POLICY PAPER

Estimating the Cost of Housing in the Irish Market: A Rental Equivalence Approach

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Abstract: Measuring the cost of housing for official estimates of inflation is of particular importance given the share of household expenditure that housing accounts for. In this paper, we present a measure of owner-occupier housing inflation using a rental equivalence approach for Ireland. We use supervisory microdata on tenancy registrations from the Residential Tenancies Board coupled with census data on owner occupation by region and housing type to develop an estimate of rental equivalence for the period 2015 to 2019. We then use this housing cost in an estimate of inflation and find that adopting such a measure would increase the headline Consumer Price Index (CPI) by 1.6 percentage points in September 2019. We also discuss data and measurement issues with our approach, compare our index to other publicly available data and suggest areas for future research.

I INTRODUCTION

Across many countries over the past 30 years, housing has become increasingly important in economic activity. In calculating the share of private domestic value for G7 countries over the period 1950-2010, Rognlie (2015), estimated that housing went from 3 per cent of GDP at the start of the sample period to about 10 per cent more recently. Leamer (2007), asserted that "housing IS the business cycle", with the residential investment component of GDP offering the best early warning sign of an oncoming recession for US data. Furthermore, as noted in Glaeser and Sinai (2013), the role of the construction sector in the lead up to the financial crisis of 2007/2008 highlights the capacity of the housing market "to drive shifts in the real economy".

The importance of housing comes as residential property markets across the OECD have, since the early 1990s, experienced significant volatility; many countries witnessed persistent increases in house prices up to 2007/2008 before experiencing significant corrections in housing prices thereafter (Bracke, 2013). Prices in a number of countries increased persistently again from 2013 onwards as macroeconomic conditions stabilised following the financial crisis. While there is still some debate as to what lies behind this increase in housing prices, the escalation in prices observed in general since the mid-1990s suggests that the cost of housing now constitutes an increased component of household expenditure. But is this reflected in the official estimates of the cost of living? Possibly reflecting the sense that housing costs are not accurately captured in such a manner, the European Central Bank (ECB, 2021) recently suggested in its new Monetary Policy Strategy that housing costs could be given more weight in the way in which inflation is measured in the Eurozone.[1] Indeed, recent discussions have taken place as to how these costs should be incorporated into the CPI (Whelan *et al.*, 2021).

No country better exemplifies the increased relevance of the residential property market than Ireland. Kelly and McQuinn (2014) and McQuinn (2017), amongst others, highlight the particularly strong rate of house price inflation vis-à-vis other Western economies. The emergence of the Celtic Tiger in the mid-1990s along with the accommodative monetary policy observed internationally at the same time saw nominal Irish housing prices grow by 334 per cent between 1995 and 2007. The international financial crisis of 2007 and 2008 led to a swift decline in investor confidence in Ireland's property sector given concerns about a price bubble and a significant oversupply of residential units. The housing market collapse began in 2008, with prices declining by 48 per cent by the end of 2013. Annual house completions dropped by 91 per cent (from a peak of 93,000 units in 2006) to a low

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[1] https://www.ecb.europa.eu/home/search/review/html/ecb.strategyreview_monpol_strategy_statement. en.html.

of 8,300 units in 2013. However, from 2014 onwards, as the Irish economy stabilised and began to grow strongly, house price inflation escalated once again with prices increasing by 63 per cent by 2019.

However, to date, few papers in an Irish context have considered how best to consider the measurement of owner-occupied housing outside the payment method that is currently used by the Central Statistics Office (CSO). In particular, there is an absence of research using timely microdata in addressing this issue. In this paper we propose a method for calculating the value of owner-occupied housing (OOH) in Ireland using the rental equivalence measure of OOH. Our approach, which follows Coffey *et al*. (2021), combines micro rent price data with data on the stock of owner-occupied housing in the country. We consider the proposal to use the rental equivalence approach worthwhile as it isolates the consumption element of owning a home, which is consistent with its usage in the CPI. In principle, the rental equivalence approach involves matching the owner occupier home with a similar property that is on the rental market. The rent of that property is then taken to be the value of consumption of the owner-occupied property. We provide estimates using both new rental data (newly registered tenancies) and renewal tenancies (which proxy existing tenancies) to capture the debate in the literature over the appropriate measure of the "opportunity cost" of housing (IMF, 2020).

Our approach is as follows. We estimate regional rent indices for groups of properties with the same characteristics, using hedonic regression methods on rental data from the Residential Tenancy Board (RTB) for the period 2015 Q1 to 2019 Q3. We then compute the weight of these indexes based off the frequency with which property types with the same characteristics appear in the owner-occupied data in the 2016 Census. Finally, we apply these weights to each of the individual rent indices and sum them together to come up with one final index for rental equivalence owner-occupied housing inflation. Using detailed information on the manner in which the Irish CPI is calculated, we then substitute in our measure of owner-occupier housing cost instead of the existing approach for the period December 2017 to September 2019. Our results are non-trivial, with the use of the rental equivalence approach to measuring housing cost resulting in the official year-on-year change in the CPI index rising by 1.6 percentage points while the year-on-year inflation rate for September 2019 increases from 0.88 to 1.78.

Our analysis suggests that changing the way owner-occupied housing is treated in the CPI has a considerable impact on the overall rate of price inflation. The very sharp increase in the overall CPI that occurs when a rental equivalence measure is deployed in the CPI reflects the importance that treating owner-occupied housing has across the basket of expenditure items. While using this approach does have benefits (in particular the conceptual fit with the consumption-focus of the CPI measurement and the measurement of opportunity cost), there are limitations with using the rental equivalence approach. First, selecting the appropriate data in terms of new or existing rents has quite an impact on the results. Second, and most

importantly, measuring the opportunity cost requires an accurate indicator of the "market price". If rent controls are in place (like in Ireland currently), this limits the benefit of using market rent data as any regulations provide a wedge between the observed and underlying market price. To accurately measure rental equivalence under rent controls, a series would need to be identified that would specifically provide a measure of the return that could be expected if a homeowner placed their property on the market. Future research could address this issue of measuring rental equivalence under rent controls in more detail.

This research focuses on presenting a measure of the rental equivalence of owner-occupied housing. We do not consider the general issue of accounting for other housing measurement in the CPI (for example non-owner occupiers). The broader issue of measuring general rental markets in the CPI or accounting for, and measuring, non-market/social housing costs in the CPI is outside the scope of this paper but is also an avenue that should be explored in future research.

This paper is divided into a number of sections. In Section II we outline the approaches to measuring the cost of OOH and their use in Ireland. It also discusses the strengths and weaknesses of the rental equivalence approach according to the literature. The third section discusses the data and summary statistics. The fourth section presents an overview of the particular method used while the fifth section presents the results. Section VI looks at the impact on the CPI, while a final section offers some conclusions and areas for future work.

II ESTIMATING THE COSTS OF OWNER-OCCUPIED HOUSING – THEORETICAL APPROACHES AND LITERATURE

2.1 An Overview of International Measures and the Irish Context

Ahrens *et al*. (2020) provide a comprehensive assessment of the different approaches used by statistical agencies to measure the cost of housing. These are the payments approach, the net acquisitions approach and the use approach. In summary, the payments approach attempts to measure the cost of OOH by measuring the actual cash flow of households with respect to the costs associated with homeownership. Among others, these costs include maintenance costs, mortgage payments and property taxes. While this approach has the benefit of being based on actual rather than imputed prices, the inclusion of interest payments in a CPI is somewhat troublesome as it represents the cost of borrowing rather than consumption expenditure (Ahrens *et al*., 2020).

The net acquisitions approach measures the spending on net purchases of dwellings by households and the associated maintenance/repair costs. It measures the cost of additions to the housing stock of the household sector and excludes transactions regarding existing dwellings between households. However, in doing so this approach overlooks the consumption services provided by the existing

housing stock. This approach further assumes that the dwelling is composed of a consumption component (the structure itself) and an asset component (the land on which its built). Under this approach the purchase of the land is treated as an asset purchase and is thus outside the scope of a Consumer Price Index (Ahrens *et al*., 2020). The separation of the structure and the land price components is usually carried out using various modelling approaches and thus the resulting index is based on a combination of actual and imputed prices rather than monetary transactions alone (Ahrens *et al*., 2020).

For Ireland, the payments approach is used to calculate the cost of OOH for the domestic CPI, while the net acquisitions approach is used for the computation of the HICP index for submission to Eurostat in line with EU regulations (Ahrens *et al*., 2020). The use approach, which comprises of two sub-approaches, is discussed in more detail in the section immediately below. Neither of the use approaches are currently used in the formal calculation of the CPI in Ireland and this paper makes its contribution to the literature by examining how one of the use approaches – the rental equivalence approach – could be deployed in the calculation of Irish CPI. The use approach is discussed in more detail in the next subsection.

2.2 The 'Use Approach'

The use approach treats the cost of owner-occupied housing services as the opportunity cost of occupying a dwelling. It comprises of two sub-approaches, the rental equivalence and the user cost approach. The rental equivalence approach calculates the cost of OOH services as the forgone rental income due to occupancy. While this can be based off an owners' own estimates, a more robust approach utilises hedonic methods to estimate this cost, usually based on rental data. The second sub-approach is the user cost method which treats the cost of housing services as the cost of holding a house as an asset. This encompasses the cost of finance, forgone investment income, depreciation, maintenance and includes expected capital gains. Ahrens *et al*. (2020) provide a comprehensive assessment of the different approaches used by statistical agencies to measure the cost of housing.

Arbitrage pricing suggests that in the absence of transaction cost and bubbles, rental equivalence and user costs should produce the same level of costs. The fact that this does not frequently happen in empirical applications has been addressed by Verbrugge (2008), who largely attributes this discrepancy to transaction costs, and the lagged response of housing supply. A drawback of the user cost approach is that it is found to be extremely volatile when standard methods of forecasting are used to measure house price expectations. In practice, it is difficult to estimate how expectations of price changes are formed, meaning that few if any statistical agencies have adopted the approach in measuring housing costs. Verbrugge (2008) recommends the rental equivalence approach to compute the cost of OOH services, as the user cost approach is unsuitable as a metric for these reasons.

Aside from these practical limitations, there are also theoretical arguments to suggest the rental equivalence is a more appropriate method. Much of the issues in the treatment of OOH in the CPI are a consequence of the simultaneous existence of OOH as both an asset and a consumption good. The primary goal of any approach to measure the cost of housing is to quantify the rise in price of the consumption services derived from housing. The user cost measures the cost of holding a durable good (asset), rather than the cost of consumption services derived from this asset. Rental equivalence on the other hand quantifies the rent which would be charged on the dwelling were it to be rented. Renting essentially involves the purchase of the consumption services derived from occupancy. Therefore, the rental equivalence approach is a more appropriate measure of the price of consumption services.

2.3 Rental Equivalence Literature
The rental equivalence approach calculates the cost of consumption services derived from OOH to be the same as the cost of services from an equivalent dwelling on the rental market. The standard assumption is that the consumption services from owner occupied and rented dwellings are the same. It should be noted that under this approach OOH can be an entirely different good to that of a rented house, however this difference arises due to the asset component of owning a home, rather than the consumption component derived from occupation of the house. The rental equivalence approach is used in the UN system of National Accounts to account for the consumption of OOH services. Under this system owner occupiers are seen as unincorporated businesses who invest in housing stock and then implicitly rent these services to themselves.

One key advantage of the rental equivalence approach is its theoretical consistency with the stated goals of the CPI. As discussed above, rental expenditure involves the purchase of the services related to occupancy of a dwelling. Therefore, the rental equivalence approach computes the price of consumption services related to a dwelling as being equivalent to the rent which would be charged for a comparable dwelling.

Díaz and Luengo-Prado (2008) construct a model in which owning a house is distinct from renting, in that ownership provides a sure stream of services, while renting allows for a greater choice in the composition of consumption. However, this greater choice is subject to the risk of future price and consumption changes. These trade-offs are essentially choices upon which modern asset pricing theory is based, with the most noteworthy example being the CCAPM introduced by Breeden (1989). Clearly the discrepancies between renting and ownership, derived from transaction costs, uncertainty, etc. are a result of a dwelling being an asset which is owned, while simultaneously providing consumption services. Hill *et al*. (2018) document how rental and housing prices can follow divergent paths over the medium term due to a range of factors, including for example "bubbles" or periods of overvaluation in housing prices. Hill *et al*. (2018) highlight this as a potential

weakness of the rental equivalence approach. Iacoviello (2005) argues that the CPI is a measure concerned with the cost of consumption goods, rather than the cost of holding assets, so monetary policy should not be based on house price movements. Therefore, according to Iacoviello (2005), it should account for the changing prices of consumption services, i.e. rent prices, rather than asset prices, which implies the rental equivalence approach is indeed the appropriate metric.

Another key advantage of the rental equivalence approach over other approaches is the issue of interest rate independence. The primary role of the CPI, aside from being a general metric of the price level in the economy, is to measure the rate of inflation to inform monetary policy decisions. If the policy instrument – interest rates – directly affects the metric in a perverse manner, interpreting inflation signals becomes much more difficult. For example, if interest rates rise because of rising inflation, and the rise in mortgage costs causes a further increase in inflation, this is counterproductive and indeed yields a perverse result from the perspective of macroeconomic stabilisation. While mortgage interest payments are directly included in the cost of OOH under the payments approach, interest rates also have a strong, although less direct, effect on the net acquisitions approach. In this case, the rise in the interest rate should cause a fall in the price of housing under standard asset pricing theory. Rigobon and Sack (2004) found robust evidence of such a causal relationship between US interest rates and asset prices. Such a direct relationship would make the true impact of monetary policy on the economy difficult to interpret.

On a theoretical level, the inclusion of financial costs (such as mortgage and insurance costs) in the CPI is inconsistent with both the scope of the index and its measurement of other prices. For example in the payments index of the ONS, the largest positive contributor to the quarterly changes were changes in the interest rates (almost 2 per cent year-on-year), while factors directly related to housing (major repairs and maintenance, stamp duty) contributed less than 0.3 per cent. The CPI captures the price of consumption, not the costs associated with financing such consumption, or indeed the management of risk in consumption. If the measure of prices for OOH includes financing costs, by consistency this implies the index should include the costs of credit cards, overdrafts and other types of credit used to finance general consumption. For these reasons, either direct or indirect impacts of interest rates on the metric of OOH costs are inappropriate. This aspect provides a benefit of the rental equivalence approach over the alternative methods.

III DATA AND SUMMARY STATISTICS

3.1 Data

In order to estimate the value of OOH using the rental equivalence approach, we mainly use two sources of data, the RTB rental dataset and Census 2016. The RTB

dataset contains information on new tenancies registered with the RTB each quarter, as well as renewals for tenancies which have had the same lease for four years (entitled Part IV renewal tenancies). Contained in this dataset is information on various characteristics of each tenancy, including the location of the property, type of property, number of bedrooms and the length of tenancy. This dataset starts in Q3 2007 but for this research we use an extract of the sample which spans the period Q1 2015 to Q3 2019. These RTB microdata have been used in a number of recent publications (Lawless *et al*., 2018; O'Toole *et al*., 2021; Coffey *et al*., 2021) and form the basis of the Quarterly Rent Index that is published by the RTB and the ESRI.

The other major dataset utilised is the housing profile is Census 2016. This dataset provides information on the number of households in the country by nature of occupancy. This allows us to find the number of households which are owner occupied. Like the RTB dataset, the Census data include information on various characteristics of the property, including the type of property and the region in which the property is located.

3.2 Summary Statistics

In this subsection, we provide some insights into the RTB microdata that is used in the first stage of the analysis. The number of observations (registered tenancies) in the sample is presented in Figure 1. The typical number of new registrations over this time period is approximately 20,000-30,000 but with a slight downward trend towards the latter part of the sample.

Figure 1: Number of Observations Over Time
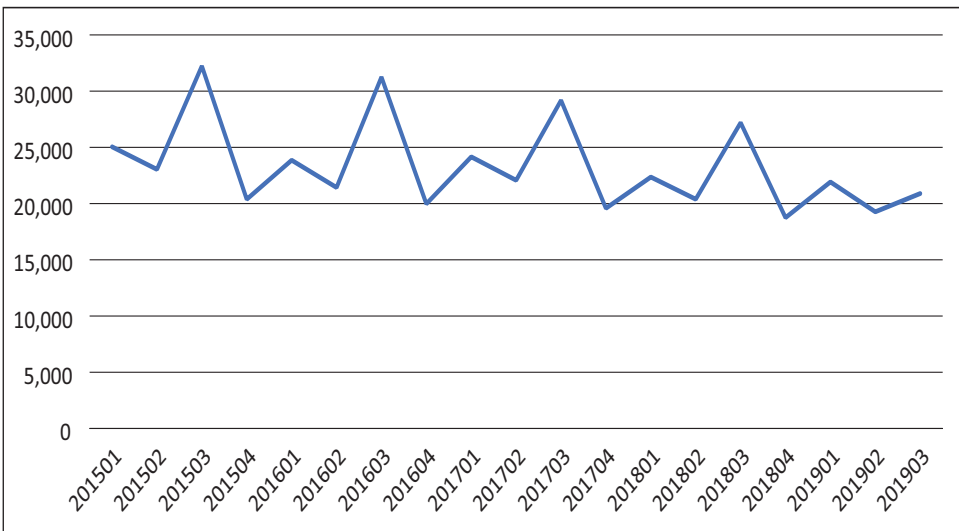
Source: Authors' calculations.

In the RTB data, two types of tenancy are identifiable. First, new tenancies which are required by law to be registered when a new tenant begins a new lease. Second, part IV renewal tenancies which is a stipulation for ongoing tenancies to be registered after four years (this has recently increased to six years). In our data, the majority of the sample are made up of new tenancies. This is likely to be explained by the traditional short-term nature of the Irish private rental sector: most tenants transition often (to other properties or to homeownership) and few end up remaining in the rental sector. However, in some of the more recent quarters, the share of part IV renewals has been increasing.

Figure 2: Share New vs Renewals Tenancies in Data over Time
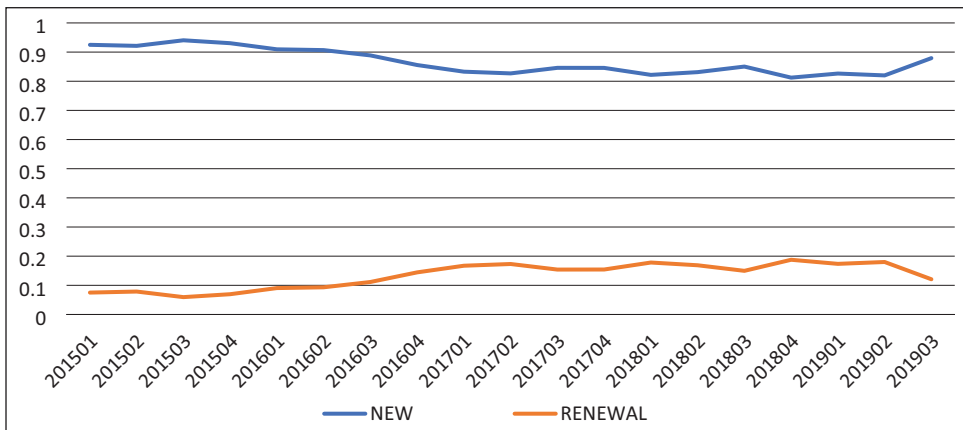
Source: Authors' calculations.

Table 1 provides some summary statistics for our sample. Over the period we are using, the sample contains approximately 442,000 observations and the average monthly rent is just over €1,086 per month. The structure of the housing stock of rented properties can be clearly identified from the data with 17 per cent of properties having one bedroom, 37 per cent having two bedrooms, 30 per cent having three bedrooms and the remaining 15 per cent having four or more bedrooms. Nearly one-in-two properties is an apartment, a further 23 per cent are semi-detached, 11 per cent are detached, while just under 15 per cent are terraced houses. A majority of properties have less than three tenants (nearly 84 per cent) and three-in-four tenancies are 12 or less months in duration. While it is not a required regulatory field in our dataset, approximately one-in-three properties have submitted a BER certificate in the dataset.

Recent research (Coffey *et al.*, 2021) notes the usefulness of controlling for utilities costs in measuring rental inflation. In our data, we have information on other (non-rent costs) that are paid by the tenants. We do not have the monetary amount of the payment; instead, we have an indicator for whether the tenant pays

oil, gas, electricity, waste charges, TV licence and other charges. Approximately 90 per cent of tenants pay electricity, 30 per cent pay gas, 83 per cent pay for the TV licence, 57 per cent pay waste charges while 33 per cent pay other charges.

Table 1: Summary Statistics

Summary Statistics			
	Mean	*Std. dev.*	*Observations*
Monthly Rent (€)	1,086.39	616.6	442,967
Number of Bedrooms			
1	0.170	0.376	
2	0.370	0.483	
3	0.309	0.462	
4 or more	0.151	0.358	
Number of Tenants			
1	0.462	0.499	
2	0.379	0.485	
3	0.079	0.269	
4 or more	0.080	0.271	
Tenancy Length			
1-6 months	0.050	0.217	
7-9 months	0.036	0.186	
10-12 months	0.667	0.471	
more than 12 months	0.248	0.432	
BER Certified	0.300	0.458	
Regions (NUTS3)			
Border	0.063	0.242	
West	0.092	0.289	
Mid-West	0.083	0.277	
South-East	0.080	0.272	
South-West	0.135	0.342	
Dublin	0.386	0.487	
Mid-East	0.108	0.310	
Midlands	0.052	0.222	
House Type			
Detached	0.112	0.315	
Semi-Detached	0.237	0.425	
Terraced	0.147	0.354	
Apartments/Flats	0.504	0.500	

Table 1: Summary Statistics (Contd.)

Summary Statistics			
	Mean	*Std. dev.*	*Observations*
Utilities			
Electricity	0.896	0.305	
Oil	0.298	0.458	
TV Licence	0.827	0.378	
Waste	0.575	0.494	
Gas	0.461	0.498	
Other	0.329	0.470	

Source: Authors' calculations.

The geographic structure of our data is critically important as our aim is to measure owner-occupied housing at a regional level and ensure our estimates of the inflation rate for OOH are as closely aligned to the housing structure indicated in the Census. In Table 1, the distribution of our tenancy data across NUTS 3 regions is presented. The largest share of the tenancies is in Dublin, at just under 40 per cent of the data. The South-West has the second largest share of tenancies at 13.5 per cent. The lowest share of tenancies is located in the Midlands at 5.2 per cent of the total.

To consider the trends across regions, the average rental values by region and quarter are presented in Figure 3. It is clear that rents in Dublin market far exceed

Figure 3: Mean Monthly Rent over Time
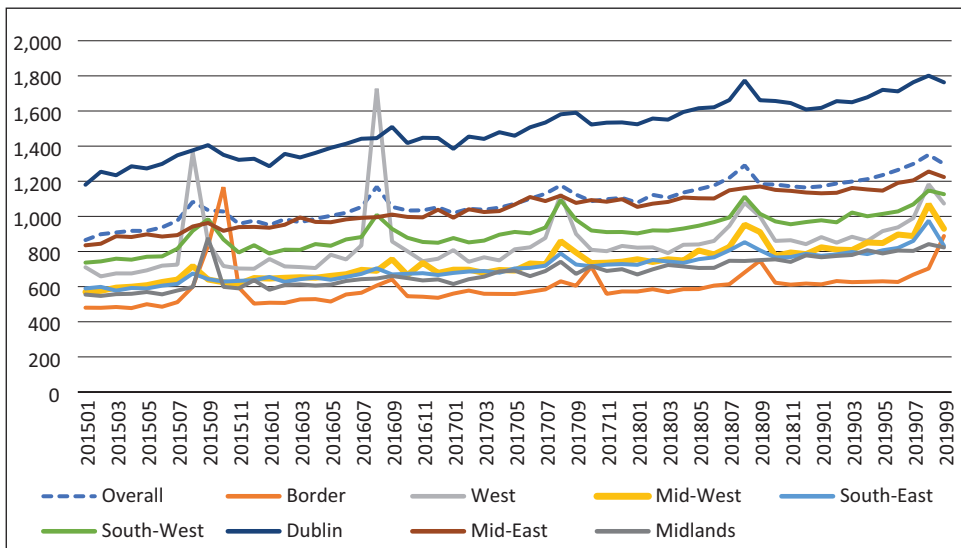
Source: Authors' calculations.

the levels in other areas, with an average of approximately €1,700 in Q3 2019. The lowest rents over the period have been recorded in the border region. In general, all regions appear to display an increasing trend in the average level of rents over the period presented.

IV ESTIMATION AND INDEXATION

The rental equivalence approach involves the estimation of the rent which would be charged on an OOH, were it available on the rental market. In order to estimate the rents which are representative of owner-occupied properties, we estimate hedonic models to match rental inflation series for properties in a similar region and housing type for the owner-occupied stock. The hedonic model exploits a rolling time dummy method in order to estimate price changes as follows:

$$lnR_{i,t} = \alpha_1 + \boldsymbol{\beta X_{it}} + \gamma_{t,r,h}(T \times R \times H) + \varepsilon_{i,t} \qquad (1)$$

Where *lnR* is the rent in tenancy *i* in period *t*. The rental index, which we use in this our baseline model, is based on new tenancies data. Thus, it can be considered a market price or flow rent. In the next section, we compare how this would compare with a rental index based on the stock of tenancies. Note that this is not a panel dataset, rather a pooled cross section of tenancies. *X* is a vector of additional explanatory variables which we vary across the specification and are discussed below. The coefficients $\gamma_{t,r,h}$ provide a trend for each housing type which are represented by the vector *H*. *H* includes indicators for four property type categories (detached, semi-detached, terraces and apartments). *R* is a vector that contains dummy variables to identify the eight NUTS3 regions (Border, West, Mid-West, South-East, South-West, Dublin, Mid-East, Midlands). *T* is a vector of monthly time dummies. The interaction of these variables provides a time series trend of rents for each housing type and region.

The key variables of interest are the monthly dummy variables, which allow us to estimate rent indexes for tenancies which exhibit specific characteristics and, in turn, match these rent indices with owner-occupied properties which have the same characteristics. Indices are estimated from January 2015 to September 2019 for new tenancies, of which there are approximately 385,000 agreements in our sample. The results are presented in Table 2.

In terms of the specifications, we run four hedonic models as outlined in Table 2. The first model contains only those variables in the control vector *X* that are specifically related to the property. These are the number of bedrooms and whether the building has a BER certificate (in the data). The property types, regions and time effects are all included in the interactions noted in Equation 1.

Table 2: Regression Output Table

	(1) Basic	(2) Basic + LEA	(3) Basic + LEA + Tenancy	(4) Advanced
Dependent Variable	Monthly Rent[†]	Monthly Rent[†]	Monthly Rent[†]	Monthly Rent[†]
1 bedroom dwelling	0	0	0	0
2 bedroom dwelling	0.292***	0.296***	0.282***	0.273***
3 bedroom dwelling	0.432***	0.437***	0.415***	0.408***
4+ bedroom dwelling	0.631***	0.591***	0.561***	0.552***
BER Certified	0.0550***	0.0422***	0.0404***	0.0334***
Interaction between Region, Time and Property Type	Yes	Yes	Yes	Yes
Sub-Regional Location Controls (LEA)	No	Yes	Yes	Yes
Controls for Number of Tenants				
1 Tenant	–	–	0	0
2 Tenant	–	–	0.0549***	0.0524***
3 Tenant	–	–	0.0637***	0.0617***
4+ Tenant	–	–	0.0864***	0.0835***
Controls for Tenancy Length				
Tenancy Length: 1-6 months	–	–	–0.0502***	–0.0488***
Tenancy Length: 7-9 months	–	–	–0.0292***	–0.0164***
Tenancy Length: 10-11 months	–	–	0	0
Tenancy Length: 12+ months	–	–	–0.0724***	–0.0698***
Controls for Utility Costs				
Electricity Included in Rent	–	–	–	–0.0417***
Heating Oil Included in Rent	–	–	–	–0.0265***
TV Licence Included in Rent	–	–	–	0.0327***
Waste Costs Included in Rent	–	–	–	–0.0390***
Gas Included in Rent	–	–	–	0.0615***
Other Utilities Included in Rent	–	–	–	0.0348***
Constant	5.676***	5.898***	5.932***	5.951***
Observations	385,230	385,230	385,230	385,230
R-Squared	0.581	0.693	0.700	0.705

Source: Authors' calculations.

Note: [†]Natural log of monthly rent used as the dependent variable in regressions. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

As geographic variation is critically important in determining the level of rents paid per property, in column (2) we further augment the specification to include dummies for the local electoral areas that each property is located in. We therefore include a vector of 166 additional dummies to control for any regional variation within the NUTS III regions. The inclusion of this variable is important and adds 11 percentage points to the R-squared. While it is not the main interest of this research, the effect of specific variables on bedroom numbers would appear to be in line with the expectation that the more bedrooms the property has, the higher the rent level associated with it.

As our main aim with the regression model is to estimate coefficients for the property-type-region-time dummies to create an index, we also wish to control for other factors which may cause variation in the rent level and be correlated with regions and housing types. We explore our data by controlling for the number of tenants, and the periodicity with which tenants pay their rent to ensure this variation is removed from the error term. It is important to note that the determination of rent levels and tenancy controls is likely endogenous, but we included these variables in the specifications to ensure as much variation as possible is purged from the error. Finally, we also include whether the tenants pay other utilities costs such as electricity, heating, gas, waste etc. as in Coffey *et al*. (2021), to ensure variation in rental levels that are due to the co-payment of services is controlled for across properties. The IMF CPI handbook on measuring rental equivalence clearly states that these factors (electricity etc.) must be excluded from the measure of housing services in any calculation (IMF, 2020, p. 45). We therefore use this specification as our benchmark. These specifications are in columns (3) and (4). The index that is based on each of the four models is presented in Figure 4. The indices are relatively similar, and we use model (4) which contains the largest number of controls as our main specification.

Using the coefficients from the interacted variables in the above regression, we construct a unique rent index for each of our 32 groups. We then turn to the owner occupier data in order to estimate the appropriate weight for each of these indices. The owner occupier weights are calculated from the Census 2016 data. The Census contains information on the region and the property type of owner-occupied dwellings. The weights are presented in Table 3.

They can be interpreted as the percentages of each type of housing present in each region. For example, the largest concentration of semi-detached and terraced houses and apartments is in Dublin (11.6 per cent, 7.5 per cent and 2.2 per cent, respectively), while the largest concentration of detached houses is in the South-West region (9.2 per cent). The coefficients on the property-type-region-time dummies are used to generate an index for each of the 32 region-property type combinations. These indices are then brought together to form one index using census weights that reflect the composition of the owner-occupied housing stock. The indices based on each of the four models outlined in Table 2 are shown in Figure 4.

Table 3: Census Weights of Property Type by Region for Owner Occupier

	Detached House	*Semi-Detached House*	*Terraced House*	*Apartment*
Border	0.071	0.013	0.005	0.001
West	0.080	0.015	0.005	0.001
Mid-West	0.070	0.023	0.012	0.001
South-East	0.063	0.020	0.010	0.001
South-West	0.092	0.034	0.020	0.002
Dublin	0.038	0.116	0.075	0.022
Mid-East	0.079	0.046	0.017	0.004
Midlands	0.044	0.014	0.005	0.001
Total:				1.000

Source: Central Statistics Office.

**Figure 4: Comparison of Indices Based on Different Models**
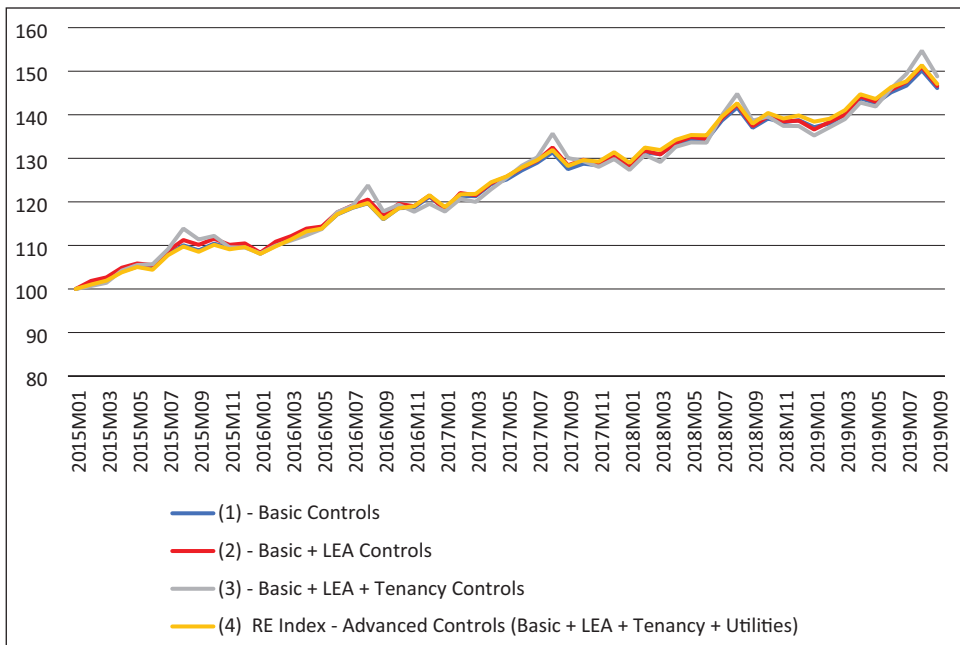
Source: Authors' calculations.

We use the RE Index (4) regression model as the baseline specification used to generate the rental equivalence indices that follow. Taking the RE Index based on the main regression model we show the impact of weighting the indices to take into consideration the regional/housing type split of the OOH stock (Table 3) in

Figure 5 where we compare it to an index where the adjustment is not made (only a time dummy is included along with other controls). When we apply these weights to each index and sum them together, we are left with one final index for all OOH. Applying these weights to the corresponding rent indices ensures that the final rent index is representative of the stock of OOH.

Figure 5: OOH Weight Adjustment vs No Weights Adjustment
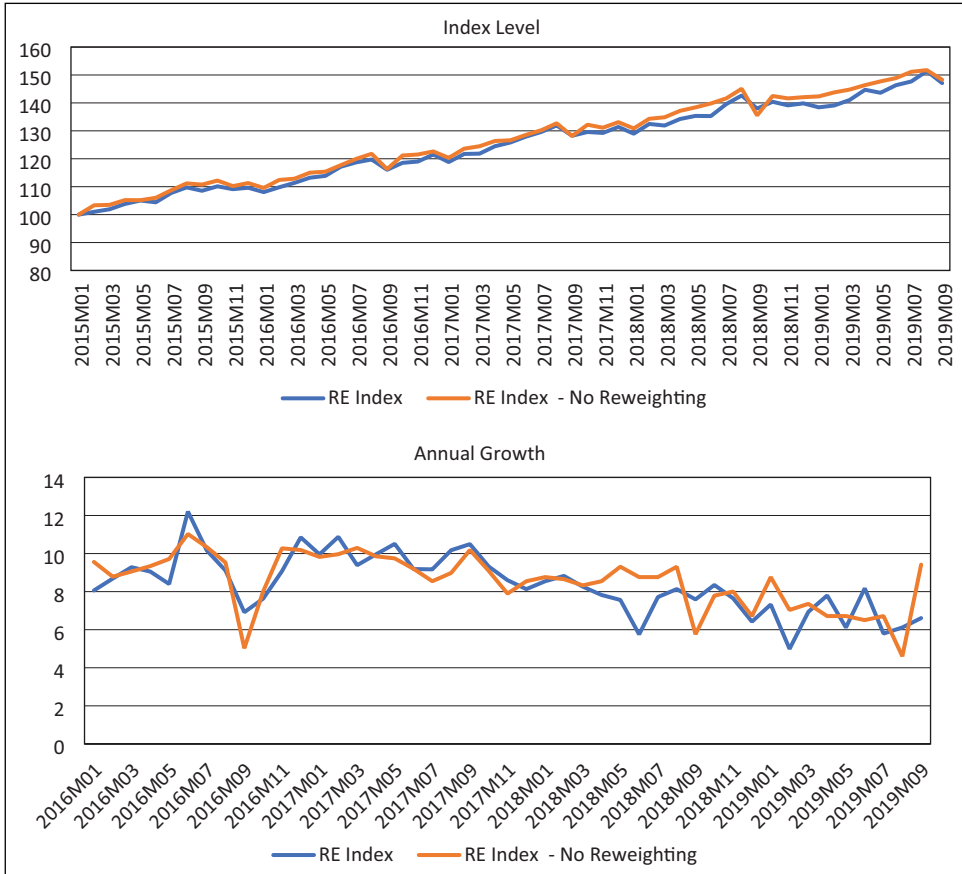
Source: Authors' calculations.

V ROBUSTNESS CHECKS – DATA CONSIDERATIONS

Two specific issues are worth considering in relation to the creation of indices for owner-occupied rental housing. First, should the data reflect new market rents or rents on the overall stock of rental housing? Second, we benchmark our index relative to two other market rent measures in Ireland from the CSO and one from a specific market provider who reports advertised rents, Daft.ie.

5.1 Using Market Price (Flow) vs Existing Contract Rental Prices (Stock)?

A considerable debate in the existing literature regards whether measuring rental equivalence should be based on market prices on new contracts (or flow prices as in IMF, 2020) or whether it should also reflect the prices of the existing within-tenancy rental contracts in the market (or stock prices). In our approach to date, we have used market price or flow rents as we feel these better capture the definition of the opportunity cost of the housing services to the owner occupier i.e. the rental equivalence measure should capture how much they would receive if there were to place their property on the rental market today. To strictly follow the definition of an appropriate rental equivalence measure as outlined in the IMF Handbook on measuring rental equivalence, market rents should be used as the measure i.e. "the prices may be estimated using the market rents payable on rented accommodation of the same type" (IMF, 2020, p.45). This research is in line with Coffey *et al*. (2021).

However, the IMF handbook does also specify that the stock measure may be a more accurate indicator to measure owner-occupied housing, especially in the case where insufficient information is available to appropriately match across properties to approximate the OOH housing stock. Given the richness and depth of our sample of data, we have sufficient information to be able to match property types and regions so therefore we can accurately measure the opportunity cost. Regardless of this, and given the specification in the CPI manual to move towards stock prices, we use data from our sample on "renewal tenancies" to attempt to provide an estimate for Ireland of what such a measure might look like if stock rents were to be used. Furthermore, if the average length of tenancies has increased in Ireland (as has been documented in recent research (Causa and Pichelmann, 2020)), and fewer new tenancies are being agreed, this could provide a challenge to accurately map across owner occupiers' and renters' housing types and thus point towards using a stock index instead.

A couple of points to note in relation to the data for this exercise. At present, there is no annual registration of tenancy data for all rental contracts in Ireland that can be used. To measure the stock of rental controls, we utilise a series in our dataset which relates to part IV tenancy renewals which are noted above. To recall what these data capture, by law, a landlord must re-register a tenancy with the RTB if the tenancy has been at least four years active. Thus longer-term contracts are picked up in our database at this point. These data provide a snapshot of the stock rental prices that we can use. The share of renewal tenancies is presented in the data section above and is between one-in-ten and one-in-five, rising over time as households have been remaining longer in their tenancies in Ireland (Causa and Pichelmann, 2020).

For this exercise, we take the renewal tenancies in our database and estimate a rental equivalence index for these households using our main benchmark

specification from above.[2] We then transform this into an index using the same weighting structure across regions and property types and compare the flow and stock indices in Figure 6.

Figure 6: New (Flows) vs Renewals (Stocks)
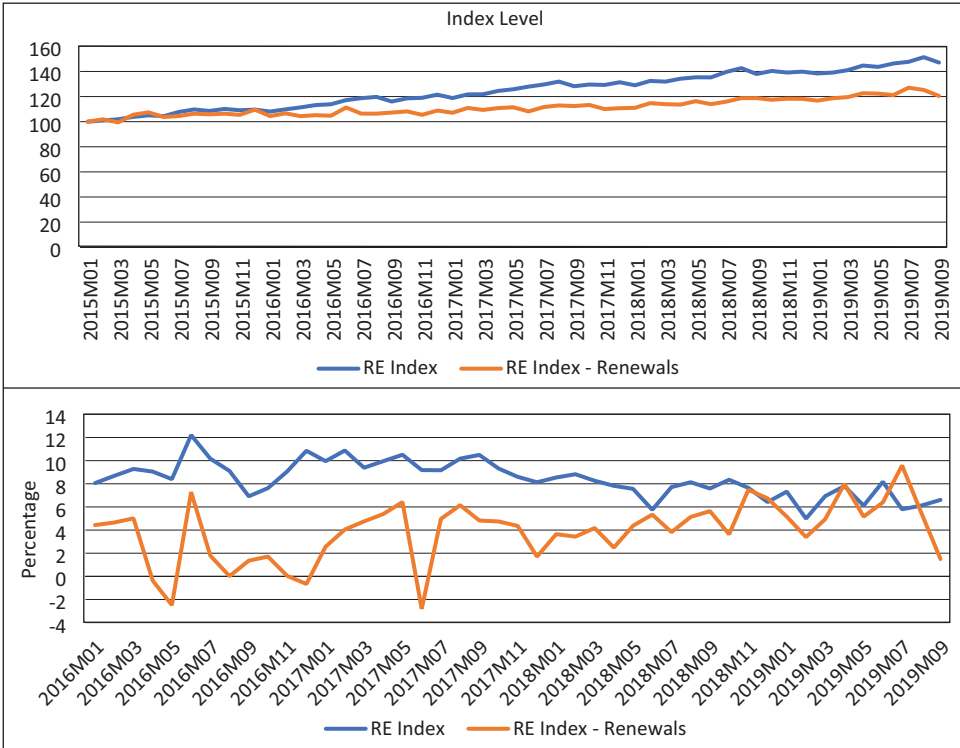
Source: Authors' calculations.

It is clear that the index is lower for the existing stock of tenancies relative to the new flow market rent tenancies index. This is unsurprising and reflects the lower level of rents that has been documented by market commentators for stock relative to flow rents for Ireland (Daft.ie, 2017; RTB, 2021). However, it is notable that towards the end of the sample, the inflation rate for renewal tenancies begins to rise markedly and the annual growth in fact exceeds that for new tenancies later in the period under investigation. The important point to note from a CPI calculation perspective is these two measures are different and therefore the selection of the appropriate measure will have implications for the resulting general inflation statistics. In particular, if the new rental data are selected, over the time period we

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[2] Estimations and sample data are not presented for brevity but are available from the authors on request.

consider, this would have the effect of raising the inflation rate of OOH and therefore passing a higher housing cost estimate through to the headline CPI.

5.2 Other Data Benchmarks

While we have utilised the official legal tenancy register in Ireland from the rental regulatory body, the RTB, it is useful to benchmark our data in the context of other datasets for Ireland. It must be noted that we only provide comparisons here of rental of rental price trends rather than OOH rental equivalence comparisons. To replicate what we present in this paper for rental equivalence for the other datasets would require access to microdata for these data which for which we do not have permission.

Two other useful rental datasets can be drawn on as a comparison. First, the Central Statistics Office uses a survey of rental market auctioneers to provide a private rent index in the current CPI. This survey provides information on the typical rent that could be expected to be charged on a property in the market. It is unclear as to whether these data relate to both new and existing rental contracts from current publicly available information.

Second, a series is available on advertised new market rents from the property website Daft.ie. The series provides considerable detail on the availability of properties and the asking prices for rents for those properties which were listed on the website, and the quarterly reports which are widely reported in market commentary.

To compare our data with these other datasets, we take our unweighted rental index from Figure 5 and plot this against the monthly data for the CSO index (in blue) and the Daft.ie series.[3] It is clear our index sits in between the lower index from the CSO and the highest index which is from Daft.ie. It is likely therefore that if the Daft.ie data were used to measure rental equivalence, the inflation rate would be higher than ours whereas the estimate based on our index would be higher than that using the CSO index.

In terms of the pros and cons of using our data relative to other datasets, using the Daft.ie information would likely be less appropriate than ours as it only captures listings which come through one specific website. If contracts are agreed by word of mouth or come through other social media or websites, these would not be captured. It is not possible to gauge the extent to which data would be missed based on this caveat. The benefit of using our data over the CSO data would be that our own index is based on actual agreed tenancies as opposed to the expectations of property experts. Our sample is also considerable in terms of the number of registrations. However, there are cons to our approach in that stocks are only measured by renewal tenancies which may not be a good guide for existing tenant rents.

[3] Daft.ie presents the data in quarterly format so we have held the data constant within the quarter to match to our monthly indicator.

Figure 7: Robustness – Data Comparison
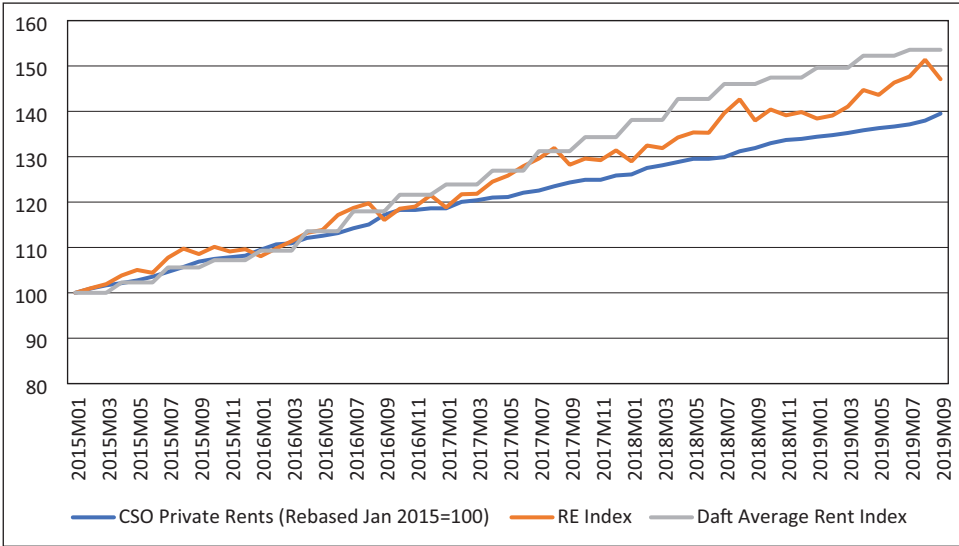
Sources: CSO, Daft.ie and authors' calculations.

VI TESTING THE IMPACT ON INFLATION

Having estimated our rental equivalence index for the cost of OOH, the next step is to incorporate this proposed new measure of housing cost into the CPI. This allows us to assess the impact of using the rental equivalence approach on the overall rate of inflation. We generate an alternative CPI using rental equivalence for Ireland for the period December 2017 to September 2019. To do this we first have to remove the items specific to the payments approach from the CPI basket and then replace them with the rental equivalence approach index. To avoid double counting under the rental equivalence approach, it is important to remove the costs normally borne by the landlord as these should have been factored into the rent setting (IMF, 2020). Ahrens *et al*. (2020) categorise the items they deemed specific to the payments approach in the Irish CPI basket into three groups. The items we treat as specific to the payments approach, and consequently remove from the CPI basket, are those core items that Ahrens *et al*. (2020) allocated to the primary group "OOH1". The full list of items removed from the consumer basket can be found in the Appendix in Table A.1. As a robustness check the items in the other groups were also removed to test the impact on the resulting CPI. The impact of removing items in addition to the core payments approach items was found to be minimal (see Appendix for more detail).

In order to accurately integrate our RE index into the CPI, we must first determine its appropriate weight. The CPI is made up of a basket of goods and

services, with each item having its own unique price index. These individual price indices are brought together by assigning each item a weight, which is calculated based on the item's importance to average household spending.[4] Generally, the weights within the CPI associated with a given sub-index or elementary aggregate (the lowest level of calculation within the CPI) should correspond to the share of total household expenditure that is accounted for by spending on those items. Goods and services included in the CPI basket are classified into various divisions and sub-divisions using the COICOP classification system.[5] The weights at a 4-digit COICOP level are updated annually using National Accounts data while the share of this weight allocated to each item within the given 4-digit COICOP group is set using the Household Budget Survey (HBS) and is only updated when the results from a new HBS are available. The weights applied by the CSO in any given year (year t) are set in December of year t-1 using the most recent National Accounts data available at that time (National Accounts for year t-2). In order to ensure that the weights approximate as closely as possible the consumers' expenditure pattern of the previous calendar year, the National Accounts data for year t-2 are uprated to December of year t-1 with relevant price data before they are used to calculate the weights for the CPI in year t.[6] The weight given to OOH under rental equivalence stems from the level of imputed rents in the National Accounts data. The value of imputed rents is calculated by using census data to apply the rent associated with dwellings of a certain type to similar owner-occupied properties. For intercensal years the CSO grows this figure forward using a rental price index and an indicator of the stock of quality adjusted housing.

Thus, the first step is to take the 2016 (Census year) value of imputed rents and uprate it to December 2017 using our RE index. We compare the uprated National Accounts value of expenditure on imputed rents to the uprated value of National Accounts expenditure on the commodity group Breads and Cereals which also derives its CPI weight from the National Accounts and is already included in the CPI. Breads and Cereals was selected as a reference for a number of reasons but chief among them was the relative stability of the commodity group's weight in the CPI basket over time. The logic behind this step is that if the uprated value of imputed rents is ten times greater than the uprated value of Breads and Cereals from the National Accounts data then the weight allocated to our RE index should also be ten times greater than the CPI weight of Breads and Cereals. By scaling up the existing weight of Breads and Cereals we can establish the appropriate weight of OOH under the RE approach in the CPI.

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[4] For more detail on how the CPI weights are computed see: https://www.cso.ie/en/media/csoie/methods/consumerpriceindex/updatingofcpiandhicpweights16.pdf.

[5] COICOP stands for 'Classification of Individual Consumption by Purpose' see CSO (2016a) for more details.

[6] For more detail on how the CPI weights are computed see CSO (2016a) and CSO (2016b).

We then reweight all remaining goods and services in the CPI to take into account the removal of the payments approach items and the introduction of the rental equivalence index. The resulting weights are used for the alternative CPI under rental equivalence for 2018. The RE index from Figure 5 is used to capture the change in price over this time for OOH while the other goods and services in the updated CPI basket derive their inflation rates from the same price indices as before.

The steps to generate a CPI using rental equivalence for 2019 are broadly the same however there is an extra step regarding the initial value of imputed rents from the National Accounts. We take the 2016 (Census year) value of imputed rents from the National Accounts and grow it forward to 2017 using our RE index. In doing so we are replacing the rental price index mentioned above used by the CSO and we are implicitly assuming that there is no change in composition of owner-occupied housing between 2016 and 2017. This step is carried out in order to ensure that there is consistency between the approach used to give OOH its weight and the approach used to give OOH its inflation rate under rental equivalence. The subsequent steps follow those outlined above.

Table 4 shows the weight given to the cost of OOH in the CPI under the two approaches for December 2017 and December 2018. The weights for all the items in the CPI basket sum to 1. The weight allocated to OOH increases dramatically under rental equivalence when compared to its weight under the payments approach. Weights here refer to weights under OOH1 for our RE index generated from our main RE index regression.

Table 4: Weight of Items

CPI Weight of Owner-Occupied Housing		
	Weights set December 2017	*Weights set December 2018*
Payments Approach Items	0.05	0.04
Rental Equivalence	0.18	0.17

Source: Authors' calculations.

This gives us a new, alternative CPI, which we calculate for the period December 2017 to September 2019. Figure 8 shows the new CPI indices along with the actual published CPI for comparison. The CPI including the rental equivalence measure of OOH is shown to be significantly higher than the published CPI. The difference between the CPI as calculated by the CSO using the payments approach and the CPI we calculated using our RE index increases across time and as of September 2019, the overall price level was 1.6 percentage points higher. This illustrates the potentially significant impact of incorporating the rental equivalence approach

within the CPI. For illustration, we have also included the basic model with LEA controls and property characteristics to address the case that the endogeneity of tenancy controls may be impactful. We also include the renewals (stock) index as well as a comparison. The impact is still quite substantial.

Figure 8: Comparing our CPI using RE to Published CPI
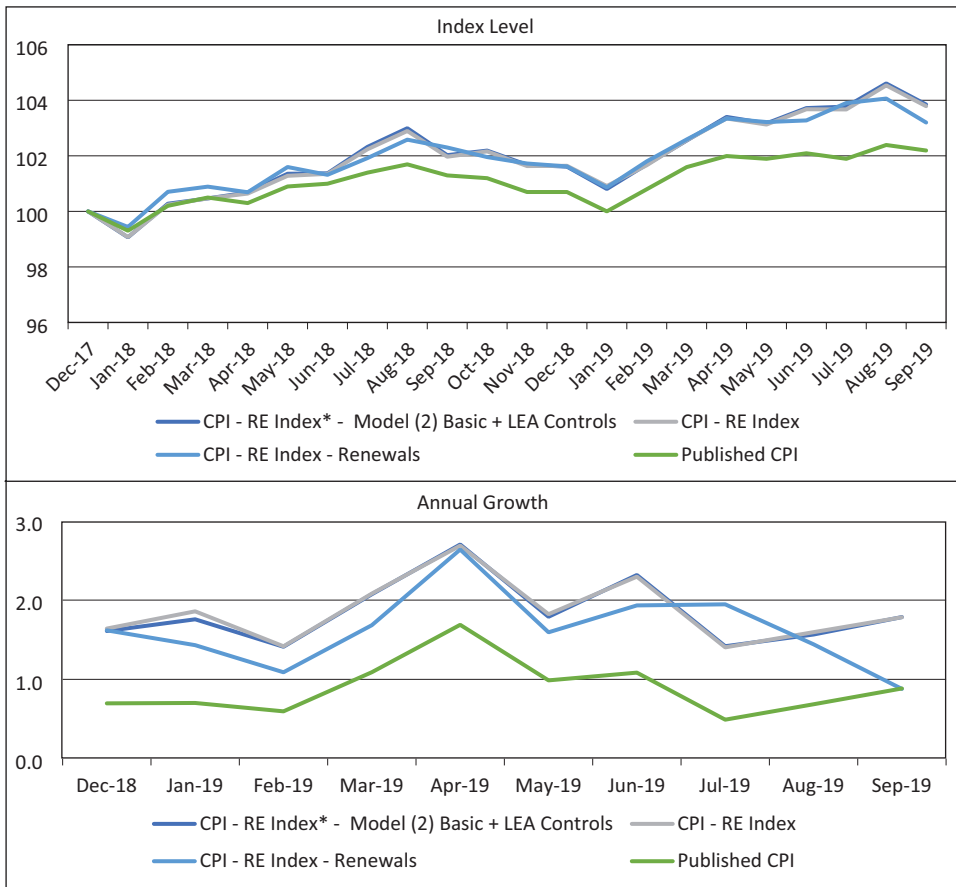
Source: Authors' calculations.

VII CONCLUSIONS

In this paper we provide a rental equivalence estimate for the cost of housing in Ireland for owner occupiers based on new market rents from the RTB tenancies register. This approach is proposed as a complement to the existing approaches used by the CSO in measuring the cost of housing, and the impact on inflation is explored if such an approach were to be used. Theoretically, a suggested advantage

of the rental equivalence approach is the isolation of the consumption element of owning a home, which is consistent with its usage as a consumer expenditure as per the calculation of the CPI. It is also less susceptible to the issue of interest rate interdependence, which can characterise other approaches.

By including the OOH measure based on the rental equivalence approach, the alternative CPI is shown to be significantly higher than the actual index. By September 2019, the difference between both indices is 1.5 per cent. This demonstrates the impact of the approach on consumer prices and also highlights the considerable variation that can pass through to overall inflation when changes to its measurement occur. For a large expenditure item like housing, the precise measure used is important and considerable research is needed to explore the advantages and disadvantages of the various approaches to accurately measuring housing cost in the CPI.

There are however some issues with the implementation of this approach to the estimation of OOH equivalent rent. On a practical level, the imputation of consumption services from data on rental transactions is reliant upon these transactions reflecting the true value of consumption services, as determined by the working of a functional market. This requirement is compromised by the fact that several areas in Ireland have been declared as "rent pressure zones",[7] where price rises for rental units are restricted to 4 per cent annually. Units which are designated as new to the market, including units which have undergone major renovation, are excluded from this regulation, as they do not have a base price. While a rental index aims to capture inflation of actual rental prices keeping quality constant, the hedonic index needed to calculate OOH costs should reflect market fundamental rents, rather than observed rents. Therefore, these rent controls present a challenge to the construction of such an index. Simply excluding such observations from the sample would yield a model of unrestricted rental prices, however this sample may suffer from selection bias and may not be representative. Therefore, it may be desirable to estimate the underlying parameters for dwellings subject to these controls. Future research will look at addressing this issue. Indeed, the IMF (2020) handbook notes that rental equivalence is not appropriate under rent controls. Future research should explore the extent to which this issue is impactful on inflation series for Ireland.

The issue of whether to use data on stock (existing) or flow (new market) rental controls is also of importance. In our comparisons above, we have identified that considerable differences can exist in estimated inflation rates depending on which approach is used. Indeed, a further limitation of our approach is that our data on the stock of rents are taken from a limited sub-sample of the existing contracts, those that become renewals through part IV tenancies. While in our approach indices using both methods have a large and similar impact on CPI, future research

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[7] Rent pressure zones were introduced in Ireland in the Planning and Development (Housing) and Residential Tenancies Act 2016.

should explore how to use new information that may become available once the RTB begins to collect an annual tenancy rent register from 2022. These may allow a more accurate measure of the stock rents over time than could be completed using the part IV renewals in our data.

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APPENDIX

Table A.1: Payments Approach Items

	OOH1	Mortgage interest Building materials House insurance – contents (non-service) House insurance – dwelling Miscellaneous goods and services
	OOH2	Plumbers' services Electricians' services Services for maintenance of heating systems Painters' services Carpenters' services Other house maintenance services Solicitors' Fees
OOH3		Floor Tiles Paint Paint Brush Paint roller Varnish DIY household maintenance products Taps/Mixer Taps

Source: Ahrens *et al.* (2020).

Table A.2: OOH Index Basket Composition Comparison

	Average Dec-17 to Sept-19
CPI inc. RE (OOH1)	101.9
CPI inc. RE (OOH2)	101.9
CPI inc. RE (OOH3)	101.9

Source: Authors' calculations.

The CPI indices produced based on the three groupings of payments approach items do differ but only fractionally. In fact, rounded to one decimal place, the indices are all identical in all periods considered except one – June 2018 where the CPI produced using the OOH1 list of items equalled 101.4 while the other two indices had a value of 101.3.