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POLICY PAPER

The Scale and Impact of the Local Authority Rent Subsidy

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Abstract: This paper examines the targeting of rent subsidies among local authority tenant households. Using microdata from the SILC survey over the period 2006 to 2015, the distributions of household rents and incomes are examined and the targeting of the local authority rental subsidy is assessed. Using propensity score matching, estimates are made of the impact of the rental subsidy on households and on the income distribution. The potential impacts on the income distribution of alternative rent subsidy mechanisms are assessed. The paper finds that the subsidisation of the rental costs paid by local authority tenants decreases income inequality, when housing costs are taken into account. Also evident is the poor targeting of rental subsidies; counter-factual scenarios in which local authority rental subsidies are directed to a greater degree towards lower income households are shown to reduce income inequality.

I INTRODUCTION

Housing policy and policy instruments have been an abiding concern for the Irish government and a policy realm toward which a very considerable proportion of its total available resources have been directed. Housing is a complex arena relevant to diverse public policy areas; however, among the foremost policy

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objectives has been the provision of housing services to households to help ensure a societally acceptable level of consumption of housing services by all. Subsidised local authority housing, in the form of a subsidised rent, is a longstanding element of the government's efforts to provide assistance to low income households. Notwithstanding those efforts, there has been an increased reliance on residential units sourced in the private rental market, as opposed to units owned by local authorities, in recent decades.

The provision of housing subsidies to low income households reduces housing costs, a major component of expenditure for many households. The prevalence and scale of subsidies provided by local authorities raise questions appropriate for economic inquiry and which this paper seeks to explore, primarily:

(i) What is the impact of the subsidy on the distribution of incomes?
(ii) Is the subsidy well-targeted?
(iii) Could counter-factual adjustments to the subsidy improve outcomes by reducing income inequality?

The answers to these questions are very relevant to public policy. The role of the government as allocator, rent-setter and, in the case of publicly-owned units, owner and vendor of housing, also requires that attention be directed toward understanding the circumstances and characteristics of local authority tenant households. The system of local authority housing subsidies is expensive and a poorly targeted subsidy would compromise policy goals and reduce the legitimacy of the subsidy. Potential violations of horizontal equity, that equals be treated equally, would be a concern if targeting is poor. As would violations of vertical equity, that is the differential treatment of dissimilar households such that subsidies are withdrawn as income increases. It is also important to consider the impact on local authorities of rents set below maintenance and management costs. An alternative scenario in which rents were, on average, higher and in which some rents equalled or exceeded costs could, for instance, alter institutional incentives toward greater investment in social housing.

The definition of income which is used to explore these questions is household disposable income after housing costs have been met. The inclusion of housing costs is somewhat novel in the Irish context.

The approach taken in this paper to explore the subsidy and its effectiveness is to examine the distributions of incomes of households in receipt of the subsidy before and after housing costs. Comparisons are made with households renting at market price. Using propensity score matching, estimates are made of the impact of the rental subsidy on households and on the income distribution. Several counter-factual scenarios assess alternative rent subsidisation scenarios, including a scenario in which no local authority housing subsidy is provided. Two other counter-factual

scenarios explore alternate methods of targeting to reorient the subsidy to a greater degree towards low income households.

The principal contribution of this paper is to identify inequalities, both among local authority tenants and between some local authority tenants and low income households among other tenure groups. This paper also highlights opportunities available to reduce such inequalities, by adjusting the local authority rent regime.

This is the first empirical, detailed study of the rents and incomes paid by households in receipt of local authority housing supports. It is also the first estimate of the scale of the subsidy received by such households in Ireland since the 1970s. The findings have important policy ramifications concerning local authority rent setting and eligibility criteria for social housing.

This paper finds that the subsidisation of local authority rents has a considerable shielding effect on the incomes of low income households. The disposable incomes of such households increase considerably relative to households renting in the private market, after housing costs have been accounted for. For instance, the ratio of median non-equivalised household income for local authority renters and private market tenants in 2015 is 0.68 before housing costs are accounted for and 0.77 after housing. The relative improvement is most striking for low income households.

Also evident is the imperfect targeting of local authority rental subsidies, in that a consistent cohort of high income recipients receive a high level of subsidy, relative to their incomes and to counterpart households renting in the private market. I use the term 'high income' to describe those households in Quintiles 4 and 5 of the income distribution of all households. The median housing cost-to-income ratio of high income local authority tenant households in 2015 was approximately 0.08, as opposed to in excess of 0.15 for high income households renting in the private market.

A counter-factual scenario in which local authority rental subsidies are withdrawn illustrates the impact of the subsidy on the income distribution, in that the Gini Coefficient measure of inequality increases from 0.354 to 0.363 when the subsidy is withdrawn. This is a considerable change given that less than 10 per cent of households in the sample would be directly affected. Two further counter-factual scenarios, in which local authority rental subsidies are directed to a greater degree toward lower income households, are also shown to reduce income inequality.

The remainder of this paper is structured as follows. Section II discusses the institutional setting. Section III briefly addresses some relevant literature. Section IV describes the data source while Section V provides some descriptive statistics. Section VI presents the counter-factual rent-setting scenarios and the propensity score matching procedure used to estimate the results. Section VII concludes by summarising the findings and identifying some policy implications.

II RATIONALE, HISTORY AND POLICY

2.1 Economic Rationale and Objections to Subsidised Housing

The motivation for the provision of social housing supports is primarily to subsidise the consumption of housing. The provision of in-kind benefits, such as the provision of reduced rent housing, reflect the fact that society has preferences regarding the consumption bundle of the beneficiaries. Redistribution is not a primary objective (Olsen, 2001), otherwise an unconditional cash subsidy would be more efficient as this would maximise beneficiaries' utility. An unconditional cash subsidy would also answer the argument that in-kind benefits are excessively paternalistic (Rosen, 1985). Society's preference for policy measures which induce consumption of housing likely stems from, as Jacobs (1961) put it, 'public conscience', a general sentiment that certain types of commodity, such as housing, are necessary for a basic level of household wellbeing. The externalities associated with the under-consumption of housing, such as public health effects, may also be a factor although economists have argued that the low magnitude of such externalities are unlikely to warrant substantial expenditure (Olsen, 2001).

Currie and Gahvari (2008) provide additional rationales for the provision of in-kind benefits, including information asymmetry. Currie and Gahvari suggest that as government cannot accurately identify those low income households in need of assistance, government therefore provides in-kind benefits to serve as a separation tool between rich and poor. In-kind transfers serve as a separation device between rich and poor due to the self-targeting property of public provision. An additional rationale identified by Currie and Gahvari is the possibility that in-kind transfers are an attempt to redistribute within households, from parents to children, by restricting transfers to items, such as housing, that benefit children more than what would have been consumed by the household in the absence of the transfer.

Currie and Gahvari also note the limited amount of research concerning the effect of providing housing on labour supply and raise the possibility that public housing may be complementary to labour supply, for reasons of proximity to jobs and transport nodes.

Murray (1999) found that the construction of public housing has added to the stock of affordable housing in the United States, however subsidised moderate income housing has had less impact on the total supply of affordable housing due to pecuniary effects. As such, public production of housing can have benefits for all consumers of affordable or low income housing.

The objections which have been raised by economists to subsidised rents are manifold, and to a great degree draw on general economic criticisms of price subsidies. Broadly, critics have argued that systems of rent subsidies misallocate housing (Barr, 1998). A specific criticism is that local authority rent subsidies result in the rent prices paid by households being arbitrary, due to variations among local authorities in the rent schemes. Such arbitrariness is relevant to concepts of the

distributive justice of the subsidy, as arbitrary rent prices may impede the achievement of horizontal and vertical equity.

2.2 Policy Context

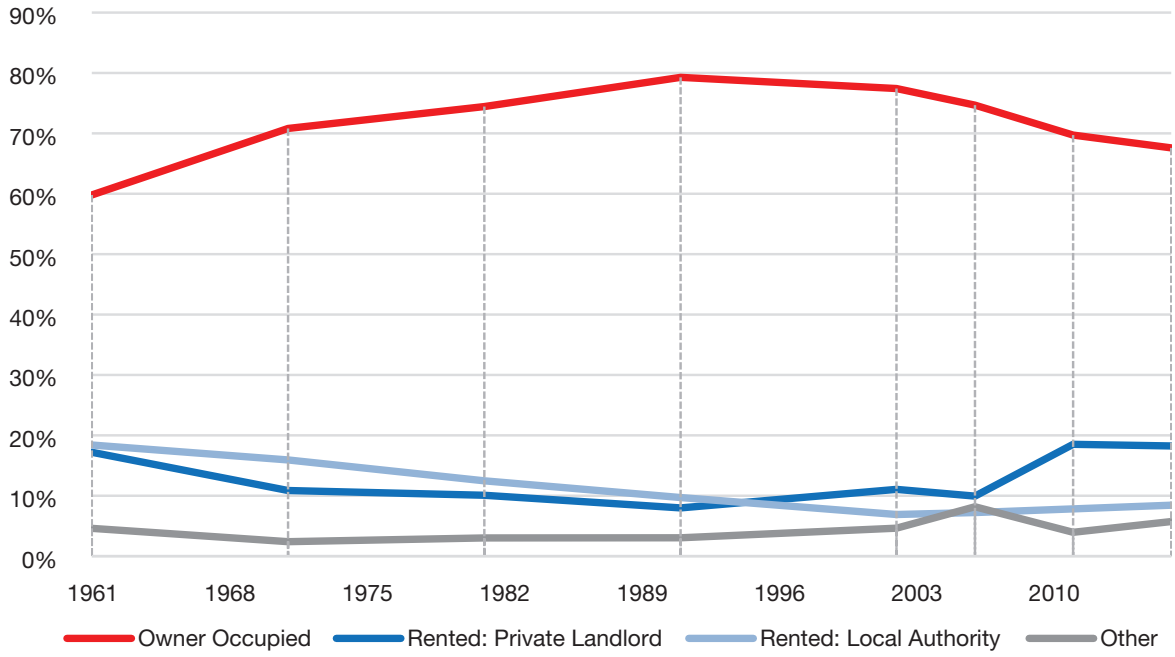
The proportion of the total national housing stock which is owned by local authorities has diminished in recent decades, not least because of a prevalence of tenant purchase schemes and, latterly, due to a much-diminished building programme. The 1971 Census reported that 18.4 per cent of all private households rented from a local authority, which fell to 6.9 per cent in 2000, and increased since to 8.4 per cent in 2016.[1] Current policy is to increase output of housing using all available channels, private and public. Expansive local authority acquisition and construction initiatives seem likely to result in an increased tenure share in coming years, which underscore the importance of this paper's findings.

The extension of the system of social housing supports into the private rental market began in the late 1970s, when Rent Supplement, an income-related housing subsidy, was introduced. Rent Supplement has been joined by similar local authority operated subsidy schemes, principally the Rental Accommodation Scheme in 2004 and the Housing Assistance Payment in 2014. The introduction of the Rental Accommodation Scheme and the Housing Assistance Payment can be regarded as a national manifestation of the international trend toward market-based, demand-side supports. The precise operation of such local authority schemes vary, however a commonality is that the tenant household resides in a privately owned unit and pays a differential rent. The tenant household therefore pays the same rent as an equivalent household leasing a local authority owned unit. The differential rent system is discussed further in Appendix D. The rules concerning eligibility for social housing are discussed in Appendix E. An effect of these demand-side subsidies has been to extend social housing into much of the private rental market. Approximately 37,000, or 2 per cent of all households, were in receipt of the Rental Accommodation Scheme or Housing Assistance Payment in 2016 (Department of Public Expenditure and Reform, 2017).[2]

[1] Note that this 8.4 per cent does not include households renting a private market unit subsidised by a local authority. As such, the 'Rented: Private Landlord' and 'Rented: Local Authority' lines in Figure 1 represent ownership, as opposed to tenancy arrangement. Approximately 37,000, or 2 per cent, of all private households were recipients of the Rental Accommodation Scheme or Housing Assistance Payment subsidies in 2016 (Department of Public Expenditure and Reform, 2017).

[2] Although not the focus of this paper, an interesting question is the degree to which rental subsidies are influencing the wider private rental market.

Figure 1: Percentage of Households by Tenure, 1961-2016



Source: Central Statistics Office, Census Reports.
Notes: Census 2016 recorded 1,702,289 private households (Central Statistics Office, 2017); at end-2016 approximately 175,000 households were paying a differential rent to a local authority; the majority, approximately 130,000 or 75 per cent, lived in local authority owned housing, the remaining 25 per cent lived in units sourced in the private market as part of the Housing Assistance Payment, Rental Accommodation Scheme or other local authority leasing arrangement (Department of Public Expenditure and Reform, 2017).[3] Despite declining from the mid-twentieth century peak of approximately 20 per cent, a considerable proportion, over 10 per cent, of total private households are paying a local authority subsidised rent.

III RELEVANT LITERATURE

Social housing in Ireland has been the subject of a considerable degree of academic enquiry in recent decades, social policy researchers and sociologists having made the principal contributions. However, prior to this paper there have been no studies focusing in detail on the targeting of housing subsidies in Ireland, or on the distributions of incomes and rents of households renting from a local authority.

[3] A further 48,000 households were in receipt of Rent Supplement, a support provided by the Department of Social Protection intended to assist persons in private accommodation who are unable to meet their own accommodation costs. Rent Supplement differs from the local authority operated rental subsidy schemes in that it is a means tested payment made to households and is therefore an element of household income. Households in receipt of Rent Supplement for more than 18 months are being transferred to the Housing Assistance Payment; as such the numbers of households paying a local authority rent will increase as the local government system takes responsibility for the full range of long-term housing supports.

Local authorities have tended to charge low rents for social housing tenants (Norris, 2003); rents below the costs of financing and which fail to cover maintenance costs have been noted (Hayden, 2014; Fitzgerald and Winston, 2005). Fahey *et al*. (2004) found that the share of household expenditure going on social rents remained fairly stable from 1973 to 2000 period, at approximately 7 per cent. Other estimates largely agree; for instance Finnerty and O'Connell (2014) estimate 7.4 per cent of household expenditure was on social rents in 2000. In relation to the distributional impact of local authority rent schemes, Blackwell (1988) noted that, at higher income levels among local authority tenants, the proportion of income spent on rent declines.

A 1977 National Economic and Social Council (NESC) report estimated the aggregate value of the local authority housing subsidy annually from 1971 to 1975, based on the difference between economic rents, based on historic costs, and total rent receipts. NESC found that the total subsidy was £26 million in 1975. The NESC report also noted the relatively low proportion of housing costs of higher income households renting from a local authority, relative to private market renters and mortgaged owner occupiers.

Savage *et al.* (2015) have examined changes to the income distribution over the 2008 to 2013 period, including household income before and after housing costs. Savage *et al*. found that the lowest income decile, across combined housing tenures, experienced the largest decline in income during this period.

While noting that a large proportion of local authority tenant households were low income, O'Callaghan *et al*. (2018) found that 14 per cent of households renting from a local authority in 2016 were within the top five income deciles.

The international literature exploring rental subsidies and the targeting thereof is somewhat mixed. Studies from the United States have noted that although subsidy beneficiaries are often concentrated among the bottom of the income distribution, many households which gain access to subsidies are better off than those which do not (Rosen, 1985). More recently, research from the United States has concluded that systematic evidence on the targeting of assistance by local authorities is limited, and research concerning how best to target scarce subsidies has received little rigorous attention (Collinson *et al.*, 2015). Research from Australia, however, has noted that the provision of public housing is highly targeted, in that 90 per cent of the benefits go to households in the first and second income quintiles. Russian research has highlighted that targeting is found to depend significantly on local programme administration (Struyk *et al.*, 2006). Research from Flanders regarding the value and targeting of rental subsidies describes the implicit subsidy as being relatively high, almost half of the theoretical market rent, and states that over 85 per cent of social housing subsidy beneficiaries are received by the bottom two income quintiles (Heylen, 2013).

Placed in an international context, the aspects of the Irish rental subsidy system which perhaps make it a fruitful topic of research are the relatively generous level

of subsidy and the latitude which local authority rent-setters have in determining the calculation of the rent and therefore the associated subsidy.

IV DATA

This paper uses the 2006 to 2015 annual waves of the Survey on Income and Living Conditions (SILC). The data collected are cross-sectional and longitudinal. The sampling frame is the register of all private households occupied on the night of the most recent census of population; sample stratification is conducted on the basis of local government administrative boundaries and the Pobal Deprivation Index. Information is provided voluntarily by households and their members concerning labour market, health and education variables, and is then matched with employee income, social welfare and agricultural payments using administrative microdata. Household cross-sectional weights are calibrated with known population totals. Further information on the SILC methodology is available from the Central Statistics Office's SILC webpage.[4]

The advantages of SILC for the purposes of this paper are its relative longevity and the detailed information it provides concerning household income, housing costs and other household characteristics.

Household disposable income is the income variable of principal interest to this paper. The distribution of joint earnings within households generally plays a major role in defining the living standards attained by its members, therefore earners and dependants are grouped into households (Salverda *et al.*, 2014). By definition, a household's tenure is experienced collectively and, as such, the household is the natural unit of observation. A household-level approach also avoids any need to assign household income components to single individuals, which could be regarded as arbitrary. Household disposable income is calculated by adding direct income, such as employee income, and social transfers, such as child benefit or rent supplement, and then deducting taxes, social insurance and regular inter-household deductions. Income variables from 2006 to 2015 have been made real using the Consumer Price Index as a deflator, the base year being 2014.

The SILC questionnaire asks renting respondent households to state how much the household has paid in rent; the responses form the basis for the annual housing cost data used for this paper.

To reduce the effect of possibly spurious outliers, the top and bottom 1 per cent of values of certain variables have been deleted, including household disposable income and housing costs. The households have been otherwise retained. As such, the number of relevant households retained in respect of the estimates of income and housing costs may differ within years from variable to variable; this is because

[4] http://www.cso.ie/en/methods/socialconditions/silc.

the deletion of the top and bottom 1 per cent of values of the income and housing cost variables has in general been applied across all households, regardless of tenure status, and the extent to which this trimming impacts on tenant households varies from variable to variable.

The meanings and definitions of the term 'tenure', as applied to housing, are not straightforward (Crook and Kemp, 2014). Tenure describes the bundle of legal arrangements and property rights existing between properties and their inhabitants. Two categories of tenure are relevant to this paper; firstly those households renting from, or paying a rent to, a local authority, secondly, those households paying a rent to a private sector landlord which is not subsidised by a local government subsidy.[5] The distinction between households renting from a local authority and private market tenant households is in line with other studies (Nygaard, 2011; Byrne *et al.*, 2018) and is justified on grounds of the considerable differences between local authority and private market rental conditions, including rent-setting practices and the property rights which accrue to local authority tenants in certain circumstances.

For the purposes of SILC, the tenure status of a given household is declared by the household reference person. As noted in Section 2.2 of this paper, approximately 25 per cent of local authority housing supports have been delivered through the private market in recent years; in such circumstances a private landlord owns the unit, however the tenant household pays a differential rent to the relevant local authority. These households are considered to be renting from a local authority, in the sense that they are paying a differential rent to a local authority. Therefore misidentification could be a concern, as the tenant household may identify as renting in the private market. However, it seems unlikely that respondent households are misidentifying their tenure. The rent is paid by the household to the local authority, therefore the principal financial relationship, from the household's perspective, is with the local authority. Under all relevant schemes aside from the Housing Assistance Payment, the local authority also sources the accommodation, agrees the temporal term of the arrangement, and the tenant household is not required to pay a deposit, which seems likely to further differentiate such arrangements, from the household's perspective, from an ordinary private market tenancy. Lastly, the total weighted proportion of SILC households reporting the payment of rent to a local authority in 2015 closely matches Census 2016 and administrative data concerning the numbers of households paying a differential rent.

From 2006 to 2015 the SILC's total completed sample size has varied between a maximum of 5,800 households in 2006 to a low of 4,300 in 2011, and has since

[5] A third rental tenure status is reported by households participating in the SILC, that of renting below market price or rent-free. These households have not been included in this analysis as the identification of such households is problematic (Carliner and Marya, 2016), and the number of such households renting below market price or rent-free in any given wave is relatively small, usually less than 200 households.

climbed to 5,400 households in 2015. The number of individuals included has varied between 11,000 and 15,000 in any given year. The response rate in 2015 was 60 per cent (Central Statistics Office, 2017). Further details concerning the total number of households and the number of local authority tenant and private market tenant households which appear in each of the 2006 to 2015 SILC waves are presented in Table A.1 in Appendix A.

V DESCRIPTIVE STATISTICS

5.1 Household Characteristics

Households renting from a local authority are distinct from other households in several respects. There is a degree of stability among many, but not all, of the characteristics of local authority tenant households across the 2006 to 2015 SILC waves. For instance, the educational attainment of household reference persons of local authority tenant households has improved considerably over the period observed.

Table 1 presents many of the principal differences, as observed in the 2015 SILC wave. Several points are notable. Firstly, local authority tenant households are far less likely to have a member of the household in employment than other

Table 1: Socio-Economic and Other Characteristics of SILC Households, 2015

	All % (n = 5,444)	*Local Authority Tenant % (n = 526)*	*Private Market Tenant % (n = 627)*
Labour Market Connection			
No Connection	35.6	60.1	24.6
Household Member in Work	64.4	39.9	75.4
Composition			
1 adult, 0 children	22.8	27.9	13.7
2 adults, 0 children	27.4	15.6	20.9
3 or more adults, 0 children	15.8	15.9	8.8
1 adult, 1 or more children	3.6	11.5	9.0
2 adults, 1-3 children	20.5	12.6	38.0
Other household with children	9.9	16.6	9.5
Age of Household Reference Person			
18-24	1.2	1.2	4.7
25-34	13.7	16.7	42.9
35-44	21.2	23.9	31.5
45-54	21.0	19.9	14.4
55-64	19.3	22.1	5.0
65+	23.5	16.3	1.5

Table 1: Socio-Economic and Other Characteristics of SILC Households, 2015 (Contd.)

	All % (n = 5,444)	*Local Authority Tenant % (n = 526)*	*Private Market Tenant % (n = 627)*
Education of Household Reference Person			
Primary or No Education	18.0	34.7	7.2
Lower Secondary or Transition Year	14.3	22.7	7.2
Upper Secondary or Technical/Vocational	25.8	26.8	29.5
Advanced Higher Certificate/Diploma	21.6	10.2	25.5
Higher Education – Honours Degree or Higher	18.8	3.9	25.3
Other / Not Stated	1.4	1.8	5.3
Principal Economic Status of Household Reference Person			
At Work	50.5	31.5	63.8
Unemployed	7.0	13.4	12.7
Student	1.7	1.1	5.0
Home Duties	15.5	22.1	11.4
Retired	17.7	11.0	1.1
Ill/Disabled	6.7	19.6	4.7
Other Inactive Person	1.0	1.4	1.4
Report Financial Stress			
Difficulty Making Ends Meet	68.0	85.8	75.5
Persons per Household			
1	22.8	27.9	13.7
2	29.4	21.4	26.0
3	17.9	19.8	25.4
4	18.6	16.7	24.6
5	8.1	7.9	8.0
6	2.2	2.8	1.4
7 or more	0.9	3.62	1.0
Housing Unit Size			
Mean Rooms in Housing Unit	5.59	4.29	4.69
Household Rent			
Mean Annual Rent, €	–	2,732	9,076

Source: Author's analysis of Survey of Income and Living Conditions Dataset.
Notes: Household weightings applied. 'Children' refers to persons under the age of 18. Respondents recorded as having difficulties making ends meet are those who stated 'some difficulty', 'difficulty' or 'great difficulty' making ends meet. In respect of the measure of rooms per housing unit, respondents were asked how many rooms are in the dwelling unit, excluding kitchenettes, utility rooms, bathrooms, toilets, garages, consulting rooms, offices and shops. A room is defined as a space of a housing unit of at least $4m^2$, including habitable cellars and attics with a height over 2m and accessible from inside the unit.

households, despite a greater proportion of the household reference persons of local authority tenant households being of working age. Secondly, the incidence of single parent households is over three times as high among local authority tenant households. Thirdly, in terms of the educational attainment of household reference persons, over 57 per cent of local authority tenant households report not having completed secondary education, as opposed to over 32 per cent of all households. Just over 14 per cent of local authority household reference persons have a third-level qualification, compared to over 40 per cent among all households.

A relatively high proportion, 68 per cent, of all households report difficulties making ends meet. As one might expect, the proportion is greater among local authority households, over 85 per cent.

Households renting from a local authority live in smaller units than other households, as measured by mean number of rooms; 4.29 as compared to 5.59. A greater proportion of households renting from a local authority are one person households; also, a greater proportion of households renting from a local authority are larger households of six persons or more.

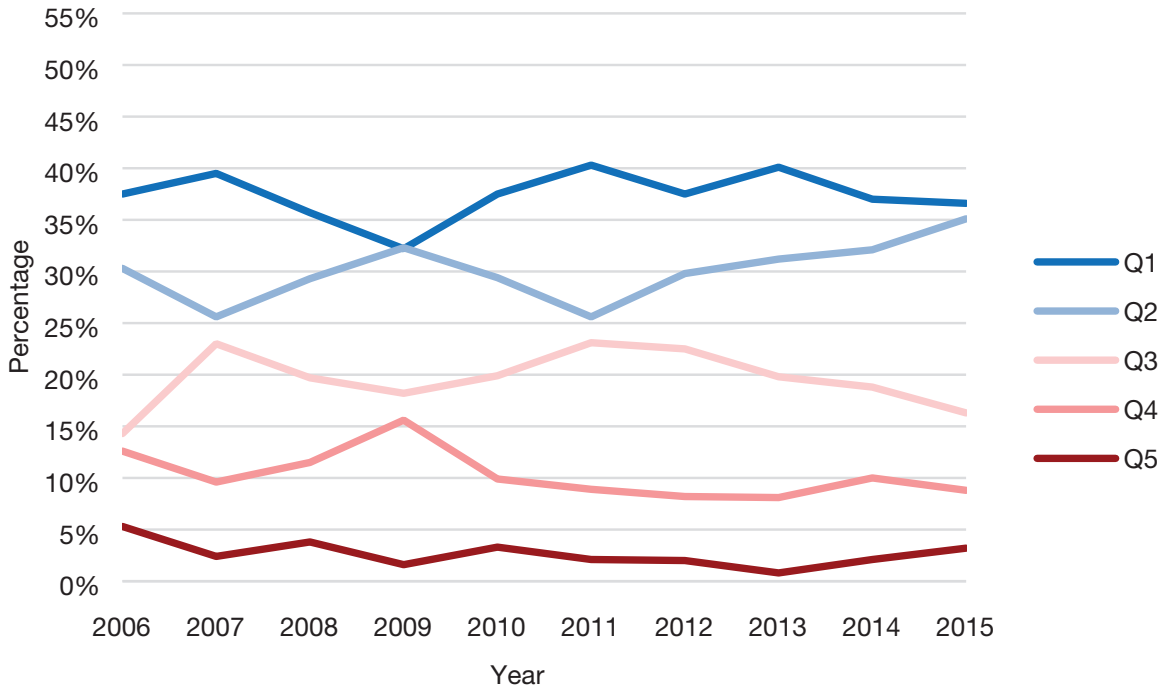
5.2 Household Incomes and Housing Costs

The local authority housing sector has for some decades been characterised as 'residualised', that is, the tendency for the sector to cater for an increased proportion of deprived households and to cater more exclusively for this group (Downey, 2005; Norris, 2005). If it is the case that local authority tenant households have universally low incomes then generous rent subsidies for all such households could be justified and there would be somewhat limited potential for the local authority rental income stream to generate revenue.

Figure 2 illustrates the percentage of households renting from a local authority which fall within each quintile of household disposable income.[6] Over 70 per cent of local authority tenant households have incomes below the median, and in many cases considerably below the median. In addition, a consistent proportion of households renting from a local authority, approximately 25 per cent to 30 per cent, are in the third or higher equivalised income quintile, which raises the question of the targeting of subsidies.

[6] Household disposable income is non-equivalised, however, Figure A.1, found in Appendix A, presents a counterpart graph using equivalised income, which therefore reflects differences in household composition. Note that the principal message of the equivalised graph is the same, in that in excess of 20 per cent of local authority tenant households have equivalised incomes close to, or above, the median. The general approach in this paper has been to use non-equivalised values in the main text, on the basis that (i) while the specific numerical results may be different when using equivalised values, the core findings are in most cases very similar, and (ii) for consistency, as the equivalisation of housing costs is not straightforward. Appendix H also presents equivalised results for the counter-factual analysis performed later in this paper.

Figure 2: Share of Local Authority Tenant Households within Each Non-Equivalised Income Quintile, 2006 to 2015



Source: Author's calculations based on Central Statistics Office, EU SILC.

Table 2 presents the median (P50), first and last deciles (P10 and P90 respectively), and first and third quartiles (P25 and P75 respectively) estimates of incomes, housing costs and income after housing costs for local authority and private market tenant households; the latter are included as the most appropriate tenure group for the purposes of comparison, and given the counter-factual analysis presented later in this paper. The estimates presented in Table 2 are in respect of 2015; tables describing the full 2006 to 2015 period for both tenure groups are provided in Appendix B. Taking into account the macroeconomic cycle experienced over the 2006 to 2015 period, there is a general stability evident in terms of the quantile values and in terms of the relationships within and between tenure groups. The year 2015 is, therefore, quite representative of the 2006 to 2015 period in those respects.

With respect to household disposable income two points are of particular relevance. Firstly, the low disposable incomes among local authority tenant households at P25 and under. Secondly, the relatively high incomes of P75 and higher local authority tenant households, when compared to other local authority tenant households and to households renting in the private market.

Also of note are other relativities between local authority and private market rents. The P75 local authority rent is lower than the P10 private market rent and the P90 local authority rent is lower than the P25 private market rent. The P10 rent paid by local authority and private market renters are quite distinct. The 2015 P10

Table 2: Household Disposable Incomes, Housing Costs and Income after Housing Costs among Renting Households, 2015

	P10 €	*P25* €	*Median* €	*P75* €	*P90* €
Disposable Incomes					
Local Authority	11,670	15,587	23,531	33,339	47,428
Private Market Tenant	16,152	25,053	36,363	49,767	73,319
Housing Costs					
Local Authority	1,303	1,564	2,607	3,650	5,214
Private Market Tenant	4,813	6,017	7,942	12,034	14,440
Household Income after Housing Costs					
Local Authority	10,129	13,488	20,420	29,843	42,628
Private Market Tenant	9,367	17,021	26,469	38,883	62,231

Source: Author's analysis of Survey of Income and Living Conditions Dataset
Notes: This table reports descriptive statistics on the distributions of three variables, within two tenure groups, for 2015. The tenure groups are households renting from a local authority and private market tenant households. The distributions concerned are household disposable income, housing costs, and household income after housing costs have been met. Values are non-equivalised. Weightings have been applied.

local authority rent is 27 per cent of the P10 private market rent, likely reflecting price inflation in the private rental market and relatively sticky local authority rents.

Combining, at the household level, the annual disposable income and annual housing costs variables provides a value for income after housing costs have been met. The range of incomes after housing costs among households renting from a local authority is quite broad; the P90 to P10 ratio exceeds 4.0 in 2015, as it does in most years.

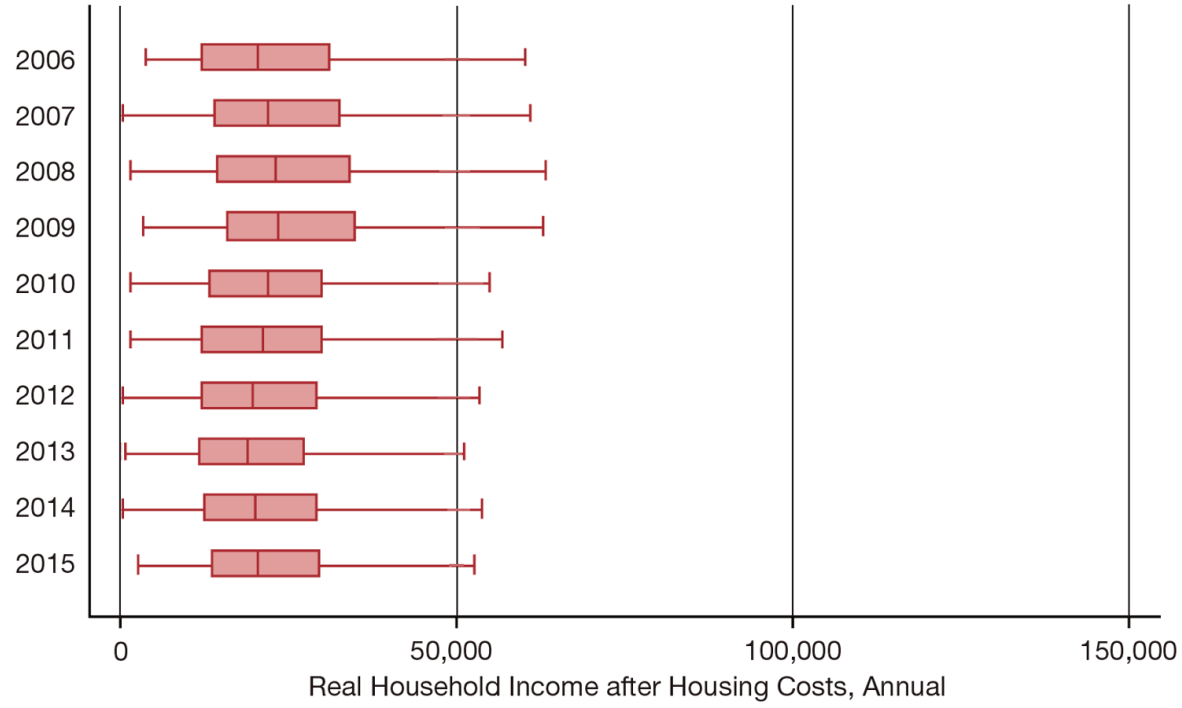
A striking aspect of Table 2 is that there were households with relatively high incomes in receipt of housing supports and paying relatively low rents, which suggests that the targeting of local authority housing supports may be problematic. A further striking aspect of Table 2 is the relationship between P10 income after housing costs of local authority and that of private market renters; the P10 income after housing costs among the former exceeded that of the latter in 2015, as it does for most years. Given the price inflation in private market rental prices over 2016 and 2017,[7] it may have been the case that the after-housing costs income position of the P10 private market rental cohort has worsened, relative to local authority renters. Other relativities between the two tenure groups are also notable. The

[7] The Residential Tenancy Board's measure of national standardised rents increased by over 14 per cent from Q4 2015 to Q4 2017 (Residential Tenancies Board, 2018).

disposable incomes of P75 local authority renting households and median private market renting households are relatively close in 2015; however, the income after housing costs of P75 local authority renting households exceeds those of median private market renting households. The impact of subsidised local authority rents is to improve the incomes of all local authority renting households, throughout the income range, relative to households in the private rental market.

The boxplot presented in Figure 3 depicts the distribution of real household disposable incomes among households renting from a local authority from 2006 to 2015. Median income among local authority tenant households grew from €23,300 in 2006 to €27,000 in 2009, before falling year-on-year to €21,500 in 2013. The pattern of income growth, decline and recovery is similar to that observed among other tenure groups, reflecting macroeconomic trends.

Figure 3: Real Local Authority Renting Household Annual Disposable Income, 2006-2015[8]



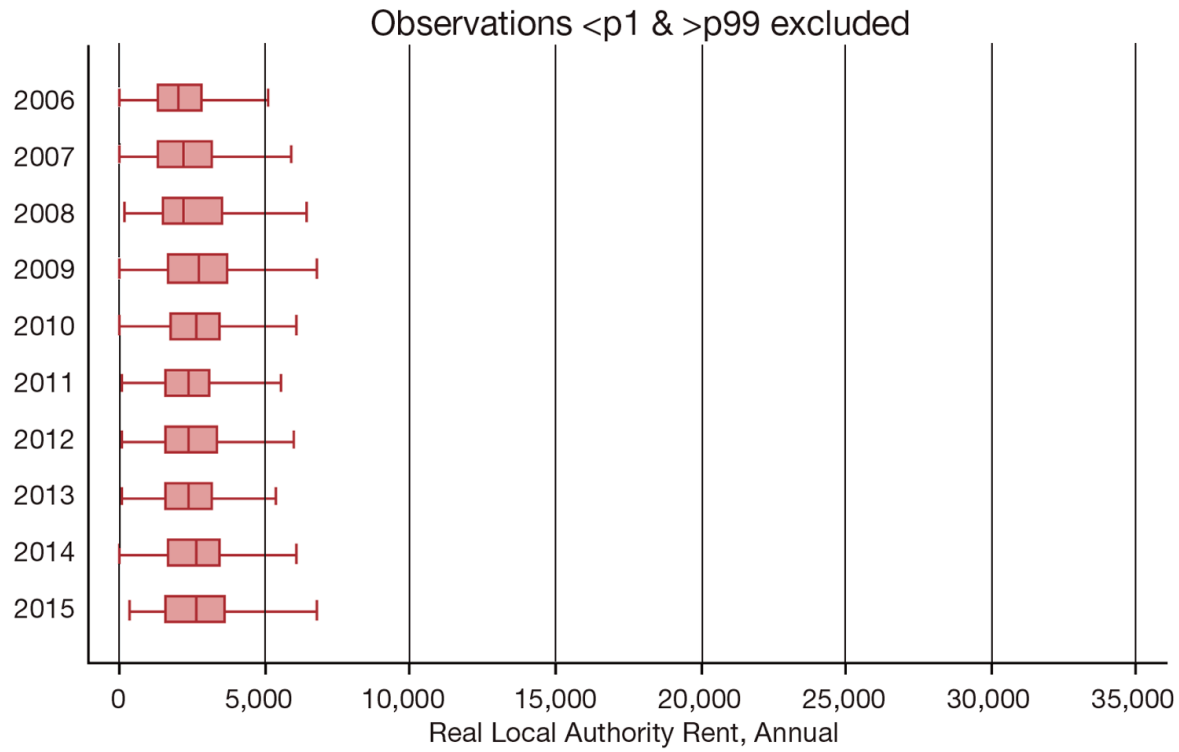
Source: Author's calculations based on Central Statistics Office, SILC.

[8] The box for each year contains the interquartile range, the line within the box represents the median. 50 per cent of the observations of any given year lie within this box. The whiskers, which are the horizontal lines above and below each box, end with lines known as fences; the upper fence is the highest observation less than or equal to the third quartile plus 1.5 times the interquartile range. The lower fence is similarly calculated by reference to the first quartile. Outliers are omitted from Figures 3, 4, 5 and 6.

Although the income distribution among local authority tenant households is less dispersed than among other tenure groups, a degree of dispersion is evident throughout the time series, in that the P90/P10 ratio is a consistent minimum of 3.8 from 2006 to 2015.

As discussed in Appendix D, local authority rents are subsidised in line with local authority-specific rent schemes under the differential rent system. The rental costs which follow do not encompass other housing costs; typically, in respect of local authority-owned accommodation, costs related to major repairs or improvements, or those related to house insurance, are met by the relevant local authority (Blackwell, 1990). The boxplot presented in Figure 4 depicts the estimated distribution of real annual rental costs for households renting from a local authority from 2006 to 2015.

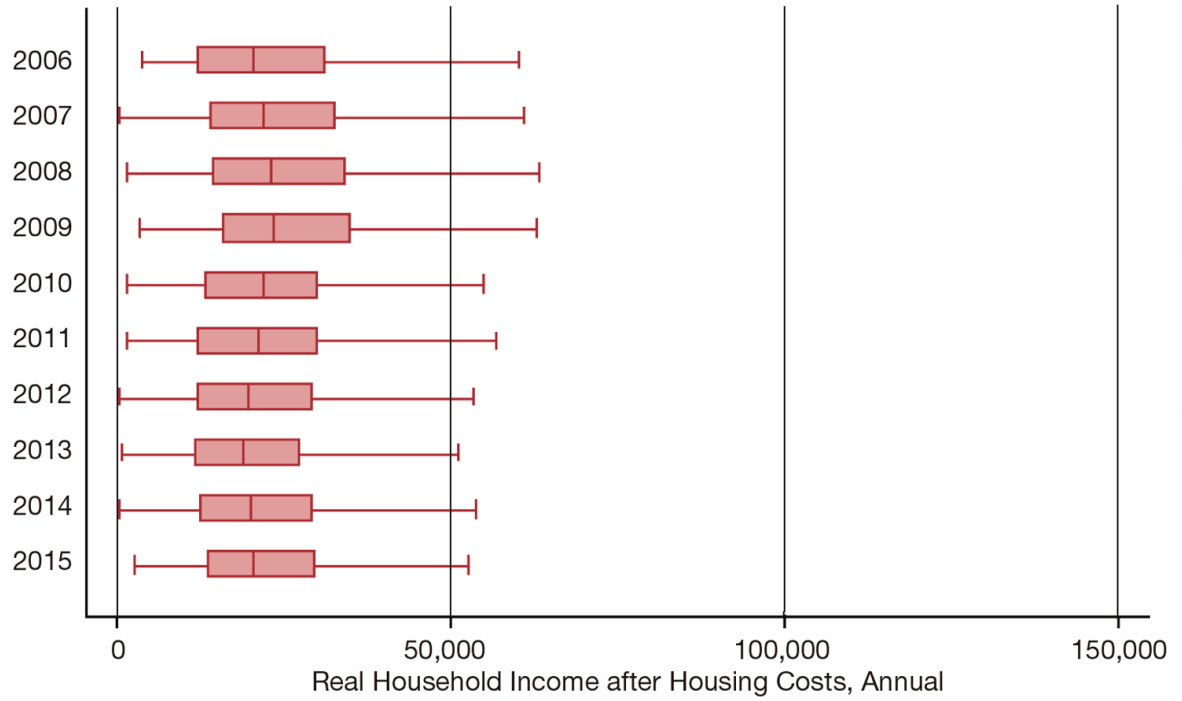
Figure 4: Real Local Authority Tenant Household Annual Rents, 2006-2015



Source: Author's calculations based on Central Statistics Office, SILC.

Although low, local authority rents have increased considerably from 2006 to 2015, which is not generally the case among private market rents. Median rents increased by 32 per cent. As one might expect given the connection between household incomes and rents under the differential rent system, the general shifts across the distribution echo the pattern depicted in Figure 3.

Figure 5: Annual Income after Housing Costs for Local Authority Renting Households, 2006-2015



Source: Author's calculations based on Central Statistics Office, SILC.

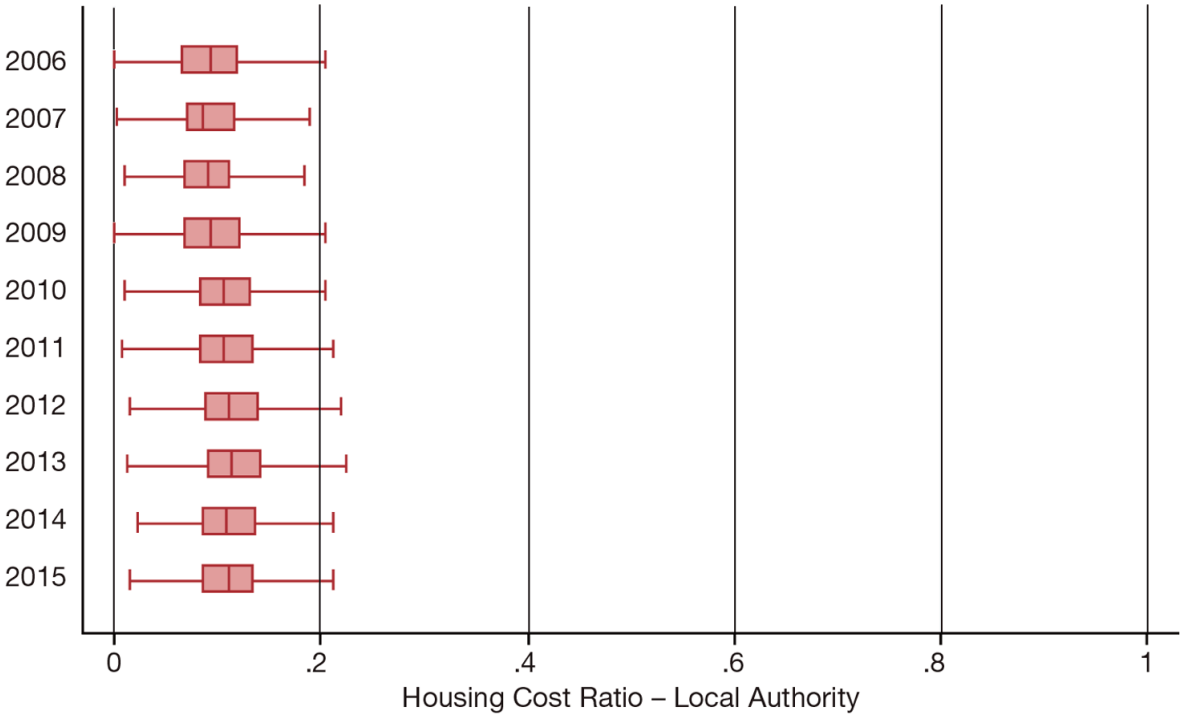
Figure 5 illustrates the income after housing costs for households renting from a local authority from 2006 to 2015. Notable is the degree of dispersion.

Housing cost-to-income ratios are a prevalent measure of housing affordability, notwithstanding that justifying normative thresholds for such ratios can be challenging (Downey, 2005). Figure 6 depicts the housing costs-to-disposable income ratio for households renting from a local authority from 2006 to 2015. Evident is a relatively low ratio for most households renting from a local authority.

Of interest is the distribution of housing cost ratios among households renting from a local authority and which are in the fourth or fifth quintile of the disposable income distribution of all households. The median housing cost ratio for such high-income households renting from a local authority in 2015 was 0.07, which compares to 0.17 for high-income households renting in the private market. The median housing cost ratio over the 2006 to 2015 for high income households renting from a local authority period has been relatively stable, ranging from 0.07 to 0.09. It seems safe to conclude that the receipt of a rental subsidy at this scale by high income households indicates imperfect targeting.

Counterpart graphs to Figures 3, 4, 5, and 6, in respect of private market renting households, are presented in Appendix C.

Figure 6: Housing Cost Ratios among Local Authority Renting Households, 2006-2015



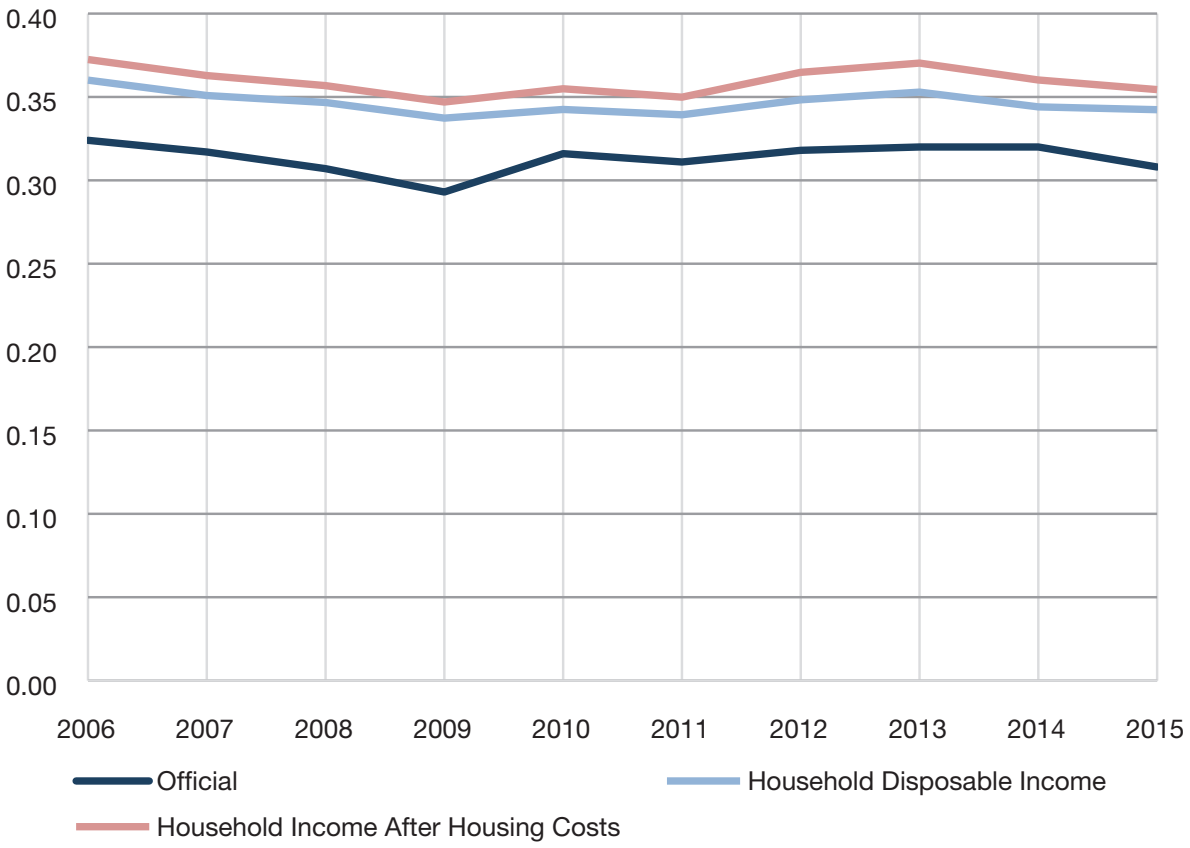
Source: Author's calculations based on Central Statistics Office, SILC.

5.3 Statistical Inequality Measures

To answer this paper's first and third research questions, that is, to determine the impact of the subsidy on the income distribution and to ask whether counter-factual adjustments to the subsidy could improve outcomes by reducing income inequality, it is necessary to measure income inequality. The Gini Coefficient is used by the Central Statistics Office as the official measure of income inequality. An increase in the Gini Coefficient signifies an increase in inequality.

Figure 7 presents the annual Gini Coefficient using three different approaches, for all SILC households regardless of tenure, from 2006 to 2015. Firstly, the official measure is reported, which is reported at the individual level and using equivalised disposable income. Secondly, the measure of household level, non-equivalised disposable income is reported. The difference between the first and second approaches is explained by differences in household composition across the income distribution. The final measure presented in Figure 7 is a measure of inequality, again at the household level, using non-equivalised income but this time measuring income inequality after housing costs, that is, mortgage and rental payments.

Figure 7: Gini Coefficient Measure of Income Inequality, 2006-2015[9]



Source: CSO Central Statistics Office (various years) and author's analysis of Survey of Income and Living Conditions Dataset

Notes: This figure reports the annual Gini Coefficient for three different income related variables, for all SILC households regardless of tenure, from 2006 to 2015. The Official measure is in respect of equivalised, individual level disposable income. Household Disposable Income is in respect of non-equivalised household disposable income before housing costs. Household Income after Housing Costs is in respect of non-equivalised household disposable income after housing costs.

A point of note is the increase in household-level inequality observed when inequality is measured after housing costs. This seems likely to have a number of causes, including the presence of a large number of households which have minimal or no housing costs, as mortgages have been amortised or are small relative to household income. The relatively high housing costs of some low to moderate income renting households may also be a factor.

[9] Note: in addition to being (i) measured at household level, and (ii) using non-equivalised income, there is a third difference between the official and the non-official measures; the latter uses an income variable in respect of which the top and bottom centile observations have been dropped. Similarly, the measure which incorporates housing costs uses housing cost data variable in respect of which the top and bottom centile observations have been dropped.

VI COUNTER-FACTUAL SCENARIOS

To determine the impact of the rental subsidy received by local authority tenants and to consider whether counter-factual adjustments could improve outcomes it is necessary to estimate the benefit of the subsidy. For the purposes of this paper, the subsidy is considered to be the difference between the rent a given household would pay if it were housed in the private rental market, that is a notional competitive market rent, and the actual rent paid.[10] Therefore the benefit, from the perspective of a household paying a local authority rent, is the difference between the actual rent paid and an estimated rent paid in a counter-factual situation, assuming the actual rent is lower.

The literature endorses the appropriateness of such an approach (Barr, 1998; Robinson, 1979; Rosenthal, 1977; Wang *et al.*, 2004).[11] However, it is important to acknowledge several points which arise from a conceptualisation of the subsidy as the difference between observed rents and a notional competitive market rent. Firstly, changes to private market rental prices during the period of observation have an effect as a notional competitive rent is obviously subject to price movements in rental markets. Demographic and labour market changes could have strong impacts on such price movements, although it is notable that for much of the 2006 to 2015 period private market rents were, in general, falling or were relatively stable. Secondly, the expansion of the private rented sector to accommodate the transfer of all local authority renting households would have general effects on supply and demand which would likely establish a different set of prices than those observed in private rental markets (and could result in general equilibrium effects). Lastly, large increases in rents would likely elicit behavioural responses from many affected households.

Alternative definitions of subsidy could be warranted; for instance, the subsidy could be defined as the difference between the rent paid by the household and the cost of providing the housing services. Several points are relevant. Firstly, for those local authority units sourced from the private market, the cost is largely composed of the market rent, plus the administrative overhead, minus the discount negotiated by the local authority, and is therefore market determined. Secondly, given the range of supply-side mechanisms and schemes which have applied to the construction or procurement of local authority owned units, calculating the cost of providing the service to include actual, historic capital costs would be challenging on a household-by-household, unit-per-unit basis. Pooling costs at local authority level would seem to diminish the goal of relating the subsidy to the actual unit cost. For somewhat

[10] By the tenant household under the differential rent system.

[11] Notwithstanding those endorsements, the conceptualisation of the subsidy at the household level as the difference between the actual rent and an estimate of the notional competitive rent that the household would pay were it to shift tenure to the private rental market should not be read as an invitation for local authorities to generally impose market rents.

similar reasons, Maclennan (1982), writing about local authority housing in the United Kingdom, stated that it was difficult to make general statements about the relationship between observed local authority rents and market rents given the then cost-based pricing structure of UK local authority rents.

For these reasons an approach based on estimating a counter-factual private market rent has been taken in this paper.

6.1 Propensity Score Matching

Microeconometric evaluations must overcome a fundamental problem, that of addressing the possible occurrence of confounding factors and selection bias. One cannot directly observe the rent that would be paid by a household living in a local authority owned unit were that household to rent in the private market. One may have strong reasons to think that the tenure groups, private market and local authority are each subject to selection bias and are therefore compositionally different. It would be obviously unsatisfactory to examine the mean housing costs of each tenure group to approximately estimate the difference since, as discussed in Section 5.1, there are considerable differences between the households in each tenure group. A solution is to conceptualise tenure status as an intervention, or treatment, and to deploy a matching estimator.

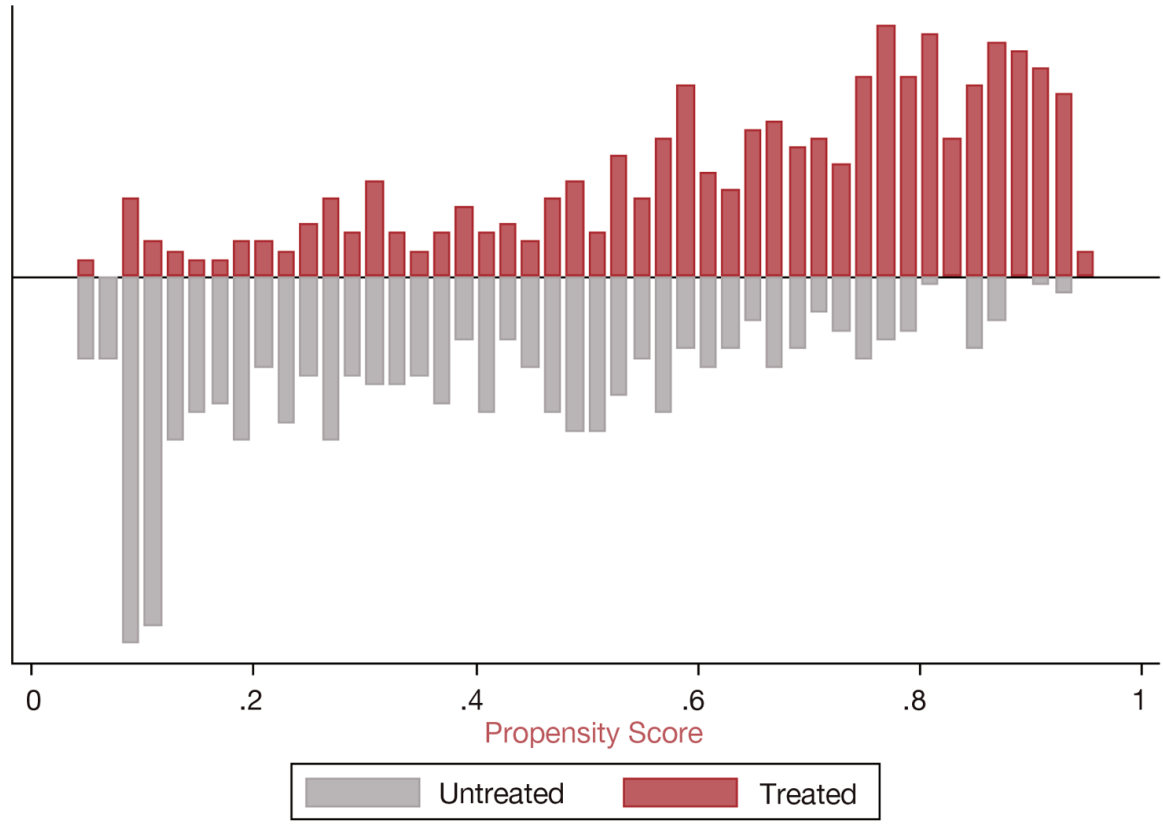
Propensity score matching approaches are applied widely to estimate causal treatment effects, in areas as diverse as pharma-epidemiological research, the evaluation of labour market policy interventions (Caliendo and Kopeinig, 2008) and agricultural contract pricing (Katchova, 2010). Propensity score matching can be applied in circumstances in which three required elements are present; a treatment, a group of treated and a group of untreated. The idea is to find a large group of treatment non-participants who are similar to the participants in all relevant characteristics, that is a well-selected control group. The matching method is designed to estimate the average effects of a programme, treatment or regime, between treated and control units. Note that the method is not restricted in application to the evaluation of interventions understood in a narrow sense, such as government programmes; propensity score matching has also been widely used to examine the impact of economic agent behaviour and consumption choices, for instance the impact of breastfeeding or of smoking. Differences in outcomes, in this instance housing costs, between the treatment recipients and the control group can therefore be attributed to the treatment.

Because it is infeasible to match units based on a vector of characteristics, given the multi-dimensionality, these characteristics are summarised using a single-index variable called a propensity score. The propensity score, for the purposes of this paper, is the predicted probability that a household would rent in the private market. The calculation of the propensity score permits units from the treated and control groups to be matched based on their propensity scores and for comparisons in outcomes between the two groups to be made.

A benefit of propensity score matching is that the method compares prices for households with similar characteristics, as propensity scores are used to make matches.

The goal is to estimate the difference between the rental prices paid by households that pay market prices (the treated group), and those that pay a local authority differential rent (the control group), accounting for the effects of exogenous factors influencing the tenure of households in each of these groups.[12] As such, the outcome variable is the annual rental price paid by a household and the treatment is whether the household is paying a private market or local authority rent. Further details concerning propensity score matching and estimands of relevance to this paper are provided in Appendix F. In short, the propensity score is used to match treated and control units as closely as possible based on their predicted probabilities of treatment.

Figure 8: Propensity Score Model Common Support Among the Treated and Control Groups



Source: Author's calculations based on Central Statistics Office, SILC.

[12] The choice of local authority tenants as control group, as opposed to the treatment group, has the benefit of generating a predicted private market rent for local authority tenant households; this predicted rent is necessary for the counter-factual scenarios.

The overlap or common support condition is a requirement which rules out perfect predictability of treatment for a given propensity score. Households with the same characteristics must have a positive probability of treated or not treated. Many studies applying propensity score matching improve the quality of matches by imposing a common support restriction, requiring that control units are included in the analysis only when their propensity scores fall within the range of propensity scores for the treated units. A drawback of such an approach often encountered is that high quality matches near the boundaries of common support may be lost and the sample size may be considerably reduced. However, as demonstrated by Figure 8, there is considerable common support among the treated and control groups used in this study. Not depicted in Figure 8 are a small number of observations, 70 in total or 6.4 per cent, which have been dropped because those observation lie outside of the strict 0.01 caliper matching method which has been imposed to ensure matching quality. All 70 dropped households had a probability of treatment greater than zero and less than one, thereby satisfying the common support assumption.

Various matching methods are typically used in propensity score matching, given that no two households will have exactly the same propensity score, as the score is a continuous variable. Caliper and nearest neighbour matching methods have been tried to match treated and control units, as have methods which use weighted averages of all individuals in the control group to construct the counterfactual outcome, that is kernel and local linear regression methods. The omission of the caliper, the selection of different numbers of nearest neighbour matches and the use of kernel and local linear matching methods have not been found to impact to any great degree on the estimates; the results of different matching methods are presented in Appendix G. The matching method selected for later analysis is a caliper of 0.01, with each treated unit matched to multiple (two) nearest neighbours as suggested by Caliendo and Kopeinig (2008).

Matching should only be applied if the underlying identifying assumption, that is, selection on observables, can be credibly invoked. The covariates which have been used in this study to estimate treatment probabilities and combined as propensity scores are set out in Table 3. These variables were selected as they are hypothesised, *a priori*, to affect a household's probability of renting in the private market. These are also variables that are, broadly, fixed over time. All of the variables are found to be significant at the 95 per cent level or higher.

Omitting important variables that simultaneously influence the participation decision and the outcome variable can increase bias in resulting estimates. Numerous alternative specifications have been tested, by iteratively adding variables to the specification. These variables included dummy variables pertaining to whether the household includes children, whether the household reference person is the only adult in the household, the principal economic status of the household reference person, the number of rooms included in the housing unit occupied by

Table 3: Treatment Probability Covariates

Variable	*Description*
Income	Household disposable income before housing costs.
Labour market connection	Dummy variable indicating whether a member of the household is in employment.
Student	Dummy variable indicating whether the household reference person is a student.
Age group 5	Dummy variable indicating whether the household reference person is aged 55-64.
Age group 6	Dummy variable indicating whether the household reference person is aged 65 or more.
Education 3	Dummy variable indicating whether the household reference person is educated to upper secondary or technical / vocational level.
Education 4	Dummy variable indicating whether the household reference person is educated to advanced higher certificate / diploma level.
Education 5	Dummy variable indicating whether the household reference person is educated to honours degree or higher level.
Education 6	Dummy variable indicating whether the household reference person's education level is other[13] or not stated.
Region – West	Dummy variable indicating whether the household is located in the West NUTs III Region (Mayo, Roscommon, Galway and Galway City).
Region – Dublin	Dummy variable indicating whether the household is located in the Dublin NUTs III Region (Dublin City, Dún Laoghaire-Rathdown, Fingal and South Dublin).

Source: Author's calculations based on Central Statistics Office, SILC.

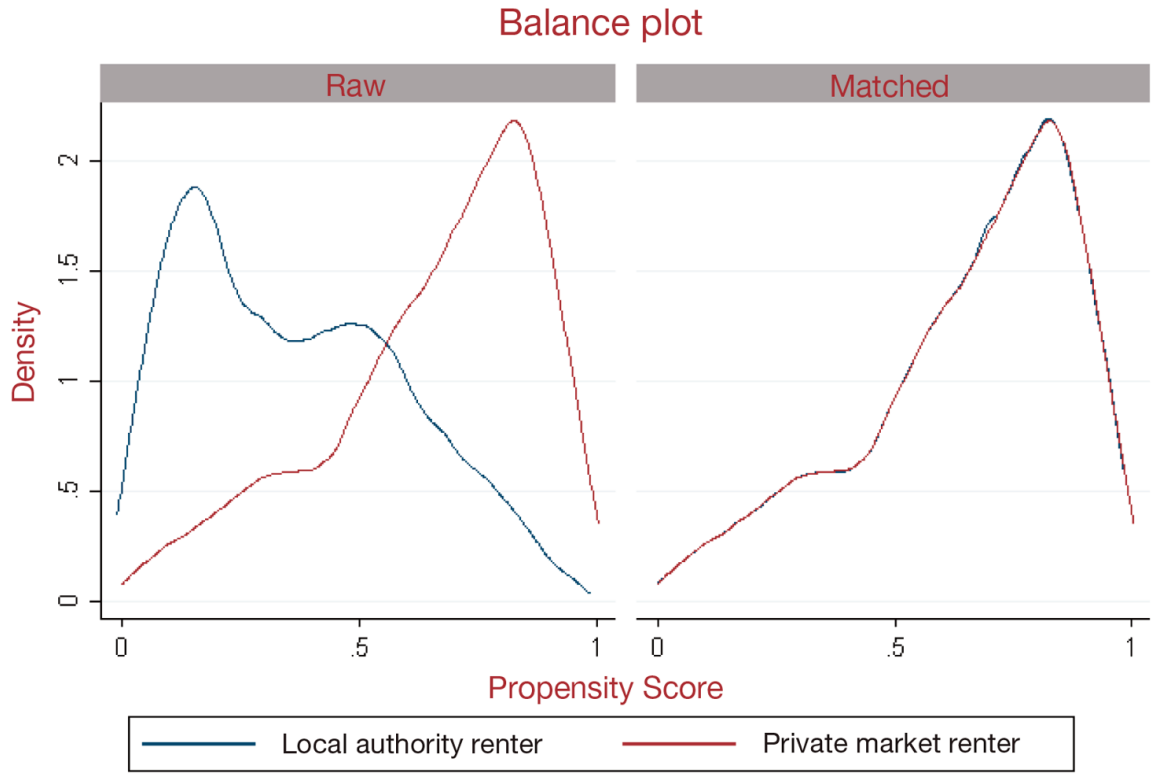
the household, and whether the household lives in an urban location. Testing by iteratively adding variables to the specification did not result in additional statistically significant variables and was found to introduce covariate imbalance, thereby degrading the quality of matches between the treated and non-treated groups.[14]

As discussed in Appendix F, the conditional independence assumption implies that all variables that influence treatment assignment and potential outcomes simultaneously have been observed. It is not possible to empirically demonstrate that there are no unobserved variables, however, SILC is a rich dataset with many variables and every effort has been made to ensure that as many observables as possible have been controlled for.

[13] Excluding primary and lower secondary education levels, which correspond to Education 1 and Education 2.

[14] Variables omitted from the specification were found to be jointly significant. While these variables have not been used, in order to preserve balance between treated and control groups, the specification which included jointly significant variables was found to have marginal impact on estimates.

Figure 9: Propensity Scores of Treated and Non-treated Groups, Before and After Matching



Source: Author's calculations based on Central Statistics Office, SILC.

An important step in any propensity score analysis is to assess the balance of the measured covariates between the treatment and non-treated groups, balance being the similarity of the covariate distributions. As illustrated by Figure 9, the propensity scores among the matched groups are well-balanced.

However, since propensity score matching conditions on the propensity score, as opposed to on all covariates, it is necessary to check whether the matching procedure balances the distribution of the relevant variables in both the treatment and control group. Individual covariates have been found to be balanced. Table G.2 in Appendix G presents the detailed results of an assessment of covariate balance using the standardised bias measure. The levels of balance in respect of each covariate are well below thresholds commonly considered to demonstrate balance.

6.2 Matching Results

The propensity score matching method involves a two-step estimation, the first of which is to estimate a logit model for a renting household's propensity to be renting privately or from a local authority depending on household characteristics. The predicted probabilities from the logit model, that is the propensity scores, are then used to match each treated household, renting on the private market, to control households, renting from a local authority. Table 4 presents the results from the

propensity score model. Note that the reported results are in respect of year 2015. An annual approach helps to isolate the impact of private market rental price growth.[15]

Table 4: Propensity Score Model Results for Renting in the Private Market

	2015	
Variables:		
Income, €000s	0.02098***	(0.00561)
Age 55-64	–1.02040***	(0.23326)
Age 65+	–1.36441***	(0.30161)
Education 3	0.86987***	(0.18409)
Education 4	1.26426***	(0.22134)
Education 5	2.02119***	(0.29178)
Education 6	1.45046***	(0.42576)
Region – West	0.80760**	(0.31814)
Region – Dublin	–0.58092***	(0.16513)
Student	1.18455**	(0.49457)
Labour market connection	0.51399***	(0.17850)
Constant	–1.22017***	
Observations	1,028	
Log likelihood	–550.07	
Chi squared statistic	324.1	
P-Value	<0.01	
Pseudo R Squared (McFadden)[16]	0.2276	

Source: Author's calculations based on Central Statistics Office, SILC.
Notes: This table reports the results of a logistic regression; the dependent variable is whether the household rents in the private market. Conventional standard errors are reported in parentheses.[17] Double asterisks denote significance levels of 0.05, triple asterisks denote significance levels of 0.01. The age dummy variables refer to the age of the household reference person. The education dummy variables refer to the education of the household reference person, as per Table 3.

[15] A panel approach would, in any event, be hindered considerably by the high rate of year-to-year attrition in the SILC dataset.
[16] It would be preferable to compute standard errors based on SILC's sampling method; however since 2014, the SILC sample is a multi-stage cluster design, stratified by region and Deprivation Index quintile. The Research Microdata Files do not provide a variable which specifies sampling strata and therefore it is not possible to formally compute standard errors which account for the sampling method employed. I have computed standard errors and significance levels on the basis of random sampling and results should therefore be interpreted with caution. The Central Statistics Office's Standard Report on Methods and Quality for 2016 does, however, state that the sampling method results in "all occupied households in Ireland having an equal probability of selection" (Central Statistics Office, 2017).
[17] Further measures of goodness of fit are included in Appendix G.

In terms of probability interpretations, households with a reference person who has attained advanced higher certificate or diploma-level education have a probability .462 higher than the constant.[18] This is the strongest dummy variable impact; the other education dummy variables included in the model also have positive marginal effects, ranging from .185 to .329. Households with a student reference person have a marginal probability effect of .263; those in the West Region have a marginal effect of .170; and those with a labour market connection have a marginal effect of .103. As regards household income, the marginal probability effect of a household with disposable income, before housing costs, at the median among local authority households is .098.

Three variables have a negative effect on the probability of renting in the private market. For households in the Dublin Region the predicted probability of renting in the private market is .086 lower than the constant. For households with a reference person aged 55 to 64, or 65+, the predicted probability is .131 and .158 lower, respectively.

Having estimated the logit model, the second step is to estimate the price differences between the 529 treated and 499 control households, that is, the difference between the rental prices paid by the treated group, renting in the private market, and the prices for the control group of households renting from a local authority.

The resulting estimands include the Average Treatment Effect on the Untreated (ATU), that is, the average increased rent a household renting from a local authority would pay were it to rent in the private market. As discussed, this estimand can be interpreted as the average annual subsidy rental received by local authority households. The annual ATU estimate, using a caliper of 0.01 and matched with two nearest neighbours is approximately €4,120. While the ATU is of interest, the principal motivation in this study for the propensity score matching exercise is to permit estimation of a predicted private market rent for each local authority household in the SILC sample and to thereby enable analysis of counter-factual scenarios.

It is notable that the 2016 average household weekly local authority rent was reported to be €68.50, compared to €199.92 in the private rented sector, as reported in Census 2016 (Central Statistics Office, 2017), which equates to an approximate annual rent price difference of €6,800 in 2016, as compared to the this study's Average Treatment Effect on the Treated (ATT) 2015 estimates of approximately €5,500 (see Appendices F and G). Given that private sector rental inflation began to accelerate over the 2015 to 2016 period, to over 8 per cent per annum according to the national index of standardised rent (Residential Tenancies Board, 2018), an ATT estimate of approximately €5,500 seems plausible.

[18] The constant has a probability interpretation of 0.227.

6.3 Counter-factual Scenario Results

Having previously addressed the targeting of the local authority rental subsidy, two research questions remain:

(i) What is the impact of the subsidy on the income distribution?
(ii) Could counter-factual adjustments to the subsidy improve outcomes by reducing income inequality?

The matching procedure permits the estimation of predicted rents if households currently renting from a local authority were to be housed in the private market. This allows for analysis of the distribution of incomes after housing costs have been met under counter-factual scenarios, three of which are considered in this paper.

Table 5 presents the P10, P25, P50, P75, P90 and mean annual disposable income of households after housing cost have been met. The actual, observed 2015 values are presented in Column 1, followed by the quantile measures under the three counter-factual scenarios in Columns 2, 3 and 4. Note that Table 5 describes only the incomes of households renting from a local authority, as such the quantile measures are solely in respect of the income distribution of households within that tenure cohort. Table 6 presents the results of the Gini Coefficient measure of income inequality under the counter-factual scenarios. Tables 5 and 6 use non-equivalised income; counterparts to Tables 5 and Table 6 using equivalised income are presented in Appendix H.

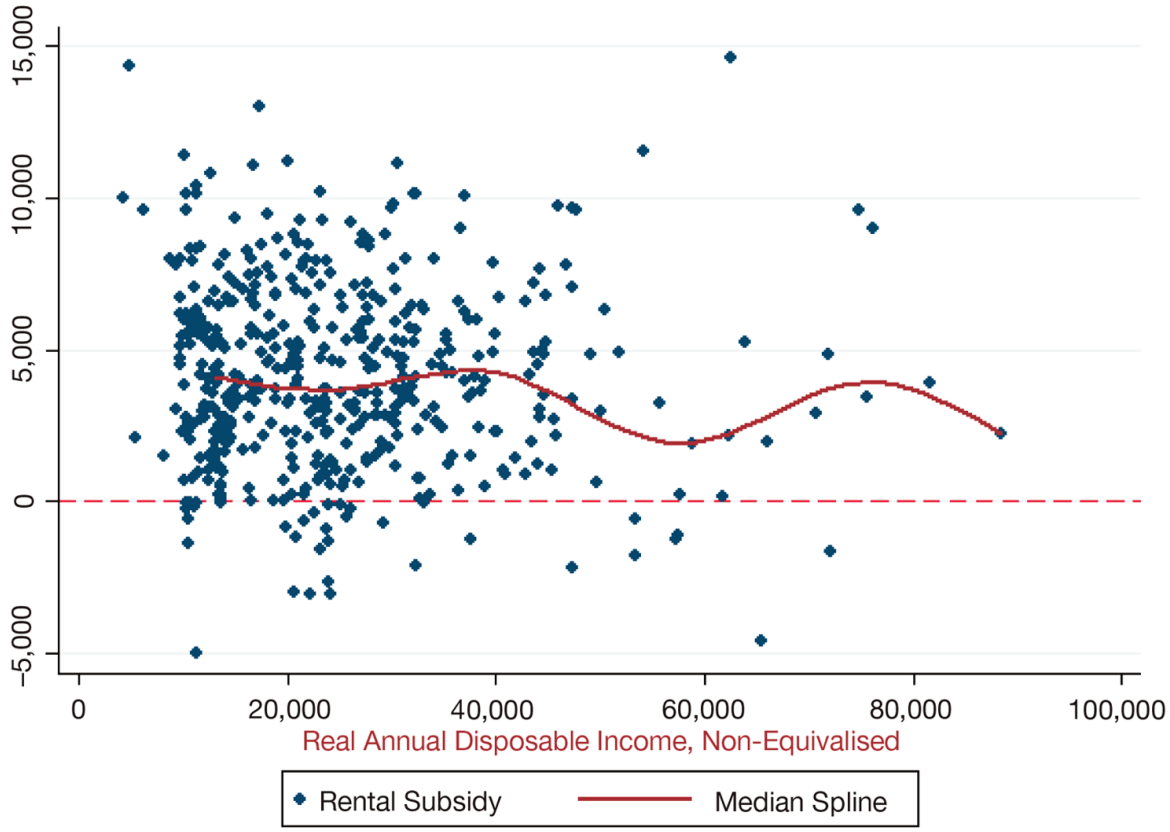
Table 5: Household Income after Housing Costs among Households Renting from a Local Authority – Actual and Counter-factual Distributional Results

	Observed Values	*Counter-factual Scenario #1: Private Market Rents*	*Counter-factual Scenario #2: Amended Local Authority Rent Regime*	*Counter-factual Scenario #3: Amended Local Authority Rent Regime*
	(1)	*(2)*	*(3)*	*(4)*
		Annual Income After Housing Costs €		
P10	10,129	5,875	10,469	11,815
P25	13,488	10,076	13,828	15,174
Median	20,420	17,035	20,420	20,420
P75	29,843	25,205	28,238	29,129
P90	42,628	38,911	39,517	38,911
Mean	24,263	20,096	23,526	24,148

Source: Author's calculations based on Central Statistics Office, SILC.
Notes: This table reports the actual observed quantile measures in Column 1 and under three counter-factual scenarios in Columns 2 to 4. Income is non-equivalised annual disposable income after housing costs.

In a counter-factual scenario in which all local authority households were to instead pay a private market rent, there is a considerable impact throughout the distribution, as P10, P25, P50, P75 and P90 lose approximately €3,400 to €4,600 of income after housing costs. The loss is proportionally most severe among lowest income households; the P10 annual household disposable income after housing costs have been met falls from €10,129 to €5,875, a drop of 42 per cent. The reduction at P25, from €13,488 to €10,076, or over 25 per cent, is also very considerable. The results of this first counter-factual demonstrate the relatively strong impact that State provision of social housing supports has on shielding the incomes of recipient households, particularly those of lower income households.

Figure 10: Estimated Rental Subsidy by Household Income, 2015



Source: Author's calculations based on Central Statistics Office, SILC.

Figure 10 illustrates the estimated value of the subsidy received, by household income. The variation at any given income point is likely to be due to the interaction between household composition and the terms of the specific local authority's differential rent scheme.[19] A notable aspect is that a small number of households, 35 in total, are estimated to receive a negative subsidy, that is, to pay a higher local

[19] It is not possible to identify the local authority in which each household is resident.

authority rent than the rent the household would pay in the private market. Of these households 83 per cent are composed solely of adults and just over half reside in the Dublin Region.

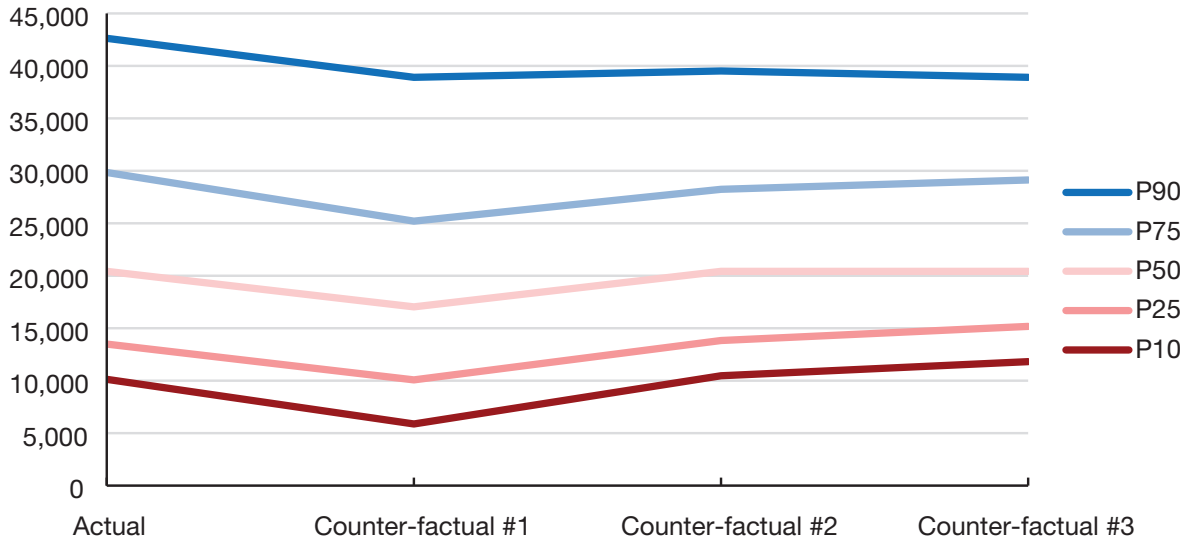
Table 6: Measures of Income Inequality under Actual and Counter-factual Income Distributions, Income after Housing Costs Non-equivalised

	Observed Values	*Counter-factual Scenario #1: Private Market Rents*	*Counter-factual Scenario #2: Amended Local Authority Rent Regime*	*Counter-factual Scenario #3: Amended Local Authority Rent Regime*
	(1)	*(2)*	*(3)*	*(4)*
	Gini Coefficient			
All Households	0.354	0.363	0.353	0.353
Renter Households	0.352	0.388	0.346	0.339
LA Renter Households	0.311	0.383	0.290	0.272

Source: Author's calculations based on Central Statistics Office, SILC.

Under the counter-factual private market rents scenario (Column 2) the Gini Coefficient for income after housing costs across the entire income distribution, regardless of tenure, is 0.363, a non-trivial increase in income inequality over the observed 2015 value of 0.354. This reduction is especially notable, given that the changes to income are concentrated within a single tenure group constituting circa 10 per cent of households across all tenure groups.

Figure 11: Household Income after Housing Costs – Actual and Counter-factual Distributional Results for Households Renting from a Local Authority, 2015



Source: Author's calculations based on Central Statistics Office, SILC.

The final research question this paper seeks to address is the question of whether adjustments to the local authority rent subsidy regime could improve outcomes by reducing income inequality. The second counter-factual scenario examines the income-after-housing-costs-impact of a targeted increase of local authority rents accompanied by the redistribution of the higher rents to lower income households. Under this counter-factual amended local authority rent regime:

- Households renting from a local authority which have a household disposable income before housing costs in the third quintile of the overall distribution pay 80 per cent of the estimated rent the household would pay were it to rent in the private market. In almost all instances this would result in an increased rent. The 20 per cent discount is motivated by a desire to retain a socio-demographic mix in local authority housing and to acknowledge that it may be the case that local authority accommodation, in some instances, is associated with social stigma;
- Households renting from a local authority which have a household disposable income before housing costs in the fourth or fifth quintile of the overall distribution pay 95 per cent of the estimated rent the household would pay were it to rent in the private market. In almost all instances this would result in an increased rent;
- Other households renting from a local authority, that is those in the first and second quintiles of the income distribution, experience no change in the rent paid; and,
- The increased rents charged to households in the third, fourth and fifth quintile would be redistributed equally among all households in the first quintile, regardless of tenure.[20]

The results of the second counter-factual scenario show a moderate impact for lower income households, in that the income after housing costs among local authority rental households at P10 increase by 3.4 per cent. Households in the first income quintile among other tenure groups would also benefit to a similar degree. The impact on higher income households renting from a local authority would be strong; at P90 income after housing costs would decline by 7.3 per cent relative to observed values. In terms of measures of income inequality, the change under the second counter-factual is minor when the measure is applied to the entire income distribution. However, the Gini Coefficient for household disposable income after housing costs among all renting households would drop from .352 to .346. Further, income inequality among households renting from a local authority would drop from .311 to .290.

[20] Higher income local authority renter households are under-represented in the 2015 sample of compared to first quintile households, in that the latter have lower weights on average than the former. Given this difference, care has been taken to ensure that the quantity of redistributed income has not been overstated.

Similar to the second scenario, the third counter-factual scenario examines the income after housing costs impact of a targeted increase of local authority rents accompanied by the redistribution of the higher rents to lower income households; however in this scenario the targeted increase has a stronger redistributive impetus. Under the third counter-factual amended local authority rent regime:

- Households renting from a local authority, which have a household disposable income before housing costs above the median of the overall distribution, pay 100 per cent of the estimated rent the household would pay were it to rent in the private market;
- Other households renting from a local authority, those on or below the median income distribution, experience no change in the rent paid; and,
- The increased rents would be redistributed equally among all households in the first income quintile which are local authority tenant households.

The results of the third counter-factual demonstrate that an amended local authority rental price regime could increase the income after housing costs among local authority rental households at P10 by 16.6 per cent and at P25 by 12.5 per cent. Unlike counter-factual scenario 2, households in the first income quintile among other tenure groups would not benefit. The impact on higher income households renting from a local authority would be strong; at P90 income after housing costs would decline by almost 9 per cent relative to observed values. In terms of measures on income inequality, the change under the third counter-factual is minor when the measure is applied to the entire income distribution, falling marginally from .354 to .353. However, the Gini Coefficient for household disposable income after housing costs among renting households would drop considerably, from .352 to .339. Further, income inequality among households renting from a local authority would drop from .311 to .272.

Table 5 presents, for households renting from a local authority, selected quantiles of the distribution of income after housing costs for observed income and the estimated income under the three counter-factual scenarios. To further examine the impact of the counter-factual scenarios a set of representative households have been selected, the incomes of which lie close to the quantiles presented in Column 1 of Table 5, and each of which rent from a local authority. The changes to the income of these households under the counter-factual scenarios on these representative households are presented in Table 7.

In general, the impact of the counter-factual scenarios on the representative households tracks the impact on the quantiles presented in Table 5. Notable exceptions are the larger negative impact of the first counter-factual scenario on the lower income households, Households A and B, which lose 55 per cent and 59 per cent of their respective incomes under this scenario. The other principal difference is that Household E's income is relatively resilient under all three counter-factual scenarios, when compared to the P90 measure.

Table 7: Household Income Actual and Counter-factual Distributional Results for Representative Households Renting from a Local Authority

	Observed Values	*Counter-factual Scenario #1: Private Market Rents*	*Counter-factual Scenario #2: Amended Local Authority Rent Regime*	*Counter-factual Scenario #3: Amended Local Authority Rent Regime*
	(1)	*(2)*	*(3)*	*(4)*
	Annual Income After Housing Costs €			
Household A	10,129	4,473	10,469	11,815
Household B	13,488	5,485	13,828	15,174
Household C	20,420	19,245	20,420	20,420
Household D	29,843	27,199	28,625	29,843
Household E	42,628	34,987	36,828	34,987

Source: Author's calculations based on Central Statistics Office, SILC.
Notes: This table reports the incomes of selected households renting from a local authority, as observed in Column 1 and under three counter-factual scenarios in Columns 2 to 4. The households have been selected on the basis that their observed incomes lie close to the P10/P25/P50/P75/P90 quantiles of the observed income distribution. Income is non-equivalised annual disposable income after housing costs.

VII CONCLUSION

As observed by Robinson (1979), measuring the benefits of housing subsidies is a complex area and unequivocal judgements are difficult or perhaps impossible for two reasons. In the first instance, there may be disagreement concerning the nature of, and how best to measure, a subsidy. Also, questions of equity and distribution inevitably involve normative judgements.

Setting aside normative considerations, this study makes the following contributions. Firstly, local authority housing supports undoubtedly make a major contribution by shielding lower income households from higher accommodation costs. Secondly, while many local authority renting households can be described as low income, there is also a cohort of households which are medium to high income. Such households have very low housing costs relative to other groups due to the operation of the local authority rental subsidy and the apparent limited withdrawal of the subsidy in the presence of relatively high incomes. Lastly, relatively straightforward amendments to the local authority rent regime could be made which could reduce income inequality after housing costs.

The findings of this study suggest that the responsiveness of local authority rental prices to income should be examined with a view to ensuring that rent prices

adjust in an equitable fashion to higher household incomes. Moderate to high incomes among local authority tenant households can be viewed as a success of the social housing programme. The household has stabilised in economic terms and moved on from the set of circumstances under which the household was eligible for social housing. One or more members are likely to be active in the labour market. There may be positive externalities and/or spillovers for geographically proximate households. It has been noted abroad that rules governing subsidised housing tenant selection have cycled back and forth over time, sometimes favouring the lowest-income households, at other times favouring 'working-but-poor' households (Collinson *et al.*, 2015). There are complex trade-offs related to prioritising the poorest on the one hand, and avoiding concentrations of disadvantage on the other, and legitimate justifications for either approach. However it seems difficult to justify the provision of generous subsidies to households which have the means to meet their housing costs. Assuming policymakers wish to reduce income inequality, by directing subsidies to those most in need, continued eligibility of the subsidy should be conditional on income and should be means tested regularly.

Distributional impacts are not the only concern of policymakers. Employment incentives, for instance, should also be a consideration of any changes made to the local authority rent regime.

This study's findings are all the more pressing given the State's policy of greatly increasing the provision of social housing by local authorities (Government of Ireland, 2016a) and of transferring Rent Supplement recipients to the Housing Assistance Payment. It may be the case that the experience of recent years results in a reversal of the decline, in terms of share, of total households, of local authority owned housing. Even before any such increase in tenure share, it is clear that the annual value of the local authority housing subsidy is very considerable, when judged against other State expenditure programmes. Based on an estimated annual average subsidy of €4,100, the aggregate annual value of the subsidy is €0.70 billion. To provide a sense of magnitude and to place this figure in a broader context, this is approximately 10 per cent of the total social welfare pension spend by the State in 2015 (Government of Ireland, 2016b), or approximately 300 per cent of the estimated 2015 tax expenditure on mortgage interest tax relief (Revenue Commissioners, 2017). In terms of the distributional impact across the income deciles, the targeting of the local authority subsidy would seem to be superior to aggregate social transfers, as the top income quintile receives a greater share of social transfers than the lowest quintile in 2015 (Government of Ireland, 2015b), which is not the case for the local authority housing subsidy. However, social transfers have a broader set of objectives than income equalising or poverty alleviation motivations.

Other commentators have observed stark inequalities within the Irish housing system (Fitzgerald and Winston, 2005). The principal contribution of this paper is

to identify further inequalities, both among local authority tenants and between some local authority tenants and low income households among other tenure groups, and to highlight the opportunities which are available to reduce such inequalities by adjusting the local authority rent regime.

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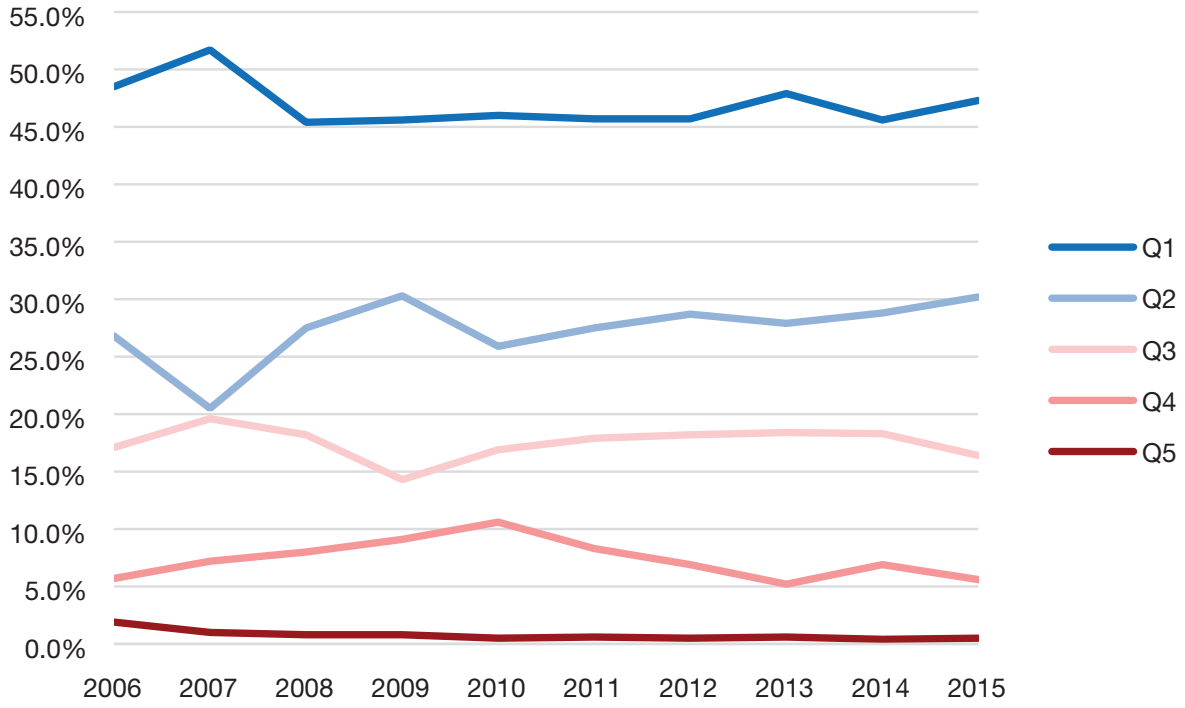
APPENDIX A: MISCELLANEOUS ADDITIONAL GRAPHS AND TABLES

Figure A.1: Share of Local Authority Tenant Households within Each Equivalised Income Quintile, 2006 to 2015



Source: Author's calculations based on Central Statistics Office, SILC.
Note: Graph Income is equivalised to account for varying household compositions using the national scale of a weight of 1 for the first adult, 0.66 for each subsequent person aged 14 and over, and 0.33 for each child aged less than 14.

Table A.1: Household Tenure Groups in SILC 2006-2015

Year	*Total Households*	*No. of Local Authority Tenant Households*	*Weighted % of Local Authority Tenant Households*	*No. of Private Market Tenant Households*	*Weighted % of Private Market Tenant Households*
2006	5,836	542	9.9	351	9.1
2007	5,608	475	9.7	344	9.1
2008	5,247	497	10.9	312	9.5
2009	5,183	529	11.8	428	10.8
2010	4,642	507	11.6	463	11.4
2011	4,333	473	11.5	535	13.9
2012	4,592	520	11.3	642	14.0
2013	4,922	527	10.7	697	15.3
2014	5,486	560	10.3	748	15.2
2015	5,407	526	9.8	628	13.5

Source: Author's analysis of Survey of Income and Living Conditions Dataset.

APPENDIX B: DISTRIBUTIONS OF INCOME, OF RENTS AND OF INCOME AFTER HOUSING COSTS

Table B.1: Household Disposable Incomes among Renting Households 2006-2015

Year	*P10€*	*P25€*	*Median€*	*P75€*	*P90€*
Local Authority Renting Households					
2006	11,031	14,176	23,312	35,645	54,245
2007	11,211	16,030	24,625	36,824	50,246
2008	12,261	16,252	25,473	38,707	55,609
2009	13,416	18,201	26,999	38,623	54,900
2010	12,212	15,492	25,336	35,558	50,545
2011	11,300	13,908	23,475	33,802	43,236
2012	10,379	13,766	22,678	32,463	41,852
2013	10,523	13,384	21,478	31,097	40,938
2014	11,637	14,894	23,197	33,643	45,347
2015	11,670	15,587	23,531	33,339	47,428
Private Market Tenant Households					
2006	15,980	23,335	33,376	48,049	73,679
2007	16,063	22,753	33,635	51,963	78,871
2008	17,619	26,108	37,835	50,677	74,495
2009	20,995	26,194	39,568	52,696	68,718
2010	16,072	23,655	33,155	47,473	63,523
2011	15,510	22,782	32,580	47,205	70,317
2012	14,751	23,069	33,044	44,633	64,836
2013	15,285	24,046	33,636	47,304	72,586
2014	14,781	24,329	35,068	50,034	71,069
2015	16,152	25,053	36,363	49,767	73,319

Source: Author's analysis of Survey of Income and Living Conditions Dataset.

Table B.2: Rents among Renting Households 2006-2015

Year	*P10€*	*P25€*	*Median€*	*P75€*	*P90€*
Local Authority Renting Households					
2006	1,015	1,326	1,974	2,877	4,625
2007	1,075	1,344	2,151	3,226	4,517
2008	1,137	1,478	2,185	3,565	4,598
2009	1,352	1,623	2,704	3,786	4,868
2010	1,366	1,748	2,622	3,550	4,643
2011	1,331	1,598	2,396	3,195	4,260
2012	1,309	1,570	2,355	3,402	4,344
2013	1,302	1,578	2,397	3,230	4,168
2014	1,352	1,664	2,600	3,484	4,524
2015	1,303	1,564	2,607	3,650	5,214

Table B.2: Rents among Renting Households 2006-2015

Year	*P10€*	*P25€*	*Median€*	*P75€*	*P90€*
Private Market Tenant Households					
2006	3,124	6,508	9,372	12,496	15,620
2007	4,715	7,073	9,430	12,408	17,371
2008	4,769	7,153	9,538	13,710	15,617
2009	4,368	6,740	9,985	13,729	16,226
2010	3,151	6,151	8,193	10,714	15,126
2011	3,502	5,899	7,988	10,651	13,518
2012	3,865	5,556	7,247	9,663	12,079
2013	4,148	5,651	7,214	10,219	13,228
2014	3,840	5,760	7,800	10,800	14,400
2015	4,813	6,017	7,942	12,034	14,440

Source: Author's analysis of Survey of Income and Living Conditions Dataset.

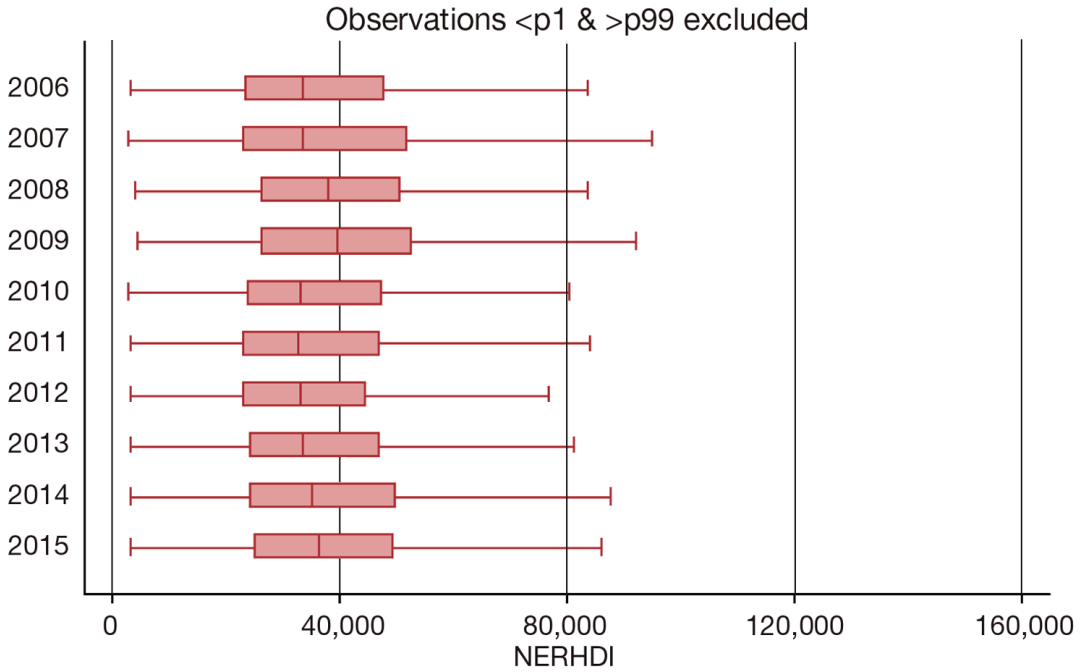
Table B.3: Income after Housing Costs among Renting Households 2006-2015

Year	*P10€*	*P25€*	*Median€*	*P75€*	*P90€*
Local Authority Renting Households					
2006	9,507	12,239	20,535	31,535	47,521
2007	9,609	13,975	22,028	32,823	46,751
2008	10,898	14,456	22,972	34,453	51,207
2009	11,953	15,806	23,341	35,067	50,102
2010	10,247	13,352	21,802	30,407	44,152
2011	9,649	12,221	20,953	30,128	39,263
2012	8,941	11,955	19,731	29,408	36,631
2013	8,753	11,568	18,911	27,535	37,351
2014	9,917	12,576	20,181	29,477	38,974
2015	10,129	13,488	20,420	29,843	42,628
Private Market Tenant Households					
2006	8,301	14,851	24,657	38,598	59,471
2007	8,454	15,243	25,499	42,971	67,624
2008	11,000	18,358	29,958	41,979	60,953
2009	10,788	18,993	30,124	41,051	55,372
2010	9,013	15,890	25,951	40,345	54,099
2011	8,719	15,441	25,047	37,682	59,387
2012	7,761	16,001	25,796	37,045	55,929
2013	9,232	16,768	26,195	39,311	61,601
2014	9,133	17,234	27,383	40,333	59,032
2015	9,367	17,021	26,469	38,883	62,231

Source: Author's analysis of Survey of Income and Living Conditions Dataset.

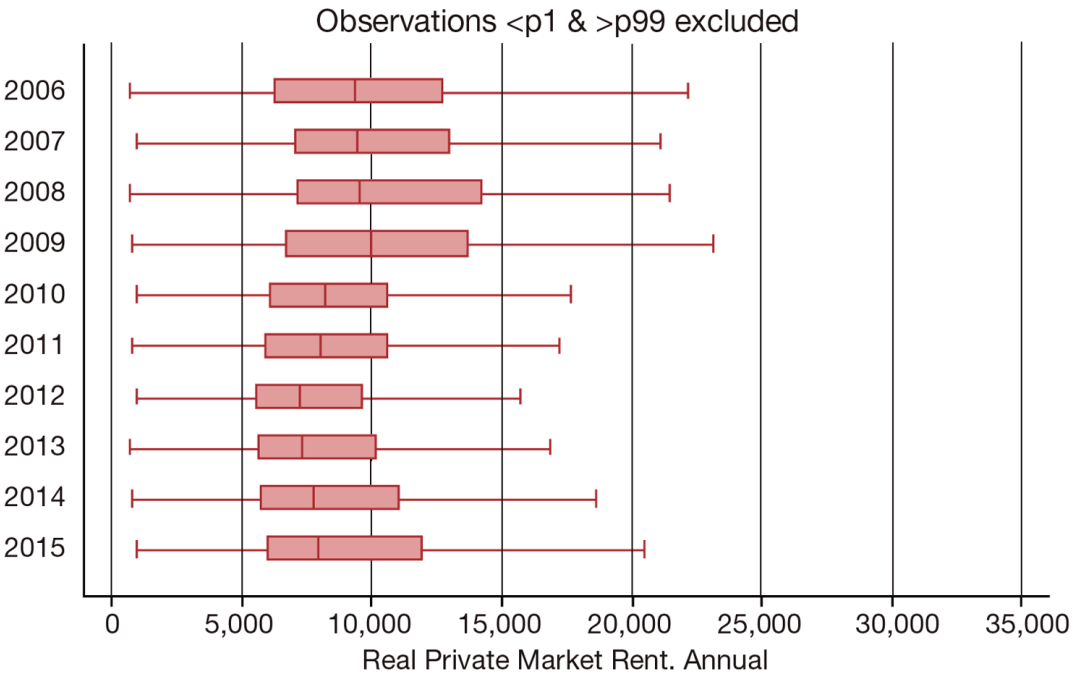
APPENDIX C: PRIVATE MARKET RENTAL COMPARISON GRAPHS

Figure C.1: Real Private Market Renting Annual Household Disposable Income, 2006-2015



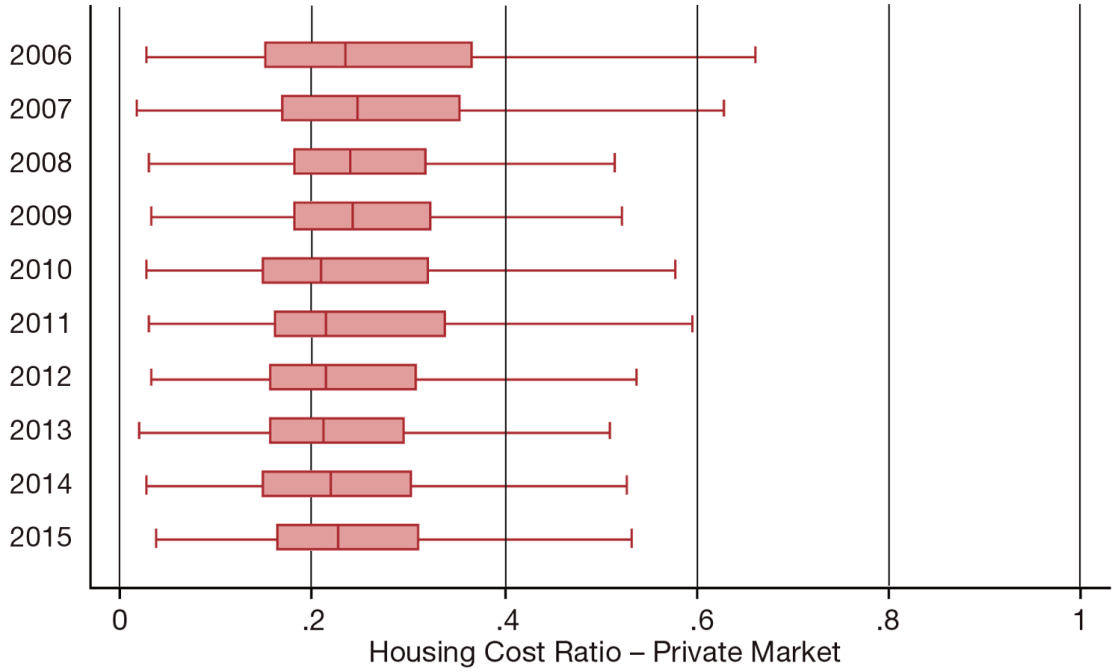
Source: Author's calculations based on Central Statistics Office, EU-SILC.

Figure C.2: Real Private Market Renting Household Annual Rents, 2006-2015



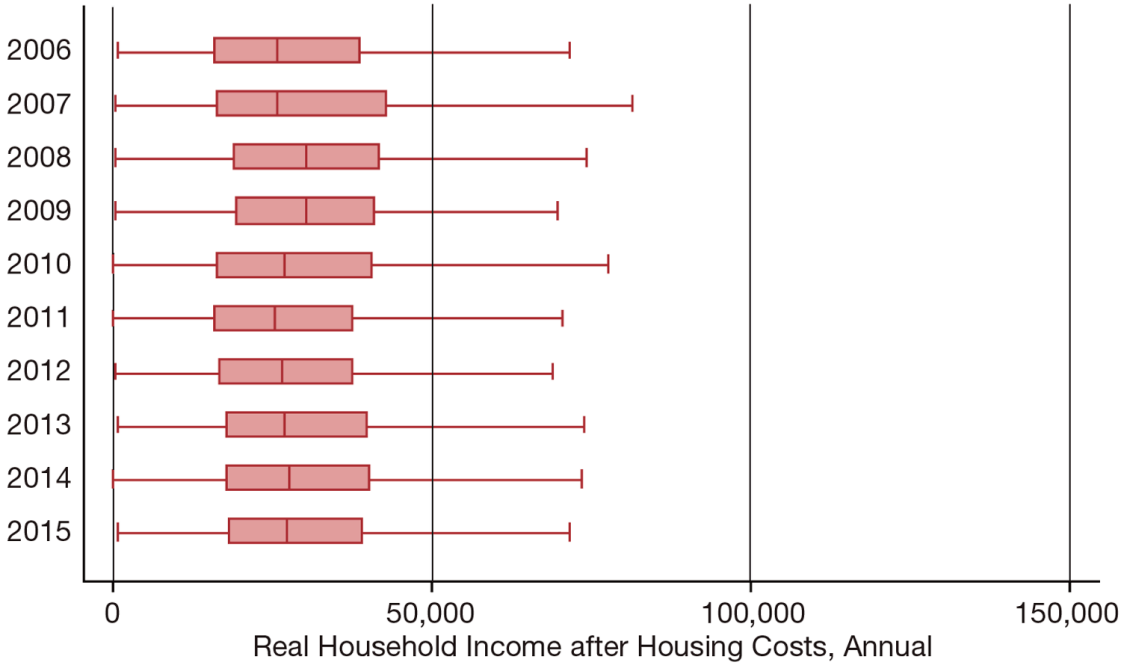
Source: Author's calculations based on Central Statistics Office, EU-SILC.

Figure C.3: Housing Cost Ratios among Private Market Renting Households, 2006-2015 (>=1 excluded)



Source: Author's calculations based on Central Statistics Office, EU-SILC.

Figure C.4: Income after Housing Costs of Private Market Renting Households, 2006-2015 (<=0 excluded)



Source: Author's calculations based on Central Statistics Office, EU-SILC.

APPENDIX D: LOCAL AUTHORITY DIFFERENTIAL RENTS

Local authority rents are defined by the differential rent schemes adopted by each local authority.

Social housing rents were initially set with reference to the cost of providing the dwelling minus Exchequer subsidy. The system of differential rents, that is rents varying according to the financial circumstances of tenants, were first introduced in Cork City in 1934 and were intended to operate on the basis of cross-subsidisation between tenant households based on household income (O'Connell, 2007). This approach slowly spread nationwide and was extended nationally, albeit with extensive local variation, by the late 1960s. Rent prices were generous under the differential rent scheme; a 1964 White Paper on housing noted that rents for much of the local authority stock were far below the costs of financing and did not cover maintenance costs (Hayden, 2014). In 1973 a national scheme of differential rents was introduced, arising in part from tenant dissatisfaction with varied local treatment of income deductions which had led to rent strikes. The national scheme was calculated proportional to the basic income of the principal earner and subsidiary earners, after tax and social welfare, before overtime, shift allowances and bonus payments, and with allowances for dependent children.

The system of differential rents remains in place, although since 1986 the details of the schemes have been devolved to local authorities and there are considerable variations in the rents paid by similar households depending on the precise parameters of the rent scheme adopted by the relevant local authority.

Currently, each local authority adopts a rent scheme which applies to local authority housing stock. In general differential rent schemes define a proportion of assessable income which is to be paid as rent, which varies from local authority to local authority in terms of the definition of assessable income, the proportion to be paid as rent, the treatment of dependent adults and children, maximum and minimum rents and the treatment of income from self-employment. As a consequence and as noted previously, notwithstanding that all local authority tenant households receive a subsidy, households which are similar in terms of composition and income can pay very different rents from local authority to local authority. Such differences raise questions of horizontal equity among tenant households.

Within local authorities, rents do not reflect housing unit characteristics. Nor do rents paid under the differential rent system bear any relation to maintenance and management costs.

Aside from provision of local authority owned accommodation, social housing is also delivered by local authorities via the subsidisation of units owned by private landlords under a variety of specific schemes. Local authorities undertake long-term leasing of accommodation from private owners under which the tenancy is secure for the term of the lease, which can last from ten to 20 years. Units are also leased from private landlords under schemes such as the Housing Assistance

Payment and Rental Accommodation Scheme. In all of these cases access is for eligible households which have secured a place on a local authority waiting list; the tenant household pays a differential rent to the local authority which is determined by household composition and income. Similar to households accommodated in local authority owned units, eligibility does not cease when the incomes of households living in a subsidised private market unit rise above a given threshold; rather the differential rent adjusts.

APPENDIX E: ELIGIBILITY RULES FOR SOCIAL HOUSING

The eligibility rules for social housing are governed by legislation and the policies of each local authority. Only those households with an income below a specified limit are eligible to make an application for social housing, a limit which varies depending on the local authority and household composition. There are three bands of local authorities. For instance, single person households have a maximum net income of €35,000 per annum to be eligible in Dublin, Cork City, Galway City, Meath, Kildare and Wicklow, which together constitute the first (highest) band of local authorities. The regulations define those income sources which are disregarded for the purposes of eligibility assessment, such as child benefit or higher education grants.

Having determined that a household is eligible, each local authority is required to prioritise eligible applications for social housing on the basis of need, which takes account of the suitability and quality of a household's current accommodation. Assessments of need are based on each household's circumstances, for instance whether the household is homeless, living in accommodation which is overcrowded or unfit for human habitation, and so forth. Local authorities may also take account of applicant households' time on the waiting list, although whether or not time waiting is considered, dwellings are still allocated primarily on the basis of need (Norris and Hayden, 2018).

The waiting list for social housing is relatively large. The total number of eligible households which qualified for social housing support on the waiting list as of 28 June 2017 was 85,799. Almost a quarter of the 85,799 households which qualified for support were waiting for a social housing support for seven years or more (Housing Agency, 2018).

Households which are resident in local authority owned units enjoy a set of tenancy conditions which are very secure. In law, local authorities have considerable flexibility to terminate tenancies, however instances of such are very rare. Tenancy security has been described as being, in practice, virtually guaranteed, provided the rules of occupancy are observed and excessive rent arrears are not a factor (Fahey and O'Connell, 1999). If the financial circumstances of the tenant improve, the rent is increased but the household is not required to leave the dwelling or neighbourhood. Similarly, changes to household composition, such as when adult children leave a unit for accommodation elsewhere, do not result in reallocation of the unit and the rehousing of the remainder of the household in a smaller unit. In practice, households enjoy the right to occupy a specific dwelling for life. Other tenancy conditions are also favourable compared to those experienced by tenants renting in the private sector. Households renting a local authority owned unit may, in some circumstances, purchase the housing unit they occupy at a considerable discount. In some local authorities, arrangements are in force which allow for 'successor' tenancies, that is the inheritance of the tenancy by the resident children

of the original tenant. The tenancy conditions which, in practice, apply to local authority owned units have implications for the capacity of local authorities to efficiently manage housing assets and to provide housing to eligible households on the waiting list.

APPENDIX F: PROPENSITY SCORE MATCHING

Typically, the estimand of primary interest when conducting a propensity score matching exercise is the average treatment effect on the treated (ATT). However, for the purposes of this study, the Average Effect on the Untreated (ATU) is also of interest.

Formally, with R denoting the outcome variable and the treatment D being a binary variable:

$$\begin{cases} R_i^C \ \ if \ \ D = 0 \\ R_i^T \ \ if \ \ D = 1 \end{cases} \tag{1}$$

R_i^C is the outcome that would be obtained if household i is not treated; R_i^T is the outcome that would be obtained if household i receives treatment.

Rosenbaum and Rubin (1983) defined the propensity score as the conditional probability of receiving treatment given pre-treatment characteristics:

$$p(X) = Pr(D = 1 \mid X) = E(D \mid X) \tag{2}$$

The propensity score $p(X_i)$ is used to match treated and control units as closely as possible based on their characteristics X_i, that is, based on predicted probabilities of treatment, to estimate the difference in outcomes, that is the ATT:

$$\begin{aligned} \text{ATT} &= E(R_i^T - R_i^C \mid D = 1) = E(E(R_i^T - R_i^C \mid D = 1, p(X_i))) \\ &= E\left(E\left(R_i^T \mid D = 1, p(X_i)\right) - E(R_i^C \mid D = 0, p(X_i)) \mid D_i = 1\right) \end{aligned} \tag{3}$$

The ATT is the difference between the two terms; the first term is the observed outcome for the treated group and the second term being the unobserved, and therefore counter-factual, outcome for the treated group had it not been treated.

The ATU, that is, the Average Effect on the Untreated is:

$$\begin{aligned} \text{ATU} = E(R_i^T - R_i^C \mid D = 0) &= E(E(R_i^T \mid D = 1, p(X_i)) \\ &- E(R_i^C \mid D = 0, p(X_i)) \mid D_i = 0 \end{aligned} \tag{4}$$

As such, the ATU is the difference between the unobserved, and therefore counter-factual, outcome for the non-treated group had it been treated and the second term, being the observed outcome for the non-treated group.

The ATE, that is, the Average Treatment Effect is:

$$ATE = E(R_i^T - R_i^C) = ATT \cdot P(D = 1) + ATU \cdot P(D = 0) \tag{5}$$

As such, the ATE is unconditional on participation and is the expected impact of the treatment on a randomly selected household.[21] The ATE is the weighted average of the ATT and ATU.

Observational studies, such as this study, require that certain identifying assumptions are invoked to solve the selection bias problem. The conditional independence assumption, or unconfoundedness assumption, implies that systematic differences in outcome between treated and control units with the same values for covariates are attributable to treatment.

$$R^T, R^C \perp D \mid X \tag{6}$$

This implies that all variables that influence treatment assignment and potential outcomes simultaneously have been observed, that is, assignment to treatment is unconfounded given the propensity score.

$$R^T, R^C \perp D \mid \mathrm{p}(X) \tag{7}$$

Put alternatively, the conditional independence assumption asserts that characteristics which may affect the outcomes are observable and included in the model. The SILC data which are used in this study provide sufficient demographic, income, spatial and other information to test the characteristics which may affect outcomes, and therefore satisfy this assumption.

Lastly, the conditional independence assumption asserts that every individual has a positive probability of receiving the treatment and not receiving the treatment, that is, each household could have been a private market renter, or not.

$$0 < P(D = 1 \mid X) < 1 \tag{8}$$

[21] In the context of this study, randomly selected from among the population of renting households.

APPENDIX G: ROBUSTNESS TO MATCHING METHOD, COVARIATE BALANCE AND MODEL FIT

Table G.1: Propensity Score Matching Estimand Results using Various Matching Methods

Matching Method	*Observations Average*	*Treatment Effect on the Treated Annual €*	*Average Treatment Effect Annual €*	*Average Treatment Effect on the Untreated Annual €*
Caliper 0.01, 1 to 1 matching (N=1)	1,028	5,445	4,681	3,872
Caliper 0.01, Nearest neighbour (N=2)	1,028	5,507	4,837	4,127
Caliper 0.01, Nearest neighbour (N=3)	1,028	5,479	4,855	4,194
Caliper 0.01, Nearest neighbour (N=5)	1,028	5,424	4,799	4,136
Caliper 0.01, Nearest neighbour (N=10)	1,028	5,422	4,812	4,166
No Caliper, Nearest neighbour (N=1)	1,098	5,740	4,882	3,861
No Caliper, Nearest neighbour (N=2)	1,098	5,775	4,982	4,038
No Caliper, Nearest neighbour (N=3)	1,098	5,797	4,962	3,968
No Caliper, Nearest neighbour (N=5)	1,098	5,705	4,971	4,097
No Caliper, Nearest neighbour (N=10)	1,098	5,648	4,996	4,218
Kernel (Epanechnikov)	1,098	5,754	5,013	4,131
Kernel (Gaussian)	1,098	5,710	5,044	4,250
Kernel (Biweight)	1,098	5,760	5,018	4,134
Kernel (Uniform)	1,098	5,741	5,014	4,149
Local Linear Regression (Epanechnikov)	1,098	5,788	4,996	4,053
Local Linear Regression (Gaussian)	1,098	5,782	4,992	4,051
Local Linear Regression (Biweight)	1,098	5,734	5,042	4,217
Local Linear Regression (Uniform)	1,098	5,717	5,010	4,168
Mahalanobis Distance Matching	1,098	5,689	5,067	–

Source: Author's calculations based on Central Statistics Office, SILC.
Note: All results are statistically significant at the 0.01 level.

Matching has been undertaken with replacement; Abadie and Imbens (2006) unambiguously favour matching with replacement on grounds that matching without replacement generates bias.

There has been debate concerning the propensity score matching method and the potential for the method to increase imbalance, inefficiency, model dependence, and bias (King and Nielsen, 2016). To help ensure that results of this study are robust to the choice of matching method, Mahalanobis Distance Matching (MDM) has also been applied and equivalent estimands are reported. Like propensity score matching, MDM is based on specific notions of distance between observations of pre-treatment covariates. MDM matches on distance calculations based on the sample covariance matrix of covariates.

Covariate Balance

Table G.2: Covariate Balance Summary

	Raw	*Matched*
Number of observations	1,028	1,058
Treated	529	529
Control	499	529
Variable	*Standardised Bias Raw*	*Standardised Bias Matched*
Income (€000s)	.596430	.098841
Age 55-64	–.441368	.053092
Age 65+	–.552971	–.086158
Region – West	.161726	.055309
Region – Dublin	–.110841	.182523
Education – 3	.181431	.03023
Education – 4	.333047	.026981
Education – 5	.508499	–.086406
Education – 6	.120512	.116352
Student	.200537	–.075338
Labour market connection	.693438	.116211

Source: Author's calculations based on Central Statistics Office, SILC.
Notes: This table reports the number of treated and control observations and the balance of covariates used by the propensity score matching model to match treated and control units. See Table 3 in the main text of this paper for a description of each variable. The standardised bias, reported for each covariate, is defined as the difference of sample means in the treated and matched control subsamples as a percentage of the square root of the average of sample variances in both groups. As such, the standardised bias compares the difference in means in units of the pooled standard deviation. It is not influenced by sample size and allows for the comparison of the relative balance of variables measured in different units.

The literature concerning the standardised bias approach does not provide an unequivocal indication for the success of the matching procedure; covariate balance thresholds of 0.25 and 0.10 have been proposed as rules of thumb (Harder *et al.*, 2010). A standardised bias of less than 0.1 has been taken to indicate a negligible difference (Austin, 2011). All of the relevant covariates are safely below the .25 threshold, eight of the 11 variables are below the strict 0.10 threshold.

Goodness of Fit

The Count R^2, which describes the share of overall correctly predicted observations, is 74.89 per cent.

The adjusted Count R^2, which compares the predictions made by the model with independent variables to a model with prediction based solely on the marginal distribution of the dependent variable, has a model-with-independent-variables error rate which is 45.2 per cent lower.

The Homer-Lemeshow x^2 value is 9.09, which suggests that the difference between observed and estimated values of predicted and observed frequencies across covariate patterns cannot be explained by a random process (Kohler and Kreuter, 2009). Given the large number of covariate patterns, which approaches the number of observations, ten groups were used to sort by predicted probabilities; within each group the frequency of observed successes was compared with the frequency estimated by the model.

APPENDIX H: EQUIVALISED INCOME DISTRIBUTION IMPACTS UNDER COUNTER-FACTUAL SCENARIOS

Table H.1: Household Income after Housing Costs among Households Renting from a Local Authority – Actual and Counter-factual Distributional Results, Equivalised

	Observed Values	*Counter-factual Scenario #1: Private Market Rents*	*Counter-factual Scenario #2: Amended Local Authority Rent Regime*	*Counter-factual Scenario #3: Amended Local Authority Rent Regime*
	(1)	*(2)*	*(3)*	*(4)*
		€ Annual Income After Housing Costs		
P10	7,595	4,266	7,641	8,211
P25	9,295	6,519	9,296	10,131
Median	11,479	9,420	11,297	11,920
P75	14,345	12,108	14,123	14,345
P90	18,635	16,831	18,434	18,511
Mean	12,351	9,816	12,148	12,632

Source: Author's calculations based on Central Statistics Office, SILC.
Notes: This table reports the actual, observed quantile measures observed in Column 1 and under three counter-factual scenarios in Columns 2 to 4. Income is equivalised annual disposable income after housing costs.

Table H.2: Measures of Income Inequality under Actual and Counter-factual Income Distributions, Income after Housing Costs Equivalised

	Observed Values	*Counter-factual Scenario #1: Private Market Rents*	*Counter-factual Scenario #2: Amended Local Authority Rent Regime*	*Counter-factual Scenario #3: Amended Local Authority Rent Regime*
	(1)	*(2)*	*(3)*	*(4)*
		Gini Coefficient		
All Households	0.311	0.322	0.309	0.309
Renter Households	0.303	0.349	0.300	0.295
Local Authority Renter Households	0.194	0.281	0.185	0.173

Source: Author's calculations based on Central Statistics Office, SILC.