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A review of the methodologies used in compiling owner-occupiers' housing indices

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Abstract: This paper examines the manner in which owner-occupiers housing costs are incorporated in the official inflation index. In particular, the focus is on the net acquisitions and the payments approach, which are currently used by the Central Statistics Office (CSO). The paper provides a detailed overview of the two approaches, along with some suggestion for further refinement.

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Introduction

The incorporation of (owner-occupied) housing costs into the headline measure of inflation is an issue that has long been debated among statisticians and economists. To this day, there is little consensus as to whether the costs related to owner occupied housing (OOH) should be included in the measure of inflation; and, if they should be, which methodology should be used in order to produce an accurate measurement of the costs necessary to meet the requirements of a general inflation measure (such as the CPI). Most statistical institutes opt for the exclusion of housing costs from the measure of inflation, arguing that the opposite would imply the incorporation of an asset into an index whose scope is to measure the change in prices of consumption goods and services. For example, a recent report by the European Commission (2018) argued, almost 20 years after the publication of the first pilot study in 2001, against the inclusion of the owner-occupied housing index in its current form into the Harmonized Index of Consumer Prices (HICP) (the inflation and price stability indicator utilized by the European Central Bank (ECB)). The report also raises issues about the practical implementation of an owner-occupying index and, in particular, the timeliness of the release of the indicator[1]. In Ireland, the treatment of housing in the CPI has been examined by the CSO for almost a decade. In 2010, a report by the National CPI Review Group was published, which highlighted a number of issues relating to the measurement of housing costs and the appropriate methodology of incorporating such costs into the measure of inflation.

Housing related expenditures constitute a significant part of households' final consumption expenditures. Evidence from the EU SILC survey indicate that in 2017, for the EU-19, 25% of the population spends more than a quarter of their disposable income on owner occupation related costs, with the corresponding figure for Ireland being 14.4% of the population. Another statistic indicating the importance of owner-occupied housing is that almost 70% of households are owner-occupiers; in particular, for the EU-19, 26.5% of the households lived in an owner-occupied home with a mortgage and a loan, while 42.8% lived in an owner-occupied home without a mortgage or a loan. The corresponding figures for Ireland are 31.8% and 37.8%, respectively. Moreover, from a more aggregate perspective, the importance of housing and its impact on overall macroeconomic performance and consumption expenditures (e.g. see Leamer (2008)) indicate that the accurate measurement of housing related costs and their incorporation into the general inflation measure could prove to be useful for the design of macroprudential and monetary policy (e.g. see Hampl and

[1] As per the European Commission guidelines, the HICP measure needs to be compiled and released by the member-states within 15 calendar days after the end of the reference month. This is not feasible given the current form and implementation approach of the owner-occupied housing index.

Havranek, 2017 and Ambrose et al., 2018). Furthermore, understanding the impact of housing cost on consumption is critical to determining the macroeconomics dynamics of consumer spending. In an Irish context, for example, McCarthy and McQuinn (2017), using a combination of loan-level and survey data, estimate that the elasticity of consumption with respect to house prices is 11 per cent, which they note as being quite high by international standards.

This paper is the first output of a research project between the Economic and Social Research Institute (ESRI) and the Central Statistics Office (CSO), which is examining the manner in which housing costs are incorporated in official measurements of inflation. As such the purpose of this paper is to examine the net acquisitions and the payments approach to measuring the cost of housing in inflation. These measures are currently those used by the CSO for the compilation of an owner-occupied housing index. The paper provides an overview of the two methods, along with a review of their implementation by the CSO and some suggested improvements. Future research in the project will focus on the use approach and in particular the rental equivalence method.

From an academic perspective, the first to argue for the inclusion of housing prices in the measure of inflation were Alchian and Klein (1973), who claimed that the inclusion of such prices in the CPI was necessary to ensure an accurate measurement of inflation. In the same vein, Goodhart (2001) argues for the importance of including housing prices in the inflation measure and presents econometric evidence which suggest that changes in house prices are closely related to changes in inflation and, output. However, Goodhart states that the Alchian and Klein approach is infeasible as it would require assigning large weights on asset prices relative to goods prices. Diewert and Nakamura (2009) argue that a direct measure of house prices, instead of rents, should be included in the CPI, to accurately capture the housing cost component. On the other hand, some economists (see, for example, Bernanke and Gertler (2000)) argue that the inclusion of asset prices in the CPI should be avoided, as they are quite volatile and would, as a result, render the CPI measure unstable and, therefore, not useful for the conduct of monetary policy. As already mentioned, another argument against the inclusion of owner-occupied housing in the CPI is that while houses are a durable good, they require a substantial investment by the household. Consequently, the investment component of the house is often quite large compared to the consumption component, which argues for its exclusion from the CPI.

National statistical institutes typically follow one of three approaches in measuring OOH costs: the *payments* approach, the *net acquisitions* approach and the *use* approach (which has two forms, the

user cost approach and *rental equivalence* approach[2]). In general, the payments approach tries to measure the actual cash flow of households with respect to owner occupation costs (such as, property taxes, mortgage payments etc.), the net acquisitions approach measures the spending on net purchases of dwellings by households and the associated maintenance and repair costs, while the use approach tries to approximate the cost of own occupation using actual, observable rents paid by private renters.

The rest of the paper is organized as follows: section 2 provides an overview of the methods used for the calculation of owner-occupied housing costs. Sections 3 and 4 present, in detail, the net acquisitions and the payments approach, respectively, along with some suggestions for a refinement of the methods as currently implemented by the CSO. A final section, Section 5, offers some concluding thoughts.

An Overview of the Methods

As already stated, the lack of consensus concerning the appropriate approach for measuring owner occupied costs has been highlighted in a number of surveys: first, a survey conducted by the ONS[3] indicates that out of the 29 countries surveyed, 13 used the rental equivalence approach, 3 used the net acquisitions approach and only one, Ireland, the payments approach[4]. It is interesting to note that, the second most popular choice of Statistical Institutes surveyed at the time was to exclude owner occupied costs from their headline CPI measure. Data presented in Hampl and Havranek (2017) show that if owner occupied housing costs are to be included in the CPI, then the rental equivalence approach is chosen by the majority of Statistical Institutes, while the OECD (2018) reports that 11 of the G20 economies still exclude these costs from their headline CPI measure and the majority of the rest utilize the rental equivalence approach[5].

The payments approach assumes that owner-occupied housing services are the same in each period and its aim is to measure the ongoing costs of living in the dwellings. It focuses on the costs incurred by households when purchasing housing goods and services and, in particular, the actual payments

[2] However, the user cost approach has been used by a very small number of National Statistical Institutes
[3] See, Johnson (2015), pg. 125
[4] Hill et al. (2019) mention that Austria is also using the payments approach for the calculation of the owner-occupied housing costs. The ONS in the UK also produces an index based on the payments approach; however, they clarify that it is a purely experimental index to be used with caution.
[5] It should also be noted that all EU member-states, following the guidelines set by the European Commission, produce a quarterly owner-occupied housing index following the net acquisitions approach. This is in addition to the approach that each national statistical institute has chosen for the production of the domestic indicator.

made to cover these purchases. These payments include, among others, mortgage interest payments, insurance costs, maintenance etc. Despite the fact that under this approach there is no need to impute prices, the inclusion of interest payments is somewhat troublesome in the context of the CPI, as it does not necessarily represent consumption but, rather, the cost of borrowing money[6].

The net acquisitions approach assumes that the dwelling comprises of an asset component, namely the land on which it is built, and a consumption component, the structure. Its focus is on measuring the change in the transaction prices of dwellings that are new to the household sector, as well as the goods and services purchased by households in their capacity as owner-occupiers. Under this approach, prices are recorded at full market prices and the overall value of the acquisition is allocated in its entirety to the time of the purchase, irrespective of when the consumption of the good actually starts. Although this assumption may conceptually seem at odds with the fact that a dwelling is a durable good with longer life compared to other durables, it ensures that all durables are treated in the same way and, additionally, it ensures consistency with all the other elements of the CPI. An important limitation of the net acquisitions approach is that by taking into account the full transaction price of the dwellings, inevitably the price of land is incorporated into the index, which is at odds with the scope of any CPI measure (the measurement of changes in the prices of consumption goods and services). In order to circumvent this problem and ensure that the net acquisitions approach is compatible with the CPI requirements, the value of the land is excluded from the calculation of the expenditure weights related to dwellings. However, given the absence of data for land prices, the separation of the structure and the land price components is made possible using various modelling approaches (e.g. hedonic regressions). This implies that the resulting index will not be based solely on actual monetary transactions but, rather, on a combination of actual and imputed prices.

Finally, the use approach method has two forms, namely the rental equivalence and user cost. Generally, it assumes that the cost of owner-occupied housing consumption services is the opportunity cost of occupying a property. The rental equivalence approach assumes that the consumption stream from OOH is identical to that of rented property, ignoring favorable tax treatment and capital market imperfections. The user cost approach assumes that owner-occupied housing and rented property are distinct goods, and the cost of consumption services from owner-occupied housing is equal to the opportunity cost of holding the home in terms of maintenance, depreciation, credit costs and forgone investment income.

[6] Moreover, the inclusion of interest payments implies that the index is sensitive to changes in the interest rates. For more details, see section 4 and the discussion related to the payments index of the ONS.

In Ireland, as already stated in the introduction, the CSO produces an owner-occupied housing cost index utilizing two of the abovementioned approaches, namely the payments and the net acquisitions approach. In particular, the payments approach is used for the computation of owner-occupied costs for the domestic CPI, while the net acquisitions approach is used for the computation of the HICP index, which is compiled on a quarterly basis and is submitted to Eurostat, as per EU regulations.

1. Net Acquisitions Approach

The choice of an index of owner-occupied housing is heavily influenced by how the consumption of housing services and the associated costs are interpreted. The net acquisitions approach interprets expenditure on land as an asset purchase and, consequently, outside the scope of the CPI. Furthermore, the structure is treated as a durable consumer good for which the cost accrues in the period of purchase. The approach measures the cost of additions to the housing stock of the household sector, thus excluding transactions of existing dwellings between households. As such, it measures the purchasing power of the household sector in terms OOH services as the cost of adding new dwellings to the sector's stock of housing. As is the case in the national accounts methodology, these measures only include additions to the stock of structures, rather than transactions of land ownership. However, unlike the national accounts, this approach measures these purchases as purchases of consumption goods rather than capital goods.

Of the three primary approaches to the incorporation of owner-occupied housing (OOH) in the CPI, the net acquisitions approach is the most conceptually simple, and is the stated preference of Eurostat for inclusion in their HICP measure. The net acquisitions approach essentially treats owner-occupied housing as a non-durable good, with services of purchases in a given period being fully accounted for in that period. This decision avoids the issue of distributing the cost over the lifetime of the dwelling. The approach implicitly assumes dwellings are made up of a pure asset component, the land, and a purely consumption component, the structure. The price which is recorded is the per-unit cost of the house which has been acquired by the household sector; this tends to be primarily composed of new dwelling purchases, regardless of when consumption of the good starts and how it is paid for. This method aligns with the stated conceptual bounds of the HICP, which specify the index should include only monetary transactions associated with the purchase of consumption services by the household sector. Moreover, this method isolates the cost of the consumption, independent of the means by which it is financed (mortgage costs). In that regard the approach is a similar treatment to other

components of the inflation index. However, in calculating OOH in this manner, it should be noted that the net acquisitions approach does overlook the consumption services provided by the existing stock of housing, the consumption services provided by land and the conceptual difficulty of defining the structure of a house as a non-durable consumption good (that is, disregarding the fact that the structure will provide a future stream of consumption services to the household).

Brief Overview of method

The net acquisitions method is explored in detail in Eurostat's "Technical manual on Owner-Occupied Housing and House Price Indices" (see Eurostat (2017)). Here, we provide an overview of the basic method used in the compilation of the index; we discuss the CSO's contribution towards an OOH index measure, which is provided to Eurostat on a quarterly basis, and we also focus on several key issues involved in the calculation of the index.

The expenditure of households on owner-occupied housing consumption services in each period is defined under net acquisitions by Hill et al. (2019) as

$$Y = NP + M\&R + TC \quad \textbf{(1)}$$

- Y - expenditure on OOH consumption services
- NP - net purchases of dwellings by the household sector excluding land
- $M\&R$ - expenditure on major renovations and repairs
- TC - all service costs associated with the acquisition and ownership of homes, including taxes, real estate fees etc.

This is simply the household sector's expenditure on new housing, accounting for the costs associated with such acquisitions.

In general, the owner-occupiers' housing related expenditures can be classified into two broad categories, namely "Acquisition of Dwellings" and the "Ownership of Dwellings".
The "Acquisition of Dwellings" category is the most significant component of these expenditures. Indicatively, in 2018, 69.2 per cent of overall OOH consumer expenditure was attributed to new dwellings in Ireland. This term captures the additions to the household sectors stock of owner-occupied dwellings through purchases of new dwellings (which are assigned the largest weight), self-

build projects by the owner-occupier and major renovation expenditures. Purchases of new dwellings can be expressed as the difference between dwelling purchases and sales of the household sector, excluding transactions of land.

In order to provide a clearer definition of what the net purchases of new dwellings encompass, consider an exposition analogous to that given by the Eurostat manual. Define

- h/h - purchases by households from other households (within sector transactions)
- nh/h - purchases by the non-household sector from households (e.g. a home which was previously owner occupied being put on the rental market)
- h/nh - purchases by the household sector from the non-household sector (purchases of new dwellings, self-built homes, homes previously rented now being owner-occupied etc.).

Now net purchases of dwellings by the household sector can be defined as

$$NP = (h/nh + h/h) - (h/h + nh/h) = h/nh - nh/h = P - S \quad \textbf{(2)}$$

where P denotes total purchases of dwellings by households and S denotes total sales of dwellings by households. This shows that net purchases of dwellings by the household sector can be interpreted as the difference between total purchases and total sales by households. The exclusion of land is a key feature of the approach, and one, which raises several difficulties. Most fundamentally, the separability of the land upon which the house is built and the structure itself is conceptually difficult. To see this, note that expenditure on private rental accommodation is interpreted as consumption expenditure. Yet, the cost of rental expenditure for identical structures varies significantly between locations, even for houses of a similar quality.[7] Consumption services for a given home are effectively dependent on the value of the land upon which it is built. The net acquisitions approach, which treats land as purely an asset, should estimate similar costs for homes in Leitrim and Dublin 2, when in reality much of the variance in rents, which are purely consumption service purchases, are due to variations in location and thus the underlying land rents. If the consumption stream derived from a unit of housing is dependent on its location, and, thus, the land on which it is built, then only considering purchases of structures could, in theory, cause a mismeasurement.

[7] For example, the average monthly rent for a five-bedroom house in Leitrim in 2019 was €683, according to the Daft.ie 2019 Q1 rental price report, while the monthly rent of a corresponding house in Dublin 2 was €3,599, over five times higher (Daft.ie-Lyons, 2019).

In practice, Eurostat has recommended a "gross price, net weight" index, which means that weights are calculated excluding land values, while the price index is calculated using gross prices, which include the value of land. This same approach is applied by the CSO, with a simple site-to-building cost (SBC) ratio. The ratio is calculated from Stamp Duty data, sourced from the Revenue Commissioners. Though most Stamp Duty does not include a separation of property cost by site and building costs, 10 per cent of submitted forms do provide values for site and building costs. A ratio of the total cost of these two sub-items is generated for each year and this average ratio is applied to total expenditure on the purchase of new dwellings to exclude land values.[8]

The "Self-build" expenditure category comprises dwellings built by individuals themselves, or by professional builders employed by said household, for their own occupation. The "Major renovations" expenditure generally increases both the value and quality of a dwelling in an effort beyond preserving value which would otherwise be considered routine maintenance. The household is therefore acquiring greater effective services from occupying by enhancing the structure itself. As a result, both of these items contribute to the total expenditure based on the acquisition of dwellings. Finally, the 'Other services related to the acquisition of dwellings' acts as the last item with respect to Acquisition of Dwellings and in the Irish case is associated with costs relating to estate agent commissions, legal conveyance fees, engineer & surveyor reports as well as stamp duty payments. This category is assigned the smallest weight in terms of the calculation of the overall index. On a country-by-country basis, these other service costs often comprise of various differing items, each set being deemed most appropriate in representing country-specific housing market characteristics.

The second major item with respect to compiling the OOH (NA) index relates to expenditure attributed towards the ownership of dwellings. This is comprised of "Major repairs and maintenance" expenditures, which represent more than 90% of the weights attributed to this item, "Insurance connected with dwellings" and "Other services related to the ownership of dwellings". Major repairs and maintenance captures any activities, which preserve the current value and expected lifespan of an existing dwelling. Insurance acts as another country-specific tool in which contributing data can vary across member states. In Ireland's case, though both building insurance and mortgage protection are listed by the CSO in constructing this measure, mortgage protection is given a zero weight due to no data currently being available for this item. Other service costs are explored on an individual

[8] In 2018, approximately 3,700 transactions included such figures, suggesting land comprised of 30 per cent of total OOH purchases of new dwelling. Rather than taking a simple average of these two totals and applying this discount factor to dwellings values, it would be advisable to compare the features of this sub-sample of Stamp Duty returns to the overall sample and form a weighted average of the ratio.

country by country basis but can include the banking fees linked to mortgages, legal certificate costs, valuation services, ongoing property tax payments and potentially required costs associated with energy efficiency and gas safety certificates. In the Irish case, the CSO uses costs associated with attaining BER certificates and valuation costs as its two service charges linked to the ownership of dwellings.

Important aspects of implementation

- **Weights**

The Eurostat technical manual highlights some of the main issues involved in the implementation of this approach, both in terms of estimating weights and house price indices. The approach states that national accounts are used to calculate the weight of OOH housing in the CPI. Data are derived from the gross fixed capital formation section of national accounts, which is at odds with the assumption that dwellings are a purely consumption good.

In order to obtain weights for the 'Acquisitions of new dwellings' and the 'Major repairs and maintenance categories', the actual rentals weight from the HICP is utilized, combined with data from the national accounts and, in particular, the Gross Fixed Capital Formation account. The following equation is used:

$$w_{NA\&M} = \frac{EX(RFCF)}{EX(PR)} w_R \qquad (3)$$

where w_R is the HICP weight for actual rentals, $EX(RFCF)$ is the expenditure on residential fixed capital formation by households and $EX(PR)$ is the expenditure on actual rentals for housing, as estimated in the national accounts. These weights can be further decomposed into two components, one reflecting the expenditure on the purchase of dwellings and another reflecting major repairs and maintenance.

Since what is needed for the computation of an owner-occupied housing cost index is an estimate of the expenditures on owner-occupied residential dwellings, equation (3) is modified as follows:

$$w_{NA\&M} = \frac{EX(RFCF)[1-\alpha]}{EX(PR)} w_R \qquad (3)$$

where α denotes the proportion of the expenditure on residential dwellings devoted to the rental market. The Eurostat manual indicates that information on α can sourced either from the national accounts or from the census (in particular, information regarding tenure of the stock of dwellings based on which an estimate of the proportion of buy-to-let can be obtained).

The data used in the calculation of these weights should be primarily sourced from the national accounts, as this is a reliable and consistent source across EU member states. Table 1 gives the

recommended data sources for the various categories of expenditure under this approach, given by Eurostat. It should be noted that data regarding the household sector's acquisition of existing dwellings is absent from the index, essentially meaning the index exclusively covers the acquisition of new dwellings. In practice, Ireland is among eleven countries[9] that contribute weights toward the net purchase of existing dwellings between the household and non-household sectors, although these expenditure levels are quite marginal relative to other forms of acquisition[10].

Table 1: Sources of weights data recommended by Eurostat

	Acquisition of Dwellings				Ownership of Dwellings		
OOH (NA) Indices	Acquisitions of New Dwellings (exc. Land)	Self Builds & Renovations	Existing Dwellings new to the OOH Sector	Services Related to Acquisition	Major Repairs & Maintenance	Insurance Connected with Dwelling	Services Related to Ownership
Source of Weight Data	Gross Fixed Capital Formation	Gross Fixed Capital Formation	No Weight	Household Final Consumption Expenditure & Gross Fixed Capital Formation	Household Final Consumption Expenditure	Household Final Consumption Expenditure	Not Addressed

Source: Eurostat (2017)

The use of national accounts data to derive weights for consumption services from OOH is somewhat inconsistent, given the fact that this expenditure is included in the national accounts as gross fixed capital formation. In fact, the national accounts system recognises owner-occupied households as unincorporated businesses, providing rental services to themselves, which are recorded as part of national income (Eurostat, 2017). This essentially amounts to separating the acquisition of a house as capital expenditure and use of the house as consumption in each period.

In the case of Ireland, Stamp Duty data is instead used by the CSO to inform weight estimates for both acquisitions of "New Dwellings" and 'Existing Dwellings New to Households'. The national accounts are used to inform weights of "Self-Builds", "Net Major Renovations", and "Major Repairs and Maintenance". Remaining items, mostly 'other services' linked to the acquisition and ownership of property, are estimated through a combination of average prices taken from CPI data multiplied by the number of relevant transactions for the specific period.

[9] According to the Owner-Occupied Housing Price Index (last updated 10th July 2019), these countries include: the Czech Republic, Denmark, Ireland, Latvia, Lithuania, the Netherlands, Austria, Poland, the UK, Iceland and Norway.

[10] It should also be noted that the current weight assigned to the "Existing dwellings new to the OOH sector" category is zero

- ***Price Indices***

Although the net acquisitions method is the stated preference of Eurostat due to its reliance on monetary as opposed to imputed transactions, some element of imputation is still required. While the weights of OOH in the HICP could indeed be calculated directly from measured data, the construction of house price indices does require some form of quality adjustment usually through estimation, in order to account for the inherent heterogeneity of dwellings. This quality adjustment is not unique to the OOH index but is also common across various components of the consumer price index.

Several methods for generating indices of house price indices are discussed by Diewert, Nakamura and Nakamura (2009), based upon a variant of the repeat sales method introduced by Summers (1973). These methods essentially estimate a time trend for repeat sales, and assume this trend holds for dwellings of all characteristics. A preferable method is described by the Eurostat technical manual and utilised by Hill et. al. (2019), which allows for the price of given characteristics to change over time. This method gives the price index as the geometric mean of hedonic indices based on data from sales in each period. The model essentially assumes a log linear relationship between the price of a dwelling and the various characteristics which determine this price (expect a given rise in price due to a percentage increase in explanatory variables e.g. size). The model is estimated for sales in each period, with estimated models then being used to calculate the expected price of a dwelling with given characteristics in any year. The index of price increases from one year to the next can be calculated as the change in the estimated price of the house sold in one of the two periods. In practice it may be preferable to use the geometric mean of both indices[11]. A more rigorous discussion of the construction of such indices is provided below.

A hedonic model is estimated from sales in each period, which usually takes a log linear form

$$\ln(P_{t,i}) = \boldsymbol{x}'_{\boldsymbol{t},\boldsymbol{i}}\boldsymbol{\beta}_{\boldsymbol{t}} + \varepsilon_{t,i} \qquad \textbf{(4)}$$

where $\boldsymbol{\beta}_{\boldsymbol{t}}$ is a vector of coefficients, $\boldsymbol{x}_{\boldsymbol{t},\boldsymbol{i}}$ is a vector of characteristics, and $\varepsilon_{t,i}$ is an error term. The estimated vector of coefficients $\widehat{\boldsymbol{\beta}}_{\boldsymbol{t}}$ can be used to create an estimated value for a home of any

[11] This is analogous to the discussion of using current or base period weights in index construction. As Blinder (1980) points out a Laspeyres index (base period weights) tends to overstate price inflation while a Paasche index underestimates it, due to ignored substitution effects. This motivates taking the geometric mean of both indices.

characteristics $\boldsymbol{x_{t,i}}$. The hedonic index is then generated by the equation

$$\frac{P_{t+1}}{P_t} = \prod_{i=1}^{n_t}\left[\frac{\hat{p}_{t+1}(\boldsymbol{x_{t,i}})}{\hat{p}_t(\boldsymbol{x_{t,i}})}\right]^{n_t} = \sum_{i=1}^{n_t}\exp\left(\frac{1}{n_t}\boldsymbol{x'_{t,i}}[\boldsymbol{\hat{\beta}_{t+1}} - \boldsymbol{\hat{\beta}_t}]\right) \quad \textbf{(5)}$$

Where $\hat{p}_{t+1,h}(x_{t,h})$ is the estimated price in period t of a house with characteristics $x_{t,h}$ from the hedonic model, and $n(t)$ is the number of houses sold in period t. The second relation follows from the log linear form of the hedonic model (4), and shows that the change in prices is the sum of changes in the price of the relevant characteristics (including a constant term). The final index is taken as the geometric mean of this index and the equivalent index calculated using houses sold in period t+1. Of the five primary models suggested by the Eurostat manual, all involve the estimation of a hedonic model of house prices to account for heterogeneity in houses sold.

A similar kind of estimation is necessary to estimate the contribution of land to the price of a house, so the price of the consumption aspect of the dwelling (the structure) can be estimated. Such a method is implemented by Larson (2015). This method assumes the price of a dwelling is a linear combination of the value of the land upon which it is built, and the structure, given by

$$P_i = \alpha L_i + \beta A_i + \varepsilon_{t,i} \quad \textbf{(6)}$$

where L_i is the land area of the dwelling and A_i is the floor area of the structure. Thus α can be interpreted as the price of land, and a land price index can be generated from the estimated values $\hat{\alpha}$. Kuminoff and Pope (2013) estimate a similar model, with a log functional form similar to (4), with the log area of land included as an independent variable in the equation.

As already mentioned, Eurostat have stated that member states should use gross price indices rather than using hedonic methods to account for the price of land. This implies that unless the value of land remains constant over time, the index will capture some movement in asset prices. Knoll et al. (2014) use data for 24 advanced economies since 1870 to provide evidence that the bulk of house price increases have historically been due to rising land values, rather than construction costs. However, as we have argued before, it is impossible in practice to separate the value of a dwelling in terms of an asset and a consumption goods using hedonic methods, unless the price is a separable function of the asset part and the consumption component, and a suitable variable is available to isolate the asset component.

Overall, the Eurostat approach essentially assumes that changes in the price of the asset component of the dwelling are proportional to the increases in price of the consumption component (the structure).

Implementation for CSO

Constructing an OOH index and RPPI

The Eurostat manual states that an OOH index should be calculated which is distinct from the broader Residential Property Price Index (RPPI). Crucially the OOH index only covers net acquisitions rather than all transactions of dwellings, and also includes renovations and other costs. The CSO index covers all purchases by the household sector, therefore excluding self builds, renovations and services. It also includes between household transactions, which are outside the scope of the HCIP under the net acquisitions approach. The CSO have identified households and non-households from the stamp duty data, so excluding between household transactions is relatively straightforward. Any stamp duty returns including a first name are considered household sector activities whereas submissions under company names are tied to the non-household sector.

The Eurostat manual makes a clear distinction between the house price index and the index for OOH to be used in the HCIP, as illustrated in Table 2. Their comparison between the two indices is given as follows:

> *"From Table 2, it is clear that the [House Price Index] HPI covers market transactions of residential properties, regardless of which institutional sector they were bought from and the purpose of the purchase. The two categories of 'new dwellings purchased' and 'purchase of existing dwellings' (HPI categories H1.1 and H1.2) enter into the compilation and should conceptually be more or less comparable with the OOHPI categories O.1.1.1.1 and O.1.1.2 respectively.*
> *Dwellings purchased by households for investment purposes (e.g. for renting) are covered by the HPI as are dwellings purchased by companies. *(RPPI excludes this)*
> *Major repairs and other services related to the purchase of a dwelling, which are covered in the OOHPI, are ruled out from the HPI since the emphasis given in this indicator is on the price of a dwelling and not on the total cost of acquiring, owning and maintaining it. Likewise, self-builds could be excluded in the HPI on the grounds that no market price exists."*

Table 2: Classification system from price indices related to dwelling acquisition and ownership

OOH Code	HPI Code	Designation	COICOP_bis
O1	**H1**	**Owner-occupiers' housing expenditures**	
O1.1	**H.1.1**	**Acquisitions of dwellings**	**04.2**
O1.1.1	H.1.1	New Dwellings	04.2.1
O1.1.1.1	H.1.1	Purchases of new dwellings	04.2.1.1
O1.1.1.2	Excluded	Self-build dwellings and major renovations	04.2.1.2
O1.1.1.2.1	Excluded	Self-build dwellings	04.2.1.2.1
O1.1.1.2.2	Excluded	Major renovations	04.2.1.2.1
O1.1.2	H.1.2	Existing dwellings new to the households	04.2.2
O1.1.3	Excluded	Other services related to acquisitions of dwellings	12.7.2
O1.2	**Excluded**	**Ownership of dwellings**	**04.3**
O1.2.1	Excluded	Major repairs and maintenance	04.3.3
O1.2.1.1	Excluded	Materials for major repairs and maintenance	04.3.3.1
O1.2.1.2	Excluded	Services for major repairs and maintenance	04.3.3.2
O1.2.2	Excluded	Insurance connected with dwellings	12.5.2
O1.2.3	Excluded	Other services related to ownership of dwellings	12.7.1

Source: Eurostat (2017)

Including self-builds and renovations price indices may be more challenging from a data perspective. In theory, this item results from a compilation of step-by-step self-build cases, building firm cases and prefabricated cases. However, measurement of construction prices can be extremely difficult upon this split. The Eurostat manual proposes using survey data to compile construction costs to estimate costs of self-builds and renovations instead. In line with this suggestion, the CSO circumvents this difficulty by using readily available data from a construction cost index, Table WPM27, which details cost increases with respect to construction.[12]

Other costs and services related to the acquisition are addressed in the Eurostat manual. These outline methods by which fixed and proportional costs can be incorporated. For price indices, CPI data is used for price indices of estate agent commissions, legal conveyance fees, and engineer/surveyor report fees.

[12] The Capital Goods Price Index (by Type of Capital Goods, Month) provides a sub-index for 'Building and Construction', which accounts for materials and wages.

- *Estate Agent Commissions* price index uses CPI data relating to 'Professional and Legal Services', specifically listed as 'Estate agents fees'. Its weight is determined by National Account data.
- *Legal conveyance fees* uses 'Solicitors fees' from the same category of miscellaneous consumption items. Its weight is determined by National Account data.
- Similarly, to BER certificates' CPI measure, *engineer/surveyor fees* provided for through 'Engineers/surveyors fees' listed under the same heading of 'Professional & legal services'. To estimate expenditure, it uses an average price of such services and multiplies by the number of net purchases (new + existing transactions) for a total expenditure measure.
-

The approach taken with respect to Stamp duty is different. An index dealing with taxes that are proportional to dwelling transaction values is measured as it would be for existing HICP framework on the treatment of service charges proportional to transaction values. The overall expenditure on housing, according to Stamp Duty data, is calculated. The percentage share of stamp duty with respect to this total expenditure value is calculated and then compared against the same ratio from a fixed base-period. Adjusting for changes in house prices, the percentage change in this Stamp Duty-to-Housing Value ratio is taken.[13]

Price indices relating to the costs of ownership are split into "Major repairs and Maintenance", "Insurance connected to the dwelling" and "Other services related to the ownership of the dwelling". The source of the weights for the "Major repairs" category is data from the EU SILC survey, while for the "Insurance" category the weights are based on data sourced from the Central Bank of Ireland. According to the CSO template sent on to the ESRI, dwellings insurance entirely captures the 'Building Insurance' aspect of the OOH index. Mortgage protection uses 'dwelling insurance' as a proxy for now but maintains a zero weight contribution to the index's overall value.

For the last two items, which form the 'Other Services related to the Ownership of Dwelling', BER Certification data are utilized and the weight is generated using an average price of such services and multiplying it by the number of transactions. In this case, the transactions used are taken from the Sustainable Energy Authority of Ireland (SEAI transactions), who issue BER certificates. To calculate a weight, the index uses an average price of such services and multiplies by the number of purchases (existing transactions) for a total expenditure measure.

[13] See Eurostat (2017) Technical Manual on OOH and HPI, Section 3.9.2 for details on Treatment of Costs Proportional to the Transaction Value.

Improvements to the construction of price indices

Based on the CSO technical paper, we propose several potential improvements for the estimation of house price indices (both for the RPPI and OOH indices).

- Hedonic method

The CSO use a rolling time dummy hedonic method to estimate house price inflation. This method assumes the price of relevant characteristics (Eircode, floor area, type and deprivation index) are constant over the duration of the sample, with price differences driven by trend variables (time-dummies).

The model estimated follows the process

$$lnp_{it} = \delta_t d_t + \boldsymbol{x_{it}}\beta + \varepsilon_{it}, \qquad I_t = \frac{e^{\delta_t}}{e^{\delta_{t-1}}}.I_t \qquad \textbf{(7)}$$

With d_t representing time dummy variables. This method is conceptually simple and works well if we have a small sample size, as the full panel is used in estimation. It also avoids the distinction between indices calculated using transaction data from periods t and $t-1$, as the time dummy is constant across dwellings. This assumption however comes at the cost of some accuracy, as changes in preferences, input prices etc. could plausibly cause the price of distinct characteristics to change. The assumption that dwellings of all type experience identical trends of inflation, even in the short term, seems implausible based upon this reasoning.

A more comprehensive hedonic method could potentially be utilized, if sample sizes for each period are sufficiently large. The model described by equations (4) and (5) describe the most comprehensive of such models, as recognized by Eurostat. These models allow the price of certain characteristics in each period to vary, thus incorporating price changes of individual qualities as well as aggregate inflation. However, this method requires the estimation of a hedonic model of price increases in each period. Therefore, whether this method would be practically applicable depends on the volume of transactions in a given period. This issue could potentially be surmounted by assuming that the price of existing dwellings is determined in the same manner as dwellings new to the sector. This would allow the use of data for all transactions to be used in estimating the coefficients of equation (4). The data specific to net acquisitions would then be used to calculate the price index using these estimates, as in (5). On an intuitive level, it is reasonable to suggest that dwellings purchased from outside the household sector provide the same consumption services as those purchased from other households,

and thus follow the same data generating process. One caveat which may cause new dwellings to follow a distinct data generating process than existing dwellings is self builds. Self-builds are by construction unique homes which are built to the owner's specification and customization, therefore they may not be readily substitutable by existing dwellings. However, given that self-builds are not included in the presently used data, this should not be an issue, implying that the assumption seems reasonable.

2. Payments Approach

As we saw in the previous section, the net acquisitions approach aims to measure the spending on net purchases of the consumer element of housing and all the related costs, limiting its scope to the purchases that occur outside of the household sector, i.e. excluding all the within the household sector purchases.

An alternative approach to calculating owner-occupied housing costs is the payments or cash-flow approach. As the name suggests, this approach focuses only on the actual cash flows that are related to expenses associated with owner-occupied housing, including mortgage interest payments, insurance, property taxes and maintenance and repair costs among others.[14]

Despite the fact that this approach has been referred to as a sometimes reasonable compromise when it comes to accounting for owner-occupied housing costs (Diewert (2003)), it is the least common approach utilized by national statistical institutes, currently being used only in Austria and Ireland[15].
The relevant literature has identified a number of drawbacks that point against the use of the payments approach (see Goodhart (2001), Diewert (2003), Diewert and Shimizu (2018) and Hill et al. (2018)). The main disadvantage of the payments approach is the inclusion of mortgage interest payments based on nominal rates. Although this seems to be quite intuitive, as mortgage payments are one of the major expenses of households concerning owner-occupied housing, it is incorrect from an analytical point of view. Since a mortgage interest payment reflects the cost of money rather than the cost of consumption it does not fall within the scope of the CPI (Eurostat (2017)) and, as such, its inclusion causes the payments approach to be unsuitable for purposes such as inflation targeting

[14] The ILO manual mentions that cash flows such as down payments, mortgage principal repayments and payments for alterations and additions do not fall into the scope of the payments approach, since they are related to capital transactions that do not alter the balance sheet of the household – see ILO (2004)
[15] As already mentioned, the ONS produces an owner-occupied housing index based on the payments approach, but they use it as an experimental index only, rather than the headline measure for such costs.

(Johnson (2015)).

Mortgage interest payments are mainly affected by changes in the domestic mortgage interest rates and the general level of inflation. The importance of changes in the nominal interest rates are evident from recently published data by the ONS. Starting with the first quarter of 2018, and following an increase in base rate of the Bank of England, changes in mortgage payments had a positive contribution to the changes in the owner occupied housing index for the first time since the second quarter of 2015. In particular, the increases in the mortgage payments have been contributing, on average, almost 1.5 percentage points to the quarterly growth of the index up to the first quarter of 2019 (last available data).

In assessing the implications for general inflation of the use of the payments approach, Diewert (2003) argues that in periods of high general inflation mortgage interest rates will increase. However, due to its construction, the index does not provide any offsetting benefit to house owners, as the appreciation of the housing asset is not taken into account. Diewert and Shimizu (2018) contend that the approach is subject to the following objections as a result; it ignores the opportunity costs of holding the equity in the owner occupied dwelling, it ignores depreciation and it uses nominal interest rates without any offset for inflation in the price of land and the structure. Furthermore, Diewert and Shimizu (2018) argue that, in general, the payments approach will tend to lead to much smaller monthly expenditures on owner occupied housing than other approaches, except during periods of high inflation. In such a case the nominal mortgage rate term may become very large without any offsetting item for inflation. However, given that the purpose of such a measure is the incorporation of owner-occupied housing costs into the CPI measure, it seems counterintuitive to include offsets for inflation.

Another issue that has been raised regarding the usefulness of the payments approach is related to the fact that it has become more common for households to draw down on the equity they have on their home and take new mortgages in order to finance other activities. This implies that, if the cost of such activities is significant, then it would be necessary to allocate a proportion of the overall mortgage interest charges as a cost of general financial services, else a (potentially significant) miss-measurement will be present. The issue goes well beyond refinancing. This kind of measure is sensitive to how housing purchases are financed via debt and equity. An increase in equity financing – such as via the Irish mortgage rules – does not actually reduce the cost of home ownership, nor does a lengthening in the average term of a mortgage.

Finally, caution needs to be exercised when the costs of repairs and maintenance are taken into account, as these costs are irregular by nature and constitute a significant part of the owner occupied housing costs.

One argument for using a payments approach based owner-occupied housing index is provided by Fenwick (2009, 2012), who argues that statistical agencies should produce a range of indexes that suit different purposes (not necessarily the pricing of owner-occupied housing services).

Overall, the evidence from the literature indicate that the payments approach does not seem to be appropriate for pricing the services stemming from owner-occupied housing, however, they are useful in terms of comparison with the other approaches employed and can also be useful for other purposes (such as the issue of housing affordability).

In what follows, we will focus on the implementation of the payments approach as is currently implemented by the CSO, along with the presentation of some initial results from an alternative owner-occupied housing cost index based on basic payments.

Current Methodology for OOH

In this section, we will summarise and review the current methodology with a focus on mortgage cost, which accounts for the largest share of OOH costs.

Mortgage Cost

The mortgage cost index (MCI) is calculated as

$$MCI_t = R_t \times \sum_{i=1}^{T} H_{t-i} w_{t-i} \qquad \textbf{(8)}$$

where

$R_t =$ Current average mortgage interest rate

$H_t =$ National house price index

$w_{t-i} =$ Mortgage weights

$T =$ Length of mortgage, assumed to be 240 months (20 years).

The source for the average interest rate R_t is a monthly survey of seven banks which report average interest rates of existing mortgages by mortgage type. R_t is calculated as the weighted average across mortgage types and banks where the weights are taken from the Central Banks' *Credit and Banking Statistics*.[16]

The house price measure H_t is the Residential Property Price Index (RPPI) published by the CSO. The RPPI is incorporated with a 2-month time lag due to a delay in the publication of the RPPI.[17]

The summation term $\sum_i H_{t-i} w_{t-i}$ is an indicator of mortgage debt outstanding, which the ILO (2014) refers to as the debt index. The CSO refer to the weights w_{t-i} as *adjusted capital outstanding*. They are calculated as the product of two components: the *capital outstanding* and the *termination factors*. *Capital outstanding* is the remaining mortgage at time $t - i$ for an exemplary 20-year fixed-rate mortgage. The mortgage outstanding after t years is

$$M_t = M_{t-1} \times (1 + R) - P \quad \text{for } t = 1, \dots, 20. \qquad \textbf{(9)}$$

where M_0 is the initial mortgage, R the fixed interest rate and P denotes the payment. In the latest worksheet file available, a €10,000 mortgage with 8.94% fixed interest rate and annual payments of €1,090.78 was used.

Termination factors are the share of mortgages that have *not* been terminated "early" after t years.[18] The CSO states that their methodology is based on Section 10.20 in ILO (2004). Indeed, the ILO propose to derive the MCI as the product of a debt index and a nominal interest index as described above. However, the CSO seems to deviate from the ILO approach when calculating the weights. CSO (2016) states that "the relative weights decline with the age of mortgage reflecting the reduction in interest payable over time" (2016, p. 23). The ILO on the other hand recommends to choose the weight to reflect the age profile of mortgages based on data from mortgage providers (§10.32). We therefore recommend that the CSO explores options to extend the survey with mortgage providers in order to get detailed data on existing mortgages and their age profile.

In particular, a potential refinement of the approach that could be investigated is the use data from each bank regarding the average repayment across loans and the number of respective customers. Based on these data an average repayment figure could be obtained and its changes could be tracked

[16] https://www.centralbank.ie/statistics/data-and-analysis/credit-and-banking-statistics

[17] We refer to the RPPI documentation for details on the compilation of the house price index: https://www.cso.ie/en/methods/prices/residentialpropertypriceindex/methodologydocuments/

[18] The data source of these factors is not known.

over time. A potential advantage of this refinement is that it will incorporate the heterogeneity of the repayment schedules faced by households, given that each one faces different interest rate types, terms etc.

Technical Remarks:

1. The capital outstanding depends on the interest rate R_t. It seems that in the calculations a fixed interest rate was assumed and not updated on a regular basis. This is although average interest rate data is collected by the CSO.
2. The calculation of capital outstanding assumes a 20-year fixed-rate mortgage. While this might be a valid simplifying assumption, the CSO could explore whether it is feasible to directly collect data on average mortgage payments from the building societies.

Other Items

The other goods and services that are associated with OOH follow a more standard approach where the price development is tracked over time based on supplier surveys. For example, the building material component is based on a survey of 4 suppliers and 4 goods, which are chosen to represent a general basket of building materials. A complication arises when calculating expenditure weights for house building insurance. The CSO derives weights based on actual gross payments whereas Eurostat and the HICP use a net approach that incorporates payments of insurance payments.

Constructing a Basic Payments-based OOH Index

We construct three variations of a simplified OOH index referred to as OOH1, OOH2 and OOH3. The data source is the CPI database with a detailed breakdown of 615 items included in the CPI. We have data available for January 2017 to April 2019. In the calculation of the indices we have incorporated the change in base weights in January 2018 and January 2019.

OOH1 uses a narrow definition of the OOH index that only includes the OOH-related items that are included in the CPI but are excluded from the HICP (see above). OOH2 are services for the maintenance and repair of the dwelling. OOH3 also adds materials for the maintenance and repair of the dwelling. The assumption is that these goods and services are predominantly purchased by owner-occupiers and landlords. The following table provides a list of items included in OOH1 and OOH2.

Table 3: Item list for three alternative OOH indices

OOH1	• 4.2.1 (1) Mortgage interest • 4.3.1 (8) Building materials • 12.5.2 (2) House insurance - contents (non-service) • 12.5.2 (3) House insurance - dwelling • 12.7 (10) Miscellaneous goods & services
OOH2 includes OOH1 plus:	4.3.2 Services for the maintenance and repair of the dwelling: • Plumbers services • Electricians services • Services for maintenance of heating systems • Painters services • Carpenters services • Other house maintenance services
OOH3 includes OOH2 plus:	4.3.1 Materials for the maintenance and repair of the dwelling: • Floor Tiles • Paint • Paint Brush • Paint roller • Varnish • DIY household maintenance products • Taps/Mixer Taps

We should note that the analysis of this section excludes stamp duties, which should be included in a payments-based OOH index. Thus, the following preliminary results have to be interpreted with

caution.

We compare the indices OOH1-OOH3 with the joint index of private and local authority rents, which are incorporated in the CPI (4.1.1). Figure 2 reveals a significant discrepancy between rental price growth and OOH cost estimates based on a simplified payments approach; see also Figure 2.A in the Appendix. Over the time period considered, rental data suggests a 13.7% increase in OOH costs, while the three payments-based indicate cost increases by between 2.1% and 2.4%.

Figure 2: OOH1, OOH2 and OOH and rental price index

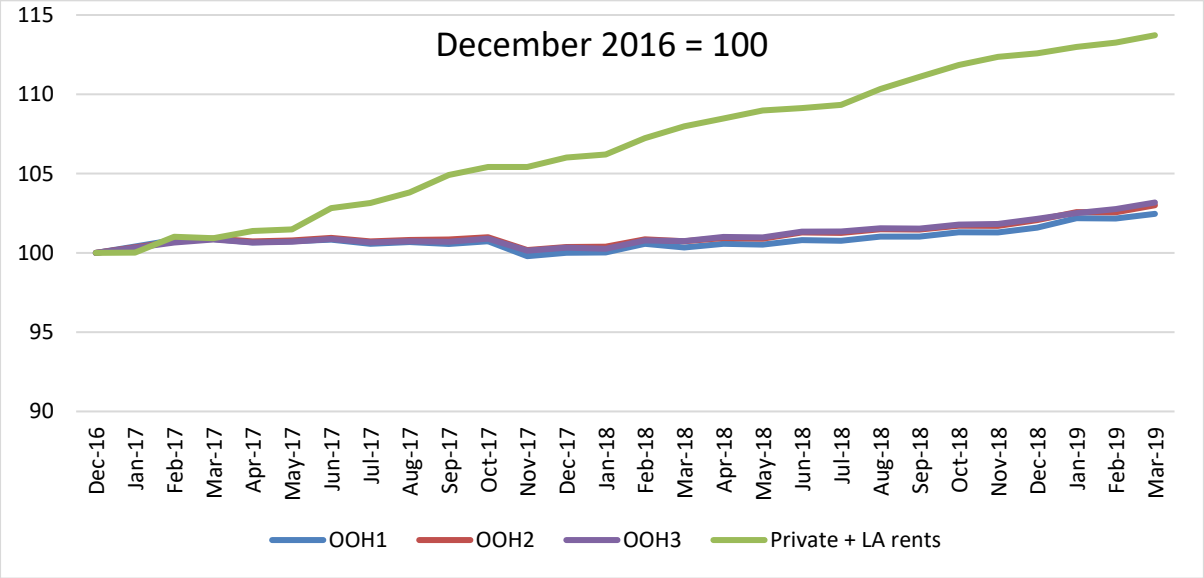

Table 4 lists growth rates over the period December 2016 to April 2019 by item. Both private and local rents have experienced strong growth, with 14.5% and 12.1%, whereas mortgage interest payments, the main component of OOH costs according to the payments approach only exhibit a growth rate of 1.9%. This indicates a significant divergence between rental prices and mortgage interest payments, which is expected given that during the period under consideration the general level of inflation has been quite low thus leading a payments-based approach to produce expenditure levels that are lower. However, the observed difference casts some doubt on the current methodology for calculating OOH costs. Furthermore, the sharp contrast between the estimates and the rental series reinforces the comments of Diewert and Shimizu (2018) that the payments approach results in smaller monthly expenditures on owner occupied housing than indicated by other approaches.

Table 4: Growth rate of April 2019 vs December 2016 by item

	Private rents	14.52
	Local authority rents	12.09
OOH1	Mortgage interest	1.90
	Building materials	10.54
	House insurance - contents (non-service)	6.39
	House insurance - dwelling	6.54
	Miscellaneous goods & services	2.75
OOH2	Plumbers services	4.22
	Electricians services	17.02
	Services for maintenance of heating systems	4.96
	Painters services	9.46
	Carpenters services	0.89
	Other house maintenance services	5.24
	Solicitors' Fees	9.85
OOH3	Floor Tiles	-18.96
	Paint	5.46
	Paint Brush	-0.91
	Paint roller	0.12
	Varnish	2.33
	DIY household maintenance products	4.96
	Taps/Mixer Taps	-3.17

Concluding comments

Accurately capturing the cost of housing in measurements of general inflation is a complex and challenging exercise with a variety of approaches being adopted across national statistical agencies. In this paper we review two approaches which have been implemented by the Central Statistics Office (CSO); the net acquisitions and the payments approach. We review the motivation for both approaches as well as some practical considerations underpinning their implementation. The paper also makes some recommendations for development of both indices.

In practice the net acquisitions approach necessitates certain assumptions concerning land prices and,

in particular, the manner in which land prices change through time and across geographical areas. One obvious addition to the implementation of the acquisitions approach would be the provision of national and a regional series of land prices. This would help to provide arguably a more accurate distinction between changes in the cost of housing due to the consumption and the investment component. The paper also contains a specific proposal for enhancing the estimation of house price indices both in the case of the residential property price indicator and for the OOH indices. In particular, the model proposed would allow for the price of certain characteristics of a house in each period to vary, therefore resulting in an index, which included changes due to individual qualities, as well as more general, aggregate inflation.

While the payments approach provides a useful insight in terms of its focus on households' disposable income and the related issue of housing affordability, a number of conceptual and empirical issues arise with its implementation. These include the indices focus on the cost of mortgage finance rather than the cost of consumption. As it typically ignores the appreciation of the housing asset, it has been argued that the approach tends to lead to smaller monthly expenditures on OOH than other approaches. Indeed, the comparison of a rental price index with certain payment type indices calculated in this paper would offer some support to this conclusion. In terms of some of the parameters and assumptions used to calculate the approach, greater use of bank level data and possibly the official loan level data maintained by the Central Bank of Ireland would be recommended. This could ensure that the most up to date and representative information on the mortgage interest rates actually paid by households as well as the tenure of mortgage contracts was being fully incorporated into the index.

Overall, given the issues, which arise with the different approaches, it is clear that having a suite of such indicators is a prudent strategy in gauging the cost of housing in inflation measures. In that vein, future research in this research project will explore the possibility of the use approach and, in particular, the rental equivalence approach to measuring housing costs.

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