

The impact of OOH augmentation on HICP measurement: Status-quo estimates for Germany[†]

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Abstract

The costs of owner-occupied housing (OOH) are not included in the Harmonised Index of Consumer Prices (HICP), which serves as the key measure for assessing the achievement of price stability in the euro area. The European Central Bank (ECB) requests an integration, with the net acquisition approach being the preferred measurement concept. An OOH-augmented HICP is expected to better represent the inflation which is relevant for households. However, the inclusion must not cause the existing HICP quality criteria to be compromised. This condition is not completely achievable with the existing OOH price index (OOHPI) because its periodicity and timeliness do not meet HICP standards and methodological issues have remained unsolved. An OOH augmentation of the HICP under status-quo conditions requires the OOHPI to be nowcast and temporally disaggregated. Evaluated in terms of year-on-year percentage changes, the mean absolute error between status-quo estimates and the benchmark, which proxies the unknown “true” OOH-augmented HICP, is about one-tenth of a percentage point if more timely indicator variables such as house price index and residential construction price index are used to perform OOHPI nowcasts. Hence, the loss in inflation measurement accuracy incurred by an OOH augmentation of the HICP can be kept within a small limit, let alone potential improvements in the timeliness of OOHPI and/or indicator variables are envisaged as further digitalisation of data processing materialises.

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I. Introduction

The Governing Council of the European Central Bank (ECB) requests the costs of owner-occupied housing (OOH) to be integrated into the scope of the Harmonised Index of Consumer Prices (HICP). This view, which had been developed in a broad-based examination in the 2021 Monetary Policy Strategy Review (ECB, 2021a, b), was recently confirmed in its 2025 update (ECB, 2025). The inclusion of OOH makes the HICP more representative, as a significant share of households' expenditures would no longer be ignored in the key measure for the assessment of price stability in the euro area. In addition, it further improves the cross-country comparability of this inflation measure given that owner-occupancy rates in European countries are rather different.

The ECB Governing Council expressed a preference to measure OOH according to the net acquisitions (NA) approach. The HICP should therefore be augmented by the price trends of those dwellings which households newly build or first acquire for their own use. This approach is methodologically consistent with the measurement of other durable goods. As OOH measurement is based on the price observations of market transactions, the NA approach fulfils a key principle that makes the HICP particularly suitable for use in monetary policy assessments. This contrasts with the rental equivalence (RE) approach for which imputed rents are used.

The implementation of the NA approach, however, entails methodological and practical challenges. From a conceptual point of view, OOH costs should refer to structures, as owner-occupiers use up only this part of their residential properties. In the OOH price indices (OOHPI) published by the European Statistical System (ESS), this is implemented with respect to weights but not prices (Eurostat, 2017, p. 95). It is currently upon further methodological research which methods might enable official statistics to split house prices into their land and structures components. On the practical side, insufficient and belated availability of house prices and residential construction prices prevent OOHPIs to be compiled at monthly periodicity and as timely as the HICP.

According to the survey the ESS conducted in preparing its response to the ECB Governing Council request, the vast majority of European statistical offices has pointed out that, because of the methodological and practical challenges, the NA approach is not implementable without jeopardising HICP quality standards (Eurostat, 2023, Section 6.2). Indeed, they are unlikely to be satisfactorily resolved in the time horizon over which users would like to see progress in the OOH augmentation of the HICP. A quantification of the impact the incorporation of OOH on the quality of the HICP may have, using today's data availability and state-of-the-art methodologies, enriches the academic discourse on current challenges related to augmenting the HICP with costs of OOH.

The OOHPI is currently available at quarterly periodicity. In Germany, its major ingredients are the house price index (HPI) and the residential construction price index (RCPI). The reporting period of the HPI is a quarter and, thus, a transformation to monthly periodicity requires temporal disaggregation. The reporting period of the RCPI is a month. However, construction prices are collected only every three months, making it necessary to fill the missing months using temporal disaggregation. In addition, the compilation of HPI and RCPI considerably lags behind HICP production. While further digitalisation of data collection and processing will probably shorten the delay somewhat, the timeliness of the HICP is expected to be met only using nowcasting.

Temporal disaggregation and nowcasting are subject to various sources of error. There is uncertainty about the data generating processes in both theoretical and statistical terms, and unpredictable shocks may affect future index values. Hence, if implemented with the aim to include OOH in the monthly HICP, while keeping its timeliness, these techniques are likely to impair inflation measurement under status-quo conditions. The objective of this paper is to estimate the contribution of OOH augmentation on the uncertainty surrounding HICP inflation. We focus on the year-on-year percentage change of the HICP because the Governing Council of the ECB has chosen this measure to assess price stability.

For the quantification of the OOH inclusion effect on inflation measurement in Germany, we mimic ongoing statistical production in real time. We derive status-quo estimates which are compiled by temporal disaggregation and nowcasting using the information currently available at HICP publication dates. Our benchmark is an approximation to the unknown “true” OOH-augmented HICP. This is the final estimate, i.e. the results of applying the compilation methods using the full sample available in our exercise.

Evaluating the year-on-year percentage changes of the OOH-augmented HICP using status-quo OOHPI estimates against the benchmark over the period from January 2021 to December 2025 yields a mean absolute error between one-tenth and one-quarter of a percentage point. In general, better outcomes are achieved when indicator variables are used in an error-correction model specification and nowcasts are performed ahead of, rather than after, temporal disaggregation. The good news is that, with a good modelling strategy, the loss in inflation measurement accuracy incurred by an OOH-augmentation of the HICP can be kept within a small limit even under status-quo conditions regarding OOHPI periodicity and timeliness.

The evaluation setup is hypothetical because the compilation methods considered here are not compatible with the current HICP regulation. Even if we envisage some adjustments to enable the inclusion of OOH, it is rather unlikely that temporal disaggregation and nowcasting will be allowed in official statistics. The methods, which are thought of being realistically implementable, may be based on more timely HPI and RCPI because of more digitised data collection and processing, for instance. Nonetheless, it is rather implausible that improvements in

the foreseeable future will end up with as short publication delays for the HPI and the RCPI as for the HICP.

Apart from frequency mismatch and publication delay, there are at least two further sources of uncertainty surrounding an OOH augmentation using the NA approach. As mentioned above, from a conceptual point of view, only the structure component of the HPI should enter. Any land-structures split is subject to modelling uncertainty. Furthermore, the incorporation of OOH costs into the scope of the HICP requires that the owner-occupiers' housing expenditure have to be estimated in order to compile a weight of OOH in the augmented HICP. The standardly used weight estimation procedure does not come without imposing assumptions owing to lack of data. So, there is uncertainty surrounding weight compilation, too.

The additional measurement error refers to the OOH augmentation explicitly and exclusively using the NA approach. Other approaches are broadly discussed in the literature (see e.g. IMF, 2025, Chapter 10, for an overview). Recent estimates for the RE approach are found in Knetsch et. al. (2025), Eiglsperger et al. (2024) and Eurostat (2023). The OOH component measured by the RE approach typically deviates somewhat from its NA counterpart and under specific circumstances, e.g. in the 2021/22 period, the differences rise to a considerable amount. Hill et al. (2023) map out an implementation strategy of the user cost approach as their preferred approach and provide country results including Germany. If we allowed OOH to be measured by the other approaches and incorporated model uncertainty in our evaluation, the measurement error would probably be much larger.

The remainder of the paper is organised as follows. The following section outlines the compilation procedure of the OOHPI and gives an overview on the time schedules of HICP, OOHPI, HPI and RCPI publications. Section III provides details on the methodological framework, comprising time series modelling and temporal disaggregation. In Section IV, we elaborate on the evaluation framework yielding our estimates for the loss in inflation measurement accuracy incurred by OOH augmentation. We draw some conclusions in Section V.

II. The OOHPI as a measure of NA-based OOH costs and its main drivers

Following about 20 years of debate amongst European price statisticians how to treat OOH in the HICP (see Astin, 2021, Section 11.2), the legislative basis for the production of OOHPI as an experimental satellite index was established (EU, 2013) and, from 2014 onwards, all euro area countries except Greece have published these indices at quarterly periodicity. In 2018, the existing OOHPI was assessed to be unsuitable for integration into the coverage of the HICP for the time being and more methodological work was advised to pursue (EU, 2018). With the outcome of the 2021 Monetary Policy Strategy Review, this issue has (re-)entered

the limelight of HICP development, as the ESS agreed – as the result of a broad-based stock-taking analysis – to conduct targeted research on remaining methodological and practical challenges.

The current legislative basis and statistical practice for the HICP and the OOHPI serve as both starting point for our reflections on proposals for further methodology developments and reference point for their evaluation in terms of potential effects on HICP quality. The HICP must be compiled monthly and delivered no later than 15 days (or 20 days) after the end of the reporting period for February to December (or January), whereas the OOHPI should be produced quarterly and made available no later than 85 days after the end of the reporting period (EU, 2016, Art. 6 and 7). In EU (2023), the methodological and technical specifications of the existing HPI and OOHPI are laid down, and Art. 11 determines the breakdown of the OOHPI.

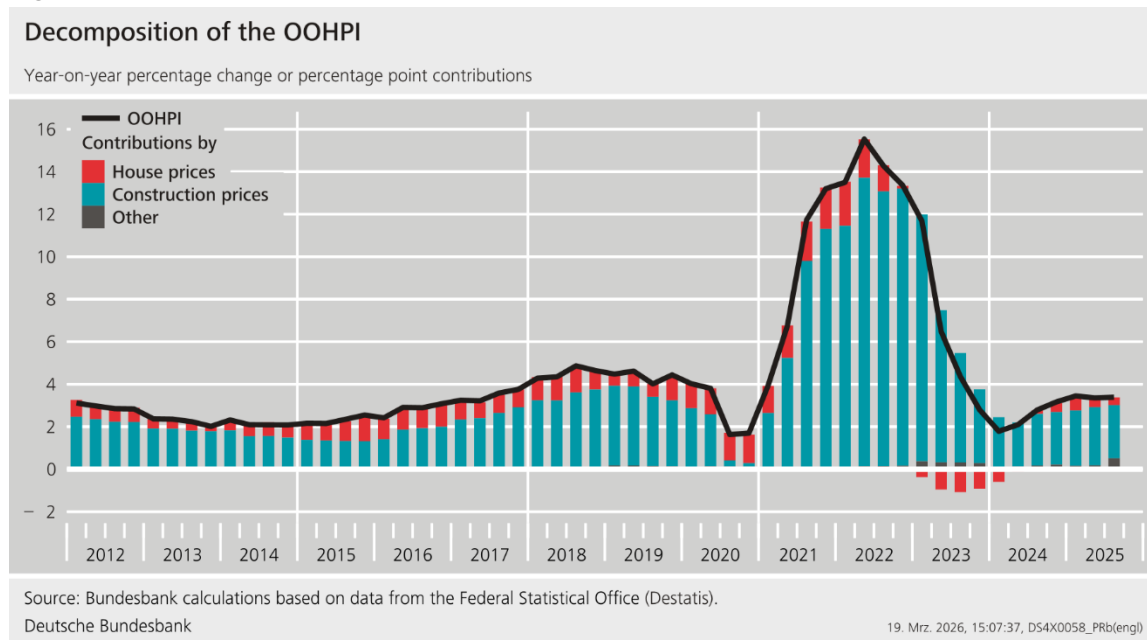
Table 1: Expenditure categories in the OOHPI (2025)			
In %			
Item	Name	Germany	Memo item: Euro Area*
O.1	Owner-occupiers' housing expenditure	100.0	100.0
O.1.1	Acquisition of dwellings	86.9	76.3
O.1.1.1	New dwellings	81.4	63.7
O.1.1.1.1	Purchases of new dwellings	9.1	19.8
O.1.1.1.2	Self-build dwellings and major renovations	72.3	43.9
O.1.1.2	Existing dwellings new to households	-	0.6
O.1.1.3	Other services related to the acquisition of dwellings	5.5	12.0
O.1.2	Ownership of dwellings	13.1	23.7
O.1.2.1	Major repairs and maintenance	9.6	20.3
O.1.2.2	Insurance connected with dwellings	2.7	2.6
O.1.2.3	Other services related to ownership of dwellings	0.8	0.8
* Without Greece.			
Source: Eurostat			

In Table 1, we map the OOHPI components to their main driving factors, which are either the HPI (marked in red) or the RCPI (in blue). In Germany, RCPI components are used by the Federal Statistical Office to derive index values for self-build dwellings and major renovations (O.1.1.1.2)¹ and major repairs and maintenance (O.1.2.1) (Brunßen and Diehl-Wolf, 2018). Their expenditures make up about four-fifths of the total amount German households spend for OOH. In the same way, the HPI component concerning new dwellings is used for the index calculation of purchases of newly built dwellings (O.1.1.1.1). For other services related to the acquisition of dwellings (O.1.1.3) the HPI component can only be considered as a proxy, assuming this category be a more or less constant factor of the house price. The share of these components in OOH expenditures is almost one-fifth, implying that the remaining components

¹ This category also contains information from the index of producer prices of industrial products sold on the domestic market. However, it can be assumed that this sub-component plays only a minor role concerning the price development of the whole OOHPI component.

generally do not provide any quantitatively relevant contribution to OOHPI developments. As shown in Figure 1, the German OOHPI is RCPI-driven to the overwhelming part and HPI-driven to a recognisable, albeit comparatively small, part.

Figure 1:



For the production of the OOHPI according to HICP standards, it is crucial to broaden and accelerate the flow of data underlying the compilations of the RCPI and the HPI. The construction price indices are based on a survey conducted amongst construction companies collecting price information for the middle month of every quarter. They are regularly released about 45 days after the end of the reporting month. As they are used for the calculation of the OOHPI categories O.1.1.1.2 and O.1.2.1, they can be taken as a proxy for the whole quarter. Hence, an observation for the RCPI will be available already about 15 days after the end of the quarter. The RCPI considered in this analysis is a composite of these two subindices aggregated using OOHPI weighting information.

The official HPI is broken down into new and existing dwellings, the former of which perfectly serves the purpose of OOHPI compilation. It is based on data about real estate transactions. The committees of surveyors of property values collate this information from transmissions of notaries and after-sale questionnaires and make it available for statistical purposes. However, missing digitalisation of transmission processes, low response rates and the regional segmentation of the committees are impediments of a more comprehensive and timely reporting of house prices.

The vdp (*Verband deutscher Pfandbriefbanken*, Association of German Pfandbrief Banks) publishes a transaction-based house price index (henceforth abbreviated by HPI^v) about 40

days after the end of the reporting quarter and, thus, more than one month earlier than official statistics (<https://www.vdpresearch.de/leistungen/preisindizes/>). The private company Europace, a subsidiary of Hypoport SE, publishes a monthly hedonic composite price index consisting of prices for apartments as well as new and existing houses (<https://europace.de/epx-hedonic/>). This index (henceforth abbreviated by HPI^e) is usually available about 10 or 15 days after the end of the reporting month. The HPI^v and HPI^e are both index series to be used in the nowcasting exercise as alternatives to the official HPI.

Table 2: Availability of quarterly indicators at monthly HICP publication dates

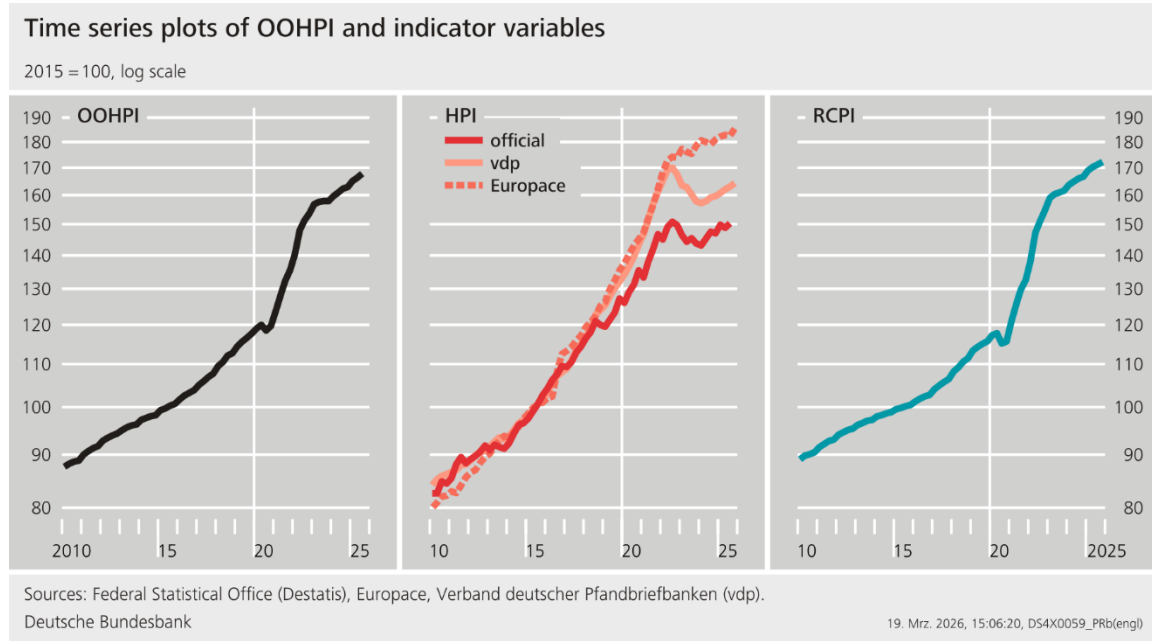
HICP publication date		Availability up to reporting period					
Quarter	Month	HICP	OOHPI	HPI ^o	HPI ^v	HPI ^e	RCPI
q	1	(q-1,3)	q-2	q-2	q-2	q-1	q-1
	2	(q,1)	q-2	q-2	q-1	q-1	q-1
	3	(q,2)	q-2	q-2	q-1	q-1	q-1

For the configuration of the nowcasting exercise, it is important to define the information set available for indicator variables at the publication dates of (final) HICP results. As shown in Table 2, when the HICP for the third month of a quarter is published, the OOHPI, HPI^o and HPI^v lag one quarter behind while the HPI^e and RCPI for the same quarter are already available. With the HICP publications of the first and the second months of a quarter, the HPI^v, HPI^e and RCPI are available for the previous quarter, whereas OOHPI and HPI^o are two quarters delayed.

III. Time series modelling for nowcasting and temporal disaggregation

The augmentation of HICP with OOH requires monthly nowcasts of the OOHPI. As the OOHPI is a quarterly index released with a time lag compared with the HICP, we obtain monthly nowcasts by applying temporal disaggregation and prediction. The two exercises are based on time series models. They are carried out one after another. Particularly for nowcasting, the knowledge of time series characteristics of OOHPI and its indicator series help specify the models in a way that promises the exercises to yield good results.

The OOHPI is available from the first quarter of 2010 (2010q1). We analyse the time series properties of the OOHPI together with its indicator series in the period from 2010q1 to 2025q4 (64 observations). As displayed in Figure 2, the OOHPI and its indicator series exhibit an upward trend. In a first step, we therefore perform unit root in order to check whether the series, transformed into logs, are driven by a stochastic trend. From the results in Table 3, we conclude that the series appear to be stationary after first differencing. Visual inspection and some formal tests let us conclude that seasonality can be ignored in the analysis.

Figure 2:**Table 3: Unit root tests**

Variable	Level [constant, trend]			First difference [constant]		
	ADF	PP	KPSS	ADF	PP	KPSS
$\ln P_t^{OOH}$	(1) 1.81	(5) 1.54	(5) 0.228***	(0) 3.72***	(1) 3.71***	(5) 0.293
$\ln P_t^H(o)$	(4) 2.22	(2) 1.19	(6) 0.117	(5) 3.05**	(1) 7.89***	(1) 0.190
$\ln P_t^H(v)$	(1) 2.23	(5) 1.52	(6) 0.115	(0) 2.93**	(1) 2.94**	(5) 0.146
$\ln P_t^H(e)$	(1) 1.88	(4) 1.74	(6) 0.144*	(0) 5.31***	(0) 5.31***	(4) 0.170
$\ln P_t^{RC}$	(1) 1.72	(5) 1.38	(6) 0.231***	(0) 3.70***	(4) 3.66***	(5) 0.316

In Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, the null hypothesis is the existence of a unit root, while in Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, the null hypothesis is the presence. In ADF tests, the numbers in parentheses indicate the lag order and, in PP and KPSS tests, the bandwidth parameter of the Bartlett kernel for estimating the heteroscedastic-autocovariance corrected variance. The deterministic components of the test equations are written in brackets in the first row. The table reports test statistics. ***, **, * means the rejection of the null hypothesis at the 1%, 5% and 10% level, respectively.

In the next step, we set up trivariate systems, grouping the OOHPI as target variables together with an indicator representing house price developments and an indicator representing residential construction price developments. In formal terms, let us consider the three-dimensional vector $x_t = (\ln P_t^{OOH}, \ln P_t^H, \ln P_t^{RC})'$, $t = 1, 2, \dots, T$, where P_t^{OOH} represents the OOHPI, P_t^H the HPI and P_t^{RC} the RCPI. T reflects the sample size.

We take vector autoregression as an econometric modelling setup with which we are going to derive specifications for nowcasting.

Vector autoregression

Assume that x_t be represented by a vector autoregression (VAR) of order p . The series of x_t may be integrated and co-integrated and, thus, the VAR(p) may be written as a vector error correction model (VECM):

$$\Delta x_t = c + \alpha \beta' x_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \varepsilon_t$$

where Δ is the difference operator, c is the intercept term, α and β are $(3 \times r)$ matrices with $0 < r < 3$, $\Gamma_1, \dots, \Gamma_{p-1}$ are (3×3) matrices. ε_t is a three-dimensional white noise process with zero mean and variance-covariance matrix Ω . β contains the cointegrating vectors. If there is none ($r = 0$), the term $\alpha \beta' x_{t-1}$ will not appear in the equation.

Table 4: Cointegration tests

Specification	VAR(2) for system $(\ln P_t^{OOH}, \ln P_t^H, \ln P_t^{RC})'$		
P_t^H	o	v	e
$r = 0$	32.14**	27.07*	36.60***
$r \leq 1$	15.60**	10.33	12.26
$r \leq 2$	0.05	0.07	3.24
β unrestricted	$(1, -0.14, -0.86)'$	$(1, -0.15, -0.83)'$	$(1, -0.17, -0.77)'$
LR test $[\chi^2(1)]$	0.32 [0.57]	3.38* [0.07]	10.06*** [0.01]
β restricted	$(1, -0.10, -0.90)'$	$(1, -0.12, -0.88)'$	$(1, -0.02, -0.98)'$

Trace statistics of the Johansen (1991) cointegration tests are reported. The system's cointegrating vector is shown in both unrestricted and restricted form. The statistics of the likelihood ratio (LR) test for binding restriction are also reported, with p-values in brackets (Johansen and Juselius, 1990). ***, **, * means the rejection of the null hypothesis at the 1%, 5% and 10% level, respectively.

As displayed in Table 4, Johansen (1991) cointegration tests provide evidence that the three variables are cointegrated. In the trivariate system with the vdp and the Europace index chosen as HPI, test results indicate towards the existence of exactly one cointegrating relation ($r = 1$). Using the official HPI, there might be even two cointegrating relations in the system.

Theoretical considerations, however, back the view that there is one cointegrating relation between the three variables. Assume the relationship between the OOHPI and its indicator variables HPI and RCPI be approximately represented by:

$$P_t^{OOH} = (P_t^H)^\lambda (P_t^{RC})^{1-\lambda}, \quad 0 < \lambda < 1.$$

By taking logs, we end up with the linear expression:

$$\ln P_t^{OOH} = \lambda \ln P_t^H + (1 - \lambda) \ln P_t^{RC}.$$

We therefore might identify this relationship as the cointegrating vector. As reported in Table 4, the restricted cointegrating vector $\beta = (1, -\lambda, -(1 - \lambda))'$ is not rejected by LR tests in the

trivariate systems containing the official index. For the vdp index used as indicator for house price trends, the hypothesis is mildly rejected, whereas it is strongly rejected in the case of the Europace index. The rejection might be due to the fact that vdp and Europace indices are not an ingredient of OOHPI compilation as the official HPI.

The VECM is a reduced-form model which allows us to impose relationships between the levels and differences of the variables stacked in x_t . It may be conditioned upon a subset of variables which is particularly helpful for parsimonious modelling when some indicator variables are earlier available than the OOHPI. Assume the period t observations of k series x_{2t} , with $0 < k < 3$, be earlier available than those of the other series x_{1t} , with $x_t = (x'_1, x'_2)'$. For nowcasting x_{1t} , we can thus apply the conditional VECM:

$$\Delta x_{1t} = c_1 + \alpha_1 \beta' x_{t-1} + \sum_{i=1}^{p-1} \Gamma_{1i} \Delta x_{t-i} + \omega \Delta x_{2t} + \varepsilon_{1t},$$

where c_1 , α_1 and ω are k -dimensional vectors and $\Gamma_{11}, \dots, \Gamma_{1p-1}$ are $(k \times 3)$ matrices.

The contemporaneous logged differences are expected to have explanatory power. By differencing the approximate theoretical relationship between the OOHPI and its indicator variables through time, we obtain an expression in the first differences of the logged variables:

$$\Delta \ln P_t^{OOH} = \lambda \Delta \ln P_t^H + (1 - \lambda) \Delta \ln P_t^{RC}.$$

This establishes a link between the contemporaneous percentage changes of indicator variables and the percentage change of the OOHPI.

Setting $x_{1t} = \ln P_t^{OOH}$ and stacking $\ln P_t^H$ and/or $\ln P_t^{RC}$ in x_{2t} whenever available, we end up with a single-equation nowcasting model for the percentage change of the OOHPI with direct impacts from contemporaneous percentage changes of indicator variables and an error-correction mechanism towards a log level relationship between OOHPI and indicator variables. This model may be specified and estimated using either monthly or quarterly data. Hence, temporal disaggregation must be performed as a preliminary or subsequent step.

IV. Measuring the additional HICP measurement error due to OOH augmentation

In this section, we quantify the OOH inclusion effect on HICP mismeasurement which is due to the frequency mismatch and the compilation delays of HPI and RCPI relative to the HICP. We mimic the monthly compilation of an OOH-augmented HICP at the point in time when the final HICP is released. Hence, we need to estimate an OOHPI about 15 or 20 days after the end of the reporting month using data available for the indicator series at this date. The compilation procedure is outlined in the first part of this section. In the second part, we present the

real-time evaluation exercise, with which we quantify the loss in inflation measurement accuracy incurred by an OOH-augmentation of the HICP.

Compiling a monthly OOH-augmented HICP

Given the ragged-edge structure of time series dataset (recall Figure 2), we need to predict OOHPI two quarters ahead when the HICP of the first and the second months of a quarter are released. It is only a one-quarter ahead prediction for the third month of a quarter. To predict OOHPI one quarter ahead, we can directly apply the error correction model derived in the previous section. For the two-quarter ahead prediction, we use the error correction model where the explanatory variables are set back by one period. In the terminology of Bhansali (1996), we perform direct forecasts, instead of iterative plug-in forecasts, when multi-step ahead predictions are needed.

Apart from the error correction specification, we consider simpler model structures, too. The simplest model is a univariate autoregressive moving-average model of the differenced OOHPI (ARIMA). In alternative specifications, we add the RCPI and the HPI, in first differences and appropriately lagged, as exogenous variables. These ARIMAX models represent an intermediate case, i.e. using the information content of indicator variables but omitting the error correction mechanism. The more parsimonious model structures might be due to potential misspecification but have an advantage that a fewer number of parameters must be estimated. Model misspecification and parameter uncertainty are separate, and often opposing, sources of forecast error. These are balanced out by specification search in real forecasting exercises.

We disaggregate the quarterly OOHPI series, complemented by the nowcast(s), into monthly series using the Denton-Cholette approach. Temporal disaggregation is performed by minimizing the squared deviations (Denton, 1971), additionally removing the transient movement at the beginning of the series (Cholette, 1984; Dagum and Cholette 2006, p. 136-137). Alternatively, we revert the sequence of the two compilation steps, meaning that we first temporally disaggregate OOHPI, HPI and RCPI and perform nowcasts using the resulting monthly dataset. We thus estimate ARIMA(X) and error correction specifications for direct OOHPI predictions three, four and five steps months ahead.

Having performed an OOHPI nowcast for the HICP reporting month m in year y , we combine HICP and OOHPI using the weight w_{y-1}^{OOH} which represents owner-occupiers' housing expenditures as a percentage of the extended scope:

$$P_{y,m}^+ = P_{y-1,12}^+ \frac{P_{y,m}^+}{P_{y-1,12}^+}$$

with

$$\frac{P_{y,m}^+}{P_{y-1,12}^+} = (1 - w_{y-1}^{OOH}) \frac{P_{y,m}^{HICP}}{P_{y-1,12}^{HICP}} + w_{y-1}^{OOH} \frac{P_{y,m}^{OOH}}{P_{y-1,12}^{OOH}}.$$

The OOH augmentation follows the principles established for the HICP as a Laspeyres-type index. The OOH-augmented HICP for each month in a calendar year results from combining HICP and OOHPI with the OOH weight referring to December of the previous year. For weight estimation, we follow the approach suggested by Knetsch et al. (2025). We do not consider OOH weights be subject to modelling uncertainty and, thus, also a source of mismeasurement.

Real-time analysis

We set up a real-time evaluation exercise, in which we compare the year-on-year percentage change of the status-quo estimates of the OOH-augmented HICP according to the various modelling variants with a benchmark. The benchmark is our best approximation to the unknown “true” OOH-augmented HICP, namely the HICP combined with the temporally disaggregated full-sample OOHPI. The real-time status-quo estimates cover the period from January 2021 to December 2025 ($I = 60$ observations). The general structures of the direct prediction models are kept unchanged regarding their general structures. However, they are re-estimated every month anew with the data available up to this point in time.

OOH-augmented HICP inflation is defined as the year-on-year percentage change of the OOH-augmented HICP:

$$\pi_t^+(v) = \frac{P_{y,m}^+(v) - P_{y-1,m}^+(v)}{P_{y-1,m}^+(v)},$$

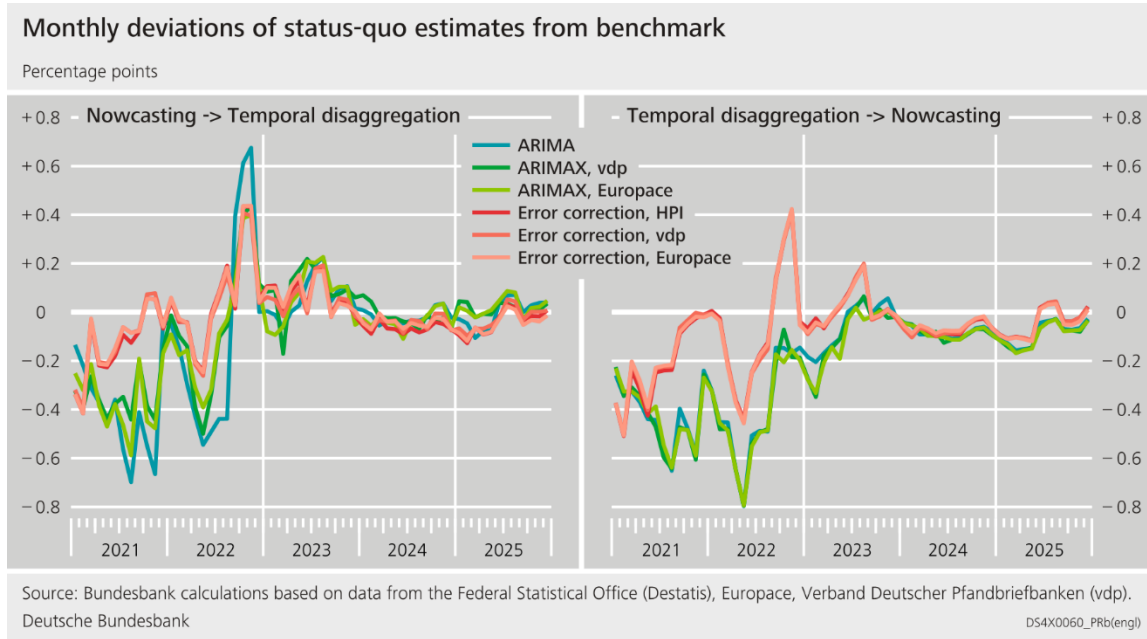
where the compilation variants are denoted by $v = 1, \dots, V$ and the benchmark by $v = 0$.

Figure 3 displays the monthly deviations of status-quo estimates of OOH-augmented HICP inflation from the benchmark for all compilation variants:

$$d_{y,m}(v) = \pi_{y,m}^+(v) - \pi_{y,m}^+(0).$$

Deviations fluctuate around the zero line, being contained by the interval of ± 0.4 percentage points with only a few exceptions. From 2023 onwards, deviations are visibly smaller for all compilation variants than in 2021 and 2022. In these two years, the OOHPI expanded very strongly, resulting from a considerably rising construction prices and buoyant house price trend. In this phase, the specification of the OOHPI nowcast model makes a difference. Indeed, ARIMA(X) models are clearly outperformed by error correction specifications. From visual inspection, we also conclude that model specification is more of a critical issue when temporal disaggregation is placed after, rather than prior to, nowcasting.

Figure 3



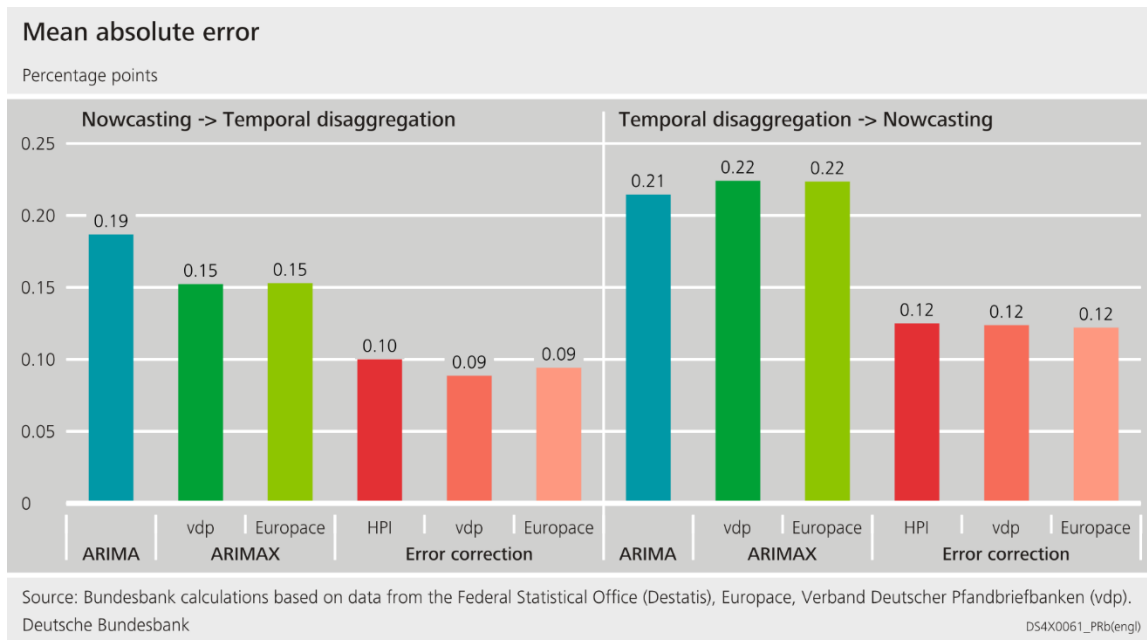
An estimate of the loss in inflation measurement accuracy incurred by an OOH-augmentation is given by averaging $d_{y,m}(v)$ in absolute value (henceforth called mean absolute error):

$$MAE(v) = \frac{1}{I} \sum_{i=1}^I |d_i(v)|, \quad i = 2021,1; 2021,2; \dots; 2025,12.$$

As displayed in Figure 4, the MAE is about one-tenth of a percentage point when OOHPI nowcasts are performed using error correction models specified on a quarterly dataset and temporal disaggregation is carried out afterwards. In reverse order, it is also the error correction specification which performs better than the alternative prediction models. However, the MAE is about one-eighth of a percentage point in this case.

The loss in inflation measurement accuracy is substantially higher when RCPI and HPI are not used as explanatory variables for the OOHPI. The MAE of the ARIMA specification is about double the size of the error correction specifications. When incorporating RCPI and HPI, it is really the error correction mechanism that makes the difference in nowcasting performance. Just adding the differenced logs of the indicator variables to the ARIMA specification only helps a little in the quarterly setup and does not help at all with monthly setup.

Figure 4



The MAE is not visibly affected by the choice of the HPI used. The official HPI is published with a longer lag than the vdp and Europace indices. In terms of MAE, this disadvantage is completely offset by the fact that some OOHPI components are directly compiled using the HPI while vdp and Europace indices can only proxy them.

Figure 5

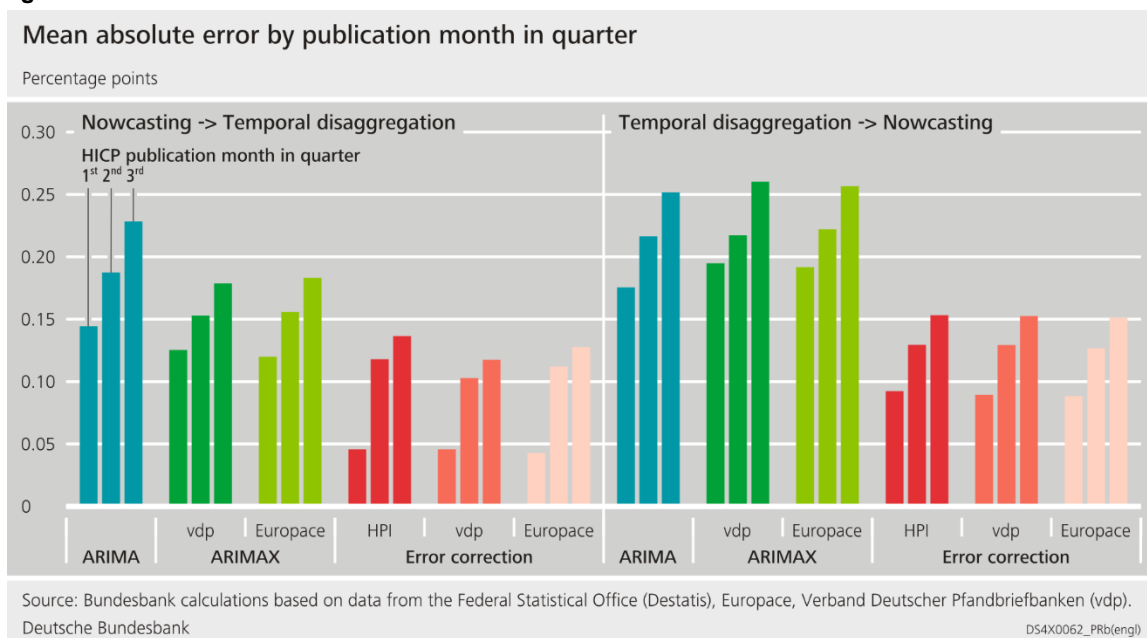


Figure 5 reveals a systematic month-in-quarter profile of the MAE, irrespective of the compilation variant applied. This is due to the ragged-edge structure of the dataset of OOHPI and indicator variables. In the first month of a quarter, the MAE is considerably lower because the OOHPI needs to be predicted only one quarter (or three months) ahead, whereas the predictions two quarters (or four and five months, respectively) ahead are required in the second and third month of a quarter. In January, April, July and October, the status-quo estimates of the OOH-augmented HICP are particularly precise. When the OOHPI nowcast is performed using an error correction model with quarterly data, the MAE amounts one-twentieth of a percentage point only.

V. Conclusions

The ECB requests OOH costs to be included in the HICP, with the NA approach being the preferred measurement methods. The inclusion is infeasible with the existing OOHPI because it is available only quarterly and with a delay of about two months. OOHPI compilation might be accelerated in the future thanks to more digitised data processing, speeding up the transmission of HPI source data to statistical offices, for instance. Even if some improvements materialise, it is unlikely that a monthly OOHPI will be available with the same short publication delay as the HICP in the foreseeable future. It is worth quantifying the loss of inflation measurement accuracy incurred by an OOH augmentation under status-quo conditions, where OOHPI nowcast and temporal disaggregation are needed.

According to our estimates, the OOH augmentation would add about one-tenth of a percentage to the inflation measurement error if quarterly OOHPI nowcasts were performed using HPI and RCPI as indicator variables in an error correction specification and the temporal disaggregation was carried as a subsequent step. Our real-time evaluation reveals that ignoring indicator variables, omitting the error correction mechanism, and reversing the sequence of compilation steps leads to larger losses in measurement accuracy.

With the order of magnitude found for the best performing models, inflation measurement does not seem to be too strongly disturbed so that the OOH-augmented HICP would be judged to be without any analytical value. Even under status-quo conditions, it might be worth considering a regular compilation of a monthly OOH-augmented HICP as a supplementary indicator. Statistical offices might consider this corollary too far-reaching because statistics should be reluctant to rely on nowcasting and temporal disaggregation. However, the results send, at least, encouraging signals to further develop data sources and compilation techniques. The OOH-augmentation of the HICP according to the NA approach without compromising quality standards will not be out of reach.

The loss in measurement accuracy is quantified with the focus on the insufficient periodicity and timeliness of OOHPI under status-quo conditions. Measurement uncertainties regarding the derivation of the OOH weight and a potential land-structures split of the HPI are faded out in this analysis. In addition, measurement uncertainty in this paper is not understood to capture the variety of OOH augmentation using the different measurement concepts.

The results for Germany are likely to draw a more positive picture than it would be expected for the euro area. The reason for this conjecture is the comparatively large weight of self-built dwellings construction in owner-occupiers' housing expenditures. With the RCPI, a timely and high-quality indicator is available in Germany for this OOHPI component. In other euro area countries, dwellings acquisition is more relevant than self-builds, suggesting that the HPI, which is the more critical indicator in terms of measurement quality, is given a stronger impact on the OOHPI. To broaden the picture, it is worth extending this analysis to the euro area HICP and/or other euro area countries.

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