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REAL INTEREST RATES AND THE ECB'S MONETARY POLICY STANCE

by Marco Bernardini*, Lara D'Arrigo*, Alessandro Lin* and Andrea Tiseno*

Abstract

We present a new market-based measure of the short-term real interest rate in the euro area. Simple metrics based on the difference between 1-year Overnight Index Swap (OIS) and Inflation-Linked Swap (ILS) rates suffer from a timing mismatch stemming from the lagged indexation of ILS. Our measure addresses this issue by leveraging on Inflation Fixing Swaps (IFS), contracts linked to each of the next 24 releases of euro area inflation. Compared to the yearly maturity structure of ILS, the monthly maturities of IFS allow for a sharp time alignment of nominal interest rate and expected inflation, yielding a more accurate and reliable measure of the ex-ante short-term real interest rate as well of its expected evolution. We use this measure to provide a comprehensive analysis of the ECB's monetary policy stance during the post-pandemic era.

JEL Classification: E31, E43, E52.

Keywords: monetary policy stance, real interest rates, natural rate, inflation expectations.

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1. Introduction[1]

The resurgence of policy rates as the primary monetary policy tool has sparked renewed interest in conventional indicators of the monetary policy stance. Following a prolonged period characterised by policy rates at their effective lower bound (ELB) and the use of unconventional monetary measures, the post-pandemic inflation surge called for a strong and swift increase of policy rates by major central banks around the globe. For the European Central Bank (ECB), the overall increase amounted to 450 basis points over the course of 15 months. As the short-term interest rate gained back its role of main monetary policy tool, interest in revisiting conventional metrics of the monetary policy stance was revived.

Against this backdrop, the difference between the *ex-ante* short-term real interest rate and the natural rate (also known as "real rate gap") provides a simple yardstick for measuring the monetary policy stance. The *ex-ante* real interest rate is defined as the difference between the nominal interest rate and the expected inflation rate. The natural rate can be conceptualised as the *ex-ante* short-term real interest rate that is neither expansionary nor contractionary.[2] The sign of the difference indicates the orientation of the stance: restrictive (positive gap), neutral (zero gap), or accommodative (negative gap). This paper focuses on the measurement of the *ex-ante* short-term real interest rate for the euro area, while it takes estimates of the natural rate off the shelf.

A simple measure of real interest rates in the euro area is the difference between Overnight Index Swap (OIS) and Inflation-Linked Swap (ILS) rates of corresponding maturity. However, this measure suffers from a timing mismatch. OIS and ILS are derivative contracts whose rates closely reflect risk-neutral expectations of the future paths of policy and inflation rates. The 1-year OIS-ILS difference is thus often used as a proxy for the short-term real interest rate. However, its interpretation as a precise "*ex-ante*" measure is complicated by a timing mismatch between reference periods. While the 1-year OIS rate is purely forward looking, the reference period of the 1-year ILS rate is lagged by three months. Specifically, the final pay-off of a 1-year OIS contract depends on the average overnight interest rate realised in the twelve months prior to the contract's conclusion, whereas that of a 1-year ILS contract is indexed to the year-on-year inflation rate of three months prior to the end of the contract. Adjusting ILS rates, to realign them with corresponding OIS rates and compute a true *ex-ante* real interest rate, is not trivial and requires relatively strong assumptions.

In this paper, we propose a more accurate and reliable market-based measure of the *ex-ante* short-term real interest rate based on Inflation Fixing Swap (IFS) rates. IFSs are swap contracts linked to each of the next 24 monthly releases of euro area year-on-year inflation rates. Hence, IFS contracts provide a direct measure of the expected monthly evolution of inflation, which allows us to circumvent the issues of lagged indexation posed by ILS contracts. Deflating nominal OIS rates by an appropriate interpolation of IFS rates allows us to solve the timing mismatch and to deliver a term

[1] The views expressed in this paper are those of the authors and do not necessarily reflect those of Banca d'Italia or the Eurosystem. We benefited from useful comments and inputs by Luca Brugnolini, Martina Cecioni, Giuseppe Ferrero, Stefano Neri, Alessandro Secchi, Fabrizio Venditti, and Roberta Zizza.

[2] In this paper we do not make a terminological distinction between "natural" and "neutral" rates (as in Obstfeld, 2023), neither we explicitly specify the exact horizon at which the natural interest rate is supposed to stabilise the inflation rate (as in Baker et al., 2023).

structure of real interest rates measured at monthly horizons. Comparing the latter to estimates of the natural rate provides an accurate assessment of near-term market expectations for the ECB's monetary policy stance.

Our new real interest rate measure provides an intuitive account of the ECB's monetary policy stance during the post-pandemic period. We start by showing how the use of the OIS-ILS measure of the *ex-ante* short-term real interest rate can lead to a distorted historical assessment of the ECB's monetary policy stance, both in terms of level and dynamics. We then exploit our estimated term structure of real interest rates to conduct two exercises. First, we decompose changes in the *ex-ante* short-term real interest rate into expected and unexpected changes of policy and inflation rates. Second, we use the term structure of real interest rates to identify changes in both the degree of restrictiveness/accommodation (overall deviation from the natural rate) and in its duration (amount of time spent in restrictive/accommodative territory).

The remainder of the paper is structured as follows. In Section 2, we review the commonly-used market-based measure of the *ex-ante* real interest rate based on the OIS-ILS difference, discuss its shortcomings, and present our proposed alternative. In Section 3, we employ our new market-based measure to provide a detailed account of the current and expected policy rate stance of the ECB during the post-pandemic era. Section 4 concludes.

2. Measuring *ex-ante* real interest rates in the euro area

2.1 Fisher equation

The real interest rate is the rate of return that investors earn on funds, adjusted for inflation to reflect its true purchasing power. Formally, it is defined by the Fisher equation that relates real interest rates to nominal interest rates and inflation rates. The realised (i.e., "*ex-post*") real interest rate $r_{k,t}$ at the end of a k-period loan initiated in period t equals the nominal interest rate $i_{k,t}$ net of the realised inflation rate over the loan term $\pi_{t,t+k}$:

$$1 + r_{k,t} = \frac{1 + i_{k,t}}{1 + \pi_{t,t+k}}, \tag{1}$$

where $\pi_{t,t+k} = P_{t+k}/P_t - 1$ and P_t denotes the consumer price level in period t. When interest and inflation rates are relatively low and assuming for simplicity the case of a one-period loan (i.e., $k = 1$), the *ex-post* identity can be approximated as:

$$r_t \approx i_t - \pi_{t+1}, \tag{2}$$

where $r_t \equiv r_{1,t}$, $i_t \equiv i_{1,t}$, and $\pi_{t+1} \equiv \pi_{t,t+1}$ to ease the notation.

The "*ex-ante*" real interest rate, however, is what matters for economic decisions. Taking expectations at time t on both sides of equation (2), the *ex-ante* real interest rate $\hat{r}_t$ is given by the following expression:

$$\hat{r}_t \approx i_t - E_t\pi_{t+1}. \tag{3}$$

The *ex-ante* real interest rate $\hat{r}_t$ links monetary policy decisions to real economic outcomes. Indeed, central banks are able to influence real interest rates and therefore, indirectly, consumers' decisions. For instance, according to standard macroeconomic theory, today's consumption gap (i.e., the deviation of log-consumption c_t from its steady-state level c^*) depends on the sum of current and anticipated deviations of the *ex-ante* short-term real interest rate from its natural counterpart $\hat{r}^*$:[3]

$$c_t - c^* = -E_t \sum_{i=0}^{\infty} (\hat{r}_{t+i} - \hat{r}^*). \tag{4}$$

This results from utility-maximisation: households make intertemporal consumption-savings decisions, to allocate their resources optimally over time, thus to some degree "forecasting" the future path of real interest rates. The higher the expectation of future real interest rates, the greater the incentive to postpone consumption. A similar argument also holds for firms' investments, which represent a highly pro-cyclical component of aggregate demand: the higher the expectation of future real interest rates, the higher the cost of borrowing and the lower the incentives to invest.

2.2 Timing mismatch arising from the use of Inflation-Linked Swaps

Since expected inflation cannot be directly observed, the *ex-ante* real interest rate must be estimated. In the academic literature, many empirical studies use the *ex-post* version of the Fisher equation and invoke rational expectations to assert that, on average, the resulting rate aligns with the *ex-ante* real interest rate.[4] However, when the daily variation of the real interest rate is itself the object of attention, rational expectations cannot be invoked for single observations and a direct measure of the *ex-ante* real interest rate becomes necessary. This is for example the case in monetary policy, for which a day-by-day measure of the *ex-ante* real interest rate is important to monitor the evolution of monetary conditions. Market-based measures satisfy this requirement.[5]

A simple market-based approach to estimate real interest rates in the euro area is to deflate OIS rates with ILS rates of corresponding maturity. OIS and ILS contracts for the euro area are

[3] The equation corresponds to the first-order condition under a log-utility, in a representative agent model. By iterating forward the so-called Euler condition $c_t - c^* = E_t(c_{t+1} - c^*) - E_t(\hat{r}_t - \hat{r}^*)$, one obtains equation (4). Also see equation (25), Ch. 3, in Galí (2015). At the same time, wealth and income effects may arise from real interest rate fluctuations.

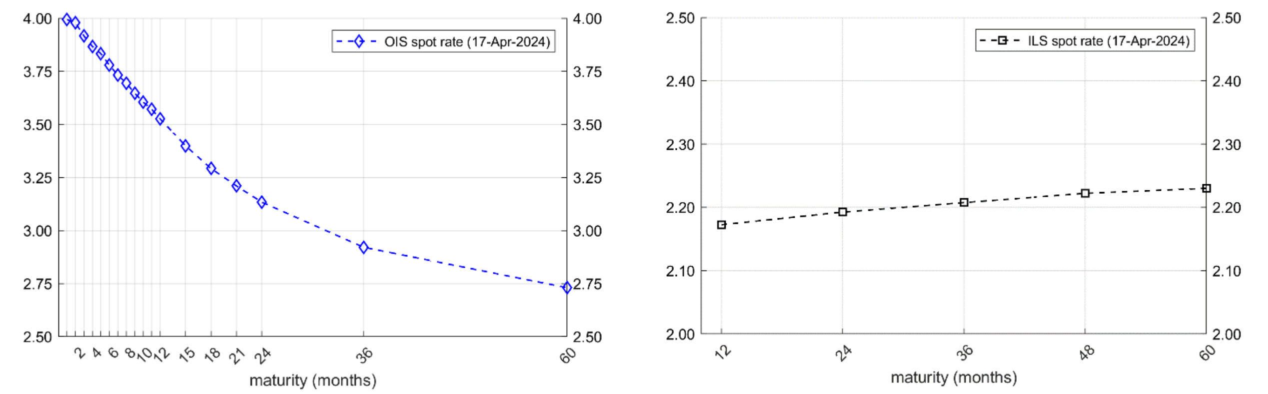
[4] This is because under rational expectations forecast errors have zero mean and are orthogonal to any information at time t.

[5] An alternative approach to the measurement of the *ex-ante* short-term real interest rate is through surveys (for instance the ECB Survey of Monetary Analysts). While survey-based approaches offer certain advantages over market-based ones, such as being free from any type of risk premium, they lack real-time availability and participants' vested interests.

financial derivative instruments linked to the euro short-term rate (€STR) and the Harmonised Index of Consumer Prices excluding Tobacco (HICPxT), respectively. The €STR is an overnight benchmark rate closely anchored to the ECB key rates, while HICPxT is a price index closely aligned with the ECB's targeted measure of consumer price inflation (HICP). These instruments share two appealing features. First, they are continuously traded in liquid markets across a wide range of maturities. Specifically, OIS contracts are available at monthly maturities in the first year, then at quarterly maturities until the second year, and yearly afterwards (Figure 1a), while ILS contracts are available at yearly maturities (Figure 1b). Second, they are immune from credit premia, as there is no exchange of principal, and carry no convenience yields. Thanks to these characteristics, they respectively provide timely market-based estimates of the expected average policy rate and the expected inflation rate in the euro area.[6] Therefore, the 1-year OIS-ILS difference is usually taken as a proxy of the short-term real interest rate.[7]

Figure 1. Maturity structure of OIS and ILS contracts

(a) OIS contracts (b) ILS contracts



Source: LSEG and Bloomberg. *Notes*: The figure illustrates the maturity structure of OIS and ILS contracts on a given date (17 April 2024). The contracts' maturities, expressed in months, are shown on the x-axis (up to the 5-year maturity); the rate levels in percentages are shown on the y-axis. The diamonds signal the available contracts.

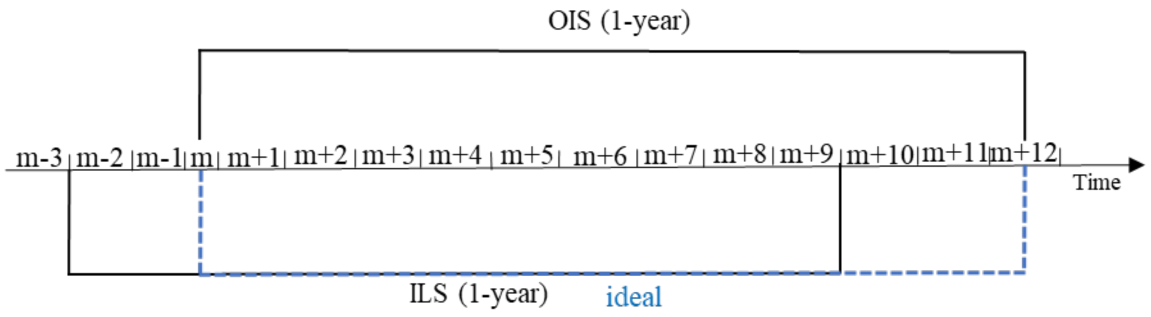
However, two indexation features of the 1-year ILS rate complicate its interpretation as a daily measure of the "inflation expected in the year ahead" and consequently the accuracy of the 1-year OIS-ILS difference as a proxy of the *ex-ante* short-term real interest rate. First, the contracts' reference period for computing the inflation accrued during the life of the contract includes a 3-month indexation lag. This lag aims at preventing settlement distortions arising from delays in

[6] In the remainder of this paper, we will use the term "expectation" to refer to the expectation under a risk neutral measure. Indeed, OIS and ILS rates also reflect term and inflation risk premia. Although we abstract from this distinction, it is worth noting that our focus primarily lies on short horizons. Consequently, any potential bias stemming from this decision is likely minimal, as term and inflation risk premia tend to be negligible at shorter maturities.

[7] See for instance slide 12 in Lane (2023) and Figure 2 in Orphanides (2024). An alternative market-based measure is provided by inflation-linked bonds (ILB), or linkers, which are bonds whose principal is indexed to inflation, designed to hedge inflation risk and typically issued by governments. Their real yield is therefore akin an expected real interest rate. In the U.S., this is the standard measure of real interest rates. The most known example is represented by Treasury Inflation-Protected Securities (TIPS), issued by the U.S. Treasury and believed to be riskless. The same approach is troublesome in the euro area, as sovereign bonds are not generally viewed as riskless and their yields reflect sovereign default premia. Additionally, the global size of the euro area inflation-indexed bond market is much smaller than in the U.S., with obvious consequences for the instruments' liquidity. As such, they cannot be easily used to infer expected real interest rates. See for instance Grønlund et al. (2024).

computation, publication and revision of price indexes. Thus, the final pay-off for a 1-year ILS contract depends on the year-on-year inflation rate realised three months prior to the end of the contract. Second, these contracts trade on a fixed base convention. This means that all contracts exchanged during a given month (irrespective of their trading date) are linked to the inflation accrued over the same fixed reference period, which only updates at the beginning of each new month. Overall, these two indexation features imply that all ILS contracts entered in a given day of month m refer to the inflation accrued from end-of-month $m-3$ to end-of-month $m+9$, generating a timing mismatch with the 1-year OIS (Figure 2). This mismatch, in turn, interferes with the computation of a purely forward-looking (i.e., *ex-ante*) real interest rate.

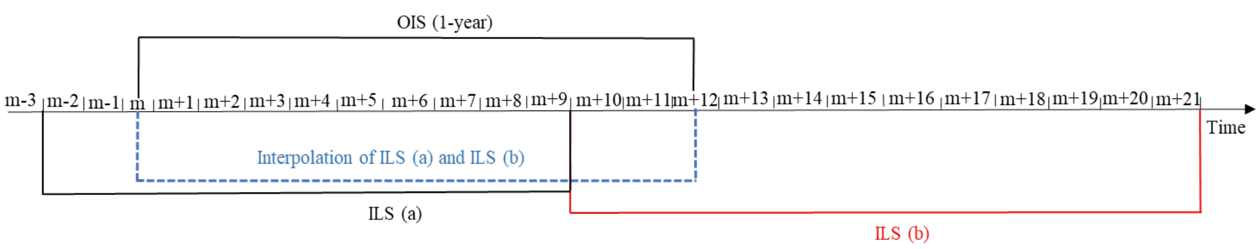
Figure 2. Timing mismatch between OIS and ILS rates



Notes: The diagram illustrates the timing mismatch between 1-year OIS and ILS rates. Time is expressed in days and divided into monthly intervals (black arrow). 1-year ILS contracts traded on a generic day of month m (black line, bottom) exchange a fixed rate with inflation accruing from the end of month $m-3$ to the end of month $m+9$. 1-year OIS contracts traded on a generic day of month m (black line, top) exchange a fixed rate with the average overnight rate over the following 1-year period (i.e., they are purely forward-looking).

Adjusting ILS rates to realign them with OIS rates of corresponding maturity requires relatively strong assumptions. A possible solution for the OIS-ILS timing mismatch consists in interpolating the 1-year and the 1-year 1-year forward ILS rates, which refer to the expected year-on-year inflation rates in $m+9$ and $m+21$, to approximate the expected inflation rate over the same reference period of the 1-year OIS (Figure 3).

Figure 3. Solution based on adjusting ILS rates



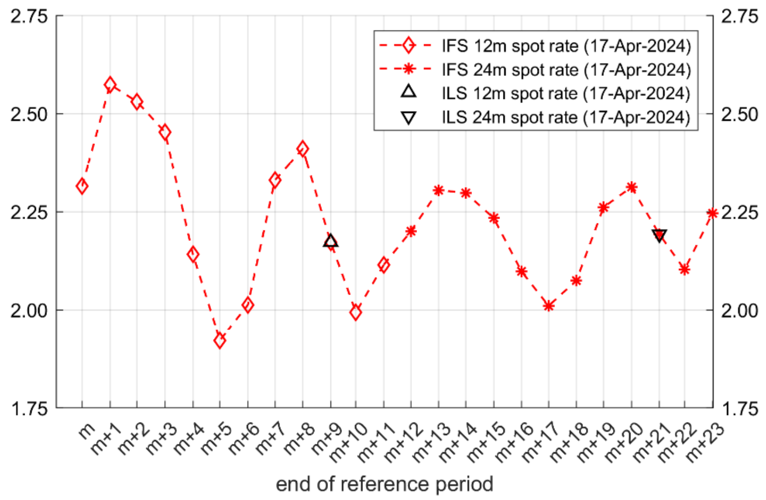
Notes: The diagram illustrates the time matching between the nominal interest rate and the expected inflation rate that can be achieved by interpolating ILS contracts. Time is expressed in days and divided into monthly intervals (black arrow). Compared to Figure 2, Figure 3 also shows ILS (b), the 1-year 1-year forward ILS rate implicit in inflation swaps that refer to the period between the end of month $m+9$ and the end of month $m+21$ (red line, bottom). An appropriate interpolation of ILS (a) and ILS (b) approximates the expected inflation over the course of the following 1-year period (blue dotted line, bottom).

This is for example the approach used by Camba-Mendez and Werner (2017) in the context of an affine term structure model used to estimate inflation risk premia. Specifically, they take the corresponding linear combination of those two contracts after carefully controlling for seasonality. However, even taking into account predictable seasonality, extrapolating rates across maturities 12 months apart is not a trivial exercise, especially in times of high inflation volatility.

2.3 Solution based on Inflation Fixing Swaps

Inflation Fixings Swaps (IFS) provide a direct measure of the monthly evolution of annual inflation expected by financial markets. IFSs are a new type of inflation swap contracts linked to each of the next 24 monthly releases of euro area inflation.[8] They are similar in structure to ILS contracts: a fixed rate is swapped (*ex-ante*) for the inflation rate accruing (*ex-post*) over a given reference period lasting 12 or 24 months.[9] By design, the IFS rate linked to month $m + 9$ corresponds to the 1-year ILS rate, whereas the IFS rate linked to $m + 21$ corresponds to the 2-year ILS rate (Figure 4).

Figure 4. Maturity structure of IFS contracts



Source: Bloomberg. *Notes*: The figure illustrates the maturity structure of IFS contracts on a given date (17 April 2024). The x-axis shows the forthcoming 24 end-of-months; the rate levels in percentages are shown on the y-axis. The diamonds and the asterisks signal the available IFS contracts. The triangles indicate the available ILS contracts over the same time span.

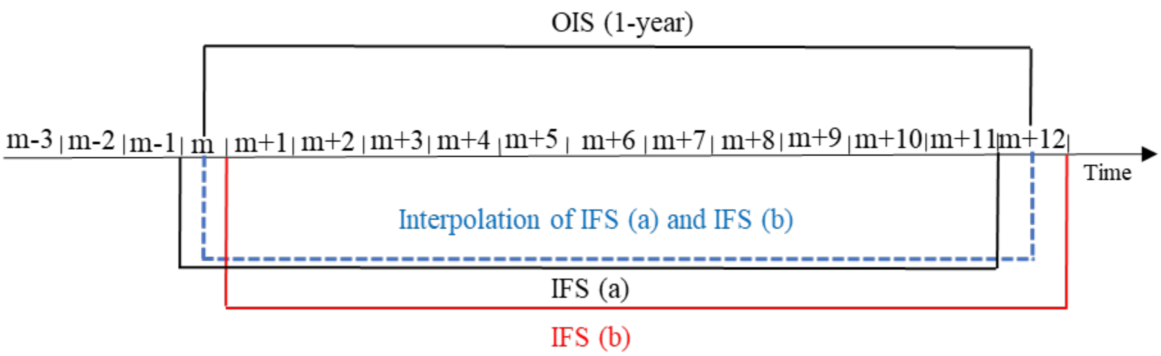
The maturity structure of IFS contracts thus provides a more accurate and reliable approach for the measurement of purely forward-looking real interest rates. The IFS rates referring to the inflation rate accruing from end-of-month $m - 1$ to end-of-month $m + 11$ and the forward IFS rate linked to the inflation rate from end-of-month m to end-of-month $m + 12$ are the nearest to the "ideal" temporal alignment depicted in Figure 2. Thus, their daily linear interpolation (illustrated in

[8] Over-the-counter quotes for IFS contracts are available in Bloomberg since 2019.

[9] During a given month m, there are 12 IFS contracts referring to the yearly inflation accruing from end-of-month $m - 12$ to end-of-month m, end-of-month $m - 11$ to end-of-month $m + 1$, …, and end-of-month $m - 1$ to end-of-month $m + 11$, and 12 IFS contracts referring to the (average) biannual inflation accruing from end-of-month $m - 12$ to end-of-month $m + 12$, end-of-month $m - 11$ to end-of-month $m + 13$, …, and end-of-month $m - 1$ to end-of-month $m + 23$. By contrast, during a given month m the 1-year ILS contract refers to inflation accrued from end-of-month $m - 3$ to end-of-month $m + 9$, the 2-year from end-of-month $m - 3$ to end-of-month $m + 21$ and so forth.

Figure 5 and elaborated in more detail in the Appendix) aligns well with the reference period of the OIS contract. This interpolation bridges expected inflation rates of maturities distanced only 1 month apart, compared to the alternative approach of interpolating ILS rates that spans across maturities separated by 12 months (shown in Figure 3). Consequently, the interpolation assumption is considerably weaker.

Figure 5. Solution based on IFS rates



Notes: The diagram illustrates the time matching between nominal and inflation rates that can be achieved by using IFS contracts. Time is expressed in days and divided into monthly intervals (black arrow). In contrast with Figure 3, that focuses on ILS rates, this figure shows IFS (a), the IFS rate linked to the inflation rate accruing from the end of month $m-1$ to the end of month $m+11$ (black line, bottom), and IFS (b), the IFS forward rate implicit in inflation fixings swaps linked to the inflation rate accruing from the end of month m to the end of month $m+12$ (red line, bottom. An appropriate interpolation of IFS(a) and IFS (b) approximates the expected inflation over the course of the following 1-year period (blue dotted line, bottom).

The maturity structure of IFS rates also provides a detailed picture of the expected evolution of the real interest rate over the near future. As of any date, OIS contracts are traded for monthly maturities (Figure 1a), so that daily linear combinations of two adjacent OIS maturities measure the riskless nominal rate for end-of-month maturities, corresponding to all maturities of IFS contracts. Deflating the former with the latter provides an estimate of the monthly forward curve of (1-year) real interest rates, 12 months out, a key advantage over existing measures. Computational details are explained in the Appendix.[10]

3. Application: post-pandemic real rates and the ECB's monetary policy stance

The IFS-based measure of *ex-ante* short-term real interest rates provides an intuitive account of the ECB's monetary policy stance during the post-pandemic period. We concentrate on this period because unconventional tools predominated in policy adjustments beforehand, diminishing the relevance of conventional measures of the stance, such as those discussed in this paper. To evaluate the IFS measure of short-term real interest rates in terms of stance, we compare it with a set of estimates of the euro-area natural rate. In particular, to effectively address the considerable model

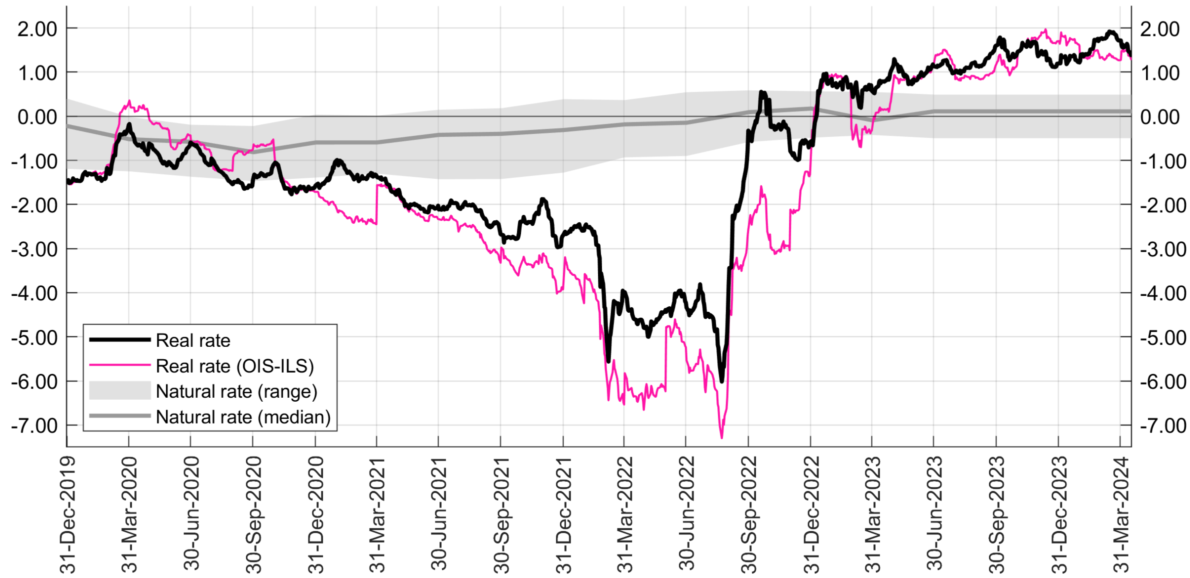
[10] A graphical representation of the nominal, real, and inflation rates, with both spot values and forward term structure can be found in the Appendix.

uncertainty surrounding natural rate estimates, we consider a broad range of estimates stemming from the large suite of models and approaches discussed in Brand et al. (2024).[11]

3.1 Post-pandemic evolution of the ECB's monetary policy stance

The time series of euro-area real interest rates estimated using IFS provide a timeline of the ECB's monetary policy stance that differs from that estimated using ILS. Figure 6 compares the evolution of the two measures. According to the IFS measure, the ECB's policy rate stance moved into accommodative territory around March 2021 and progressively loosened until the *ex-ante* short-term real interest rate reached -6% in August 2022. Since then, the stance abruptly reversed, was fully normalised by September 2022, moved into restrictive territory in early 2023, and reached its most stringent level in March 2024, when the *ex-ante* short-term real interest rate peaked at 2%. Against this backdrop, the lagged and fixed-based indexations bias both the level and the dynamics of the raw measure based on the OIS-ILS difference, providing a distorted picture. In fact, between January 2021 and April 2023 our measure of the *ex-ante* short-term real interest rate has been consistently higher, by approximately 1 percentage point on average and by up to 2 points. In terms of dynamics, some extreme divergences between the two series are found in early 2021 and after October 2023, when the OIS-ILS measure was signalling a decrease in the short-term real interest rate, which instead was stable or even at times rising according to our new measure.

Figure 6. Evolution of the real rate gap since 2020
(*percent*)



Source: authors' elaboration on Bloomberg and LSEG data. *Notes*: The chart shows (*i*) our measure of the *ex-ante* 1-year real interest rate based on the use of Inflation Fixing Swaps, (*ii*) the simple measure based on 1-year OIS-ILS difference and (*iii*) a range of estimates of r^* (10th and 90th percentiles). The range is available until 2023Q3 and kept constant afterwards. The solid grey line denotes the median of this range.

[11] They include some slow-moving measures and a larger number of cyclical measures of the natural rate, which are primarily derived from Eurosystem's staff models and calculations. In this paper, we take the 10th, the 50th and the 90th percentiles of the range of quarterly estimates of r^*.

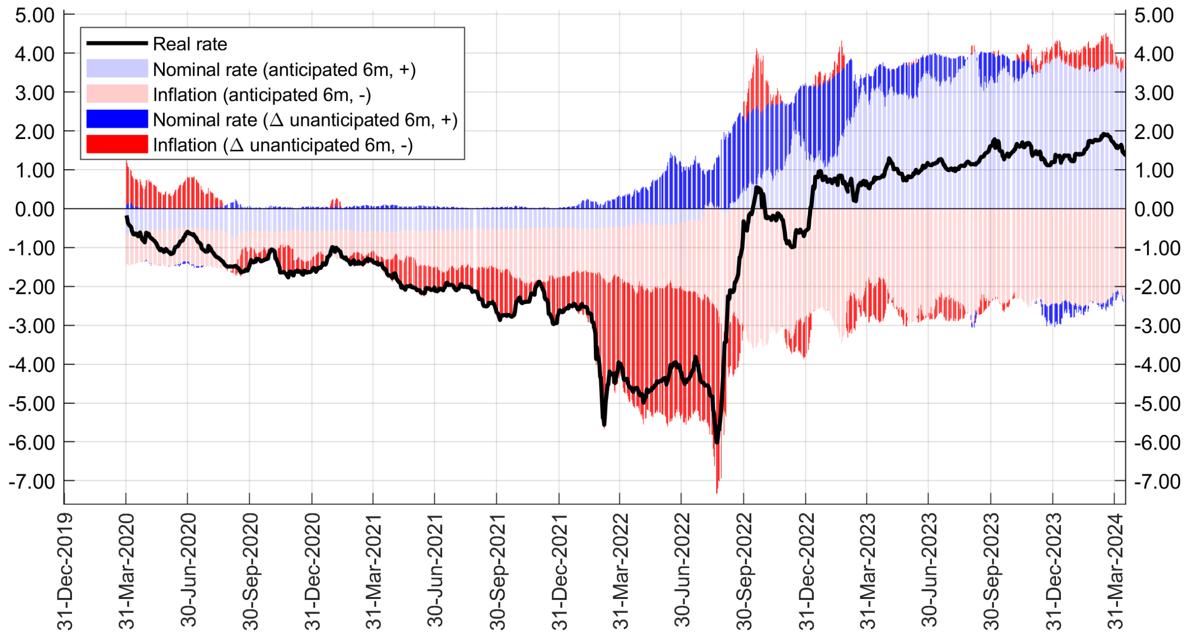
In order to characterise the driving forces behind the observed changes in the stance, we decompose the dynamics of the short-term real interest rate into anticipated and unanticipated components (expected policy rate and inflation paths). For a fixed forecasting horizon *h*, we compute the following decomposition:

$$\hat{r}_{12m,t} = \overbrace{E_{t-h}\hat{r}_{12m,t}}^{anticipated} + \overbrace{\hat{r}_{12m,t} - E_{t-h}\hat{r}_{12m,t}}^{revision}$$
$$= \underbrace{\overbrace{E_{t-h}i_{12m,t}}^{anticipated} + \overbrace{i_{12m,t} - E_{t-h}i_{12m,t}}^{revision}}_{expected\ policy\ rate} - \left(\underbrace{\overbrace{E_{t-h}\pi_{t,t+12m}}^{anticipated} + \overbrace{E_t\pi_{t,t+12m} - E_{t-h}\pi_{t,t+12m}}^{revision}}_{expected\ inflation}\right) \tag{5}$$

where $E_{t-h}\hat{r}_{12m,t}$, $E_{t-h}i_{12m,t}$ and $E_{t-h}\pi_{t,t+12m}$ denote, respectively, the *ex-ante* 1-year real interest rate and its two components in day t, as expected h-periods before. We set $h = 6m$.[12] Figure 7 depicts the decomposition.

Figure 7. Decomposition of the real rate into expected and unexpected factors

(*percent*)



Source: authors' elaboration on Bloomberg and LSEG. *Notes*: The chart shows the decomposition of the *ex-ante* short term real interest rate (black solid line) in: *(i)* nominal rate anticipated 6-months behind (light blue bars), *(ii)* revision of nominal rate (dark blue bars), *(iii)* anticipated inflation 6-months behind (flipped sign, light red bars), *(iv)* revision of inflation outlook (flipped sign, dark red bars).

The black line is the real interest rate on day t. The light blue and red bars represent, respectively, the nominal interest rate and the inflation components of the 6-month ahead prediction, while the dark blue and red bars their revisions. The larger the dark bars, the larger the surprises. The decomposition

[12] For example, on the 30th June 2023, we take the short-term real interest rate, its inflation and nominal rate components, and the corresponding inflation and nominal rate projections as of the 31st December 2022.

into the anticipated and unanticipated components can be helpful in identifying the innovations that occurred in the 6 months preceding any given date. For instance, if expected nominal rates increase more than anticipated while expected inflation decreases more than anticipated, it would be consistent with an unexpected monetary tightening.

According to our decomposition, the significant volatility in the short-term real interest rate observed during the post-pandemic period has been driven by four (largely unexpected) events.

- **Inflation awakening (summer 2021)**. The period of low inflation in the euro area ended with the recovery from the Covid-19 pandemic and the start of the energy crisis in mid-2021 (Neri, 2024). This led to a series of upward revisions of short-term inflation expectations, as indicated by the dark red bars in mid-2021, that – amid stable short-term nominal rates – pushed down the short-term real interest rate (Figure 7). This was broadly consistent with the combination of the post-pandemic surge in demand, global supply disruptions, and global shortage of oil and gas. As those shocks and the corresponding inflation spike were expected to be short-lived, market pricing reflected the view that the ECB would not react.[13] Taken together, the short-term real interest rate experienced a steady decline from around -1.5% to -3.0% over the course of 2021, with a significant contribution stemming from non-anticipated components.

- **Russian invasion of Ukraine (February 2022)**. What was initially believed to be a transitory phenomenon turned out to persist far beyond expectations following the abrupt invasion of Ukraine. The conflict spurred a sudden acceleration in energy commodity inflation, especially gas prices, resulting in an unexpected and persistent increase in short-term inflation expectations (dark red bars in the first half of 2022, Figure 7). At the same time, markets began to expect the ECB would raise policy rates and as a consequence short-term nominal rates increased more than anticipated (dark blue bars in the first half of 2022, Figure 7). Overall, the real interest rate, which was anticipated to remain around -2% for the period (sum of light bars in the first half of 2022, Figure 7), experienced a sharp drop to around -5%.

- **Strength of the ECB's rate hiking cycle (second half of 2022)**. The expectations of a lift-off from the ELB became reality in the summer of 2022. The ECB first announced (in June) and then decided (in July) a first policy rate tightening to counteract the growing inflationary pressures. What followed was a period of rapid and strong policy rate hikes, whose corresponding increase in short-term nominal rates was partly unanticipated (dark blue bars around September 2022, Figure 7). In a short span of time, real interest rates increased beyond anticipated levels (about 6 percentage points in the course of just a couple of months), reaching positive territory in October 2022. This very rapid build-up was characterised by inflation revisions to the downside (increasing real interest rates, dark red bars around October 2022, Figure 7), which were however short lived. By the end of 2022, the inflation outlook was again revised upwards (decreasing real interest rates, dark red bars around December 2022, Figure 7). The following real interest rate dynamics were mostly anticipated (light bars after

[13] See Lane (2024) for more details.

March 2023, Figure 7), but accompanied by a series of upward revisions of both inflation and nominal rates until September 2023 (Bernardini and Lin, 2024).

- **“Passive” tightening (winter 2023-24)**. The ECB raised policy rates for the last time in September 2023. As inflation continued its downward trend, real interest rates continued to climb between the last quarter of 2023 and the first quarter of 2024, primarily due to a faster-than-initially anticipated disinflation process (dark red bars since late 2023, Figure 7). This period underscores how policy inaction, which might appear as a decision that maintains the *status quo*, can easily reveal its non-neutrality when the inflation process surprises to the downside (Panetta, 2024).

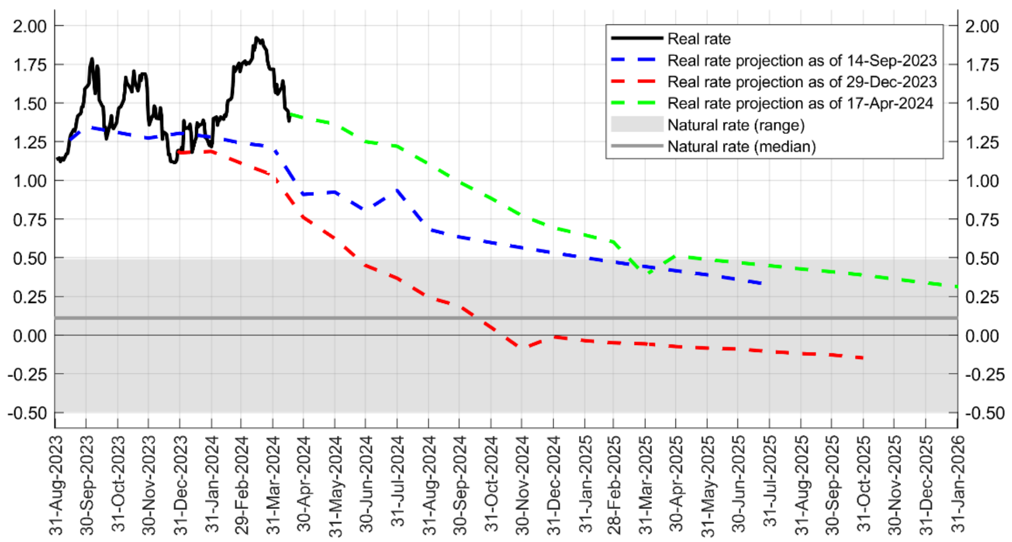
3.2 Expected future stance of the ECB’s monetary policy

The IFS-based measure also offers a unique advantage in providing a detailed understanding of the expected evolution of the ECB’s monetary policy stance as perceived by financial markets. Unlike the simple OIS-ILS measure, the IFS-based measure enables the computation of the expected path of the short-term real interest rate over monthly horizons. This allows for a finer-grained understanding of how changes in market expectations translate into changes in either the “degree” of restrictiveness of the monetary policy stance (i.e., the distance of the real interest rate path from the natural rate), its “duration” (i.e., the amount of time spent in restrictive territory), or both.

To visually illustrate the types of insights provided by the IFS measure, Figure 8 shows the path of the euro-area short-term real interest rate expected at three different points in time.

Figure 8. Anticipated future real rate gaps

(*percent*)



Source: authors' elaboration on Bloomberg and LSEG data. *Notes*: The chart shows (*i*) our measure of the *ex-ante* 1-year real interest rate based on the use of Inflation Fixing Swaps, (*ii*) its expected path as of different points in time and (*iii*) a range of estimates of the natural rate (10th and 90th percentiles). The range is available until 2023Q3 and kept constant afterwards. The solid grey line denotes the median of this range.

On the back of an unexpectedly rapid disinflation process, at the end of 2023 financial markets were anticipating a very rapid normalisation, with the ECB's monetary policy stance expected to turn into neutral territory by mid-2024 (dashed red line in Figure 8). However, policy rate expectations experienced a notable revision in the first months of 2024. By April 2024, the expected "neutrality date" was significantly postponed, *de facto* reverting to the September 2023 view of a return to neutral territory no earlier than March 2025 (dashed green and blue lines). Yet, despite the alignment in terms of the "duration" of monetary policy restrictiveness, a substantial difference emerged in terms of the "degree" of restrictiveness: the future real interest rate path as expected in April 2024, in fact, appeared distinctly higher compared to September 2023, unequivocally signalling expectations of a tighter monetary policy stance than previously anticipated.

4. Conclusions

We propose a new market-based approach for measuring *ex-ante* real interest rates in the euro area, aimed at rectifying the timing mismatch that severely bias the standard OIS-ILS measure. Our approach overcomes the timing mismatch between OIS and ILS rates caused by the lagged indexation inflation swaps by leveraging on IFS, recently-introduced inflation swap contracts linked to each of the next 24 monthly releases of euro-area year-on-year inflation rates. The resulting measure offers an accurate and reliable depiction of the dynamics of current and future *ex-ante* short-term real interest rates as perceived by financial markets, thus serving as a key factor in the measurement of the monetary policy stance.

The implications of our new approach hold considerable promise for both scholars and policymakers. For scholars, the adoption of our measure provides an opportunity to enhance the precision and reliability of their analyses. By eliminating the timing mismatch associated with the standard OIS-ILS measure, researchers can avoid spurious relationships between financial variables, thereby fostering more rigorous and credible research outcomes. This is particularly relevant for the growing literature aimed at identifying economic shocks based on high-frequency variation in financial variables.

For policymakers, our approach uncovers clean and fine-grained insights which can better guide their decision-making. By providing an unbiased picture of the ECB's monetary policy stance as perceived by financial markets, our measure ensures that policymakers are correctly informed. Moreover, it enables them to grasp subtle details about market expectations regarding the future evolution of the stance. This includes disentangling the effects of macroeconomic shocks on distinct dimensions of the stance, such as expectations on the degree of restrictiveness/accommodation as well as its duration.

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Appendix

To measure the historical dynamics of the *ex-ante* short-term real interest rate, we adjust the 1-year OIS rate by the observed €STR-DFR spread and then deflate it with a linear combination of the fixing rates that swap year-on-year inflation in the two closest months. For instance, on the 10th March 2024 we combine linearly the February 2025 inflation fixing rate (i.e., which provides the expected year-on-year inflation from end-of-February 2024 to end-of-February 2025) and the March 2025 one. We then weight the two by the share of days until the end of the month. For instance, on the 10th March 2024, we weigh them by $\frac{21}{31}$ (February 2025) and $\frac{10}{31}$ (March 2025). Finally, we apply the following formula:

$$\hat{r}_{12m,t} = OIS_{12m,t} - \left(\frac{N(t) - D(t)}{N(t)} IFS_{m(t)+11,t} + \frac{D(t)}{N(t)} IFS_{m(t)+12,t}\right) \tag{1}$$

where $OIS_{12m,t}$ is the 1-year OIS rate observed on day t, $IFS_{m(t)+11,t}$ and $IFS_{m(t)+12,t}$ are the above-mentioned inflation fixing (forward) rates, $N(t)$ is the number of days in month $m(t)$ of date t, and $D(t)$ is day of the month of date t.

To measure the expected real interest rate path, we use the full set of fixings swaps and the term structure of OIS with maturities up to 24 months (again, adjusted by the observed €STR-DFR spread). For instance, on the 10th March 2024 we select the two 1-year forward OIS rates whose reference starting dates are the closest to the reference starting point d we are interested in (e.g. 30th June 2024). We then weigh the two according to the closeness of their starting date to d. In the considered example, on the 10th March 2024 we weigh the 1-year forward OIS rate starting on the 10th June 2024 by $\frac{10}{30}$ and the one starting on 10th July 2024 by $\frac{20}{30}$.[14] Finally, we apply the following formula:

$$E_t\hat{r}_{12m,d} = \left(\frac{D(t)}{N(d)} OIS_{12m,d-N(t),t} + \frac{N(d) - D(t)}{N(d)} OIS_{12m,d,t}\right) - IFS_{m(d)+12,t} \tag{2}$$

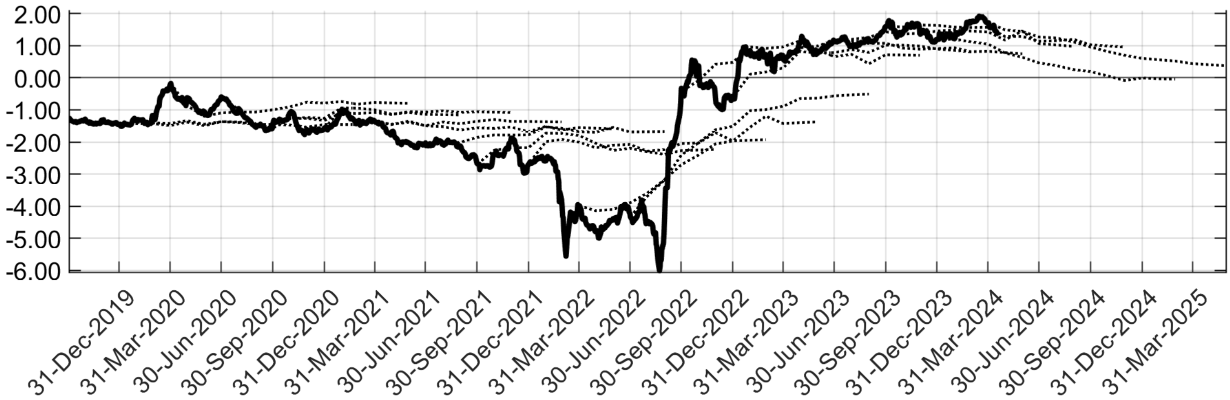
Figure A1 provides an overview of our new indicator from October 2019 to April 2024. Panel (a) shows the historical dynamics of the short-term real interest rate along with expectations about its future path, formed at different dates t. For simplicity, we only report expectations formed at end-of-quarter dates. Panels (b) and (c) shows its two components: the one-year nominal interest rate and year-on-year inflation rate expected in one year.

[14] IFS rates cover inflation expectations up to 23 months. We use 1-year forward ILS rates to linearly extend the maturity structure beyond the horizon covered by the inflation fixings. In doing that, we take into account the mentioned indexation lag (e.g., on the 10th March 2024 we assign the 1y1y ILS rate to the expected year-or-year inflation in December 2025).

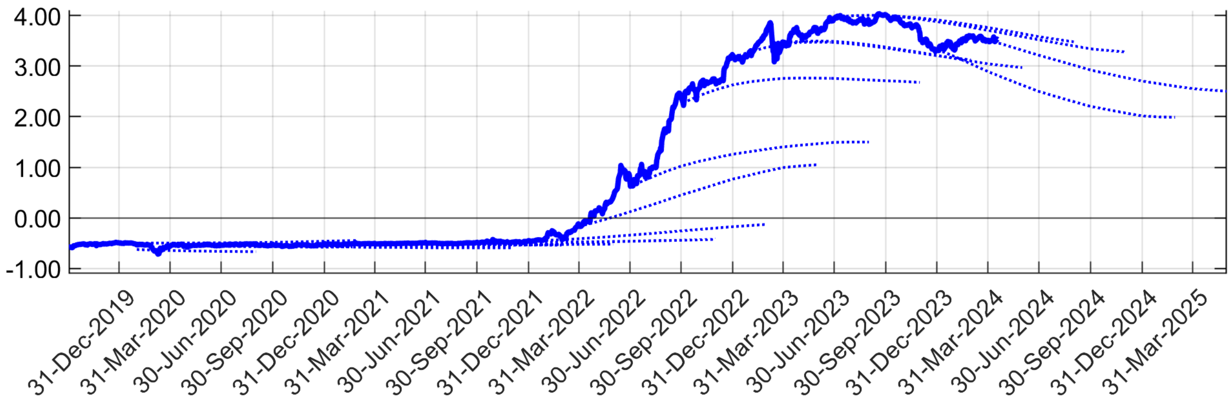
Figure A1. Broad overview of the IFS measure

(*percent*)

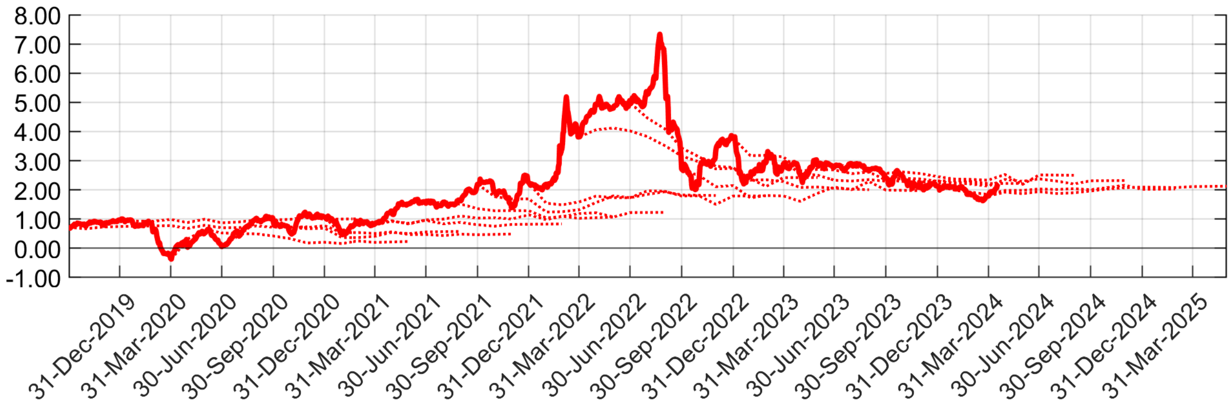
(a) *ex-ante* 1-year real interest rate ($\hat{r}_{12m,t}$)



(b) 1-year nominal interest rate ($i_{12m,t}$)



(c) 1-year ahead annual expected inflation rate ($E_t\pi_{t,t+12m}$)



Source: authors' elaboration on Bloomberg and LSEG data. *Notes*: The first panel shows the *ex-ante* short-term real interest rate (solid line) and its future expected path (as of each end-of-quarter; dotted lines). The second and third panels show the two components of the *ex-ante* short-term real interest rate.