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House Prices in the Measurement of Inflation: An Application Using Irish Data

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Abstract: This paper illustrates the impact on Irish inflation of including a house-price series with the current components of the harmonised index of consumer prices (HICP). We construct a dynamic factor index of inflation that weights the individual price series according to the strength of their signal about the common trend in prices. As the relatively noisy house-price series attracts a weight of only 3 per cent in the index, the inclusion of house prices in this way does not hugely alter the recent pattern of inflation for Ireland, despite house prices exhibiting much stronger growth on average than the current measure of consumer prices.

I INTRODUCTION

Controlling the change in the overall level of prices is the primary goal of many of the world's central banks. Therefore, the issue of how to measure inflation is of obvious interest to monetary policymakers. From a practical point of view, the issue essentially boils down to two main questions: (1) What constituent price series should be included in the measure of inflation and (2) how should these series be weighted together to form an index? The answers to these questions depend to a large extent on the theoretical underpinnings of the policymakers' framework. In the US, for example, the consumer price

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index is designed to function as a cost-of-living index and so consumer expenditure patterns guide the choice of component series and their relative weights. This is not the only option, however. In designing a price statistic for the Euro area, the initial task was to construct a reasonable price statistic that would be comparable across the member countries. Now that this challenge has been overcome, the focus can shift to "fine-tuning" the index to best capture the measure of inflation of interest to policymakers based on their underlying theoretical framework.

An important element of the current debate in Europe is the question of how house prices should be included in the harmonised index of consumer prices (HICP); the measure of inflation currently relied upon for policymaking purposes by the European Central Bank (ECB).[1] Housing represents a significant proportion of the expenditure of most consumers, yet the cost of owner-occupied housing is not currently represented in any way in the HICP. How should these costs be included in the measure of inflation targeted by the ECB?

If the answer to this question is anything other than total omission, then several challenges await. The first, and by no means trivial, task is to construct an appropriate measure of these housing costs on a consistent basis across all member states. To this end, Eurostat is currently conducting a pilot study in five countries, aimed at capturing a measure of the net acquisitions cost of housing.[2] The next, and perhaps more difficult, question, is how to incorporate this measure into the existing index. This is essentially an issue of how to weight housing with the other components of the index. The answer to this question depends on what the authorities wish to measure with the HICP. In the US, owner-occupied housing is measured on a rental equivalence basis, as this approach is seen as consistent with the cost-of-living basis that underlies the consumer price index there. Eurostat, however, have explicitly denied that the HICP is a cost-of-living index. It is not clear, however, what the underlying theoretical basis is for the HICP. The decision on what weight to assign to housing costs is inextricably linked to this issue of the underlying theoretical framework.

Much of the general debate on the appropriate aggregate price statistic for

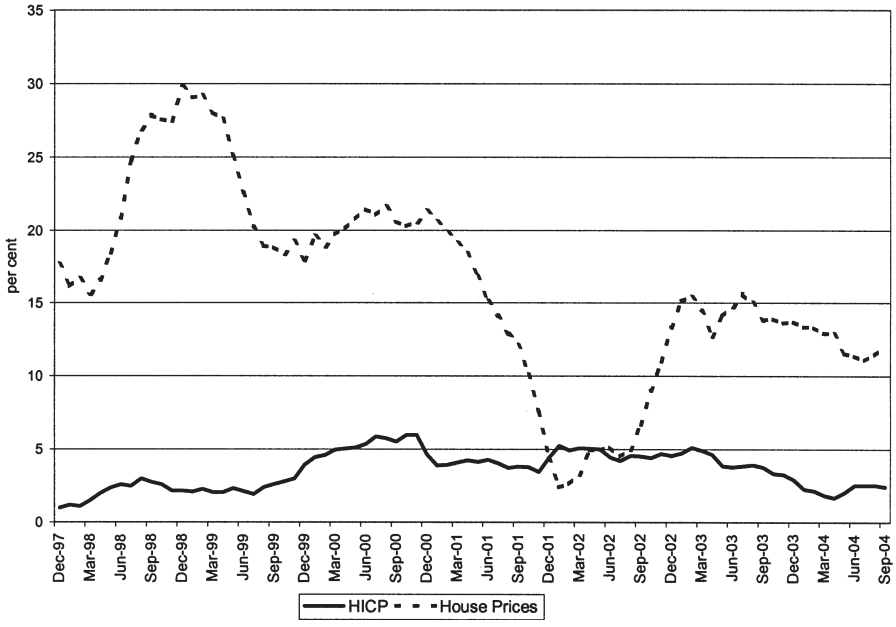
[1] A *Financial Times* article in November 2004 surmised that house prices might be included in the HICP as soon as 2006, if pilot studies are successful. The headline refers to the Bank of England forecasts but the same issue is relevant for the ECB. More recently, an article in the ECB's July *Monthly Bulletin* identified the incorporation of owner-occupied housing into the HICP as a main priority and predicted a decision by 2008.

[2] Net acquisitions cost includes the price of the home, certain fees and insurance costs but excludes the price of land. The countries participating in the study are the UK, Germany, Spain, Finland and Poland.

monetary policymaking has centred on the idea of capturing some core measure of inflation. Many approaches have been explored, such as those looking to exclude certain components from current consumption-based price statistics (for example, CPI excluding food and energy), those exploring different statistical methods for constructing such indices (the median CPI series maintained by the Federal Reserve Bank of Cleveland) and others seeking to expand the range of prices in the index to include asset prices along with prices of goods and services for current consumption (see for example, Bryan *et al.* (2001) and a recent *Economist* magazine article that discusses a broader index for the US constructed by Ian Morris from HSBC).

Obviously, these different approaches can produce very different inflation series and so the choice of an appropriate series for policy-making purposes is a crucial one. In the Irish case, as Figure 1 shows, house prices have generally been increasing at much higher rates than the level of consumer prices captured by the HICP in recent years. This might lead one to expect that monetary policy formulated on the basis of a broader price index that included house prices would necessarily be significantly tighter than that based on the current HICP measure. As we will see below, however, this may not necessarily be the case, as the outcome will depend on the weighting scheme employed.

Figure 1: *HICP versus House Prices – Year-To-Year Changes*



The net acquisitions cost approach to the incorporation of housing into the HICP can be thought about in the context of the broader literature on the role of asset prices in the measurement of inflation for monetary policy purposes. The idea that asset prices should be included directly in the measurement of inflation was brought to the fore in Alchian and Klein (1973). Since then, Pollack (1975) has developed the theoretical basis for the inclusion of asset prices while Shibuya (1992), Shiratsuka (1999) and Bryan *et al.* (2001) are examples of some related empirical work.

The prospect of including the price of housing in the measure of inflation targeted by the ECB can also be thought about in the context of the discussion on the appropriate role of monetary policy during asset-price booms and busts. For example, Bernanke and Gertler (1999) and Cecchetti *et al.* (2000) focus on the inclusion of asset prices as an additional element in the policy rule along with (traditionally-measured) inflation and the output gap.[3] If the net acquisition cost of housing is directly included in the policy makers' measure of inflation, then wide swings in the price of these assets may elicit a policy response without adding more elements to the policy rule.

Ideally, any analysis of the inclusion of the cost of owner-occupied housing in the HICP should take place at the Eurozone level, given this is the level at which the ECB conducts monetary policy. Unfortunately, the absence of appropriate house-price data at the Eurozone level precludes such a study at this point. Consequently, this paper takes a case study approach to the issue, focusing on the impact of the inclusion of house prices on the HICP for Ireland. Ireland is a particularly interesting case for a number of reasons: First, after Spain, Ireland has the highest share of owner-occupier households in the Euro area[4] and so the potential impact of the inclusion of the net acquisition cost of housing is large; and, second, house prices in Ireland have behaved very differently in recent years than the prices of the existing components of the HICP, again pointing to a potentially large impact. Therefore, the Irish case can provide an early benchmark of sorts from which to gauge the potential impact of a change of this nature to the HICP.

This paper incorporates house prices into the HICP for Ireland by constructing a dynamic factor index (DFI) of inflation based on the current components of the HICP and a series representing the net acquisition cost of housing. Intuitively, this methodology assigns weights to the constituent series based on the strength of the signal each series contains about the "core" movement in prices. Therefore, by construction, it "smoothes out" large shocks

[3] For a comprehensive review of the literature, see Detken and Smets (2004).
[4] See the ECB *Monthly Bulletin,* July 2005, p.66 for data on the share of owner-occupiers in Euro area countries.

to individual price series, such as the sharp fall in house prices apparent in the graph towards the end of 2001 in response to changes in the tax code.[5] Given Eurostat's denial that the HICP is a cost-of-living index, it provides an alternative weighting scheme for the components of the inflation measure to that based on expenditure patterns. This could be particularly useful to policymakers considering the inclusion of an asset-price series such as the net acquisition cost of housing along with the prices of traditional consumption goods such as food and clothing.

The rest of the paper is structured as follows. Section II discusses briefly the literature on inflation measurement and the conceptual bases underlying different approaches to the measurement issue. The next section outlines the empirical model used to assign weights to component price series based on their statistical properties rather than their importance in expenditure terms in some typical consumer basket. Section IV presents the results of an application of this model to Irish data and compares the inflation series obtained to other measures of inflation including the headline HICP currently used for policy analysis. Section V concludes and discusses some possible policy implications of the inclusion of house prices in the HICP.

II DEFINING AND MEASURING INFLATION

The appropriate treatment of housing in any measure of inflation depends on what it is the aggregate price statistic is trying to capture. In the US, the Bureau of Labor Statistics (BLS) has explicitly stated that the consumer price index (CPI) is a cost of living index, the theoretical basis of which centres around consumer welfare. Specifically, it aims to answer the question of "… how the minimum expenditure necessary to obtain a certain level of utility responds to price changes" (Fixler, 1993, p.4). Up until the early 1980s, the BLS used an asset-price measure to capture the change in the cost of owner-occupied housing but changed its methodology in favour of the current owners' equivalent rent approach in light of its belief that the asset-price approach was inappropriate for its conceptual framework. Under the current methodology, owners' equivalent rent attracts a weight or relative importance of around 20 per cent. This weight reflects the importance of such housing expenditures in the consumer basket in accordance with the conceptual framework underlying the CPI.

[5] For further details on factors affecting house prices, including links to the Bacon reports on housing, see the Department of the Environment, Heritage and Local Government's web site at http://www.environ.ie/DOEI/DOEIPol.nsf/wvNavView/Housing+Policy?OpenDocument&Lang=#l4

In contrast to the BLS, the conceptual basis laid out by Eurostat for the HICP is not clear-cut. According to Eurostat (2004), the aim of the HICP is "… to cover the full range of final consumption expenditure for all types of households in order to give a timely and relevant picture of inflation" (p. 4). The coverage of the HICP is based on the concept of household final monetary consumption expenditure as defined by the European System of Accounts, 1995. Eurostat specifically states that the HICP is not a cost-of-living index (Eurostat, 2004, p. 4) and should be viewed as measuring "… the prices of a fixed expenditure pattern" rather than a fixed level of utility. As a result, the pilot studies for the inclusion of housing are based on the net acquisition costs of housing, reflecting actual monetary consumption, rather than an imputed measure of the housing services along the lines of the BLS approach.[6] Therefore, there is no reason to expect that the weight assigned to housing in the index should necessarily resemble the 20 per cent assigned to housing in the US. How should the weighting scheme for such price statistic be determined?

In the absence of a definitive framework from Eurostat, we turn to the general literature on inflation measurement for monetary policy purposes for guidance. Wynne (1999), Bryan *et al.* (2001) and Cecchetti and Wynne (2003) all point to the concept of monetary inflation for central bank policy purposes that finds its basis in the equation of exchange. In this context, Wynne (1999) concludes "… that for the purposes of monetary policy what is needed is not a microeconomic theory of the cost of living, but a macroeconomic theory of the cost of inflation". (p. 4). His argument centres on the idea that central banks should focus on controlling a price measure that best captures the costs associated with inflation. This macroeconomic approach, by definition, need not be constrained by the traditional consumer welfare foundations of cost-of-living indices and so would be consistent with the inclusion of asset prices such as the net acquisition cost of housing.

The general idea behind the concept of monetary inflation is that it is the change in the "P" in "MV=PY" that should be of concern to monetary policy makers. As pointed out in Cecchetti and Wynne (2003), the roots of the concept date back to Jevons (1865) who held that the change in the central bank's holdings of gold must affect all prices in equal proportion. Thus, observed changes in the prices of individual goods or services can be thought of as consisting of two components – a general or common (monetary) inflation component and a good- or service-specific (relative-price) change component. It

[6] It is worth noting that the total exclusion of owner-occupied housing from the HICP since its inception arose due to practical issues concerning harmonisation of measures across member states.

is the common or monetary component, as a measure of the change in the purchasing power of money, that is directly of concern to monetary policy makers.

How does this help with the housing measurement issue currently facing Eurostat? If we interpret statements by Eurostat defining the HICP in terms of monetary consumption along with their rejection of the cost-of-living framework as a desire to measure monetary inflation, then we can use this concept as a guide for constructing a price statistic that includes the acquisition cost of housing. The problem boils down to one of finding the weights for the individual price series that separate the monetary inflation component from relative price changes. The statistical model described in the next section operationalises this concept of extracting the common inflation component from a set of individual price series.[7]

III THE EMPIRICAL MODEL

We follow the methodology first proposed in Bryan and Cecchetti (1993) as a method for measuring inflation and used to incorporate asset prices in measures of US inflation in Bryan *et al.* (2001) and (2003).[8] In that work, the joint statistical properties of the individual price series are utilised in order to construct a dynamic factor index (DFI). The DFI corresponds to the common component of the observed price series and so represents our measure of monetary inflation as described in the previous section. The DFI exploits the fact that the information contained in individual $\dot{p}_{it}$'s about the common trend π_t differs – that is the "signal-to-noise" ratio varies across different sets of goods, services and assets. In particular, asset prices such as house prices tend to be quite noisy relative to some consumption-based components, and so may not be very important in constructing the DFI. As in the papers above, we write the model as

$$\dot{p}_{it} = \pi_t + x_{it} \tag{1}$$

$$\psi(L)\pi_t = \delta + \xi_t \tag{2}$$

$$\theta_i(L)x_{it} = \eta_{it} \tag{3}$$

[7] Ideally, we would like to be able to examine the relationship between our measure of monetary inflation and developments in the monetary aggregates. In addition to the usual small open economy issues affecting the relationship for Ireland, however, the absence of a consistent monetary aggregate series over the time period in question (which obviously included the move to EMU) makes this impossible. For details of the breaks and other measurement issues with Irish money supply series in recent years, see Donnery (2003).

[8] The original version of the model used was developed by Stock and Watson (1991) to construct a coincident indicator of economic activity.

where $\dot{p}_{it}$, π_t, and x_{it} are the first differences of the logs of the observed variables, the common unobserved component representing inflation and the idiosyncratic relative price movement in the i^{th} series, respectively. $\psi(L)$ and $\theta_i(L)$ are vectors of lag polynomials and ξ_t and η_t are i.i.d. random variables. Throughout, it is assumed that both the common element, π_t, and the idiosyncratic components, x_{it} can be modelled as AR(2) processes.[9]

The main identifying assumption of the model is that the common component and the idiosyncratic components are mutually uncorrelated at all leads and lags. This is achieved by assuming that $\theta(L)$ is diagonal and that all the error terms in the model are mutually uncorrelated. This is consistent with the notion that the common component captures all the comovement in the observed series, leaving x_{it} to reflect only idiosyncratic movements. To set the scale of π_t, the variance of ξ_t is normalised to one. The parameters of the model are then estimated via maximum likelihood using the Kalman filter. As a by-product, the Kalman filter recursively constructs MMSE estimates of the unobserved components π_t and x_{it} given observations of $\dot{p}_{it}$. The common index can be written as a linear component of current and past values of the observed series

$$\hat{\pi}_t = \sum_i \hat{w}_i(L)\, \dot{p}_{it} \tag{4}$$

These are the (implicit) weights used to construct the common inflation component – our estimate of monetary inflation. Intuitively, these weights are chosen in order for the relative price movements in the constituent data series to cancel out, thus revealing the unobserved common component.[10]

This approach to estimating the weights was chosen for a number of reasons. First, it matches best (among alternatives such as variance-weighting and principal component approaches, for example) the concept of inflation we are trying to capture in that it weights the constituent series on the basis of the strength of the signal they provide regarding the common component. Second, the approach takes into account both the time-series and cross-sectional properties of the data, unlike a purely variance-based approach, which ignores the time-series properties. The major drawback, of course, is that "history changes" with the addition of new data as the implicit weights obtained will differ across different data sets.

We apply this model to the components of the HICP at different levels of disaggregation for Ireland and then add a house-price index to the list of

[9] Choosing AR processed of different orders does not materially impact the results.
[10] More details are given in Appendix A.

constituent series. We are interested in the weights the model assigns to the constituent series (particularly the house-price series) and in the impact the inclusion of house prices has on the overall measure of inflation. The next section discusses these findings and compares the results of the model to inflation series constructed using different weighting schemes.

IV THE RESULTS FOR IRELAND

Data on the HICP components were obtained from Eurostat.[11] Our initial investigation focuses on a 12-component breakdown of the HICP. (As a robustness check, the exercise looking at three components of the HICP was also carried out. The results are included in Appendix B.) The house-price index used is that complied by Permanent TSB in association with the Economic and Social Research Institute (ESRI).[12] The TSB house-price index was chosen above the official Department of the Environment, Heritage and Local Government (DoE) house-price data for several reasons. First, the TSB index is available monthly rather than quarterly and so works better for the statistical model employed. Second, the construction of the TSB index mirrors quite closely the index being used in the Eurostat pilot study in other European countries and therefore is likely to reflect quite accurately any actual measure of house prices that Eurostat may eventually incorporate into the HICP.[13]

The analysis was carried out using monthly data spanning December 1996 to September 2004. Table 1 illustrates the weights obtained by applying the DFI model to the component series of the HICP and the house-price index. The first column shows the expenditure-based weights currently used by Eurostat in the construction of the HICP. Comparing the first and second columns of the table, where only the current components of the HICP are included, we can see that the weights implied by the DFI model differ substantially from the expenditure weights. For example, the food category attracts a much lower weight using the DFI methodology than it does using the expenditure approach, due to the relatively volatile nature of food prices. The fact that the

[11] http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MASTER_prices&depth=2&language=en

[12] http://www.permanenttsb.ie/pdf/7055%20PTSB%20House%20Index%20112.pdf

[13] Another attractive feature of the TSB index is that it is "mix-adjusted" and so takes account of the changing quality of the houses included. Obviously, for policy purposes, it would be preferable to use official data from the DoE who are developing the coverage and frequency of their data on an ongoing basis. Comparing quarterly averages of the TSB index with the DoE quarterly series on new house prices for the period examined in this paper gives a correlation coefficient of 0.99.

two sets of weights are very different is not unexpected as the bases upon which they are calculated are totally different. The DFI weights are based purely on the statistical information content of the constituent series and have nothing to do with the cost-of-living concept underlying the expenditure weights. They merely weight the constituent series in the best way to estimate the common element of the price changes.[14]

Table 1: *Comparison of Expenditure, DFI Weights and Variance-Based Weights*

	Expenditure	*DFI no hp*	*DFI with hp*	*VAR with hp*
Food and non-alc beverages	18.40	8.22	8.00	13.03
Alc bev, tobacco etc.	8.78	4.12	4.12	1.92
Clothing & footwear	5.74	3.48	3.21	0.09
Housing, water, fuel etc.	8.01	6.80	6.56	4.77
Furnishings etc.	4.92	16.60	15.31	2.34
Health	1.85	9.89	9.92	7.50
Transport	12.84	6.03	5.84	3.28
Communications	1.94	3.66	3.61	1.46
Recreation & Culture	11.90	14.29	13.79	26.93
Education	1.43	3.64	3.49	1.00
Restaurants & Hotels	18.95	9.71	9.58	16.35
Misc goods and svs	5.24	13.56	13.22	17.22
House prices (hp)	n.a.	n.a.	3.35	4.11

The third column shows the weights obtained when the house-price series is added to the constituent series of the HICP. Not surprisingly, house prices attract a relatively low weight of 3.35 per cent. Given that thirteen series were used to construct the index, the average weight would be 7.69 per cent and so a weight of 3.35 per cent indicates that the signal-to-noise ratio is relatively low in the house price series. When the HICP is disaggregated to a lesser degree, as shown in Appendix B, house prices attract a weight of 8.69 per cent, but this should be interpreted in relation to an average weight of 25 per cent, as only four series were used to construct the index.

When looking at this weight of 3.35 per cent versus weights obtained for the US in previous papers, account must also be taken of the number and type of series involved in the estimation. In Table 2 of Bryan *et al.* (2001), house prices attract a weight of only 1.44 per cent when included with a nine-component breakdown of the CPI for the period 1977-1999, indicating a

[14] See Cecchetti and Wynne (2003) p. 410 for a simple example comparing the cost-of-living index with the DFI.

significantly lower weight for housing than that obtained here, as it should be compared with an average weight of 10 per cent rather than 7.69 per cent. A direct comparison with the results in Bryan *et al.* (2003) is more difficult, as the weight of 2.3 per cent for housing reported in Table 1 for the period 1977-2001 is based on estimations that include six asset-type series along with the nine-component breakdown of the CPI. While, as might be expected, the weight for housing when other asset-price series are included is higher than that obtained in Bryan *et al.* (2001), it is still lower than the results obtained for Ireland (2.3 per cent with 15 series versus 3.35 per cent with 13 series). On the basis of this evidence, it would appear that house prices are more informative about monetary inflation in Ireland than in the US for the time frames examined.[15]

The final column of Table 1 contains a set of weights calculated on the basis of the inverse of the variances of the constituent series. Essentially, the more volatile the sub-index, the lower the weight it obtained. As expected, the DFI and variance-based weights are more closely related to each other than they are to the expenditure-based weights. (The correlation between DFI-hp and VAR-hp weights is .66 while that between DFI-no hp and the expenditure weights is .14). A chart comparing the DFI and VAR weights is shown in Appendix B. While the two sets of weights are clearly related, they are significantly different for some of the sub-series, indicating the importance of time-series properties as well as cross-sectional properties in constructing the DFI weights.[16]

Another comparison of interest is to look at the components of the HICP weighted together with house prices where the weights are related to expenditure shares. It is not obvious what the weight for house prices should be, so three weights were chosen – 20 per cent to correspond to the weight on owner-equivalent rent in the US and the upper-bound of the proposed weight for the Euro-area in most discussions, 10 per cent to reflect informal discussions with several policymakers and 3 per cent to correspond to the weight obtained from the DFI methodology. The weights on the other series

[15] While DFI weights for Ireland are charted in Bryan *et al.* (2001), a comparison with the current analysis is not very meaningful. The chart reflects the weighting of only 3 quarterly series – the aggregate CPI index, a quarterly house price series from the Department of the Environment and a measure of stock prices. No breakdown of the CPI into its constituent series was carried out.

[16] A related concept to dynamic factor analysis is that of principal component analysis (PCA). As noted in Gilbert and Pichette (2003) "…dynamic factors first explain common movements in the measurements, rather than the most variation, as in PCA." While dynamic factor analysis is more closely linked to the concept of monetary inflation, PCA can provide a useful cross-check as to the appropriateness of the single-index model. Principal component analysis based on the correlation matrix for the 13 sub-series of interest indicates that 92.9 per cent of the variation is explained by the first principal component.

were scaled down accordingly. A table of these expenditure-based weights is included in Appendix B.

Figures 2 and 3 compare the levels and annual percentage changes in the HICP and the inflation series constructed using the DFI model.[17] Figure 2 shows that the price-level measure that includes house prices has been higher since mid-1997 than either measure that excludes the house-price index. The pattern in the inflation rates calculated from these prices series is less clear cut. We can see from Figure 3 that early in the period the rate of change that includes house prices was higher than the other measures. Since mid-2000, however, the HICP has oscillated above and below the broader measure. Changes in the tax treatment of housing caused sharp movements in house prices around this time and no doubt affected the broad inflation measure to some extent.

Figure 2: *HICP versus DFI – Levels*

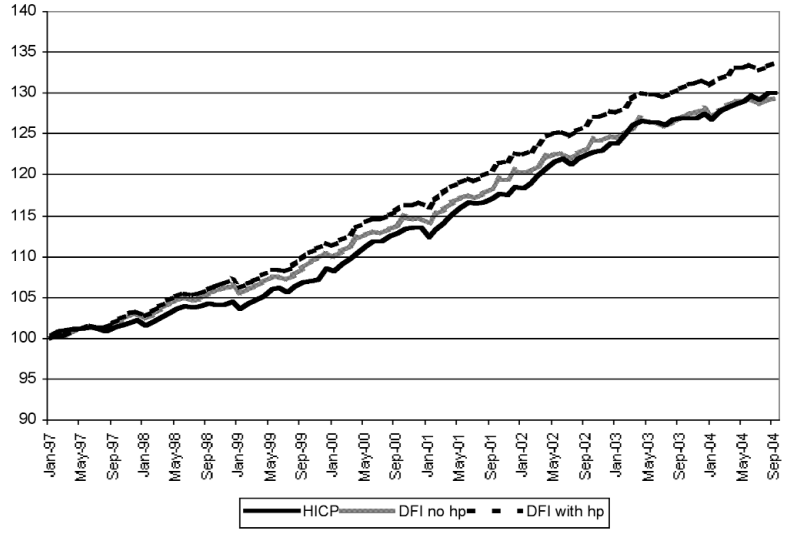


Figure 4 plots the annual change in the DFI-hp series with the various expenditure-weighted HICP series that include house prices. Here it is obvious that the inclusion of house prices with a higher weight makes a substantial difference to the pattern of measured inflation – at the upper-limit implying double-digit inflation rates for Ireland in the early part of this decade.

[17] Comparable figures based on the three-component breakdown of the HICP are included in Appendix B along with correlation coefficients for the different inflation measures.

Figure 3: *HICP versus DFI – Year-to-Year Changes*

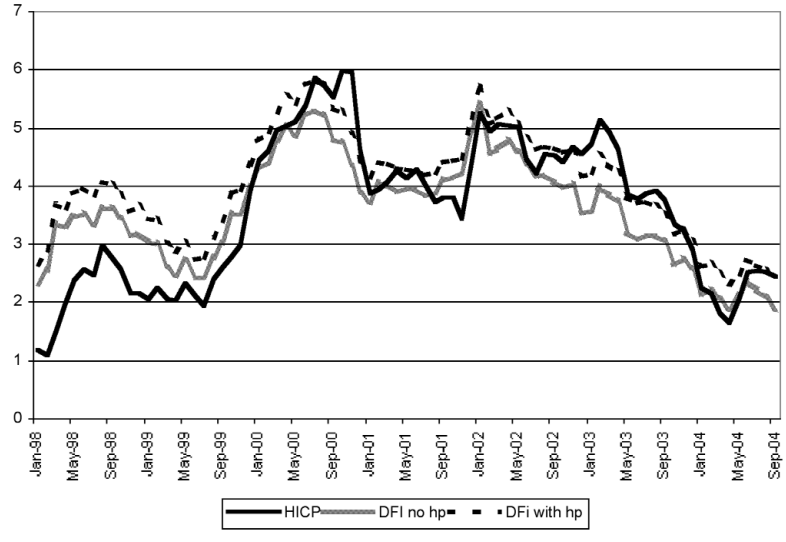
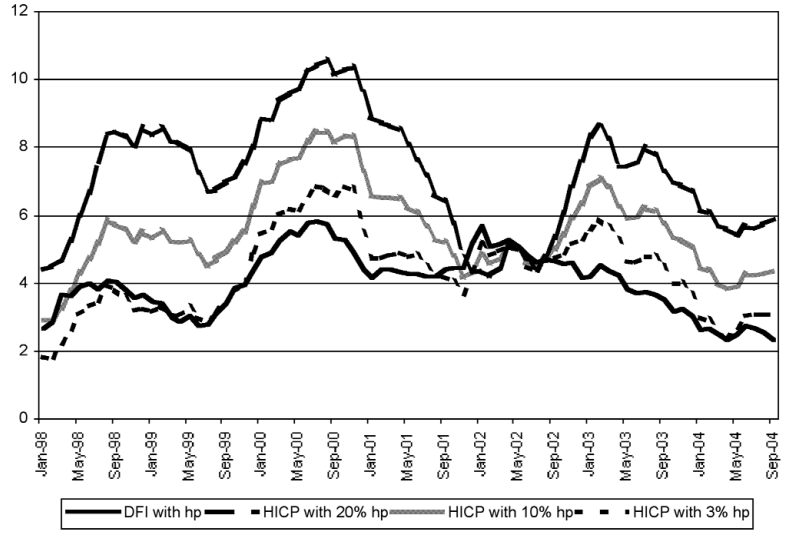


Figure 4: *HICP with House Prices versus DFI – Year-to-Year Changes*



Looking at the correlations among a selection of the series, we can see that the levels of the series are all highly correlated while the annual movements are less so. Again, the expenditure-weighted series that includes house prices stands out. In general, however, despite the record performance of the housing market in past years and the distortions caused by changes in tax policy, the

overall pattern of inflation is not affected hugely when house prices are included.

Table 2: *Correlations Among Selected Price Statistics*

Correlations of Levels

	HICP	*DFI no hp*	*DFI with hp*	*HICP with 10% hp*
HICP	1			
DFI no hp	0.99722	1		
DFI with hp	0.99779	0.99987	1.00000	
HICP with 10 per cent hp	0.99707	0.99746	0.99821	1

Correlations of Year-to-Year Changes

	HICP	*DFI no hp*	*DFI with hp*	*HICP with 10% hp*
HICP	1			
DFI no hp	0.85214	1		
DFI with hp	0.88291	0.99473	1	
HICP with 10 per cent hp	0.74721	0.60087	0.64150	1

Of course, the results relating to the DFI series described above are, by definition, a product of the methodology used to obtain them. The advantage of the DFI measure over other weighting schemes is that the impact of idiosyncratic factors is down-weighted. By construction, therefore, it captures the idea of core inflation and tends to reflect better than traditional headline rates the medium-term trend in inflation that is of primary interest to policy makers. As Cecchetti and Wynne (2003) point out, the DFI approach gives higher weight to the more persistent components of the inflation index. The stickier price components are arguably the ones leading to the costs associated with inflation and so should be of primary concern to policymakers whose focus is on minimising the harmful effects of inflation in the economy.

V CONCLUSIONS

The literature on inflation measurement tells us that whether and how house prices should be incorporated in the aggregate price statistic used for monetary policy purposes depends ultimately on what it is policymakers are trying to measure – in other words – it depends on the underlying theoretical framework guiding policymakers. The pilot study on the net acquisition costs

of housing currently being carried out by Eurostat together with official statements by the organisation would indicate that European policymakers are interested in some measure of "monetary inflation" rather than a cost-of-living type index along the lines of the CPI in the US. This gives us some direction in answering the two questions set out in the introduction. First, Eurostat are likely to include a measure of owner-occupied housing in the HICP at some point in the future, and, second, the weight of about 20 per cent given to owner-occupied housing in the cost-of-living based US CPI, where it is measured on a rental equivalence basis, is not necessarily a good benchmark to use when deciding what weight to give the net acquisition cost of housing series in the HICP. If some notion of the cost of living is not the theoretical basis for the measure of inflation, then it is not obvious that individual price series should be combined based on their expenditure weights to form the aggregate price statistic.

The methodology employed in this paper suggests an alternative weighting scheme that aims to be consistent with the costs associated with inflation rather than with the cost of living. The analysis focuses on Ireland, as a member of the Euro area. An analysis of Irish inflation where house prices are included is particularly interesting in this case, given the phenomenal performance of the Irish housing market over recent years and the high level of owner-occupancy among Irish households.

The empirical results from the DFI model suggest that if house prices are to be included in the HICP for Ireland, they should receive a relatively small weight on average and so the impact on the measure of inflation used for policy purposes would be not be very substantial. Consequently, based on Irish data, the implications of switching to a differently constructed inflation target that includes housing should not have huge consequences for monetary policy. The low weight assigned to house prices arises from the construction of the index based on the signal-to-noise ratio contained in the constituent series. Because house prices tend to be relatively more volatile than many of the consumption-based components of the HICP, they receive a small weight of around 3 per cent.

This 3 per cent weight contrasts starkly with weights of around 20 per cent for house prices that have been mentioned in the context of the current debate in Europe. Inflation series constructed using a 20 per cent weight for housing show a much more troubling picture, with inflation rates measured in this way reaching double-digits at times. The implication for the appropriate stance of monetary policy could clearly be very different depending on the weight assigned to house prices, especially if house prices continue to change at higher or lower rates than the prices of goods and services. This points to a pressing need for European policy makers to clarify the nature of the

theoretical framework underlying the HICP in order to guide the construction of an appropriate price statistic.

The aim of this paper was not to provide a definitive answer to the question of the appropriate weight for house prices in the HICP. The purpose, rather, was to show what an index constructed on the basis of a signal extraction technique to measure monetary inflation would imply for the importance of house prices in a broad price index and how inflation would differ based on such an index. This is a potentially useful addition to the discussion on how movements in house prices might be included. This approach provides an alternative benchmark to the US weight and arguably provides a measure of inflation that is more in line with the concept of inflation that European policymakers have stated they are interested in.

This study focusing on Ireland was facilitated by the availability of good quality data on the net acquisition cost of housing in Ireland. Obviously, ECB policy is conducted on the basis of developments in the Euro area as a whole and any impact of house prices on the Euro area HICP will have implications for Ireland. As comparable data become available for more members of the Euro area, it will be interesting to compare results across member states.

REFERENCES

ALCHIAN, A. A., and B. KLEIN, 1973. "On a Correct Measure of Inflation", *Journal of Money, Credit and Banking*, Vol. 5, No. 1 February. Part 1, pp. 173-191.

BERNANKE, B., and M. GERTLER, 1999. "Monetary Policy and Asset Market Volatility", *Federal Reserve Bank of Kansas City Economic Review,* Vol. 84, No. 4, pp. 17-52.

BRYAN, MICHAEL F. and STEPHEN G. CECCHETTI, 1993. "The Consumer Price Index as a Measure of Inflation", *Economic Review of the Federal Reserve Bank of Cleveland*, Vol. 29, Q4, pp. 15-24.

BRYAN, MICHAEL F., STEPHEN G. CECCHETTI and RÓISÍN O'SULLIVAN, 2001. "Asset Prices in the Measurement of Inflation", *De Economist*, Vol. 149, No. 4, pp. 405-431.

BRYAN, MICHAEL F., STEPHEN G. CECCHETTI and RÓISÍN O'SULLIVAN, 2003. "A Stochastic Index of the Cost of Life: An Application to Recent and Historical Asset Price Fluctuations" in William C. Hunter, George G. Kaufman and Michael Pomerleano (eds.), *Asset Price Bubbles: Implications for Monetary, Regulatory, and International Policies*", pp. 277-290. Cambridge: Mass, MIT Press.

CECCHETTI, S., H. GENBERG, J. LIPSKY, and S. WADHWANI 2000. "Asset Prices and Central Bank Policy", Geneva Reports on the World Economy, No. 2, ICMB, London: Geneva and CEPR.

CECCHETTI, STEPHEN G. and MARK A. WYNNE, 2003. "Defining Price Stability", *Economic Policy,* Vol. 37, October, pp. 395-434.

DETKEN, CARSTEN and FRANK SMETS, 2004. "Asset Price Booms and Monetary

Policy", *ECB Working Paper Series no. 364*, May.
DONNERY, SHARON, 2003. "Money Supply in Ireland", *Central Bank & Financial Services Authority of Ireland Quarterly Bulletin*, Autumn, pp. 73-95.
ECB MONTHLY BULLETIN, 2005. "The Harmonised Index of Consumer Prices: Concept, Properties and Experience to Date", July, pp. 55-68.
ECONOMIST, 2005. "Steering by a Faulty Compass: Are Central Banks watching the Wrong Measure of Inflation?" 24 February.
EUROSTAT 2004. "Harmonised Indices of Consumer Prices (HICPs): A Short Guide for Users", http://epp.eurostat.cec.eu.int/cache/ITY_OFFPUB/KS-BE-04-001/EN/KS-BE-04-001-EN.PDF.
FINANCIAL TIMES, 2004. "House prices expected to be included in inflation measure: Bank forecasts are in line for a dramatic change", November 10.
FIXLER, DENNIS, 1993. "The Consumer Price Index: Underlying Concepts and Caveats", *Monthly Labor Review*, Vol. 116, No. 12, pp. 3-12.
GILBERT, PAUL D. and LISE PICHETTE, 2003. "Dynamic Factor Analysis for Measuring Money", *Bank of Canada Working Paper*, No. 21.
JEVONS, W. S., 1865. "On the Variation of Prices and the Value of the Currency since 1782", *Journal of the Royal Statistical Society*, Vol. 28, pp. 294-325.
POLLACK, ROBERT A., 1975. "The Intertemporal Cost-of-Living Index", *Annals of Economic and Social Measurement*, Vol. 4, No. 1, Winter, pp. 179-195. (Reprinted in Robert A. Pollack (1989), The Theory of the Cost-of-Living Index, New York: Oxford University Press.)
SHIBUYA, HIROSHI, 1992. "Dynamic Equilibrium Price Index: Asset Price and Inflation", *Bank of Japan Monetary and Economic Studies*, Bank of Japan, Vol. 10, No. 1, pp. 95-109.
SHIRATSUKA, SHIGENORI, 1999. "Asset Price Fluctuations and Price Indices", *Institute for Monetary and Economic Studies*, Bank of Japan, Discussion Paper No. 99-E-21.
STOCK, JAMES H. and MARK W. WATSON 1991. "A Probability Model of the Coincident Economic Indicators", in K. Lahiri and G.H. Moore (eds.), *Leading Economic Indicators, New Approaches and Forecasting Records*, pp. 63-89. Cambridge: Cambridge University Press.
WYNNE, MARK A., 1999. "Core inflation: A Review of Some Conceptual Issues", *European Central Bank Working Paper* No. 5, May.

APPENDIX A

The model used is an application of the model developed by Stock and Watson (1991). Some key features of the model and estimation procedure are:

- There is a single common factor.
- The model is linear in the unobserved variables.
- Prior to estimation, the data are standardised.
- The model is put in state-space form and estimated via the Kalman filter. This involves specifying initial values for each of the parameters and letting the filter equations recursively calculate the predicted state vector. The Gaussian log likelihood (L) is computed and estimates of the parameters are obtained by maximising L using the BFGS hill-climbing optimisation technique.
- The filter produces the MMSE estimator of the common component π (an unobserved or state variable) at time t using observations of the data only up to time t. (An alternative would be the Kalman smoother, which would use the entire sample to produce the estimator. This was not done as it has less practical usage in a policy environment.)
- The weights can change over time but at any given time they sum to one.
- The weights reported represent the implicit weights used to construct the common component by computing the responses of this common component to unit impulses in the observed series.
- Different specifications for the common and idiosyncratic components were tested and were found not to impact the weights obtained.

APPENDIX B

Table B1: *Comparison of Weights Based on a 3-Component Breakdown of the HICP*

	Expenditure	*DFI no hp*	*DFI with hp*
HICP ex food & energy	63.90	66.50	47.99
Food, alcohol, tobacco	27.19	28.62	33.36
Energy	8.91	4.88	9.96
House prices (hp)	n.a.	n.a.	8.69

Figure B1: *DFI versus Inverse Variance Weights (12-Component Breakdown of the HICP)*

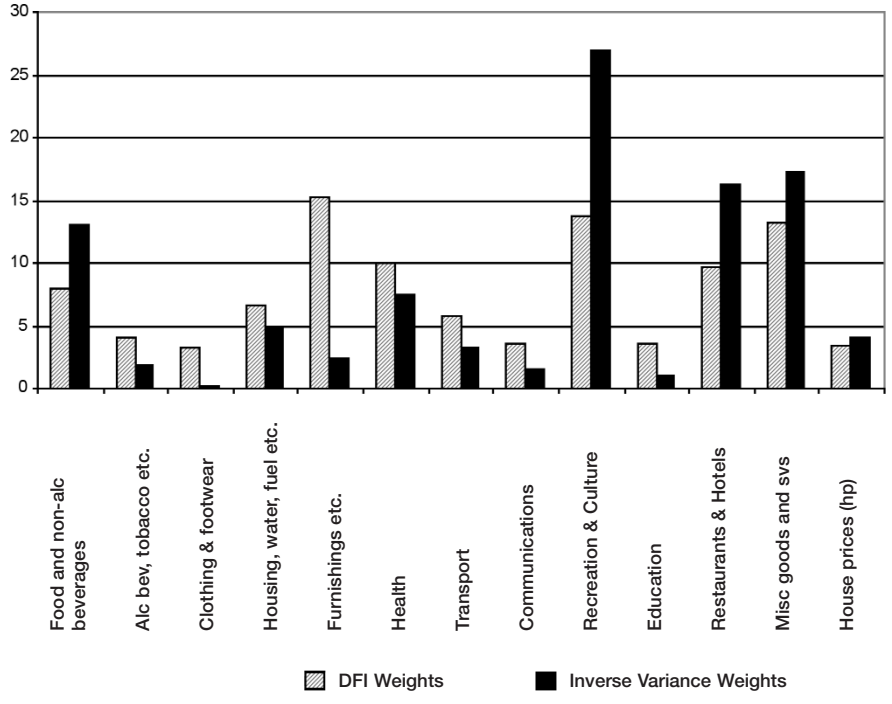


Table B2: *Expenditure Weights with Various Weights on House Prices (12-Component Breakdown of the HICP)*

	Expenditure	*Exp –20% hp*	*Exp –10% hp*	*Exp –3% hp*
Food and non-alc beverages	18.40	14.72	16.56	17.85
Alc bev, tobacco etc.	8.78	7.03	7.91	8.52
Clothing & footwear	5.74	4.59	5.17	5.57
Housing, water, fuel etc.	8.01	6.40	7.20	7.76
Furnishings etc.	4.92	3.94	4.43	4.77
Health	1.85	1.48	1.66	1.79
Transport	12.84	10.27	11.56	12.46
Communications	1.94	1.55	1.75	1.88
Recreation & Culture	11.90	9.52	10.71	11.54
Education	1.43	1.15	1.29	1.39
Restaurants & Hotels	18.95	15.16	17.05	18.38
Misc goods and svs	5.24	4.19	4.72	5.08
House prices (hp)	n.a.	20.00	10.00	3.00

Figure B2: *HICP versus DFI – Year-to-Year Changes for 3-Component Breakdown of the HICP*

Table B3: *Correlations Among Series Based on 3-Component Breakdown of the HICP*

Correlations of Levels

	HICP	*DFI- no HP*	*DFI – HP*
HICP	1		
DFI no house prices	0.99793	1	
DFI with house prices	0.99954	0.99688	1

Correlations of Year-to-Year Changes

	HICP	*DFI- no HP*	*DFI – HP*
HICP	1		
DFI no house prices	0.88133	1	
DFI with house prices	0.98421	0.83215	1