The pass-through of policy interest rates to bank retail rates in Austria

Robert Ferstl, Bernhard Graf, Claudia Kwapil[1]

The 25th anniversary of the European monetary union provides an excellent opportunity to examine whether the pass-through of monetary policy has changed over time. The interest rate channel of monetary policy – i.e. the transmission of policy rates to money market rates and ultimately to bank retail deposit and lending rates – is crucial to the functioning of monetary policy. Only if this channel works properly can monetary policy rates influence investment and saving decisions of households and businesses, thereby steering inflation. We provide an empirical analysis of the pass-through in Austria and the euro area, examining the speed of the transmission process, alongside short-term (a)symmetries and long-term pass-through coefficients. In line with the previous literature, our findings suggest that the long-term pass-through is nearly complete for bank lending and time deposit rates in Austria. Moreover, we provide evidence of an asymmetric pass-through to (overnight and time) deposit rates in Austria, with decreases in money market rates being propagated more quickly than increases. Overnight deposit rates not only show a significantly more sluggish pass-through process than other retail rates, but also an incomplete long-term pass-through coefficient. Moreover, all Austrian retail rates adjust more quickly to changes in money market rates than their respective counterparts in the euro area aggregate. Finally, we find a long-term stable relationship between money market and retail interest rates, indicating that the pass-through process in Austria has not significantly changed over time.

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The starting point for this article is a recent strand of literature – like Deutsche Bundesbank (2023) for Germany, Ferrer Pérez et al. (2023) for Spain, Byrne and Foster (2023) for Ireland and the euro area and Messer and Niepmann (2023) for the euro area as well – arguing that the current pass-through to retail rates in the euro area seems more sluggish than in the past, at least in some countries. Explanations for this inertia include the high level of excess reserves as well as imperfect competition in the banking industry.

Since the establishment of the Economic and Monetary Union (EMU) in 1999, monetary policy in the euro area has navigated through various monetary policy episodes. In the early years of EMU, policy rates fluctuated between 2.5 and 4.75% and excess reserves were negligible. The calm start came to an end in 2008, as the euro area faced two subsequent recessions that called for a monetary policy response. Thereupon, the European Central Bank (ECB) lowered monetary policy interest rates into negative territory and created a massive volume of excess reserves through unconventional monetary policy measures. It was only in 2021, when inflation started to increase significantly, that the ECB raised policy rates again. They climbed up to 4.0% and excess reserves, while still abundant, started to decline. It is easy to imagine that these very different monetary policy episodes and

[1] *Oesterreichische Nationalbank (OeNB), Monetary Policy Section: robert.ferstl@oenb.at, bernhard.graf@oenb.at and claudia.kwapil@oenb.at. Opinions expressed by the authors of studies do not necessarily reflect the official viewpoint of the OeNB, the European Central Bank or the Eurosystem.*

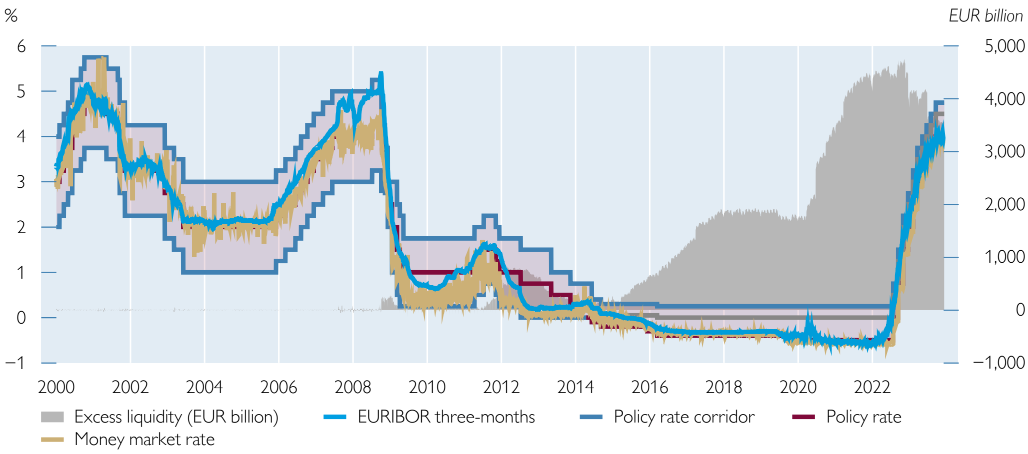
macro-economic circumstances led to changes in the transmission process and thus in the pass-through process of monetary policy. Hence, we set out to look at the effect monetary policy rates had on refinancing conditions of households and firms in Austria and the euro area during the first 25 years of the EMU and aim to determine whether the interest rate pass-through changed over time. To this end, we reproduce a broad strand of empirical results investigating the interest rate channel of monetary policy established in the period up to the Great Financial Crisis for the time frame covering unconventional monetary policy measures.

Chart 1 illustrates that using its three key interest rates, the ECB closely manages very short-term money market rates, i.e. the euro overnight index average (EONIA)/euro short-term rate (€STR) and – if changes in policy rates are expected to persist – money market rates like the three-month EURIBOR. To ensure that monetary policy effectively impacts inflation, it is essential that changes in policy rates are transmitted to money market rates, and subsequently, to lending and deposit rates for both nonfinancial corporations and households. In the transmission process within the euro area, retail rates offered by banks assume a particularly important role because both businesses and households heavily depend on bank financing. Changes in nominal interest rates are transmitted to real rates, which ultimately affect household consumption and business investment decisions. More specifically, if bank retail deposit rates increase in line with money market rates, saving becomes more attractive and higher real interest rates discourage consumption and investment. Furthermore, if bank lending rates and, consequently, real borrowing costs for businesses and households increase together with money market rates, credit demand will decline, thereby curbing consumption and investment. Slowing down the growth of the real economy – by reducing the growth rates of consumption and investment – is a crucial step to control inflationary trends (see e.g. Beyer et al., 2017). Hence, the effective functioning of the interest rate channel of monetary policy transmission is an important precondition for successfully steering inflation.

If the interest rate channel – which is the most important channel in monetary policy transmission in the euro area (see ECB, 2010) – is impaired and changes in

Chart 1

Key ECB interest rates, money market rates and excess liquidity



Source: ECB Statistical Data Warehouse.

policy rates are not fully transmitted to retail interest rates, monetary policy has to take this into account, either by taking measures enhancing the transmission or by increasing rates more aggressively (see e.g. Kwapil and Scharler, 2010). Hence, it is essential for monetary policymakers to understand how retail rates offered by banks in all euro area countries respond to changes in money market rates and how these react to changes in policy rates (i.e. key ECB interest rates).

Hence, we address the following questions: Is there a stable relationship between money market rates and retail rates in Austria and the euro area? What insights can we gain from this relationship regarding the completeness of pass-through? Is there a difference between short-run and long-run pass-through? We analyze these questions along three dimensions: First, we make a comparison over time. Second, we compare our results for Austria with those for the euro area. Third, we consider the possibility of an asymmetric pass-through of positive and negative changes in money market rates to bank interest rates.

The article is structured as follows: Section 1 gives an overview of the related literature, section 2 presents the data used in the subsequent analysis and motivates our modeling choices, section 3 introduces the econometric model, section 4 presents our results, and section 5 concludes.

1 Related literature

Central bankers and academics alike have a keen interest in understanding how monetary policy decisions affect bank retail rates. There is a substantial body of literature analyzing the extent to which changes in reference rates impact retail deposit and lending rates. Several papers, such as Gregor et al. (2021) as well as Andries and Billon (2016), offer excellent surveys of this literature.

In general, we conclude from the literature that the pass-through of policy rates to retail rates varies from country to country, differs between deposit and lending rates, and is heterogeneous across different maturities and customer types. Furthermore, the transmission of policy rate changes to retail rates is not immediate. Therefore, the short-term pass-through is typically incomplete. In a survey of 39 studies focused on the euro area pre-2008, Andries and Billon (2016) find that there is a nearly complete long-term pass-through to lending rates for firms, while monetary policy changes are only partially transmitted to deposit rates. In a sample of 54 studies primarily covering advanced economies, Gregor et al. (2021) show that the pass-through to corporate lending rates is stronger than to consumer lending rates. Kok Sørensen and Werner (2006) introduce a "relative adjustment"[2] measure, which combines the swiftness of adjustment and the extent of the long-run pass-through in euro area countries. According to their findings, interest rates on corporate loans exhibit the highest level of responsiveness to changes in reference rates. Following closely are rates on mortgage loans and rates on time deposits, which also show a swift adjustment. By contrast, rates on consumer loans and current account deposits appear to be the least responsive among the observed retail rate categories.

Trying to answer the question whether the interest rate pass-through in the euro area changed during the Global Financial Crisis, Blot and Labondance (2013),

[2] *"Relative adjustment" herein refers to the combined analyses of the estimated long-run pass-through and the adjustment speed parameters.*

Hristov et al. (2014), Avouyi-Dovi et al. (2017) as well as Holton et al. (2018) present empirical evidence that the transmission of monetary policy became significantly impaired in the years after 2008. Their results indicate a slower pass-through to retail interest rates, pointing to a reduced effectiveness of monetary policy during the crisis.

The literature on monetary transmission in Austria focuses primarily on lending rates. Most of these studies find that the impact multiplier is significantly below one (see e.g. Bernhofer and van Treeck, 2013; Blot and Labondance, 2013; Jobst and Kwapil, 2008; Marotta, 2009), indicating that the pass-through from reference rates to retail rates takes time. The long-run pass-through, however, is found to be close to complete for loans to firms and for mortgage loans (see e.g. Bernhofer and van Treeck, 2013; Blot and Labondance, 2013; Jobst and Kwapil, 2008; Marotta, 2010). According to Kok Sørensen and Werner (2006) the pass-through to mortgage lending rates in Austria seems to be weaker than for firm lending rates.

2 Data and modeling approach

This section describes the data used in this study and motivates the chosen modeling approach from an econometric and a theoretical point of view.

2.1 Retail interest rates on deposits and loans

Charts 2 to 4 present commercial banks' retail interest rates for Austria.[3] Our analysis specifically focuses on interest rates for new business, including renegotiations. This emphasis is based on the understanding that shifts in marginal retail rates, rather than interest rates on the stock of monetary aggregates, are the primary drivers influencing the behavior of economic agents.

In line with the existing literature discussed in section 1, we distinguish between contracts of monetary financial institutions (i.e. banks) with households (including non-profit institutions serving households) on the one side and contracts of banks with nonfinancial corporations on the other side. Additionally, we differentiate between overnight deposits and time deposits, with the latter representing a weighted average across all maturities beyond one day. Accordingly, we discuss four categories of deposits: *time deposits by nonfinancial corporations, time deposits by households, overnight deposits by nonfinancial corporations* and *overnight deposits by households*. On the lending side, we distinguish between two categories. *Loans to households* uses a weighted interest rate aggregate consisting of all maturities[4] for house purchases, while *loans to nonfinancial corporations* uses a weighted aggregate across all categories of loans. Due to data availability, some of the time series start in January 2000, while others are available only as of 2003. All time series come at a monthly frequency.

Charts 2 to 4 show that retail rates follow the trend of policy rates.[5] However, they do not move in perfect synchronization, revealing distinct behaviors between

[3] *Source: ECB Statistical Data Warehouse (SDW).*

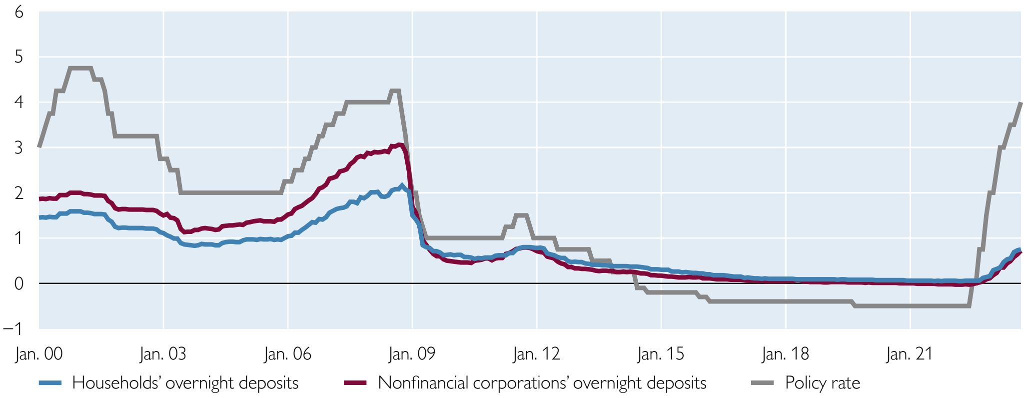
[4] *These aggregates are referred to as "cost-of-borrowing" indicators. For details on the methodology, see Composite cost of borrowing indicators*

[5] *The policy rate we use represents end-of-month values for the rate on the main refinancing operations up to May 2014, and for the rate on the deposit facility thereafter.*

Chart 2

Overnight deposit rates in Austria

Bank interest rates on new business in % (including renegotiations)



Source: ECB Statistical Data Warehouse.

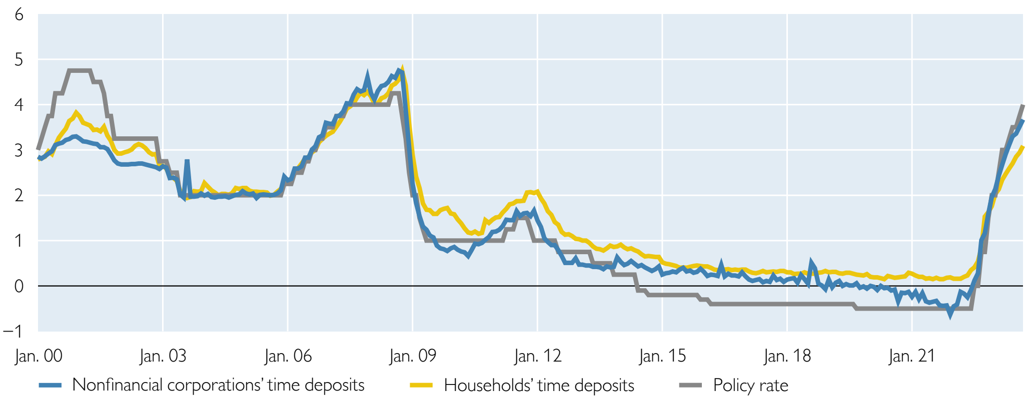
loan and deposit categories, as well as customer segments, as discussed in the literature (see section 1).

In chart 2, it is evident that the pass-through to overnight deposit rates is more sluggish for households than for nonfinancial corporations. Notably, average overnight deposit rates for Austrian households remained positive even in 2020/21, while corporate deposit rates dipped below zero. As early as 2009, the Austrian Supreme Court, in the case 5Ob138/09v, banned zero and negative interest rates on households' savings deposits. The court's rationale rests on the premise that households' saving deposits are characterized by a specific duration, serve an investment purpose and typically function with capital accumulation and profit-generation objectives. As a result, an interest rate of zero or below is fundamentally at odds with the statutory purposes of savings deposits. It is important to note, however, that this ruling does not apply to current accounts, which are part of our overnight deposit category, that primarily serve payment functions.

Chart 3

Time deposit rates in Austria

Bank interest rates on new business in % (including renegotiations)

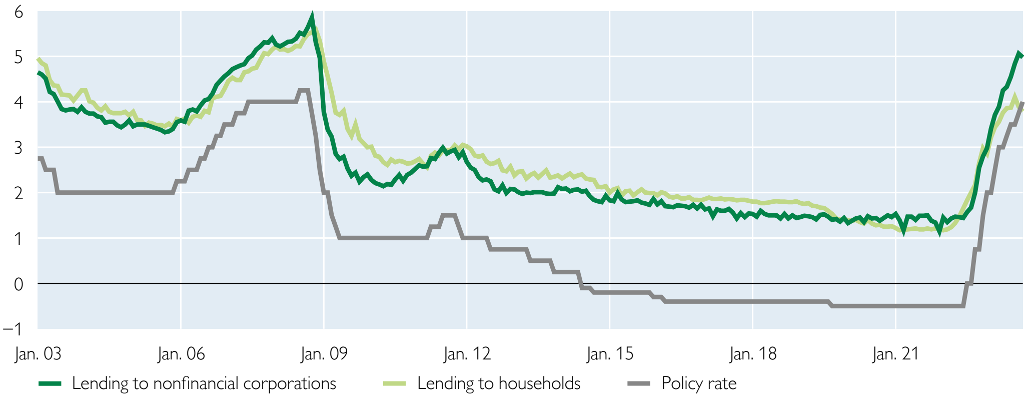


Source: ECB Statistical Data Warehouse.

Chart 4

Lending rates in Austria

Bank interest rates on new business in % (including renegotiations)



Source: ECB Statistical Data Warehouse.

The overnight interest rate aggregate employed in this analysis comprises both categories – overnight savings deposits and current accounts. Although the legal framework specifically pertains to households' time deposits (see also chart 3), its influence appears to have extended to the pricing of overnight deposits, as evidenced by both time series consistently remaining in positive territory throughout the entire investigation period.

Charts 2 and 3 suggest that time deposits mirror the movement of policy rates more closely than overnight deposits and are thus less sticky. In addition, the charts show that time deposits held by nonfinancial corporations dipped further below zero than the corresponding overnight deposits. Comparing time deposit rates across customer groups (see chart 3) reveals that interest rates for nonfinancial corporations are more volatile and, during most of the sample, closer to policy rates than those for households.[6]

While lending rates are generally higher than deposit rates, a visual inspection of chart 4 shows that lending rates are typically lower for nonfinancial corporations than for households' house purchases. It is only in hiking cycles that we find lending rates for nonfinancial corporations exceeding those for households.[7] Generally, it seems that lending rates for nonfinancial corporations are more sensitive to policy rates than household lending rates.

2.2 Modeling approach

From a merely statistical point of view, the well-known problem of spurious correlation can arise in empirical analysis of (macro-)economic time series. It refers to a situation when two (or more) non-stationary variables are regressed on each other that do not share a meaningful causal relationship but exhibit a common trend. Naïve econometric inference in such a situation would produce spurious,

[6] *Nevertheless, these observations are only indicative, as the maturity composition of households' time deposits might differ from those of non-financial corporations.*

[7] *This result may be driven by the repricing of real estate assets, which typically lose value in hiking cycles. This reduces collateral values and hence dampens household demand for loans, exerting downward pressure on lending rates for house purchases.*

non-meaningful results. However, under the Granger representation theorem (see Engle and Granger, 1987), if a stationary linear combination of the variables (in our case: interest rates) exists, a stable long-run relationship between the two variables is implied. Hence, the variables can be modeled in the form of an error correction model (ECM), which recovers the short-run and implied long-run relationship between the variables in a non-spurious, consistent way. We start with a general approach modeling the pass-through relationship, i.e. an autoregressive distributed lag (ARDL) model, which nests the univariate ECM, and subsequently add specific details like asymmetries.

The literature on the pass-through of monetary policy to bank retail rates for the euro area in general (for an overview see e.g. Gregor et al., 2021 as well as Andries and Billon, 2016) and Austria in particular finds contemporaneous pass-through coefficients significantly below unity. This means that the pass-through of policy rates to bank retail rates does not happen within a month but takes some time. Accordingly, using an ARDL model seems appropriate as it models the response of bank interest rates to money market rates in a lagged fashion, leaving room for the initial shock to propagate to bank rates within a few months.

In addition, we expect money market rates and bank retail rates to share a stable long-run co-integrating relationship. First, money market rates represent the banks' relevant marginal funding costs. Therefore, lending rates cannot remain below money market rates for an extended period due to profitability concerns. Additionally, they cannot significantly exceed them as competition would force banks with higher rates out of the loan market. Second, assuming there is competition in the deposit market, retail deposit rates cannot undershoot money market rates too strongly because such deviations would lead to deposit flight, and they cannot overshoot them too strongly either because of profitability reasons.[8] Any such deviation will not only be asymptotically corrected by lagged dependent variable terms but is also expected to be corrected within the next period in a linear and stable fashion, motivating the estimation of a time-constant adjustment speed parameter in the ECM.

Finally, our theoretical argument in favor of a stable long-run relationship can be justified by joint co-integration tests of all variables considered in the models.

2.3 Money market rates proxying monetary policy rates

In line with the empirical literature on the transmission of monetary policy (see, for instance, Sander and Kleimeier, 2004, as well as De Bondt et al., 2005), we utilize money market rates with different maturities as proxies for the policy rate. First, money market rates exhibit greater volatility than policy rates, rendering them more suitable from an econometric perspective. Second, money market rates with short- to medium-term maturities are more closely tied to banks' refinancing costs, which – following an "industrial organization inspired cost-of-funds approach" (see Sander and Kleimeier, 2004, p. 463) – drive banks' retail pricing. Third, expectations of the path of future policy rates are priced in money market

[8] *See, for example Kho (2023), for a discussion of the role of local deposit market concentration on bank deposit pricing. We, however, do not consider specific concentration measures as additional variables. In the case of Austria, bank concentration as measured by the Herfindahl-Hirschman-Index of total assets is relatively low and very stable in comparison to other euro area countries across much of the sample (EU structural financial indicators (June 2020) (europa.eu)).*

rates.[9] In that, money market rates capture the broader stance of monetary policy at any given point in time, which we deem part of the monetary policy transmission mechanism.

To pinpoint the optimal maturity for the employed money market rates, we adopt a pragmatic stance letting the data guide our choice. More precisely, we choose the maturity of the relevant money market rate that exhibits the most stable co-integrating relationship with the corresponding retail rate. This procedure leads us to the following choices:

In explaining the development of overnight deposit rates, we employ unsecured overnight money market rates as a proxy for the policy rate. This explanatory variable is a monthly average of the EONIA up to September 2019 and, from October 2019 onward, of the €STR. In explaining the evolution of time deposits, we use the monthly average of the three-month EURIBOR. For lending rates, we consider a reference rate with a longer maturity, i.e. the monthly average of the 12-month EURIBOR as the explanatory variable. Part of the loan aggregates reflect longer-term contracts (with household retail lending rates pertaining to mortgage loans for house purchases solely) which are priced in accordance with medium-term money market rates.[10]

An ARDL model assessing the monthly pass-through of policy rates to unsecured overnight money market rates indicates an almost immediate and complete pass-through. Moreover, we use a Granger causality test to examine whether the selected money market rates drive (in a Granger-causal sense) the dependent variables in question. We find convincing evidence that most money market rates unidirectionally (Granger)-cause the retail interest rates in each specific relationship.

3 Estimating the interest rate pass-through

In this section, we discuss the econometric models used in this study.

3.1 The basic model

We apply an ECM as argued in subsection 2.2 and commonly used in the empirical pass-through literature (see e.g. Moder, 2023; Egert et al., 2007; Holton and d'Acri, 2018 as well as Deutsche Bundesbank, 2019 and 2023). To empirically investigate the transmission from money market rates to bank retail rates, we estimate a general *ARDL(p,q)*-model following Pesaran and Shin (1999):[11]

$$y_t = \alpha + \sum_{i=1}^{p} \beta_i \, y_{t-i} + \sum_{j=0}^{q} \gamma_j \, m_{t-j} + \epsilon_t \text{, where } \epsilon_t \sim N(0, \sigma_\epsilon^2) \qquad (1)$$

[9] *To see this, consider the three-month EURIBOR as shown in chart 1, which exhibits a strong uptick in anticipation of changes in monetary policy rates at the start of 2022.*

[10] *Since 3-, 6- and 12-month EURIBOR money market rates reflect the most liquid money market segments and are the common reference interest rates for banks in the euro area (see Bundesbank, 2019), and we deem them especially informative for pricing of the retail interest aggregates considered. Moreover, our results for time lending rates are robust to employing 3- and 6-month EURIBOR rates.*

[11] *Note that the effect of excess liquidity on the pass-through in the ample reserve regime as of 2012 is captured by money market rates as they reflect liquidity conditions in money markets. This can be seen in chart 1, where money market rates move below the corridor set by the deposit facility rate in 2020–2022. The inclusion of excess liquidity as an additional exogenous variable in our models yields little additional explanatory power.*

and y_t denotes the relevant retail rate and m_t represents the corresponding money market rate. In equation (1), p denotes the maximum lag of the dependent variable and q is the maximum lag of the explanatory variable.

The above model can be reformulated in first differences of y_t:

$$\Delta y_t = \alpha + \sum_{i=1}^{p-1} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q-1} \gamma_j \, \Delta m_{t-j} + \theta_1 y_{t-1} + \theta_2 m_{t-1} + \epsilon_t \qquad (2)$$

and the associated error correction form is:

$$\Delta y_t = \sum_{i=1}^{p-1} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q-1} \gamma_j \, \Delta m_{t-j} + \theta_1 (y_{t-1} + \frac{\theta_2}{\theta_1} m_{t-1} + \frac{\alpha}{\theta_1}) + \epsilon_t \qquad (3)$$

where $\theta_1 = -(1 - \sum_{i=1}^{p} \beta_i)$ and $\theta_2 = \sum_{j=0}^{q} \gamma_j$ and the co-integrating equation is given by the expression in parentheses. The error-correction coefficient Θ_1 represents the speed of adjustment to the long-run equilibrium. Moreover, Θ_2/Θ_1 represents the long-run pass-through coefficient.

We determine the optimal lag orders p and q by minimizing the Akaike Information Criterion (AIC) over the whole estimation period. We then proceed by evaluating the existence and form of the co-integrating relationship by performing a bounds F-test and bounds T-test as in Pesaran et al. (2001). The existence of co-integrating relationships is important for the interpretation of the long-run coefficients. If the bounds test is not passed, only the short-run coefficients will have an economically meaningful interpretation.[12]

3.2 Asymmetries

Going one step further, we explore the potential for an asymmetric pass-through of positive and negative changes in money market rates to bank retail rates. Hence, we test for pass-through coefficients that are statistically different depending on whether money market rates increase or decrease. For instance, Egert et al. (2007) provide evidence for asymmetries in the pass-through of money market rates to bank lending rates for a sample of Central and Central Eastern European countries.

We analyze the possibility of an asymmetric pass-through in the following model specification following Greenwood-Nimmo et al. (2010) and Shin et al. (2014). Hence, the short-term parameters y_j in equation (3) may be different for positive and negative changes in money market rates: γ_j^- $if \Delta m_{t-j} < 0$ and γ_j^+ $if \; \Delta m_{t-j} \geq 0$

Due to the negative interest rate policy implemented between 2014 and 2022, one might expect $\gamma_j^- \neq \gamma_j^+$. Charts 2 to 4 already suggest that in some cases the pass-through to retail rates was more sluggish during this time. The legal framework in Austria preventing some deposit rates from entering negative territory (as

[12] *An Augmented Dickey-Fuller test (including an intercept and no time trend) indicates that all variables concerned are I(1). Furthermore, we confirm that combinations of variables employed in our models form stationary time series. Hence, we proceed by employing the Engle-Granger One-Step Approach by estimating the short-run and long-run coefficients in an ARDL specification.*

discussed in subsection 2.1) could explain the asymmetric pass-through to household deposit rates in our sample.

The case for an asymmetric pass-through in the euro area has been made in empirical investigations, such as Sander and Kleimeier (2002), who attribute this finding to imperfections in market competition. According to this literature, positive changes in money market rates are transmitted faster to lending rates than negative changes, while deposit rates react more quickly to negative changes in money market rates than to positive ones.

3.3 Risk measure

Following Deutsche Bundesbank (2019, 2023) and ECB (2017), we use the spread measure s_t as an additional explanatory variable and allow for a maximum of k lags. Therefore, equation (1) is extended with $\sum_{h=0}^{k} \rho_h s_{t-h}$. The spread is computed as the difference between the overnight interest swap rate at 10-year maturity and the 10-year government bond rate. It captures risk and term premiums over time and across countries. We do not expect this variable to be a relevant explanatory factor for the interest rate pass-through in Austria. Nonetheless, it could play a crucial role in the pass-through model for loans in the euro area aggregate. In particular, it might have explanatory power especially in the crisis years of 2008–2020, where divergent country risk premiums may have had a significant influence on banks' refinancing costs.

4 Results

Table 1 contains our estimation results for the pass-through to Austrian retail rates (in the upper part) as well as to retail rates in the euro area (in the lower part). Column (4) indicates whether we use a linear ARDL model or a nonlinear ARDL model (NARDL), in which the coefficients differ depending on the direction of the change in the explanatory variables (see subsection 3.2). Moreover, the lag structure of the short-run and long-run coefficients is given in parentheses. We include short-run and long-run asymmetries in the model and perform symmetry tests on the coefficients. As we find no significant long-run asymmetries, we report only a single coefficient in column (7). Statistically significant short-run asymmetries are only present in the pass-through to deposit rates. Consequently, we report single coefficients also in columns (8) and (9) for the pass-through process to lending rates. Where we use a nonlinear ARDL-model, column (8) gives the coefficients for increasing money market rates, while column (9) shows the coefficients for decreasing money market rates. As discussed in subsection 3.3, we augment the models for euro area lending rates with a risk measure, whose long- and short-term coefficients are given in columns (11) and (12).[13] Finally, to assess the models' dynamics, in column (10) we report the inverse parameter of the speed of adjustment (i.e. $\frac{1}{\theta_1}$) measured in months.

[13] *As a robustness check, we include the risk measure not only in the pass-through equations for loan rates in the euro area, but also in all other equations. However, the coefficients associated with the risk measure do not exhibit statistical significance, as they are not significantly different from zero.*

4.1 Model results

According to the bounds test given in column (13) of table 1, we find stable co-integrating relationships for all types of retail interest rates in Austria. For the euro area aggregate, however, (overnight and time) deposits for households do not pass the bounds test. Consequently, only the short-run coefficients have an economically meaningful interpretation.

Our estimates of the long-term pass-through coefficients in column (7) for Austrian retail rates significantly deviate from zero and are close to one. The only exception are the estimates for overnight deposit rates for households, which are not significantly different from zero. Hence, we find long-run pass-through coefficients of monetary policy to Austrian retail rates for lending and deposits qualitatively in line with results of empirical studies conducted before unconventional monetary policy measures were introduced in the euro area. This observation aligns with the findings in the literature, as discussed in section 1.

For the euro area aggregate, a nearly complete pass-through in column (7) is evident only for lending rates and rates on time deposits of nonfinancial corporations. The other deposit rates suffer from the fact that they either do not pass the bounds test or their long-term coefficient is not significantly different from zero. Our findings for the euro area broadly confirm those of Kok Sørensen and Werner (2006).

When comparing long-term pass-through effects between Austria and the euro area, our results suggest that the long-term pass-through to lending rates seems more complete in the euro area aggregate. Conversely, there is evidence that the pass-through to term-deposits is more complete in Austria.

While the short-run pass-through to lending rates in columns (8) and (9) seems to be symmetric in Austria as well as in the euro area, we provide evidence that the short-run pass-through to deposit rates is asymmetric. In the short term, deposit rates seem to react more strongly to decreases in money market rates. In contrast, they react more slowly to increases in money market rates. It is important to note, however, that this relates only to the strength of the short-term adjustment, as our evidence suggests symmetric long-term coefficients. Column (8) of table 1 shows that the short-term pass-through (i.e. within one month) to overnight deposit rates in Austria and the euro area is basically zero. Hence, overnight deposit rates react more sluggishly than the other retail rates when money market rates increase.

Additionally, our estimations of the (inverse) adjustment speed parameters, as shown in column (10) of table 1, are economically meaningful for the pass-through equations of loans and time deposits. In particular, Austrian lending rates seem to converge to their long-run equilibriums within a year. Rates on nonfinancial corporations' time deposits react even faster, while rates on households' time deposits react a bit more slowly. The relative pattern seems similar in the euro area. However, our findings suggest that the speed of adjustment is in general higher in Austria than in the euro area aggregate.

Our estimates for the speed of adjustment of overnight deposits align with the coefficients in Deutsche Bundesbank (2023). Hence, in Austria as well as the euro area, the adjustment to the long-run equilibrium would take up to a decade. This finding is particularly intriguing because – despite statistical tests confirming a stable co-integrating relationship – there is no plausible economic explanation for why the adjustment to the long-run equilibrium takes so much time.

The risk measure we incorporate in estimating the pass-through to lending rates in the euro area is significantly different from zero, both in the long-term and the short term. The findings presented in column (11) of table 1 indicate that aggregate risk premiums indeed capture a significant part of variation in lending rates in the euro area.

4.2 Model evaluation: cumulative dynamic multipliers and robustness

Cumulative dynamic multiplier plots, as shown in charts 5 to 10, are a graphical representation of the dependent variable's estimated response to a change in the money market rate over a given time horizon. The long-run limits in the charts correspond to the portion of money market rate changes transmitted to bank retail rates in the new equilibrium given no additional disturbances occur. In other words, charts 5 to 10 condense the joint information on short-run (asymmetric) and long-run coefficients presented in table 1.

Chart 5 to 10 illustrate the estimated cumulative dynamic multipliers for the pass-through models in Austria. In charts 5 and 6, we show the non-linear reaction of Austrian lending rates to a unit shock to the 12-month EURIBOR and the long-term equilibrium, respectively. For lending rates, we estimate symmetrical models. The graphical representation of our results show that the long-term pass-through coefficients are quite similar for nonfinancial corporations and households. However, it also becomes clear that lending rates to nonfinancial corporations adjust more quickly than mortgage rates for households.

Charts 7 to 10 show the reaction of deposit rates in Austria to their corresponding money market rates in nonlinear models. Time deposit rates for nonfinancial corporations mostly fluctuate around their long-run limit. This is because of their rapid adjustment, as indicated by the low value of the inverse adjustment speed parameter (see table 1, column (10)). Time deposit rates for households adjust more slowly. However, they also converge within the first few months. Households' time deposits respond more quickly to falling money market rates than to increasing money market rates. For overnight deposits, we see a more persistent asymmetry and the slow convergence to the long-run limit as discussed in subsection 4.1.

Finally, we conduct tests to identify any structural breaks in the estimated relationships shown in table 1:[14] An analysis of recursive coefficients estimated between January 2000 and September 2023 reveals no significant changes or discontinuities. This indicates that the pass-through mechanism via the interest rate channel of monetary policy remains effective in a stable manner. While we do not find significant structural breaks, we find tentative evidence that short-run asymmetry in overnight deposit pricing may have become more pronounced since the start of the current hiking cycle judged by recursive coefficients. Moreover, to detect possible structural changes in the pass-through mechanism we conduct CUSUM (cumulative sum) tests on the estimated residuals, which do not reveal significant structural breaks in the models shown above.[15] These findings lead us

[14] *The results for Austria and the euro area are not shown but are available from the authors upon request.*

[15] *The model pertaining to the pass-through equation of time deposits for nonfinancial corporations presents the only exception in this regard. Recursive CUSUM estimates (employing non-robust standard errors) exceed the threshold set by the confidence interval between 2016 and 2018. However, as recursive-coefficient estimates are stable throughout the whole time horizon considered, we interpret these results tentatively. Moreover, we do not find evidence for residuals heteroskedasticity in any of the models presented above, as judged by Durbin-Watson statistics.*

to conclude that the pass-through mechanism for bank lending and time deposit rates has exhibited a stable functional form since the start of EMU in 1999.

Table 1

Estimation results

(1) Region	(2) Name	(3) Sample	(4) Model	(5) Reference rate	(6) Long-term constant	(7) Long-term pass-through coefficient	(8) Short-term coefficient (+)	(9) Short-term coefficient (-)	(10) Inverse adjustment speed	(11) Risk measure - long-term coefficient	(12) Risk measure - short-term coefficient	(13) Bounds test confirms co-integration[1]
Austria	Loans to nonfinancial corporations	May 03–Sep. 23	ARDL(4,3)	EURIBOR 12m	1.55***	0.77***	0.3**		11***			Yes**
	Loans to households	May 03–Sep. 23	ARDL(4,5)	EURIBOR 12m	1.67***	0.74***	0.03		13***			Yes***
	Time deposits by non-financial corporations	Jan. 03–Sep. 23	NARDL(6,5)	EURIBOR 3m	0.31***	0.88***	0.78***	0.85***	5***			Yes**
	Time deposits by households	July 00–Sep. 23	NARDL(6,2)	EURIBOR 3m	0.57***	0.83***	0.29**	0.39***	19***			Yes***
	Overnight deposits by nonfinancial corporations	Aug. 00–Sep. 23	NARDL(4,6)	€STR	0.72*	1.15**	0.03	0.27***	75***			Yes***
	Overnight deposits by households	June 00–Sep. 23	NARDL(4,4)	€STR	0.55	0.8	0.001	0.14***	93***			Yes**
Euro area	Loans to nonfinancial corporations	Jan. 05–Sep. 23	ARDL(6,1,4)	EURIBOR 12m	1.63***	0.86***	0.49***		12***	0.51***	–0.12***	Yes***
	Loans to households	Sep. 04–Sep. 23	ARDL(5,4,0)	EURIBOR 12m	1.67***	0.82***	0.13***		35***	0.43***	0.01**	Yes***
	Time deposits by non-financial corporations	June 00–Sep. 23	NARDL(5,3)	EURIBOR 3m	0.37***	0.79***	0.54***	0.71***	21***			Yes**
	Time deposits by households	Aug. 00–Sep. 23	NARDL(4,6)	EURIBOR 3m	0.62	0.71***	0.26***	0.45***	85*			No
	Overnight deposits by nonfinancial corporations	July 00–Sep. 23	NARDL(6,3)	€STR	0.54	1.18	–0.07***	0.09**	136***			Yes***
	Overnight deposits by households	June 00–Sep. 23	NARDL(5,3)	€STR	0.21*	0.43***	0.03	0.12***	103***			No

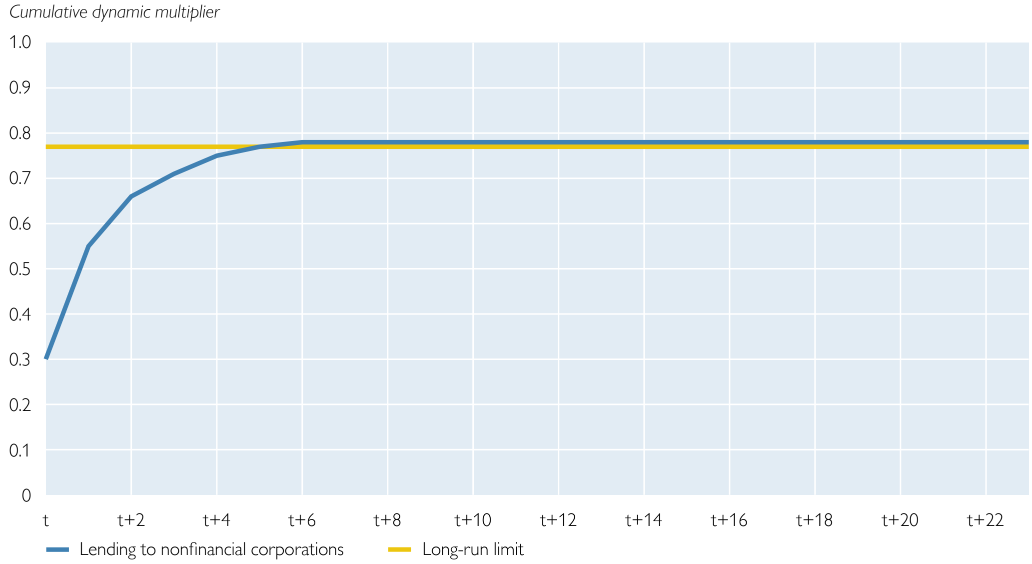
Source: ECB MFI interest rate statistics, authors' own calculations.

[1] Given knowledge of the order of integration of dependent and independent variable(s), the bounds test is an F-test on joint significance of the estimated coefficients of short-run lags.

*Note: *, **, and *** denote significance at 1%, 5% and 10% levels, respectively. The plus and minus signs in parentheses in the header of columns (8) and (9) represent the positive and negative contributions in an asymmetric nonlinear ARDL model, respectively. A single coefficient is shown for standard ARDL models. We use heteroskedasticity- and auto-correlation consistent standard errors and covariances (Newey-West).*

Chart 5

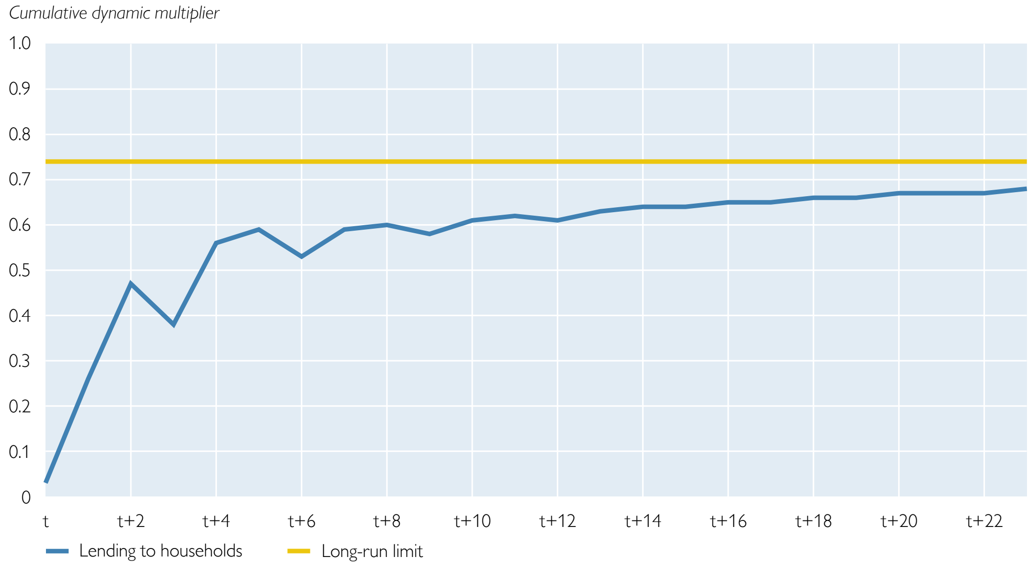
Dynamic response of lending rates to nonfinancial corporations in Austria



Source: ECB Statistical Data Warehouse and authors' calculations.

Chart 6

Dynamic response of lending rates to households in Austria

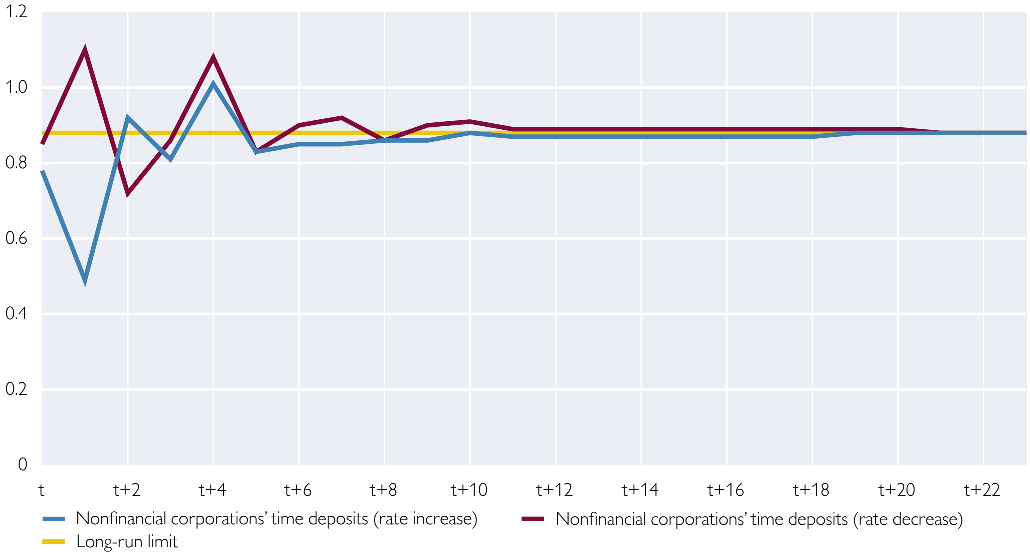


Source: ECB Statistical Data Warehouse and authors' calculations.

Chart 7

Dynamic response of nonfinancial corporations' time deposit rates in Austria

Cumulative dynamic multiplier

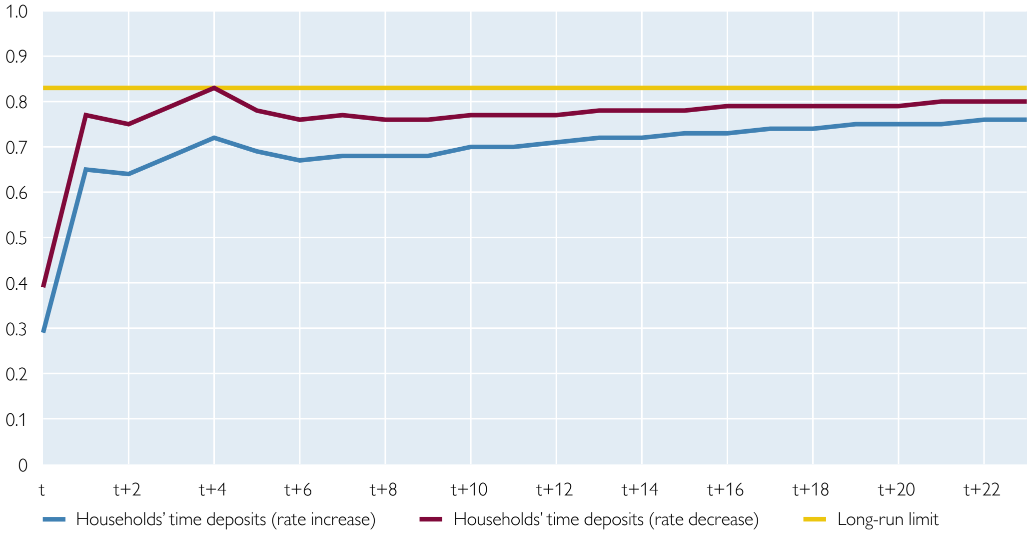


Source: ECB Statistical Data Warehouse and authors' calculations.

Chart 8

Dynamic response of households' time deposit rates in Austria

Cumulative dynamic multiplier

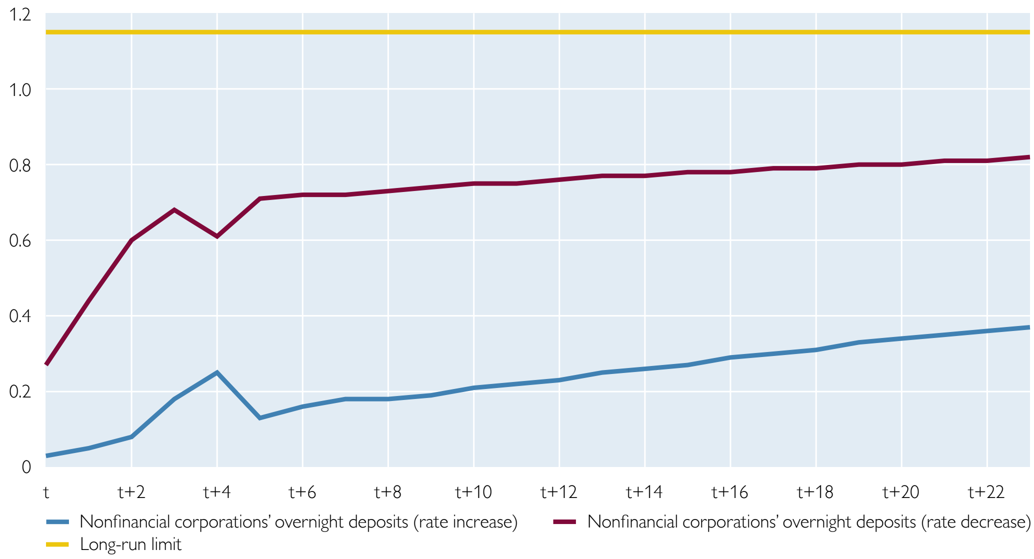


Source: ECB Statistical Data Warehouse and authors' calculations.

Chart 9

Dynamic response of nonfinancial corporations' overnight deposit rates in Austria

Cumulative dynamic multiplier

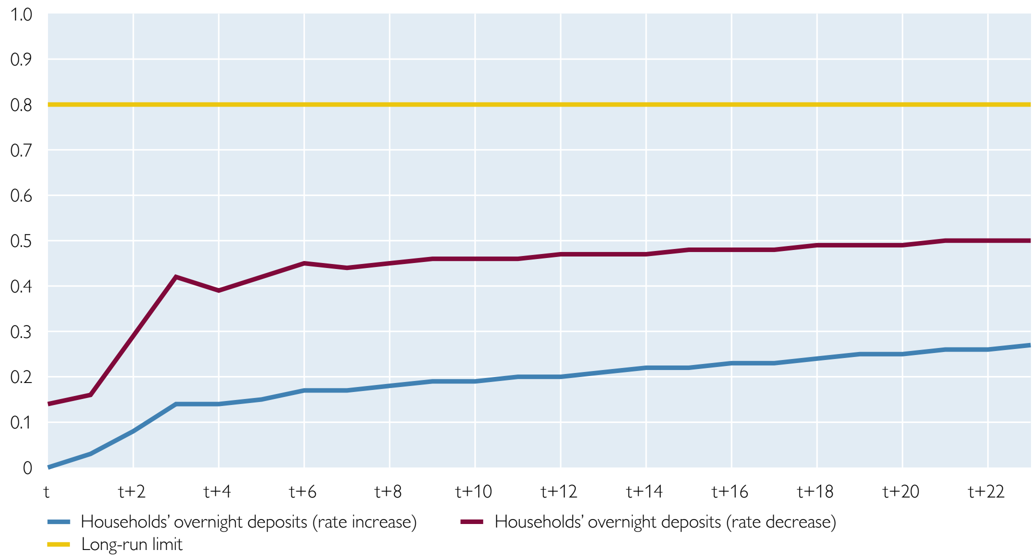


Source: ECB Statistical Data Warehouse and authors' calculations.

Chart 10

Dynamic response of households' overnight deposit rates in Austria

Cumulative dynamic multiplier



Source: ECB Statistical Data Warehouse and authors' calculations.

5 Conclusion

It is crucial to understand the impact of the ECB's single monetary policy on refinancing conditions in Austria and whether it has changed in the last 25 years since the introduction of the euro. Our study sheds light on pass-through dynamics, i.e. how changes in policy rates drive changes in money market rates and further in retail lending and deposit rates for new contracts.

Our estimated long-term pass-through coefficients for Austrian lending rates and time deposit rates are below but close to one. Hence, the pass-through can be deemed nearly complete. In addition, the pass-through to retail rates of nonfinancial corporations (in each category) is generally faster than to households. Moreover, our results for Austria reflect quite well the findings of Kok Sørensen and Werner (2006), who find that the long-term pass-through to mortgage-lending rates in Austria is slightly weaker than for firm lending rates. For all categories of retail rates, we find that the pass-through process is generally faster in Austria than in the euro area.

The reaction of Austrian overnight deposit rates in response to changes in policy rates is much more sluggish compared to other retail rates mentioned above and is considered to be incomplete. Additionally, we provide evidence for an asymmetric short-term adjustment of retail deposit interest rates to positive and negative movements in money market rates. Within one month, overnight deposit rates respond somewhat to declining money market rates, while they do not change in response to rising money market rates. Hence, we argue that an asymmetric pass-through to retail deposit rates needs to be considered when assessing their short-run dynamics.

Our estimates of a short-term pass-through to overnight deposit rates of essentially zero (when policy rates rise) align well with observed Cumulative Deposit Betas[16] during the current hiking cycle. Ferstl et al. (2023) show that between July 2022 and June 2023 only 12.5% of the change in policy rates was transmitted to Austrian overnight deposit rates. Comparable results have been found in previous research for both the euro area and Austria (see e.g. Kok Sørensen and Werner, 2006; Messer and Niepmann, 2023; Sander and Kleimeier, 2004). Also, Breyer et al. (2023) document the stickiness of overnight deposit rates. They conclude that the difference in the adjustment speed between lending and deposit rates improves the average bank's net interest margin and thus boosts profitability.

Finally, we come back to the starting point of this article citing a recent strand of literature finding that some categories of retail rates have shown a more sluggish response to changes in policy rates in the current hiking cycle. However, consistent with previous pass-through research, we find a stable co-integrating relationship between money market and retail interest rates in Austria. This suggests that the underlying theoretical framework governing the pass-through process of monetary policy characterizes the empirical pattern in the given time frame sufficiently well. Furthermore, it leads us to conclude that the long-term pass-through process in Austria has not significantly changed since 2003. This finding is corroborated by stable recursive long-term pass-through coefficient estimates from 2012 onwards,

[16] *The Cumulative Deposit Beta is a measure of the strength of pass-through at a given point in time. It is computed as the cumulative change of retail rates divided by the cumulative change in monetary policy rates since the start of a hiking cycle.*

capturing the whole period of unconventional monetary policy measures that led to an ample reserve regime. However, we also find tentative evidence that the asymmetry of the short-run pass-through process to overnight deposit rates has become more pronounced. In other words, overnight deposit rates indeed seem to respond more sluggishly to policy rate changes in the current hiking cycle.

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