate for the effect of a 1 euro higher housing allowance is about 0.2 euros, which is low in comparison to many previous estimates. A potential explanation for the finding is that demand responses to the structure of the subsidy scheme are muted by moving costs and short expected HA spells. Consistent with this idea, we find some indication of rent effects when we focus on long-term HA recipients or flats inhabited by HA recipients for several years.

We contribute to the small literature on the incidence of housing demand subsidies by utilizing a plausibly exogenous source of variation in HA generosity. Our paper is closely related to the studies analyzing reforms which change the parameters of the scheme and therefore affect the distribution of benefits across households. Our finding that the incidence of differences in HA scheme is largely on the tenant is in contrast with most previous studies, but in line with the recent study by Brewer et al. (2014) on the UK system.

In the UK, housing benefit is capped by a rent ceiling and is means-tested above an income limit which depends on household characteristics. Gibbons and Manning (2006) study a reform which lowered the rent ceiling for new claimants in 1996 and 1997 without affecting the benefits enjoyed by existing claimants. The results indicate that roughly 60% of the housing benefit reduction was passed on to landlords in the form of lower rents. Brewer et al. (2014) study a similar reform in 2011 and compare new claimants before and after the reform. Their results suggest that the incidence is 90% on the tenants, but they also report substantial variation between claimant groups. According to Brewer et al. (2014), the two reforms affected different segments of the rent distribution with potentially different demand elasticities. This could explain the contradictory results of the two studies.

Fack (2006) and Laferrère and Le Blanc (2004) study French reforms which extended the housing subsidy program to households not previously eligible. Both studies find that the rents of housing benefit claimants increased faster than those of non-claimants after the reforms.

Collison and Ganong (2016) in turn study two different reforms of the US voucher¹ system. In the first reform, in 2005, the fair market rents (FMRs) determining the local rent ceilings were

¹ The US voucher system is very different from the Finnish HA system. A household is eligible for a voucher if its income is low enough relative to the local income level. If a household receives a voucher, it needs to find an

revised which created exogenous geographic variation in the rent ceiling revisions. The results suggest that increases in rent ceilings did not induce demand changes but increased the rents of voucher recipients.² In the second reform, the metropolitan area level FMR was replaced with zip code level FMRs in Dallas. The reform effectively reduced the out-of-pocket rent of voucher recipients in expensive neighborhoods relative to low-cost neighborhoods. The results suggest that the reform shifted housing demand of voucher recipients from low-cost neighborhoods to expensive neighborhoods and led to rent increases in expensive and rent reductions in low-cost neighborhoods.

Also in Finland, two previous studies have analyzed the incidence of HAs exploiting variation in the rent ceilings used in calculating the HA. The comparison of our analysis to the previous Finnish studies highlights the importance of a credible research design and transparent empirical analysis. Viren (2013) regresses rents on maximum achievable HA. His results suggest that 30–50% of the HA is shifted to rents while our results imply a much smaller rent effect. We argue that the internal validity of our research design is higher as we focus on the discontinuities in the rent ceilings at certain cut-offs that generate plausibly exogenous variation in the allowance, and perform extensive robustness and validity checks.

Kangasharju (2010) utilizes the reform of 2002 as a source of exogenous variation to analyze the impact of HA on rents. The main result is that one additional euro in HA led to a 60–70 cent increase in the rents paid by the claimants relative to non-claimants. In Appendix B of this paper, we repeat the analysis of the 2002 reform using the same data and the methods described in Kangasharju (2010) but find different results. In particular, we do not find evidence of substantial effects on rents.

When interpreting the results, it is important to note that our analysis is not directly informative about the effects of the overall size of the HA system. The overall rental effects are studied by Eriksen and Ross (2015) who analyze the impact of changes in the US housing voucher program. They exploit two reforms which increased the supply of housing vouchers to a varying degree in different metropolitan areas. The results indicate that increased supply

apartment which satisfies the requirements of the program. Finally, the size of the subsidy is calculated based on local rent ceilings which the housing authorities set based on the local FMR determined by the US Department of Housing and Urban Development (HUD).

² For most recipients, the rent was below the rent ceiling before the reform. This means that their out-of-pocket rent is a fixed share of their income and not affected by their rent.

of vouchers did not affect the overall rental rate³ but shifted demand from lower quality units towards higher quality units.

2 The institutional setting

2.1 The housing allowance system

The Finnish housing allowance program consists of three parts: general HA, HA for pensioners and housing supplement for students. The program is financed by the government through the Social Insurance Institution of Finland (Kela). We focus on the general HA, which is intended for working age low-income households and is the most important tenant-based housing subsidy system in terms of the number of recipients and total outlays.

Our data cover the years 2008 to 2013.⁴ In 2013, general HA expenditures were roughly 670 million euros (Kela, 2014) which amounts to 0.34% of GDP. In December 2013, roughly eight percent of population under the age of 65 years received the general HA. The average monthly allowance was about 280 euros.

Eligibility for the HA is based on pre-tax income, financial wealth and household size but does not depend on whether the tenant lives in private rental housing or social housing. The allowance is determined by the following formula:⁵

$$(1) \quad HA = 0.8 * [\min(Rent, Rent^{max}) - deductible]$$

First, the allowance covers rents up to a maximum compensable rent ($Rent^{max}$) which depends on the floor area and rent of the unit. 1) If the floor area of the unit exceeds the floor area ceiling, the excess floor area is neglected when calculating the HA ($Rent^{max} = floor\ area\ ceiling / floor\ area \times Rent$). The floor area ceiling depends positively on household size. 2) If the rent per square meter exceeds the rent ceiling, the excess rent is neglected when calculating the HA ($Rent^{max} = rent\ ceiling \times floor\ area$). The rent ceiling depends on the floor area of the unit, the construction (or major renovation) year and location of the building. 3) If

³ This finding is in contrast with the results in Susin (2002).

⁴ The general HA (*yleinen asumistuki*) was reformed in the beginning of 2015. As our data cover the time period between 2008 and 2013, in what follows we will describe the system as it existed before this recent reform.

⁵ Lyytikäinen (2008) provides a more detailed description of the system.

both the floor area ceiling and the rent ceiling are exceeded then $Rent^{max} = rent\ ceiling \times floor\ area\ ceiling$.

The HA system imposes no constraints on the choice of the rental unit, and the rent paid by a HA recipient often exceeds the maximum compensable rent. In this case, the tenant pays the remainder of the rent entirely out-of-pocket.

Second, the allowance is means-tested and involves a deductible if household income exceeds an income limit which depends on the household size. Above the income limit, the deductible increases with pre-tax income and is lower for larger households. The allowance covers 80% of the difference between the actual rent (or the maximum compensable rent) and the deductible.

Finnish municipalities are divided into four regions according to housing affordability. The city of Helsinki forms region 1. Region 2 consists of the rest of the Helsinki Metropolitan Area (HMA). Region 3 includes 30 medium sized towns, and region 4 is the rest of Finland. Each affordability region has its own rent ceilings with the highest rent ceilings in Helsinki. The income limits in turn are the same in regions 1 and 2 and lower in the other two regions.

The tenant applies for the HA from Kela and typically the HA is paid to the tenant. However, when applying for the HA, the household can also authorize Kela to pay the subsidy directly to the landlord. In our estimation sample about 26% of the recipients choose this alternative. In these cases, the landlord knows not only the recipient status of the tenant but also the amount of subsidy received.

As an example, Table 1 shows the rent ceilings in medium-sized towns (region 3) in 2012. Our estimation strategy exploits the feature that the rent ceiling is a step function of the unit size and the construction year of the building. The floor area and construction year cut-offs are the same for all affordability regions, but the rent ceilings and the size of the jump at the cut-offs vary slightly from one affordability region to another.

Table 1. Rent ceilings (euro/m² per month) as a function of floor area and construction year, affordability region 3, year 2012.

Floor area (m ²)	Construction year		
	–1985	1986–1995	1996–
< 26	11.4	12.68	13.18
26 – 30.9	10.56	11.84	12.34
31 – 35.9	9.72	11	11.5
36 – 45.9	9.27	10.64	11.15
46 – 60.9	8.96	10.26	10.76
61 – 80.9	8.76	9.82	10.33
> 81	8.68	9.74	10.24

As the table shows, the discontinuities in the schedule are quite large. For instance, for a housing unit of 35 square meters, the rent ceiling is 9.72 euros per square meter if the building is constructed in 1985, but is 13% higher (11 euros) if the building is constructed in 1986. That is, the maximum compensable monthly rent is 340.5 euros in a building constructed in 1985 and 385.0 euros in a building constructed in 1986. In the same manner, the rent ceiling is 10.56 euros per square meter for a housing unit of size 30.5 square meters built in 1985, but is 8% lower if the floor area is 31 square meters. Translated into rent levels, this means that for a 30.5 square meter dwelling the maximum compensable monthly rent is 322.1 euros while for a 31 square meter dwelling, it is 301.3 euros.

2.2 Social housing and social assistance

The second major housing-related subsidy program in Finland is social rental housing intended mostly for low-income households. In 2008, roughly half of all rental housing was social housing, but the share of the social rental housing has been decreasing slightly over the last ten years.

The social housing units are mainly owned by municipalities but also by various non-profit organizations. The owners receive subsidies from the municipality and the central government and commit to different types of regulation. For instance, the rents cannot be freely set but must be based on the capital and maintenance costs of the building. Because of the restrictions in rent setting, one would not expect the HA to affect rents in the social housing sector.

Finally, some HA recipients may also be entitled to social assistance available to households whose income and assets do not cover their necessary daily expenses, including housing. For these households, social assistance can cover up to 100% of the cost of housing.

3 Potential mechanisms

Housing subsidy programs are targeted at low-income households with the aim of reducing the cost and improving the quality of housing. In broad terms, the programs directly affect recipient households' disposable income but may affect households also through the allocation of households into rental housing units, through the effects on rental rates, and through the taxes required to finance the programs. At least in principle, the programs may also affect the overall stock of rental housing and its distribution. All these effects are likely to depend on the share of recipient households in the rental market, on the elasticity of rental housing demand and supply, and on how competitive the rental market is.

If the rental housing market is characterized by substantial frictions, it is possible that an increase in the HA mainly affects the rents of recipient households. If rents are negotiated between the tenant and the landlord, the rent of any given unit may depend on the characteristics of the tenant, for instance the amount of housing allowance received.

Recipient and non-recipient households may face different rental rates for other reasons too. For instance, if landlords perceive HA recipients to be more costly than other tenants due to, say, a higher risk of damage to the unit, HA recipients may face a rent premium. On the other hand, landlords may also view them as less risky because the housing authority at least partly guarantees a steady stream of rental payments.

As our data only cover recipient households, we are unable to study the potential effects of the HA system on the overall rental rate or differences in rents paid by recipient and non-recipient households. However, our data contain information about whether the HA was paid directly to the landlord which enables us to study whether the effects are heterogeneous in this respect.

In the analysis, we exploit the discontinuities in the rent ceilings and focus on how differences in HA generosity translate into differences in rental rates among recipient households. Several issues may be important for the analysis and interpretation of the results.

First, as shown in Figure 1, the stepwise changes in the rent ceiling induce changes in the level of the HA around the cut-offs. Therefore, for recipient households, the willingness to pay should change at the cut-off while the incentives of non-recipients should not. This could mean that HA recipients are over-represented just below the floor area cut-offs and above the construction year cut-offs. The increased demand on the generous side of the cut-offs could lead to higher rents for these dwellings.

A second issue concerns the behavioral responses of landlords. If the share of HA recipients is large, the demand incentives provided by the HA system could lead to changes in the overall rental housing stock. This type of supply response should reinforce discontinuities in the floor area and construction year distributions. We do not have data on the characteristics of the overall rental stock, but we can analyze the distribution of recipient households in the proximity of the cut-offs. This will allow us to make some inferences on the possible effects on the overall rental housing stock.

In addition, the landlords' incentive to maintain and renovate units changes at the cut-offs as recipient households' willingness to pay for the units changes. As a result, it is possible that the rent level develops smoothly when crossing the cut-offs but discontinuities in the HA translate into discontinuities in quality-adjusted rents. This is an issue to be kept in mind when interpreting the results as we do not have data on the quality of units.

Third, the incentives generated by the cut-offs may be weakened by other institutional details. For instance, optimizing housing choices precisely might be difficult if the rental market is thin with respect to the relevant unit characteristics (floor area and construction year). Also, the difference in the willingness to pay between two alternative, otherwise similar dwellings but with different levels of HA should depend on how long the household expects to rely on HA. Therefore, the demand responses around the cut-offs should depend on expected benefit duration. Finally, the incentives may also be muted because the social assistance system covers housing costs for HA recipients with very low incomes. Our data will allow us to address these concerns. We study whether the results are sensitive to differences in benefit duration. We also analyze separately a subsample of recipient households with income levels high enough not to be eligible for social assistance. For these households the incentives generated by the HA system should not be blurred by the availability of social assistance.

Fourth, if the rent is below the rent ceiling, the tenant and the landlord may have an incentive to collude so as to maximize the HA received. In the Finnish system, the HA covers up to

80% of the rent. Therefore, the incentive to collude is not as high powered as, for instance, in the US voucher system where, below the rent ceiling, any increase in rent is entirely paid by the housing authority. In addition, as we will show in the next section, the vast majority of recipient households in the private rental market have rents above the rent ceiling.

4 Empirical analysis

4.1 Data

We use data on all HA recipients provided by Kela for the years 2008–2013. The data are originally monthly payment data. We keep only regular payments⁶ and collapse the data by address, recipient, monthly rent, monthly HA and year. We define cases where any of these five variables changes as new observations.

We limit the analysis to dwellings with a floor area below 41 square meters because the discontinuities in HA are stronger for small flats than for larger flats. In addition, for small flats, the floor area ceilings are not binding and the whole floor area of the flat is typically taken into account when determining the HA. For larger flats, the floor area ceiling often becomes binding. In addition, because the floor area ceilings depend on the household size, they cause noise for bigger flats.

As discussed in Section 2, rents in the social housing sector are set administratively and the rent ceilings are typically not binding. Therefore, we restrict our attention to the private rental market only, but report the results concerning the social housing sector in Appendix A.

Figure 3 shows that there are clear discontinuities in the rent ceiling at all floor area cut-offs in our main estimation sample. For instance, on average the rent ceiling used to calculate the HA for flats with a floor area of 26m² is slightly less than 12 euros and roughly 12.8 euros for flats with a floor area of 25.5m². As the figure shows, there is also some variation in the rent ceiling away from the cut-offs. This is because the rent ceiling varies from one affordability region to another and also depends on the construction year of the building. The rent ceilings are also typically adjusted upwards each year.

⁶ We drop claw-backs and retrospective payments.

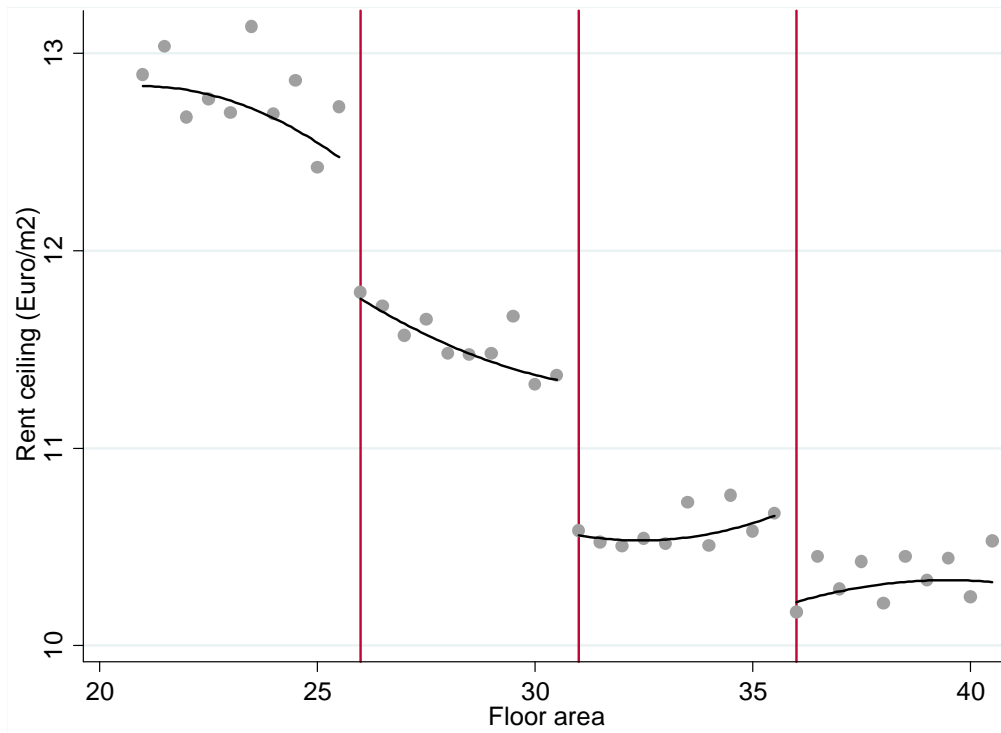


Figure 3. Floor area and monthly rent ceiling.

The rent ceilings and income limits used in calculating the HA vary from one affordability region to another. Nevertheless, the rent ceiling is binding relatively infrequently in affordability region 4, which consists of small municipalities. In addition, rental market conditions may be quite different in rural areas than in large cities and towns. Therefore, we leave out affordability region 4 from the analysis.⁷

In regions 1–3, the rent ceilings are binding for over 80% of small flats. This is important for the analysis. If the actual rents per square meter were substantially lower than the rent ceilings used to calculate the HA, changes in the rent ceilings should not be expected to influence rents. Figure 4 shows the distribution of the proportionate differences between actual rents and the rent ceiling in our main estimation sample.

⁷ A series of municipal mergers took place in Finland during the time period of the study. Most importantly, in the beginning of 2009, some 70 small municipalities merged with larger ones and are likely to have moved from affordability region 4 to region 3 as a result of the merger.

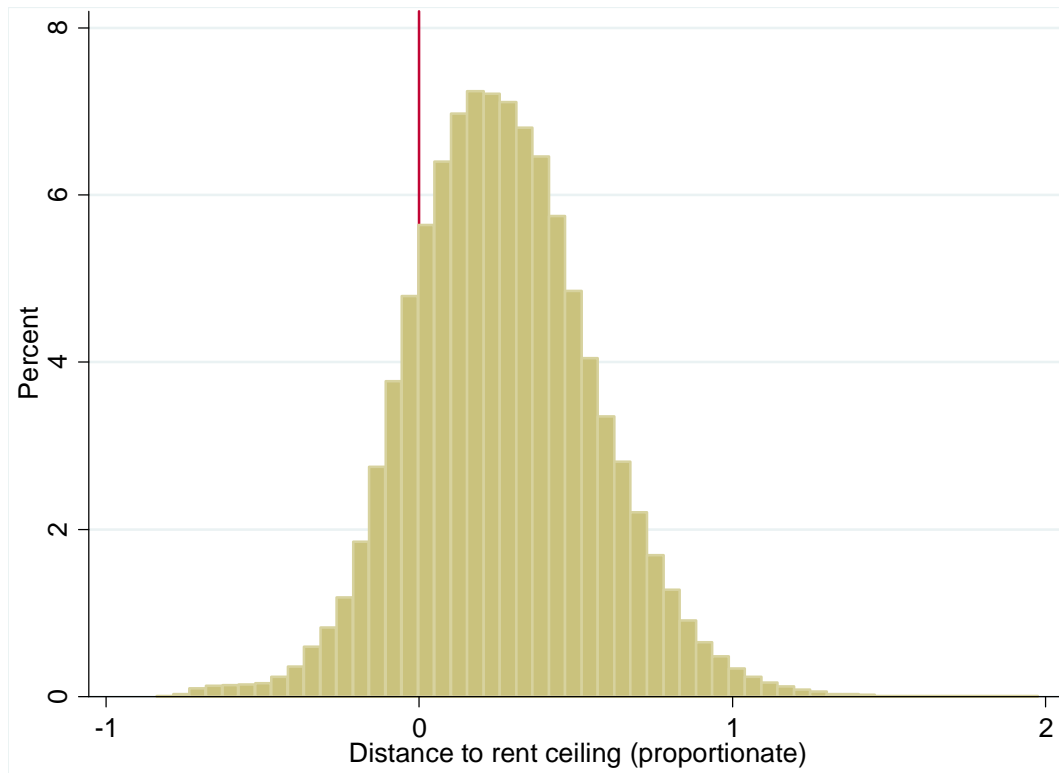


Figure 4. Actual rents relative to the rent ceiling.

Figure 1 in the Introduction showed that the discontinuities in rent ceiling cause clear discontinuities in actual HA. The discontinuities in the rent ceiling shown in Figure 3 are somewhat stronger. There are three main reasons for this. First, as Figure 4 shows, the rent ceiling is not always binding and hence the HA does not change at the cut-off. Second, the HA also depends on the income of the household through the deductible. In addition, even when the deductible is zero, the HA only covers 80% of the rent up to the rent ceiling. Nevertheless, individual jumps are clearly visible and economically significant for low-income households.

Our data cannot be used to assess the importance of HA for the entire private rental market because they only include information on HA recipients. Based on additional calculations using the Income Distribution Survey data (IDS)⁸ for the same time period, the share of HA recipients was slightly below 20% in the kind of flats included in our main estimation sample. The share varies by affordability region and the type of dwelling.

⁸ The IDS data are a representative sample of Finnish households with an annual sample size of about 10,000 households.

Table 2 shows summary statistics for the main variables for our main estimation sample. With the above restrictions, there are some 273,000 observations in the data (83,620 recipients and 73,819 flats). The mean rent is roughly 434 euros/month and the mean floor area 32 square meters. On average, the HA is some 226 euros/month which implies that the average net rent (or out-of-pocket rent) is roughly 208 euros/month.

Table 2. Summary statistics for the main estimation sample (N = 272,941).

Variable	Mean	Std. Dev.	Min	Max
Rent ceiling/m ²	11.07	1.48	7.73	15.35
Rent (EUR per month)	433.96	107.22	61.74	1580.00
Rent/m ²	14.07	4.10	2.00	39.74
HA (EUR per month)	225.70	73.11	16.83	481.60
HA/m ²	7.27	2.40	0.42	17.17
Net rent (EUR per month)	208.26	112.52	12.35	1354.40
Net rent/m ²	6.80	3.92	0.40	34.44
Floor area	31.53	4.87	21.00	40.50
Floor area>25.9	0.87	0.34	0.00	1.00
Floor area>30.9	0.57	0.50	0.00	1.00
Floor area>35.9	0.22	0.42	0.00	1.00
Construction year	1985.10	21.83	1620.00	2013.00
Age of recipient	32.98	12.28	16.00	66.00
Household size	1.04	0.23	1.00	8.00
Deductible (EUR per month)	46.63	83.19	0.00	468.00
Hh income excluding HA (EUR per month)	561.03	349.35	0.00	2156.00
Rent ceiling binding	0.83	0.38	0.00	1.00
HA paid to landlord	0.26	0.44	0.00	1.00
Private owner	0.74	0.44	0.00	1.00
Integer floor area	0.76	0.43	0.00	1.00
Affordability region 1	0.21	0.41	0.00	1.00
Affordability region 2	0.05	0.23	0.00	1.00
Affordability region 3	0.74	0.44	0.00	1.00

As discussed in Section 2, the expected benefits of adjusting housing choices according to the HA scheme depend on how persistent the recipient status is expected to be. Table 3 reports observed lengths of HA spells starting in 2009.⁹ Approximately 28% do not continue as HA recipients in 2010 and for another 29% the spell discontinues before 2011. Thus for the

⁹ The sample used to produce Table 3 includes recipients who were in our estimation sample in 2009 but did not receive HA in 2008. The length of spell is calculated so that it is not affected by attrition from the estimation sample (e.g. through moving to another area or to a larger dwelling).

majority of HA recipients, the subsidy appears to serve as temporary assistance. On the other hand, some 23% continue as recipients for five or more years.

Table 3. Length of HA spells starting in 2009

Length of HA spell	Percent	Cumulative percentage
1 year	28.19	28.19
2 years	29.4	57.58
3 years	12.58	70.17
4 years	6.81	76.97
5 or more years	23.03	100

4.2 Empirical strategy

Estimating the effect of housing allowance on rents is challenging because typically, other things equal, the housing allowance is bigger if the rent is higher. This reverse causality implies that simple OLS regression gives biased results. In addition, housing allowance is likely to be correlated with other factors that affect rent.

However, the fact that the rent ceiling jumps at certain cut-off points can be used to identify the impact of the HA on rent. The idea is to compare rents below and above the cut-off points where the HA changes sharply. These discontinuities generate variation in the generosity of the housing allowance. The variation is plausibly exogenous because there is no reason, other than the HA, to expect the relationship between rents and floor space (or construction year) to be stepwise, when we control for smooth but flexible functions of these attributes.

Our empirical strategy has the features of a regression discontinuity design (RDD) discussed in e.g. Lee and Lemieux (2010). However, the setting differs from an ideal RDD in that HA recipients can sort into flats with different attributes. The discontinuities may also affect selection into the sample.¹⁰ Sorting of HA recipients to flats with more generous HA is one of the channels through which rents could be affected because such sorting would increase the demand for flats where the HA is higher. The standard RDD tests (balancing tests and McCrary test) are useful in studying potential sorting.

¹⁰ A household with a relatively large deductible may be eligible on the generous side of the cut-off but not on the other side. Similarly, the discontinuity in the size of the HA may affect take-up.

The main focus of our empirical analysis is on the floor area discontinuities, because visual examination of the data shows that the relationship between rent and floor area is smoother than the relationship between rent and construction year. Thus, the floor area cut-offs likely provide a cleaner source of variation and give more precise estimates. The same methodology can be used for the construction year discontinuities. We present the results for the construction year discontinuities in Appendix A and discuss the findings briefly after analyzing the floor area cut-offs.

Our sample consists of units with floor area varying from 21m² to 40.9m². The sample therefore includes the first three floor area cut-offs shown in Table 1 (26m², 31m² and 36m²). 98% of the observations of floor area are concentrated on multiples of 0.5m² (76% integers). We round the observations not divisible by 0.5m² down to the closest 0.5m². Thus we have 40 floor area clusters. Heaping of the observations to integer values may bias our estimation results if the likelihood of an integer floor area is correlated with some determinants of rent (Barreca et al. 2016). We address this concern by controlling for integer values and testing for the robustness of our results for dropping non-integers.

Our empirical analysis has three steps. First, in order to visualize the discontinuities at the floor area cut-offs, we calculate bin averages for rent ceiling, HA, rent, and net rent in our sample for the discrete values of floor areas and plot these averages at the floor area values. The graphical analysis is presented in Figures 1–3. In each figure, the dots show bin averages of these variables and the vertical red lines show the location of the cut-offs where the rent ceiling changes. The figures include the fits of second order polynomials estimated separately for each group separated by the cut-offs.¹¹

Second, we estimate the effect of each cut-off on the HA and the rent separately¹² using the model

$$(2) \quad Y_i = \alpha + \sum_j \beta_j D_j(\text{Floor area}_i > \text{cutoff}_j) + f(\text{Floor area}_i) + \delta' X_i + u_i.$$

The dependent variable Y_i is HA per square meter or rent per square meter in unit i . The explanatory variables of interest are the dummy variables D for values above the various floor

¹¹ The regression is weighted by the number of observations in the bin.

¹² Alternatively, we could pool the discontinuities and normalize the floor area to zero at each discontinuity to estimate a pooled RD treatment effect. Our strategy is preferable because it fully exploits the information available in our multi-cut-off setup (See Cattaneo et al., 2016).

area cut-offs. Using floor area group dummies defined in an overlapping way implies that the β coefficients can be interpreted as the impact of crossing the cut-off on Y_i . We control for the direct impact of floor area by including a smooth function f of floor area in the model. The function is allowed to vary between the cut-offs. In order to allow for a straightforward interpretation of the β coefficients, the function f is in practice modeled through an overlapping sequence of floor area variables normalized to zero at the cut-offs. These normalized floor area variables are interacted with the respective floor area group dummies:

$$(3) \quad f(\text{Floor area}_i) = g_0(\text{Floor area}_i) + \sum_j [D_j(\text{Floor area}_i > \text{cutoff}_j) * g_j(\text{Floor area}_i - \text{cutoff}_j)].$$

Other control variables in X_i include municipality-specific year fixed effects, postcode fixed effects and affordability group-specific dummies for construction year dummies, type of land lord (an individual or a firm) and integer value of floor area. We include these control variables in all specifications to gain precision. In addition, some specifications include characteristics of recipient households (income, household size and age of household head).

Finally, we quantify the impact of HA on rent through instrumental variables regression where we use the discontinuities as exogenous instruments for HA. The first stage of the IV regression is model (2) with HA as the dependent variable. The floor area group dummies are the excluded instruments. In the second stage, we estimate the model:

$$(4) \quad R_i = \beta_1 + \beta_2 \widehat{HA}_i + f(\text{Floor area}_i) + \gamma X_i + u_i,$$

where R_i is the rent per square meter and the regressors are the predicted HA from the first stage together with polynomials of floor area and other controls.

This kind of IV regression arguably solves the reverse causality and omitted variables issues and gives an estimate of the impact of HA on rent isolated from other determinants of rent.

The identifying assumption is that the floor area cut-off dummies are orthogonal to the error term. This should be the case if other determinants of HA develop smoothly with respect to floor area and are therefore captured by the f function. The main worry here is that sorting and sample selection might lead to discontinuities in the background characteristics. This can be examined through balance of covariates tests where we use characteristics of the dwellings and HA recipients as dependent variables in model (2).

As discussed above, our assignment variable is discrete. This means that we cannot compare the means of the dependent variable just below and above the cut-offs. The conditions for non-parametric or semi-parametric methods are not satisfied (Lee and Card, 2008). Thus we are forced to perform simple parametric RDD analysis, where we choose a functional form for the relationship between the assignment variable and the outcome variable. We use 1st and 2nd order polynomials which are allowed to vary between the cut-offs in our main tables. The use of higher order polynomials would likely lead to overfitting, but we report specifications with all (81) combinations of 1st–3rd order polynomials for the four intervals separated by the cut-offs as a robustness check.

The discreteness of the assignment variable also has implications for statistical inference. As pointed out by Lee and Card (2008), specification errors in the fitted regression line imply that at each discrete value there is an error component positively correlated within observations at that particular point. As a result, conventional standard errors are downward-biased. Therefore, we cluster standard errors at discrete values of floor area.

4.3 Results

Our graphical analysis (Figures 1–3) shows that there are clear discontinuities in the rent ceilings and actual HA received at the floor area cut-offs. It also suggests that these differences in the generosity of the HA system do not translate into differences in relative rents.

We now turn to regression analysis where we estimate the size of the discontinuities in HA and rents at the cut-offs, and estimate the impact of HA on rent utilizing the three discontinuities as instruments for HA.

Table 4 shows the estimation results for model (2). The coefficients are changes in HA, in rent or in net rent in euros (per square meter per month) when crossing the floor area cut-offs. Columns 1–4 report the effect of crossing the cut-offs on HA per square meter and columns 5–8 show the effect on rent per square meter. For both outcomes, we consider four different specifications. To gain precision, all the specifications include construction year dummies interacted with affordability group, a dummy for integer values of floor area interacted with affordability group, municipality-year fixed effects (34 municipalities and 6 years) and postcode fixed effects (799 postcodes). The first specification is a naïve regression where we

do not control for floor area. In the second and the third specifications, we add 1st and 2nd order polynomials of floor area. The last specification includes household characteristics as additional controls. For the third outcome, the net rent per square meter per month in column 9, we report only the third specification without the household characteristics.

The first four columns show that there are clear and statistically significant jumps in HA per square meter at all three cut-offs. The units are euros/m² per month. Comparisons of the jumps in HA with the mean income and HA reported in Table 2 indicates that the jumps are not large but not negligible either. For example, crossing the first cut-off implies on average a 15 euro reduction in the monthly HA ($26\text{m}^2 * 0.576 \text{ euros/m}^2$) which corresponds to a 6.7% decrease in HA or 1.9% decrease in income (including HA).

Turning to the rent per square meter in columns 5–8, all the coefficients are negative and significant in the naïve regression of column 5 where we do not control for floor area. In column 6, where this effect is controlled for using the 1st order polynomials, there is one significant coefficient with a counterintuitive sign. With the 2nd order polynomials in column 7, all the coefficients are close to zero and statistically insignificant and have reasonably narrow confidence intervals. Adding household characteristics in column 8 has little effect on the results.

Column 9 shows that crossing the floor area cut-offs has a statistically significant effect on the net rent (the difference between the actual rent and the HA) of the recipient households. At all the cut-offs, households just to the right of the cut-off have higher housing expenses after the housing allowance has been taken into account than those just to the left of the cut-off.

Table 4. Discontinuities in HA, rent and net rent (1st stage and reduced form of IV regression).

Dep var	(1) HA/m2	(2) HA/m2	(3) HA/m2	(4) HA/m2	(5) Rent/m2	(6) Rent/m2	(7) Rent/m2	(8) Rent/m2	(9) Net Rent/m2
Floor area>25.9	-0.786*** [0.042]	-0.527*** [0.033]	-0.497*** [0.062]	-0.576*** [0.038]	-2.232*** [0.390]	0.263*** [0.093]	-0.134 [0.159]	-0.152 [0.167]	0.363** [0.156]
Floor area>30.9	-0.662*** [0.042]	-0.409*** [0.037]	-0.455*** [0.066]	-0.575*** [0.043]	-1.331*** [0.223]	0.118 [0.073]	0.193 [0.122]	0.165 [0.130]	0.648*** [0.079]
Floor area>35.9	-0.644*** [0.104]	-0.118* [0.068]	-0.224*** [0.076]	-0.245*** [0.042]	-0.853*** [0.144]	0.127* [0.070]	-0.008 [0.084]	0.024 [0.081]	0.216*** [0.057]
1 st stage F	463.7	96.2	50.4	183.8					
N	272941	272941	272941	272941	272941	272941	272941	272941	272941
Order of polynomials of floor area	No	1st	2nd	2nd	No	1st	2nd	2nd	2nd
Dwelling and area characteristics	X	X	X	X	X	X	X	X	X
Household characteristics				X				X	

Notes: Table shows coefficients on the dummies for crossing floor area cut-offs. Dwelling and area characteristics include construction year dummies interacted with affordability group, dummy for integer values of floor area interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Household characteristics include age of recipient, age squared, household income (pre-allowance), income squared and household size dummies. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table 5 shows the result of the IV regression of model (4). The specifications used are the same as in Table 4. The first stage F-statistics are high indicating that the instruments are strong enough for reliable estimation. The first stage regressions are reported in Table 4. Table A5 in the appendix shows the results with all possible combinations of 1st–3rd order polynomials of floor area for the intervals between the cut-offs.

In the first column of Table 5 without the 1st or 2nd order polynomial of the floor area, the housing allowance coefficient is positive and significant. Adding the 1st and 2nd order polynomials first turns the estimate negative and significant and then brings it close to zero.

In column 5, the dependent variable is the net rent per square meter. The results indicate that a higher HA translates roughly one-to-one into a lower net rent.

Table 5. IV results on the effect of housing allowance on rents.

	(1)	(2)	(3)	(4)	(5)
Dep var	Rent/m2	Rent/m2	Rent/m2	Rent/m2	Net Rent/m2
HA/m2	2.043*** [0.122]	-0.395** [0.170]	-0.14 [0.178]	-0.1 [0.151]	-1.140*** [0.178]
1 st stage F	463.7	96.2	50.4	183.8	50.4
N	272941	272941	272941	272941	272941
Order of polynomials of floor area	No	1st	2nd	2nd	2nd
Dwelling and area characteristics	X	X	X	X	X
Household characteristics				X	

Notes: Table shows IV regression results on the effect of HA/m2 on rent/m2 and net rent/m2. The excluded instruments are the three dummies for floor area cut-offs. 1st stage regressions are shown in Table 4. Dwelling and area characteristics include construction year dummies interacted with affordability group, dummy for integer values of floor area interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Household characteristics include age of recipient, age squared, household income (pre-allowance), income squared and household size dummies. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Results for sub-groups

As discussed in Section 2, there are reasons to expect that the effects of HA on rents are heterogeneous and depend on the circumstances of the household. In Table 6, we repeat the analysis discussed above for various sub-samples based on recipient and unit characteristics. The first panel shows the IV estimates for the effects of HA on rents (corresponding to column 3 in Table 5) and the second panel the reduced form of the IV regressions (corresponding to column 7 in Table 4).

In the first column, we limit the sample to those 26% of the HA recipients whose HA is paid directly to the landlord. In the second and the third columns, we divide the sample into two groups based on income: those with incomes lower and higher than the mean income. This is because the details of the housing allowance system might be less important for those with very low incomes as they are eligible for social assistance covering their housing costs. In the fourth and fifth columns, we focus on those flats and recipient households that appear regularly (in at least five out of six years) in our data. The rationale is that one might not expect HA to influence willingness to pay for different types of units or housing consumption choices if the household's reliance on the HA is very short term. While we cannot know what the expectations of the recipient households are when they make their housing consumption choices, we can examine whether the effects are different for those who end up receiving HA for extended durations. Finally, in columns 6 and 7 we consider the effects separately for those with a private individual and a corporation as their landlord. The effects could be different as institutional landlords are more likely to use posted rents as opposed to bargaining while private landlords might be more willing to negotiate with potential tenants.

Starting from the reduced form of the IV estimates in the lower panel, there is some evidence of rent effects for long-term HA recipients and flats inhabited by HA recipients for longer periods. In these groups, there is a statistically significant (at the 5% level) downward shift in rent at the first cut-off, and also at the third cut-off for the long term HA flat group. In the other groups, none of the coefficients for crossing the floor area cut-offs are significant, apart from one with a counterintuitive sign in column 7. Despite some significant coefficients in the reduced form regressions, all the IV estimates in the upper panel are insignificant. The results are not entirely conclusive for some sub-groups because the standard errors are rather high.

Table 6. Estimated effect of HA on rent in sub-groups.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sub-sample	HA paid to landlord	Below mean income	Above mean income	Flat in data in 5 or more years	Recipient in data in 5 or more years	Private landlord	Firm landlord
Dep var	Rent/m2	Rent/m2	Rent/m2	Rent/m2	Rent/m2	Rent/m2	Rent/m2
<i>Panel A: IV results</i>							
HA/m2	0.024 [0.330]	-0.096 [0.121]	-0.195 [0.277]	0.27 [0.250]	0.164 [0.270]	-0.057 [0.104]	-0.775 [0.499]
1st stage F	45.2	403.4	44.4	17.6	23.1	82.3	4.7
N	71514	125758	147183	101484	114173	200709	72232
<i>Panel B: Reduced form of IV</i>							
Floor area>25.9	-0.295 [0.292]	-0.01 [0.135]	-0.268 [0.225]	-0.638** [0.259]	-0.468** [0.207]	0.031 [0.084]	-0.387 [0.486]
Floor area>30.9	0.187 [0.256]	0.083 [0.088]	0.278 [0.171]	0.369* [0.217]	0.316 [0.241]	0.011 [0.086]	0.605*** [0.217]
Floor area>35.9	0.106 [0.134]	0.037 [0.115]	-0.025 [0.078]	-0.257* [0.138]	-0.218** [0.098]	0.044 [0.087]	0.072 [0.141]
N	71514	125758	147183	101484	114173	200709	72232
Order of polynomials of floor area	2nd	2nd	2nd	2nd	2nd	2nd	2nd
Dwelling and area characteristics	X	X	X	X	X	X	X

Notes: Panel A shows IV regression results on the effect of HA/m2 on rent/m2 and net rent/m2. The excluded instruments are the three dummies for floor area cut-offs. Panel B shows coefficients on the dummies for crossing floor area cut-offs from a regression of Rent/m2 on floor area group dummies and controls. Dwelling and area characteristics include construction year dummies interacted with affordability group, dummy for integer values of floor area interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

All the results above concern tenants in the private rental market. Table A4 in Appendix A reports estimates for municipality owned housing and for privately-owned subsidized housing. The reduced form of IV estimates might suggest some impact on rents in the privately-owned subsidized housing at one of the cut-offs, but the IV estimates are insignificant for both sectors. In both cases, the first stage F values are low which is not surprising as the rent ceiling is much less frequently binding in the social housing sector than in the private rental market. Also the share of very small flats is smaller than the private rental market. Accordingly, the standard errors are large especially at the first floor area cut-off.

Construction year cut-offs

The analysis above utilizes variation due to discontinuities in HA at floor area cutoffs. The effects might differ for other types of variation in HA. For example, the dependence of HA on other characteristics might trigger rent responses if the demand for these characteristics is more price elastic than the demand for housing space. Collison and Ganong (2016), for instance, study a reform which made the US housing voucher system more generous in expensive neighborhoods and less generous in low-cost neighborhoods, and find evidence of demand and price responses. Brewer et al. (2014) argue that variation in the incidence is explained by differences in demand elasticities across recipient groups.

The stepwise dependence of HA on construction year of the dwelling offers an additional source of variation in HA¹³. We repeat the analysis presented and discussed above using the cut-offs for the year of construction or major renovation (henceforth construction year) in the appendix. There are two construction year cut-offs in the scheme, in 1986 and 1996. For the analysis, we restrict the sample to a +/- 10 year band around these cut-offs (flats built between 1975 and 2006) which reduces the sample size from roughly 273,000 to 132,086.

Figures A1 and A2 in Appendix A show that the discontinuity in HA is particularly strong at the 1986 cut-off. In Figure A3, there is some indication of an upward shift in rents at the first cut-off, but no sign of a jump in rents at the second cut-off. The figure also reveals that there is substantial variation in rents and the relationship between rents and construction year does not appear to be very smooth. Thus the analysis utilizing the floor area discontinuities is likely to be more reliable. Table A1 shows estimates of the discontinuities in HA and rent and Table

¹³ Variation in HA generosity across the borders of the four affordability regions is probably not exogenous in Finland because the borders coincide with municipality borders where other determinants of rents, such as local taxes and public services, change at the same time. Moreover, RDD type analysis might not be feasible because the rental market is often thin in border areas which are typically outside urban areas.

A2 reports the IV estimates. According to columns 7 and 8 in Table A1, there is a jump in the rent at the second cut-off but not at the first cut-off where the discontinuity in HA is larger. The IV estimates are close to zero and insignificant. Overall, the results are in line with the findings of the analysis based on the floor area cut-offs.

Relationship with previous Finnish studies

The finding that differences in the level of HA do not capitalize into rents is in contrast with many previous studies including two Finnish studies (Viren, 2013, and Kangasharju, 2010). Viren (2013) uses similar (but smaller) register data on HA recipients as we do for an earlier time period. The analysis exploits the whole range of variation embedded in the rent ceiling differences.¹⁴ He estimates reduced form models of rent on maximum achievable HA and various controls. As regards floor area and construction year, his controls include only the first order terms fitted over the whole support of the distribution of floor area and construction year. In the light of our analysis, this is clearly insufficient to capture the underlying relationship between these attributes and rents. We, on the other hand, focus on data close to cut-offs where rent ceilings have important impact on actual HA and generate plausibly exogenous variation in the allowance. We also control for the running variables in a more flexible way and perform extensive robustness and validity checks. Therefore, we argue that the internal validity of the analysis is higher here than in Viren (2013).

Kangasharju (2010) in turn studies a reform which increased the rent ceilings in 2002 using the Income Distribution Statistics data which combines register data and survey elements. The IDS is a representative sample of Finish households and contains both HA recipient and non-recipient households. The study presents differences-in-differences results based on the comparison rental rates of recipient and non-recipient households before and after the reform as well as an instrumental variable estimation exploiting the variation in the changes in the rent ceiling. The main result is that one additional euro in HA led to a 60–70 cent increase in the rents paid by the recipient household. In Appendix B of this paper, we repeat the analysis of the 2002 reform using the same data and the methods described in Kangasharju (2010) but find different results. In particular, we do not find evidence of large rent effects.

¹⁴ The discussion presenting the empirical strategy in Viren (2013) is not very detailed and hence it is not entirely clear what the sources of identifying variation are.

4.4 Robustness and validity

In this section, we report the results of robustness checks. We also discuss internal validity (in particular, the possible manipulation of the assignment variable close to the cut-offs and the balance of the covariates by treatment status) and external validity of the results.

Internal validity

The existence of the floor area cut-offs at which the rent ceiling changes may, at least in principle, induce behavioral responses both on the demand and on the supply side. When thinking about the supply, two issues should be discussed. First, the ability of landlords or tenants to manipulate floor area (reported to Kela) could invalidate our RD analysis. The concern would be that units with floor area just above the cut-offs are reported to have floor area below the cut-off for the unit to qualify for a higher HA. Second, if the construction of new units responds to this incentive, over time, the whole rental housing stock could start to reflect these cut-offs in the system. Another potential channel through which the rental housing stock can adjust is the conversion of owner-occupied units to rental units and vice versa.

In addition, it is possible that the cut-offs also lead to sorting by inducing changes in the level of the HA and thereby in the net rents. Because non-claimants and claimants face different incentives, the claimants could be expected to be over-represented just below the floor area cut-offs.

All these different ways of manipulating the assignment variable should show up as discontinuities in the distribution of floor area at the cut-offs. We examine the distribution in Figure 5 and in Table 7.

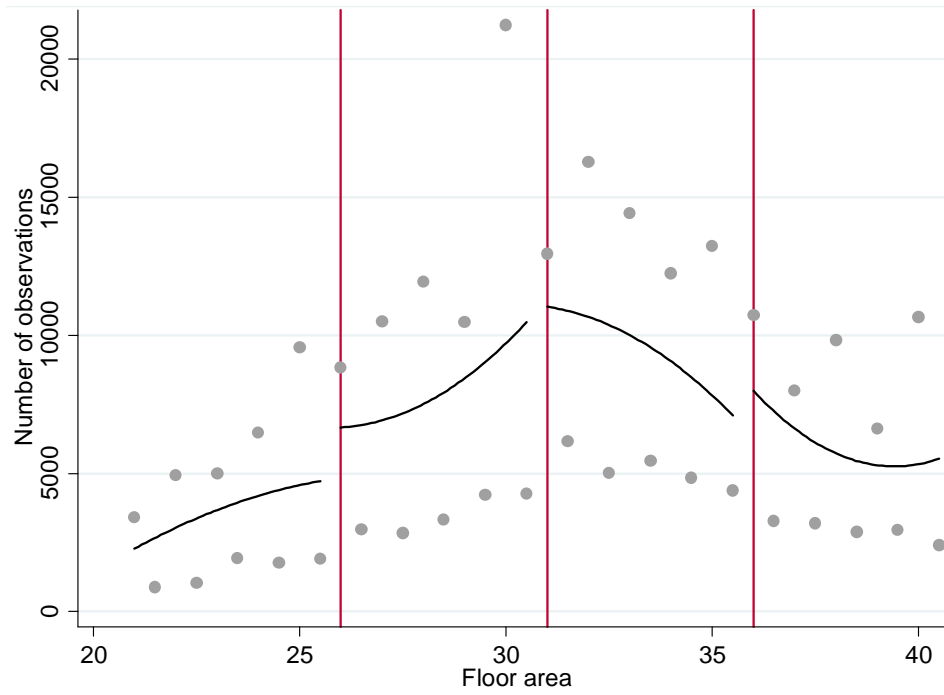


Figure 5. Distribution of floor area of HA recipient households.

Figure 5 shows that there are spikes in the distribution at round values 25, 30 and 35 just below the cut-offs, but there is a similar spike at 40 square meters with no floor area cut-off (and also at 20 square meters, which is not shown in the figure). The figure also shows that integers are in general much more common than half-integers. In general, based on the figure, it seems that there are no abnormal jumps in the distribution at the cut-offs.

Table 7 shows the change in the number of observations (and log of number of observations) when crossing the cut-offs when we control for 2nd order polynomials of floor area. A dummy for integer values is included as a control, because otherwise the presence of integers just to the right of cut-offs could bias the test. The table confirms that there are no statistically significant jumps in the density of floor area at the cut-offs.

Table 7. Tests for discontinuities in the density of floor area.

	(1)	(2)
Dep var	Number of observations	Ln(Number of observations)
Floor area>25.9	-388.017 [1492.702]	0.132 [0.294]
Floor area>30.9	-2485.19 [5996.131]	-0.202 [0.348]
Floor area>35.9	-520.999 [1187.473]	-0.178 [0.158]
N	40	40
Order of polynomial of floor area	2nd	2nd

Notes: Table shows coefficients on the dummies for crossing floor area cut-offs. Dummy for integer values of floor area included as a control. Heteroskedasticity robust standard errors are in brackets * p<0.1, ** p<0.05, *** p<0.01.

We then turn to characteristics of the dwelling and the tenant household. Figure 6 and Table 8 report the balance of covariates tests for some household characteristics (household age, size and income). They also show the construction year, share of units located in Helsinki and share of private owners at different floor areas. The construction year and Helsinki dummy are of particular interest because the rent ceiling depends not only on the floor area but also on the construction year and affordability group.

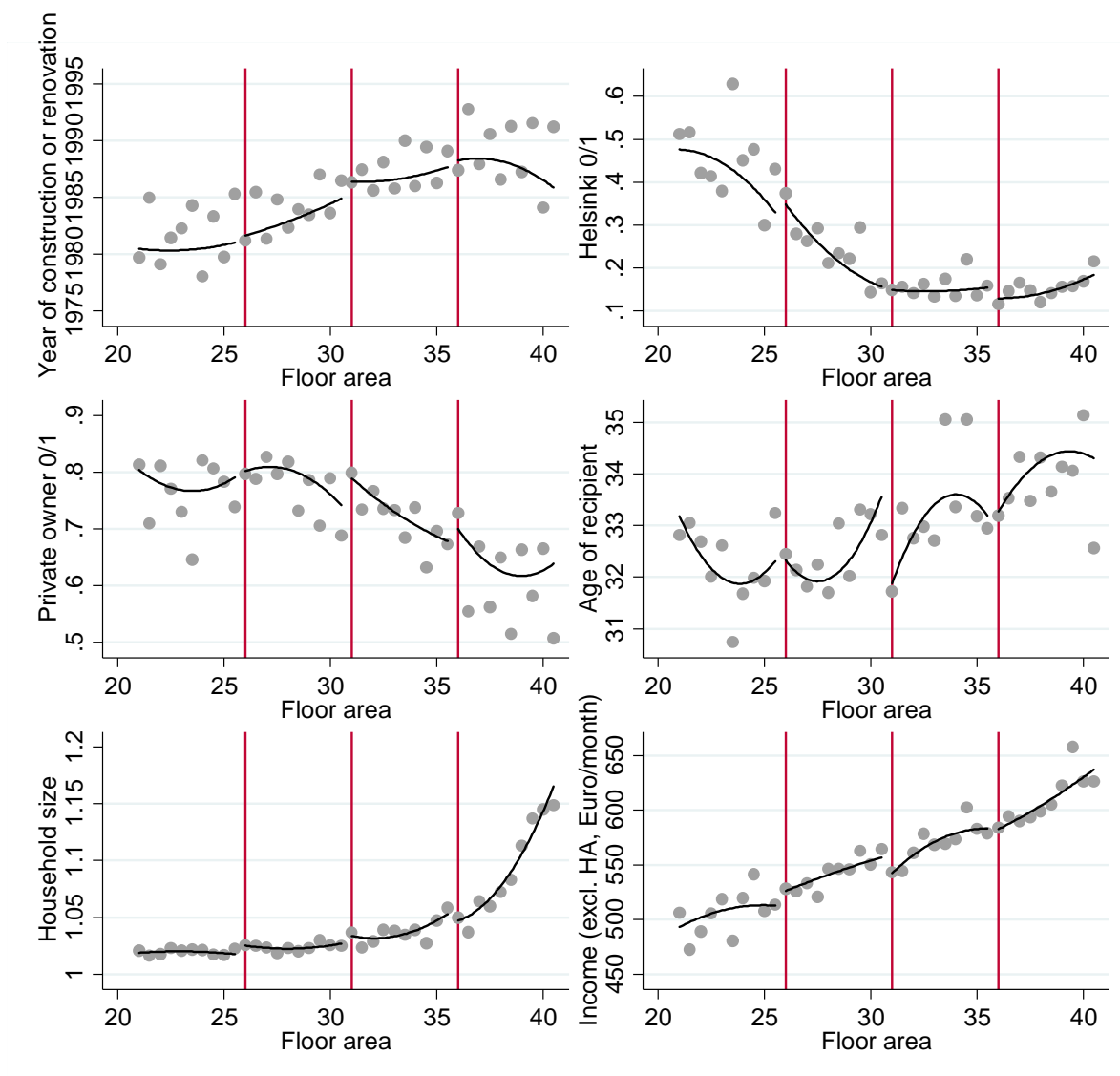


Figure 6. Discontinuities in dwelling and household characteristics.

Figure 6 shows that in general larger units tend to be located in newer buildings are less likely to be located in Helsinki and more likely to have a private owner. Also, as to be expected, households in larger units are older, larger and have higher incomes.

Table 8 shows that the year of construction, dummy for Helsinki and dummy for private owner are balanced at the cut-offs but for household characteristics there are statistically significant jumps at some of the cut-offs, indicating that there may be sorting based on household characteristics into different floor area groups. The fact that the sign of the jumps varies between cut-offs, however, suggests that an alternative reason is that standard errors are downward biased for household characteristics because errors are correlated within household and the same households are observed many times. Table A3 in Appendix A shows that only

one of the coefficients is significant at the 5% level when we cluster standard errors at the household level. Using household level clustering in our main analysis leads to lower standard errors, and thus, we hold to the more conservative floor area clustering.

Table 8. Balance of covariates tests.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep var	Year of construction	Helsinki	Private owner	Age	hh size	hh income
Floor area>25.9	0.377 [2.821]	0.052 [0.103]	-0.002 [0.039]	-0.293 [0.619]	0.009*** [0.003]	14.5 [11.503]
Floor area>30.9	1.039 [1.393]	0.000 [0.035]	0.069 [0.046]	-2.270*** [0.510]	0.005 [0.003]	-17.281** [6.866]
Floor area>35.9	0.235 [1.829]	-0.029 [0.024]	0.029 [0.034]	0.409 [0.534]	-0.012** [0.006]	0.205 [5.008]
N	272941	272941	272941	272941	272941	272941
Order of polynomial of floor area	2nd	2nd	2nd	2nd	2nd	2nd

Notes: Table shows coefficients on the dummies for crossing floor area cut-offs. Standard errors clustered at discrete values of floor area are in brackets. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9 addresses the concern that non-random heaping of data to integer values of floor area might bias our results. We control for integer values through a dummy variable in all regressions but this might not be sufficient. As suggested by Barreca et al. (2016), we report the IV and reduced form of IV estimates for a sample limited to integers of floor area in Table 9. The results are very similar to the corresponding specification in Tables 4 and 5. Note that the standard errors in Table 9 are likely to be downward biased due to the low number of clusters (20 instead of 40).

Table 9. Integers only sample.

Dep var	(1) Integer values of floor area only Rent/m2
<i>Panel A: IV results</i>	
HA/m2	-0.063 [0.080]
1 st stage F	130.5
N	204432
<i>Panel B: Reduced form of IV</i>	
Floor area>25.9	-0.009 [0.115]
Floor area>30.9	0.031 [0.050]
Floor area>35.9	0.088 [0.083]
Order of polynomials of floor area	2nd
Dwelling characteristics	X

Notes: Panel A shows IV regression results on the effect of HA/m2 on rent/m2 and net rent/m2. The excluded instruments are the three dummies for floor area cut-offs. Panel B shows coefficients on the dummies for crossing floor area cut-offs from a regression of Rent/m2 on floor area group dummies and controls. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Finally, we analyze the robustness of the IV estimates to functional form of floor area by reporting specifications with all combinations of 1st–3rd order polynomials for the four intervals separated by the three floor area cut-offs as a robustness check (81 specifications altogether). The findings are reported in Table A5. We do not find positive point estimates in any of the specifications. There are some counterintuitive negative and significant estimates when we use a 1st order polynomial for the first interval. With intermediate degrees of flexibility we find small and insignificant estimates similar to our main specifications. With higher order polynomials the point estimates tend to move further away from zero but remain statistically insignificant.

External validity

Our results suggest that the incidence of differences in HA due to discontinuities in the Finnish HA scheme is on the tenant. The results may be generalizable to other settings where HA depends on characteristics of the dwelling or characteristics of the household, such as household size and income. The findings are not informative whether the demand increase

due to the existence of the HA scheme affects the overall rent level or whether HA recipients pay a premium relative to non-recipients.

5 Conclusions

We study the effect of housing demand subsidies on rents exploiting the stepwise nature of the Finnish HA scheme. During the time period of the study, the HA system featured discontinuities in the rent ceiling per square meter as a function of the floor area of the unit. These discontinuities are informative of whether the HA capitalizes into rents because there is no other reason to expect the relationship between rents and unit size to be stepwise.

The discontinuities in the amount of HA at cut-offs studied are economically and statistically significant. However, we do not find evidence of discontinuities in rents at these cut-offs when focusing on HA recipient households in the private rental housing market. Instead, it seems that differences in the size of the housing allowance are translated into differences in the out-of-pocket rent of the recipient households.

More generally, while our results are not informative about the effects of the overall size of the housing allowance system, they do suggest that the incidence of small changes in the parameters of the system is largely on the tenants. In our subsample analysis, we find some indication of rent effects when we focus on long term HA recipients or flats inhabited by HA recipients for several years. This suggests that the dynamics of recipient status and the rental markets may matter for the incidence of HA.

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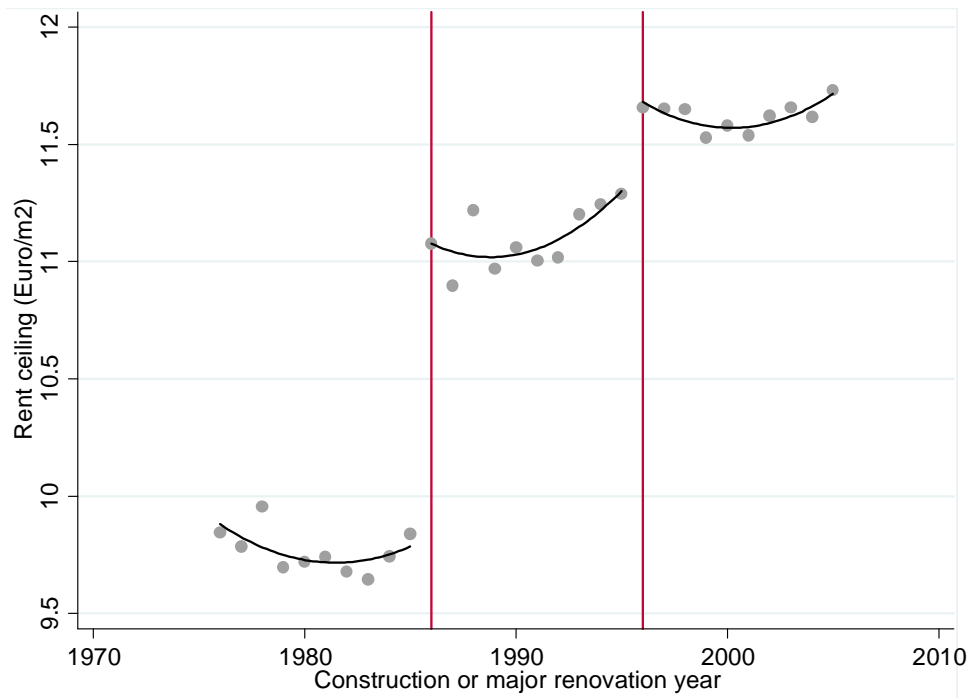
Appendix A: Additional Figures and Tables

Figure A1. Construction year and rent ceiling.

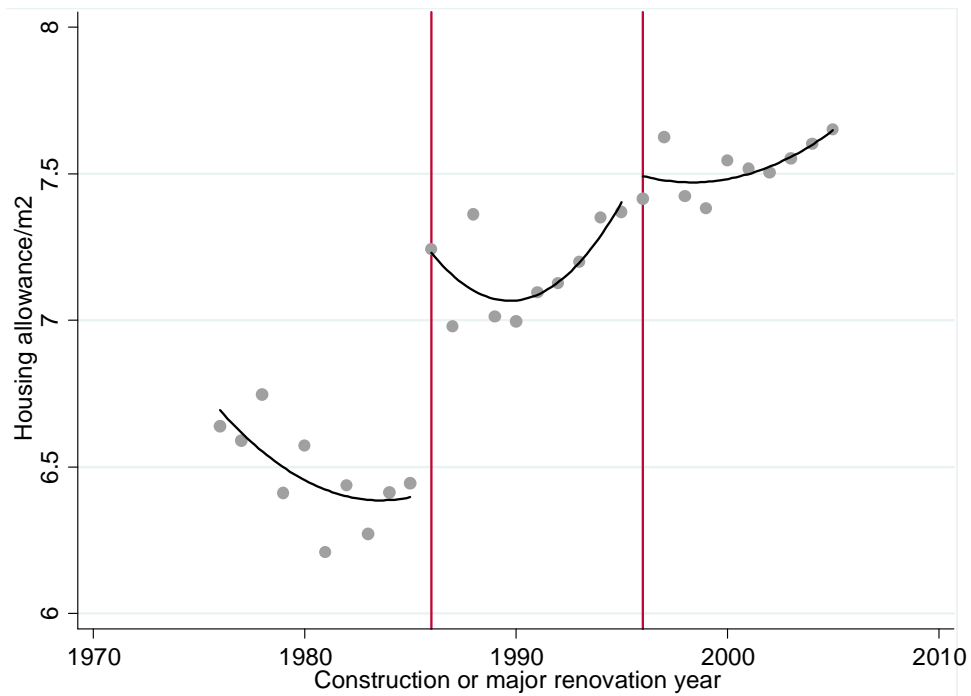


Figure A2. Construction year and HA per square meter.

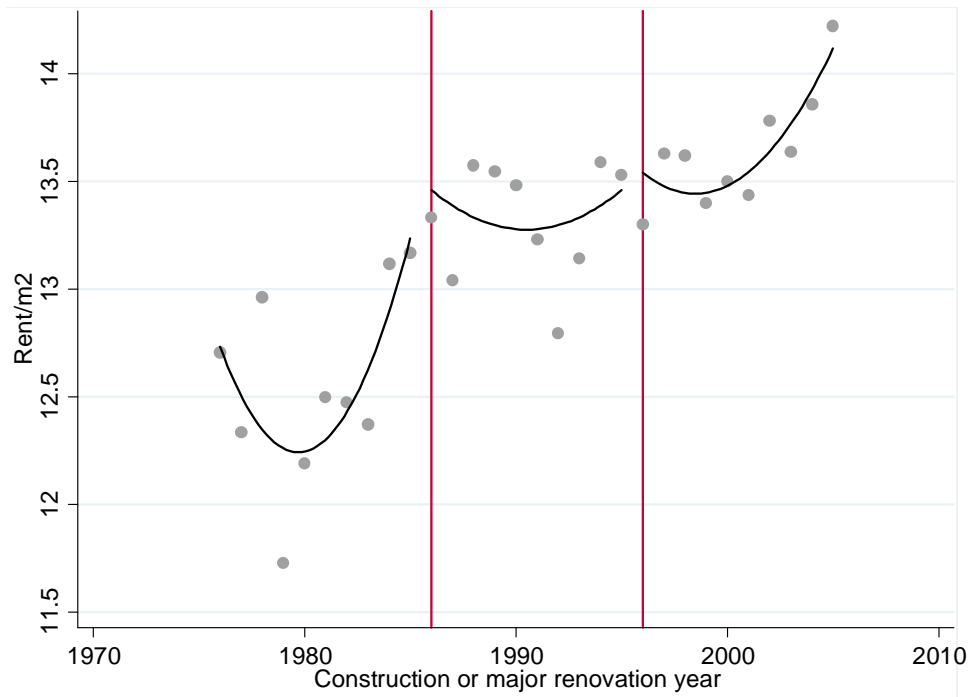


Figure A3. Construction year and rent per square meter

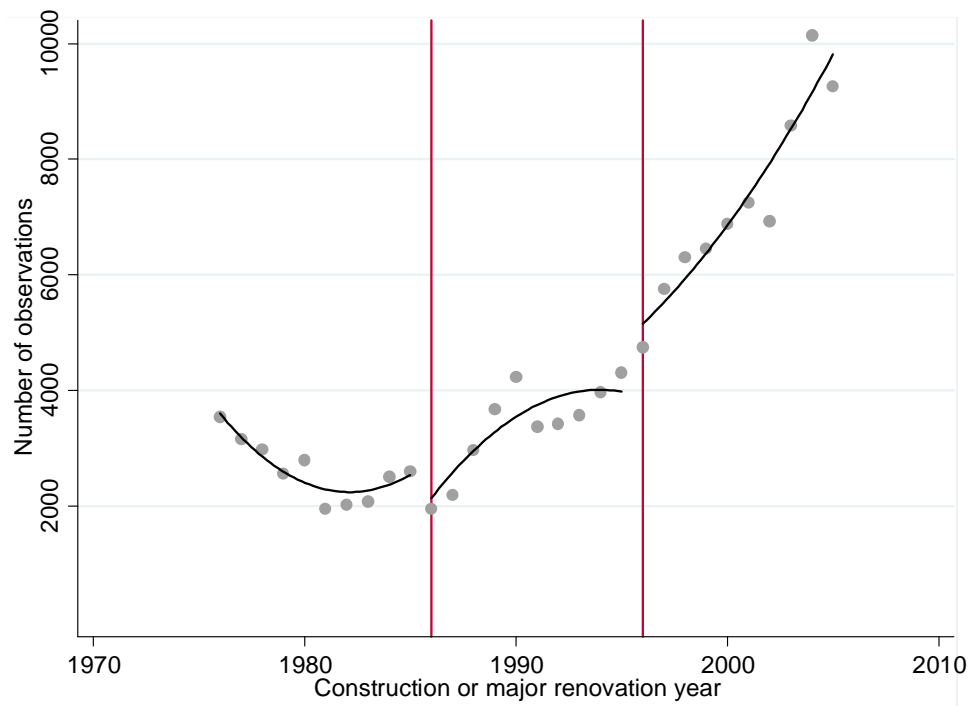


Figure A4. Distribution of construction year.

Table A1. Discontinuities in HA, rent and net rent (1st stage and reduced form of IV regression, construction year cut-offs).

Dep var	(1) HA/m2	(2) HA/m2	(3) HA/m2	(4) HA/m2	(5) Rent/m2	(6) Rent/m2	(7) Rent/m2	(8) Rent/m2	(9) Net Rent/m2
Construction or renovation year>1986	0.652*** [0.045]	0.770*** [0.067]	0.799*** [0.081]	0.731*** [0.042]	0.161 [0.104]	0.464*** [0.159]	-0.143 [0.177]	-0.089 [0.177]	-0.942*** [0.179]
Construction or renovation year>1996	0.281*** [0.032]	0.247*** [0.049]	0.152** [0.072]	0.409*** [0.039]	0.218** [0.086]	0.204** [0.084]	0.373** [0.146]	0.332** [0.144]	0.221 [0.144]
1 st stage F	242.6	68.5	52.5	307.3					
N	132086	132086	132086	132086	132086	132086	132086	132086	132086
Order of polynomials of floor area	No	1st	2nd	2nd	No	1st	2nd	2nd	2nd
Dwelling and area characteristics	X	X	X	X	X	X	X	X	X
Household characteristics				X				X	

Notes: Table shows coefficients on the dummies for crossing floor area cut-offs. Dwelling and area characteristics include floor area dummies interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Household characteristics include age of recipient, age squared, household income (pre-allowance), income squared and household size dummies. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table A2. IV results on the effect of housing allowance on rents (construction year cut-offs).

Dep var	(1) Rent/m2	(2) Rent/m2	(3) Rent/m2	(4) Rent/m2	(5) Net Rent/m2
HA/m2	0.415*** [0.095]	0.618*** [0.213]	0.071 [0.221]	0.229 [0.173]	-0.929*** [0.221]
1 st stage F	242.6	68.5	52.5	307.3	52.5
N	132086	132086	132086	132086	132086
Order of polynomials of floor area	No	1st	2nd	2nd	2nd
Dwelling and area characteristics	X	X	X	X	X
Household characteristics				X	

Notes: Table shows IV regression results on the effect of HA/m2 on rent/m2 and net rent/m2. The excluded instruments are the two dummies for construction year cut-offs. 1st stage regressions are shown in Table 3. Dwelling and area characteristics include floor area dummies interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Household characteristics include age of recipient, age squared, household income (pre-allowance), income squared and household size dummies. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table A3. Balance of covariates tests, clustering at household level.

Dep var	(1) Age	(2) hh size	(3) hh income
Floor area>25.9	-0.293 [0.619]	0.009 [0.006]	14.5 [13.764]
Floor area>30.9	-2.270*** [0.447]	0.005 [0.005]	-17.281* [9.372]
Floor area>35.9	0.409 [0.484]	-0.012* [0.007]	0.205 [10.938]
N	272941	272941	272941
Order of polynomial of floor area	2nd	2nd	2nd

Notes: Table shows coefficients on the dummies for crossing floor area cut-offs. Standard errors clustered at household level are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table A4. Estimated effect of HA on rent in the social housing sector.

	(1)	(2)
Dep var	Municipalities Rent/m2	Non-profit organisations Rent/m2
<i>Panel A: IV results</i>		
HA/m2	0.581 [0.516]	0.445* [0.258]
1 st stage F	2.6	9.2
N	93369	65110
<i>Panel B: Reduced form of IV</i>		
Floor area>25.9	0.128 [0.437]	0.854 [0.599]
Floor area>30.9	-0.165 [0.193]	0.550* [0.305]
Floor area>35.9	-0.012 [0.057]	-0.450*** [0.175]
Order of polynomials of floor area	2nd	2nd
Dwelling and area characteristics	X	X

Notes: Panel A shows IV regression results on the effect of HA/m2 on rent/m2 and net rent/m2. The excluded instruments are the three dummies for floor area cut-offs. Panel B shows coefficients on the dummies for crossing floor area cut-offs from a regression of Rent/m2 on floor area group dummies and controls. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table A5. Robustness of IV estimates to functional form. (Model title indicates the order of polynomial used for each interval around the cut-offs.)

IV1111	IV1112	IV1113	IV1121	IV1122	IV1123	IV1131	IV1132	IV1133
-0.395**	-0.414**	-0.412**	-0.463***	-0.450***	-0.434***	-0.464***	-0.428***	-0.462***
[0.170]	[0.168]	[0.163]	[0.140]	[0.136]	[0.133]	[0.138]	[0.136]	[0.136]
IV1211	IV1212	IV1213	IV1221	IV1222	IV1223	IV1231	IV1232	IV1233
-0.379**	-0.372**	-0.369**	-0.458***	-0.442***	-0.427***	-0.455***	-0.420***	-0.453***
[0.172]	[0.172]	[0.168]	[0.155]	[0.150]	[0.147]	[0.152]	[0.147]	[0.147]
IV1311	IV1312	IV1313	IV1321	IV1322	IV1323	IV1331	IV1332	IV1333
-0.390**	-0.405***	-0.393***	-0.468***	-0.470***	-0.535***	-0.549***	-0.475***	-0.524***
[0.163]	[0.151]	[0.149]	[0.154]	[0.163]	[0.161]	[0.172]	[0.174]	[0.174]
IV2111	IV2112	IV2113	IV2121	IV2122	IV2123	IV2131	IV2132	IV2133
-0.242	-0.225	-0.223	-0.285	-0.269	-0.255	-0.283	-0.252	-0.283
[0.170]	[0.164]	[0.162]	[0.186]	[0.177]	[0.174]	[0.179]	[0.174]	[0.174]
IV2211	IV2212	IV2213	IV2221	IV2222	IV2223	IV2231	IV2232	IV2233
-0.08	-0.091	-0.09	-0.156	-0.14	-0.129	-0.149	-0.108	-0.124
[0.157]	[0.156]	[0.154]	[0.188]	[0.178]	[0.172]	[0.184]	[0.176]	[0.183]
IV2311	IV2312	IV2313	IV2321	IV2322	IV2323	IV2331	IV2332	IV2333
-0.12	-0.124	-0.118	-0.15	-0.088	-0.089	-0.085	-0.029	-0.044
[0.169]	[0.167]	[0.162]	[0.189]	[0.237]	[0.261]	[0.285]	[0.249]	[0.270]
IV3111	IV3112	IV3113	IV3121	IV3122	IV3123	IV3131	IV3132	IV3133
-0.146	-0.155	-0.146	-0.218	-0.233	-0.213	-0.207	-0.167	-0.184
[0.190]	[0.193]	[0.187]	[0.165]	[0.165]	[0.158]	[0.168]	[0.162]	[0.167]
IV3211	IV3212	IV3213	IV3221	IV3222	IV3223	IV3231	IV3232	IV3233
-0.114	-0.114	-0.109	-0.163	-0.264	-0.373	-0.521	-0.357	-0.441
[0.168]	[0.165]	[0.161]	[0.195]	[0.278]	[0.330]	[0.394]	[0.340]	[0.388]
IV3311	IV3312	IV3313	IV3321	IV3322	IV3323	IV3331	IV3332	IV3333
-0.264	-0.309	-0.291	-0.398	-0.377	-0.476	-0.498	-0.345	-0.441
[0.220]	[0.211]	[0.198]	[0.301]	[0.300]	[0.357]	[0.483]	[0.320]	[0.399]

Notes: Table shows IV regression results on the effect of HA/m² on rent/m². Model titles indicate the polynomials used for each interval of floor area separated by the cut-offs. For example IV2222 means that we use a second order polynomial for all four intervals. Controls include dwelling and area characteristics: construction year dummies interacted with affordability group, dummy for integer values of floor area interacted with affordability group, municipality-year fixed effects and postcode fixed effects. Standard errors clustered at discrete values of floor area are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Appendix B: Robustness analysis of Kangasharju (2010)

In this appendix, we study the robustness of the findings of Kangasharju (2010) (henceforth K2010) by analyzing the 2002 reform using the same data. The program code used in K2010 was not available to us but we follow the methodology as reported in the paper. We focus on Table 8 and 9 of the original paper.

We end up with a substantially larger estimation sample than K2010. Thus, using the terminology suggested by Clemens (2017) our analysis is perhaps better interpreted as a robustness check by reanalyzing the data than as a replication. The reason for the difference in sample size is not known to us but probably reflects differences in choices made when constructing the estimation sample (not all choices are reported in K2010).

The 2002 reform

The reform divided the HMA into two regions: the city of Helsinki (affordability region 1) and the rest of the metropolitan area (affordability region 2). In addition, the reform reduced the number of construction year cut-offs from three to two and divided the first floor area group (flats smaller than 36m²) into three different groups (smaller than 25.9m², 26–30.9m² and 31–35.9m²). But most importantly for the identification of the effects of HA on rents, the reform increased the rent ceilings with varying degrees for all HA recipients. The increases were largest for small flats in the city of Helsinki. For instance, for a 25m² flat located in Helsinki and built before 1985, the rent ceiling increased from 7.74 euros to 11.25 euros per square meter.

Data

We use the Income Distribution Statistics data from Statistics Finland for the years 2000–2003. The data contain roughly 10,000 households and 28,000 individuals each year and combines register data with a survey. Each household is present in the data for two consecutive years. Information on rents is based on the housing allowance register and the survey.

The data include information on the number of months HA was received, the total annual amount of HA and the amount of HA received in December by each member of the household. We collapse the data to the household level and sum up the HA variables within the household. We define HA recipients as households that, according to the IDS records, have received HA within the survey year and have at least one HA month. We drop

households with negative HA (due to claw back of excessive HA paid previously), households with positive HA but zero HA months, and households with zero HA but positive HA months. In addition we drop out households with zero or missing rent.

Methods

The main method of K2010 is an instrumental variables regression of rent/m² on HA/m² where the change in the rent ceiling due to the reform of 2002 is used as an instrument for housing allowance. Before the instrumental variables estimation he runs a differences-in-differences (DiD) regression of ln(rent/m²) on a dummy for HA recipient status (*Allowance*), dummy for years 2002 and 2003 after the reform (*After*), interaction term (*Allowance*After*) and a set of control variables (see K2010, Table A1) interacted with dummies for Helsinki and the rest of the HMA. He runs the DiD regression separately for the private rental market and social housing units owned by municipalities, and for two time windows around the reform (2001–2002 and 2000–2003). In addition, he reports two placebo tests using a two-year period before the reform (2000–2001) and after the reform (2002–2003). He finds a weakly significant positive effect on rents for the two-year window (2001–2002) and a significant positive effect for the wider time window (2000–2003) in the private rental markets but no impact in the placebo tests or in the municipal social housing sector.

Table B1 shows our results from a similar DiD analysis. Our estimation sample (N=3641) is larger than in K2010 (N=2660).¹⁶ For the private rental market in the upper panel, we find smaller DiD coefficients than K2010. With the 2-year window (2001–2002) our point estimate is 0.03 and insignificant (compared with 0.048 with t-value 1.7 in K2010) and with the 4-year window our point estimate is 0.035 and significant at the 10% level (K2010's estimate is 0.051 with t-value 2.4). The placebo estimates are similar to K2010.

Turning to the municipal housing sector in the lower panel, we find positive and significant DiD estimates. The results are unexpected since in the municipal rental sector rents should be based on maintenance and capital costs and should not be affected by the amount of HA. They are also in contrast with K2010's finding of small and insignificant coefficients. On the other hand, as Table B3 below indicates, the changes in the rent ceilings caused by the reform are not correlated with the HA variable. This would suggest that the differences in changes in

¹⁶ Apparently, there is an error in the 'free markets' 2000–2001 sample size (Column (a) of Table 8 in K2010), because the 2000–2001 and 2002–2003 sample sizes should sum up to the 'All' sample size.

the rental rates of recipient and non-recipient households in the municipal rental sector are not driven by the reform.

Table B1. Reanalysis of the 2002 reform – DiD estimates (cf. K2010 Table 8)

Period	Placebo 2000–01	2-year window 2001–02	Placebo 2002–03	4-year window 2000–03
Free markets				
Allowance*After	0.016 [0.031]	0.03 [0.033]	-0.024 [0.028]	0.035* [0.021]
R ²	0.63	0.613	0.622	0.615
Sample size	1769	1786	1872	3641
Number of assisted households	408	323	345	753
Municipal sector				
Allowance*After	-0.03 [0.026]	0.055** [0.026]	-0.011 [0.027]	0.036** [0.017]
R ²	0.463	0.509	0.491	0.454
Sample size	1154	1152	1216	2370
Number of assisted households	392	375	401	793

Notes: Table shows DiD estimates of the HA reform of 2002. All specifications include control variables listed in Kangasharju (2010). Robust standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01

Table B2 reports the IV estimates for the effect of HA on rent. For the ‘Assisted only’ sample HA/m² is instrumented with *After*Change*, where *Change* is the change in the rent ceiling in the 2002 reform for the type of flat inhabited by the household. The main effects of *After* and *Change* are included in the controls along with the same controls as in the DiD estimation of Table B1. For the ‘All’ sample including both HA recipients and non-recipients, the excluded instrument is *Allowance*After*Change*. The main effects and pairwise interactions of *Allowance*, *After* and *Change* are controlled for.

The two first columns of Table B2 show the results for the free market sector (logarithmic model in the upper panel and linear model in the lower panel). K2010 reported elasticities of 0.24 (for assisted only) and 0.31 (for all households) and euro-on-euro effects of roughly 0.7. Starting from the ‘assisted only’ sample in the first column of Table B2, our IV estimates are smaller than in K2010 and statistically insignificant. Turning to the ‘All’ sample in column 2, a notable difference between our analysis and K2010 is that we find low first stage F values indicating severe weak instrument problems, whereas he reported very strong first stage F values for the ‘All’ sample. The 3rd and 4th column show the results for the municipal social

housing sector. Similarly to K2010, the first stage F-statistics are too low for meaningful IV estimation. Table B3 reports the first stage results for all IV specifications.

Table B2. Reanalysis of the 2002 reform – IV estimates (cf. K2010 Table 9)

	Dep. var. Ln(rent/m ²)			
	Free markets		Municipal sector	
	Assisted only	All	Assisted only	All
ln(HA/m ²)	0.100	0.463	-1.979	0.017
	[0.096]	[0.324]	[4.696]	[0.020]
Sample size	753	3641	793	2370
First stage F (Kleibergen-Paap)	12.89	3.293	0.167	0.258
	Dep. var. rent/m ²			
	Free markets		Municipal sector	
	Assisted only	All	Assisted only	All
HA/m ²	0.321	1.25	3.76	-0.013
	[0.212]	[1.511]	[9.282]	[0.065]
Sample size	753	3641	793	2370
First stage F (Kleibergen-Paap)	8.344	0.949	0.14	0.044

Notes: Table shows IV estimates of the effect of HA on rents. The excluded instrument is *After*Change* (or *After*Ln(Change)*) for the 'Assisted only' sample, and *Allowance*After*Change* (or *Allowance*After*Ln(Change)*) for the 'All' sample. All specifications include control variables listed in Kangasharju (2010), and main effects and pairwise interactions of *After*, *Allowance* and *Change*. First stage estimates are shown in Table B3. Robust standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

Table B3. Reanalysis of the 2002 reform – first stage of IV estimates (cf. K2010 Table A3)

	Dep. var. Ln(HA/m ²)			
	Free markets		Municipal sector	
	Assisted only	All	Assisted only	All
ln(Change)*After	2.336*** [0.651]		-0.25 [0.605]	
ln(Change)*After*Allowance		1.170* [0.645]		-0.296 [0.583]
Sample size	753	3641	793	2370
First stage F (Kleibergen-Paap)	12.89	3.293	0.167	0.258
	Dep. var. HA/m ²			
	Free markets		Municipal sector	
	Assisted only	All	Assisted only	All
Change*After	1.559*** [0.539]		0.13 [0.353]	
Change*After*Allowance		0.435 [0.446]		-0.062 [0.296]
Sample size	753	3641	793	2370
First stage F (Kleibergen-Paap)	8.344	0.949	0.14	0.044

Notes: Table shows the first stage of the IV estimates reported in Table B2. Robust standard errors are in brackets. * p<0.1, ** p<0.05, *** p<0.01.

The conclusion is that the results indicating large effects of HA on rents found in K2010 are not robust to reanalysis of the same data following the methods as reported in the paper. The results of our reanalysis are consistent with the other findings of this paper suggesting that the incidence of differences in HA for different types of dwellings is on the tenant.