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The pass through of monetary policy to euro area bank interest rates

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Abstract

We examine the transmission of monetary policy to bank interest rates in the euro area, using rolling 10-year samples. The results suggest that the pass through of policy rates to bank interest rates was relatively stable prior to the use of unconventional monetary policy measures, in which case the multiplier increased, especially for housing and short-term NFCs loans. It appears that Quantitative Easing (QE) operations allow for bank lending rates to further decline, however, this could lead to higher lending in those particular loan categories, with certain repercussions to the economy. In addition to the excess liquidity created by asset purchases, other factors such as credit risk and house price growth also appear to impact the pass through.

Keywords: pass through, deposit beta, error correction, euro area, asset purchases
JEL Codes: E52, E58, E43

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The pass through of monetary policy to euro area bank interest rates

1. Introduction

The bank interest rate pass-through process is probably the most important link in the process of monetary policy transmission. Decisions made by banks about the yields received and paid on their assets (loans) and liabilities (deposits) have an effect on the spending and investing habits of depositors and borrowers, which in turn has an impact on real economic activity. As such, stronger monetary policy transmission results from a quicker and more complete pass-through of official and market interest rates to retail bank interest rates, with a higher impact on the overall economy, avoiding any welfare costs (Kobayashi, 2008) and financial stability issues (Kwapil and Scharler, 2010).

The paper aims to examine the degree and the speed of adjustment of the bank interest rates, following a change of the market/policy rate. In particular, by using data for the 19 euro area countries, for both deposit (households and non-financial corporations) and lending rates (for house purchase, consumption, short- and long-term NFCs) we examine how the pass through changes over time. To do so, we employ an error-correction model, in which the long-term coefficient (beta) determines the pass through (multiplier), while the theta term signifies the equilibrium adjustment term.

Our results suggest that while the theta does change over time, the changes are usually not that large. The transmission of monetary policy to bank interest rates (beta coefficient) was relatively constant prior to the use of unconventional monetary policy measures (which varied in timing and scope between countries, highlighting important heterogeneity issues). With the introduction of asset purchase programmes, the pass through began to rise, even though it took around three years to have an economically meaningful effect on the multiplier. At the same time, given that the effects from asset purchases are not the same for all countries, heterogeneity also increased. Following

the additional increase in asset purchases during the pandemic, the pass-through became even stronger, and more so for loans compared to deposits, with the deposits to loans multiplier ratio being less than zero since 2018. These results hold for both NFCs and housing loans, and to a lesser extent for consumption loans.

As such, is appears that Quantitative Easing (QE) operations, which lower bond yields and thus ease financing conditions, allow for bank interest rates to further decline than would have been the case if only the policy rate was taken into consideration. This is evident in the 2018-2020 period, when bank rates changed while the policy rate remained stable. However, since the increase in the pass through is related only to specific categories, such as house purchases and short-term NFCs loans, this suggests that banks are likely to have increased lending in those categories that they saw as the safest (Michail, 2023). While is meaningful from a credit risk perspective, it appears to have also had an impact on the overall economy, via the notable increase in house prices over the period, to an extent where policymakers considered it a bubble (Di Casola et al., 2022)

We also provide a quantitative confirmation of the above conclusions, using a panel regression in which the multiplier (beta) values act as the dependent variable. The results confirm the above, as excess liquidity (defined as the ratio of total deposits over total loans) appears to have a strong impact on the pass-through levels. In particular, excess liquidity has a positive sign for both lending (house purchase and short-term NFCs loans) and deposit rate multipliers, suggesting that the higher the liquidity, the higher the pass-through. Given that excess liquidity can be created via asset purchase programmes, and that excess liquidity remains in the system for a while, it appears that asset purchase programmes can have a longer-lasting impact on the pass-through. Further to excess liquidity, credit risk appears to have the expected positive impact on

the pass-through for lending rates, while higher house price growth lowers bank deposit interest rates.

The remainder of the paper is as follows: the next section offers a review of the (relatively scarce) literature on the topic, while section 3 offers the data and model employed. Section 4 shows the results from the estimation across all lending deposit interest rates, with section 5 testing for the determinants of the beta and last section providing a summary and conclusions.

2. Literature review

Quite a few studies have been carried out throughout the years in an effort to better understand the interest rate pass-through in the euro area. Emphasis is usually placed on three primary issues: the completeness (or lack thereof) of long-run pass-through; the short-run speed of adjustment; and the degree of heterogeneity in the pass-through across countries and interest rate categories.

For example, De Bondt (2002; 2005), using a cointegration-based model of the interest rate pass-through process finds that the euro adoption has sped up the pass-through process as well as improved the speed of loan rate adjustment, something that is likely a result of increased competition, a result confirmed by De Bondt et al., (2005). Additionally, it appears that short-term retail bank interest rates are sticky; as a result, the pass-through of market interest rates to these rates appears to be at its peak around 50%. Long-term pass-through, however, is higher and nearly 100%.

Using a similar cointegration setup, Sander and Kleimeier (2002) identify the factors that affect the speed of transmission. These include the lack of competition between banks (a theme also supported by the results Leroy and Lucotte, 2015), information asymmetries, "menu costs", and the implicit interest rate insurance provided by banks, motivated by maintaining long-term relationships. As a result, the

authors confirm that the speed of adjustment differs across countries, while the nature of the adjustment process itself is also quite heterogeneous.

In the same manner as the previous studies, Kok and Werner (2006) investigate how different bank interest rates are affected by market interest rates. The authors show that heterogeneity is present in the estimates, and the fact that the long-run multipliers and speed of adjustment coefficients vary across countries may indicate some degree of fragmentation and lack of integration in the euro area's retail banking industry.

The interest rate pass-through process is also examined by Bernhofer and Van Treeck (2013) using a combination of single country and panel cointegration techniques. The authors find evidence of substantial heterogeneity in the short-run pass-through and, using sub-sample analysis, they conclude that the degree of heterogeneity and the overall efficiency of the interest rate pass-through have not improved in the second half of the period since the founding of the European Monetary Union. Krylova et al., (2014), also report results in favour of the heterogeneity conclusions, in a DSGE model that also controls for the riskiness of borrowers.

Taking into account the impact of the Global Financial Crisis (GFC), some more recent studies have empirically investigated how lending rates in major advanced economies respond to monetary policy rates. For example, Illes and Lombardi (2013) find that the pass-through of monetary policy has not worked as well as it did prior to the GFC and that borrowers have only partially benefited from low policy rates, particularly in peripheral countries in the euro area. Furthermore, Horvath (2018) reports that the GFC had increased the heterogeneity of the results, while similar results, highlighting the negative impact of the GFC on the pass-through, were reached by Gambacorta et al., (2015), with Illes et al., (2019) suggesting that higher bank funding costs are one of the main reasons behind this. Holton and d'Acri (2018) support the

view that reliance on central bank funding played a role in fragmenting the pass through of monetary policy, with bank market power also playing a role in the determination of the pass through.

To counter the decline in the pass-through, central banks introduced unconventional monetary policy measures, which boosted the pass-through to lending rates, as more recent studies have shown. For example, Von Borstel et al., (2016) note that unconventional measures helped decrease lending rates, mainly due to large shocks rather than propagation. Horvath et al., (2018) also support this conclusion, suggesting that asset purchases (balance sheet policies) helped boost the pass-through, with Blot and Labondance (2022) suggesting that liquidity provisions and covered bond purchase programmes influenced bank interest rates beyond the usual policy rate pass through.

To sum up the literature, Gregor et al., (2021), provide a meta-analysis of the results and find systematically lower estimated pass-through coefficients in studies that focus on the pass-through to consumer lending rates and rates on long-term loans. Importantly, the interest rate pass-through is significantly influenced by the country's macro-financial environment, while the global financial crisis appears to have weakened the pass-through across the board (see also Andries and Billon (2016) for an earlier overview of the literature). At the same time, unconventional monetary policy measures appear to have helped boost the pass-through.

Despite the findings of the literature, there is still scarce evidence concerning the pass-through during unconventional monetary policy periods. At the same time, researchers should aim to observe whether the end of the asset purchase period in the euro area, observed in 2022, had a meaningful impact on the pass-through. Furthermore, it would be useful to examine whether the factors that affected the pass through over

the previous periods are still valid. To do so, the next section presents the empirical methodology used.

3. Data and methodology

The bank and market interest rate data used in this study were collected from European Central Bank's Statistical Warehouse (ECB SDW) from the period 2003M01-2023M04. Due to data availability issues, the sample is different for some countries. In particular, for the majority of euro area countries included (Austria, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain) the sample ranges from 2003M01 to 2023M04, while for Estonia, Latvia, Lithuania, Slovakia and Slovenia the sample ranges from 2005M05 to 2023M04. Finally, for Belgium, Cyprus and Malta, the available sample is 2008M01-2023M04. For the market interest rate, we have selected the Euribor 3-month rate, while for the bank rates, we have included four lending rates and four deposit rates. The inclusion of different bank interest rate categories allows us to examine the degree of heterogeneity among the different products as well as the difference between lending and deposit rates.

More specifically, we include the lending rate for house purchases by households, as well as the lending rate for consumption loans (which includes consumer-focused loans, such as personal loans, automobile loans, and credit card debt). Regarding non-financial corporations (NFCs), we follow Kok and Werner (2005) and use the short- and long-term lending rates, where the former is based on loans granted to non-financial corporations with interest rate fixation up to one year and the latter with an interest rate fixation of over 5 years. At the same time, to examine the pass-through to deposit rates, we include both the overnight deposit rates and the ones with maturity up to one year, for both households and NFCs. All data were obtained from the ECB SDW, with the sample size as specified above. Furthermore, in our

analysis, we use new loan contracts, given that terms may differ for outstanding contracts, something which could bias the results.

The econometric methodology employed follows the existing literature on the topic (inter alia Kok and Werner, 2005; Bernhofer and Van Treeck, 2013), by specifying an error correction specification, as per Engle and Granger (1987), such that:

$$\Delta BR_{i,t} = \gamma_i + \theta_i\left(BR_{i,t-1} - c_i - \beta_i MR_{i,t-1}\right) + \varphi_{i,0}\Delta MR_{i,t} + u_{i,t}$$

where *i=1,…,19* is the index for each country and *t=1,…,N* is the index for each time period.[1] In this setup, changes in bank interest rates ($\Delta BR_{i,t}$) are explained by the long-term multiplier (β_i), which defines the speed of the transmission of policy rate changes to bank rates. In a perfectly functioning market, and in the absence of any disturbances (i.e. in equilibrium conditions, see Hendry and Juselius, 2000; 2001), the value of the long-run multiplier would be very close to one. Any remaining adjustments towards the long-run equilibrium between bank rates and market rates, are then measured by the speed of adjustment parameter, θ_i, as well as by changes of current market rate.

As per the literature, long-run multipliers tend to differ between countries, and hence it is sensible to estimate equation (1) at the country level instead of pooling the countries with respect to this parameter. Furthermore, given that the pass-through of market rates to bank rates may vary over time, given the specificities of the economy at each point in time, we employ 10-year (120-observation) intervals and estimate a rolling regression to examine whether the relationship is time varying.[2] In every case, the end date of the rolling sample is used. The following section presents the results from the estimations.

[1] While not presented here for the sake of brevity, all country series are integrated of order 1. Unit root tests are available upon request.

[2] In robustness checks, different 15-year and 8-year intervals were employed, with the results providing similar conclusions. The estimates are available upon request.

4. Empirical Estimates

4.1. The pass-through multiplier

Tables 1-8 provide the findings for the long-run pass through for each of the loan and deposit rates specified above. The solid line offers the coefficient estimate while the dotted lines denote the 95% confidence interval. We note again that a long-run multiplier of one denotes a perfect (one-to-one) pass-through of market interest rates to bank interest rates, a multiplier with a value of more than one suggests a sort of over-shooting, and one with a value of less than one suggests a limited pass-through. Naturally, values that differ meaningfully from one imply that the pass through of policy is affected by other economic factors, such as unconventional policy measures, banking distress, or even high risk and lack or abundance of liquidity in the economy.

Table 1 shows the pass through for the house purchase lending rate in each euro area country. Interestingly, all countries start with a pass-through coefficient below unity, standing at approximately 0.5, which then increases over time. The peak of the pass through rate is, usually, over one with the exception of Estonia and Luxembourg, where the coefficients are decreasing while Ireland's and Lithuania's are approaching zero. Overall, in the samples that end prior to 2020, countries do not present a complete pass-through of market interest rate to bank interest rate.

However, once the unconventional monetary policy period enters our rolling sample, most countries experienced continuous increases in the pass through. In particular, from March 2015 until November 2019 when the ECB's Asset Purchase Programme (APP) was active and being a net purchaser in the bond market, the pass through appears to have risen in most countries. For example, in Germany, the pass through rate moved from around 0.7% in the beginning of the sample, to almost 1% in

2018. A similar image emerges for the other Big-5 countries, with France, Spain, Italy, and the Netherlands exhibiting an almost identical path.

The pass-through further increased during the Covid-19 pandemic across the Big-5, with the introduction of the Pandemic Emergency Purchase Programme (PEPP), in addition to the reduction of the interest rate to -0.50%. Up until early 2022, when both the PEPP (March) and the APP (June) ended, the pass-through of policy continued to rise, reflecting the further easing of financing conditions and the on-going decline of bank rates, in contrast to the relative stability of the market rate. The suggestion that the pass through is amplified by asset purchases is in line with the previous literature (Von Borstel et al., 2016; Horvath et al., 2018; Blot and Labondance, 2022). From mid-2022 onwards, when all unconventional policies ended and interest rates began their increase, the pass-through appears to have returned to its initial levels.

In Table 2, which offers the pass through estimates for lending rates on consumption loans, a negative multiplier is observed in seven countries (Austria, Finland, Germany, Greece, Ireland, Latvia, Lithuania) during the unconventional monetary policy period, while the pass through also decreased in Slovenia. As such, the estimates suggest that bank interest rates did not move in the direction of the policy rate in those countries. In other words, bank interest rates either remained at the same levels or actually increased over that particular period, not reflecting the change in funding costs. In other countries such as Slovakia and Estonia, the pass through moved from negative to positive, while for the remaining the path was upwards and above one.[3] While, in accordance to the literature (De Bondt et al., 2005) we also find that the estimates tend to be lower than in the house purchase category, what appears to be more

[3] Due to data limitation issues, we have removed the Netherlands from the analysis of lending rate for consumption loans.

important is the observed heterogeneity in the responses. Lending rates for consumption loans appear to have important differences across countries, making their setting mechanism is more unclear compared to housing loans. As such, studies that are more specific may be required to reach definite conclusions.

On the other hand, the behaviour of the short-run NFC lending rate is as expected: in most countries, the multiplier was quite stable until 2018, when they began to rise. Prior to the imposition of unconventional monetary policy measures, and especially before the samples ending in 2018, the pass through was very stable in France, Germany, Austria, Italy, and the Netherlands, and to a smaller extent in Finland, Greece, Luxembourg, Portugal, and Spain. Overall, it appears that it took around three years of asset purchases for the pass-through to change in the euro area, and the onset of the pandemic caused a significant increase in the pass-through, which, as before, declined when the APP and PEPP ended and policy rates began to rise. The results area broadly similar for the long-term interest rates, even though the initial coefficients are smaller (around 0.5-0.6 on average for the Big-5 countries), variation is usually larger in smaller countries, suggesting that they are affected by idiosyncratic factors, and thus confidence bands are wider (Table 4). [4]

In the case of deposit rates (Table 5), the first conclusion is that the overall pass-through is lower for overnight deposits than for lending rates. This is an understandable conclusion, given the maturity transformation required to move from overnight to longer loan durations. The same path is again followed here, with the multiplier peaking during the unconventional policy period, and with a significant decline in the pass-through from mid-2022 onwards. In Table 6, which shows the overnight deposit rate

[4] Malta was excluded from the analysis due to insufficient data (data on lending rates for NFCs with a maturity of over 5 years are only available from 2008M12 up to 2013M05).

multiplier for Non-Financial Corporations (NFCs), in most of the countries, the pass-through tends to decline over time, even though some do exhibit a small increase during the unconventional policy period.

In the case of household deposit rates with a maturity of up to one year (Table 7), the pass through is quite similar to the ones for lending, even though, in most cases, the peak value of the multiplier is lower than the respective house purchase lending rates. In quite a few countries[5], other than the Big-5, the estimates are quite volatile, suggesting the presence of idiosyncratic factors, as well as the varying effect of unconventional policy measures. For example, in countries for which the purchases eased conditions the most (e.g. Cyprus, Italy, Greece) the multiplier value appears to have peaked at a higher level.

Similar conclusions are reached for NFCs deposit rates, however, with a slight decrease in the pass through observed for most countries prior to the onset of the pandemic. In general, the analysis shows that the long run pass through is more complete for deposit rates with maturity up to one year.

An important distinction here relates to the relative change of deposit and lending rate multipliers. If the former is higher, then it means that funding is scarcer, banks are actively looking for more and hence have a benefit to raise deposit rates by more than lending rates. On the other hand, if the lending rate multiplier is higher, it suggests that banks enter a profit-making mode, where they seek to benefit from interest rate changes, which also implies that presence of ample liquidity conditions in that point in time. In the estimates, it appears that the pass through to lending rates is higher than the pass through to deposit rates, especially for households, with this being more

[5] The tables of the pass-through of deposit rates for households and NFCs with a maturity of up to one year do not include Ireland because data are only available from 2017M07 and onwards.

evident after 2018 (Table 9 – big 4 countries), a theme in line the ample liquidity conditions in the economy due to the asset purchase programmes. As expected, the difference in the lending/deposit pass through has decreased with the end of the unconventional monetary policy measures and the rate hikes that followed, in the 2022-2023 period.

Concerning heterogeneity, in addition to the qualitative evaluation of its existence in the previous paragraphs of this section, we proceed to capture it more formally via the use of the standard deviation of the multipliers. This simple metric allows us to observe how far away from the average countries have moved over time. In particular, Table 10 offers the standard deviation of the estimates, over their common samples. As expected, heterogeneity increased significantly over the asset purchase period, with the exclusion of the lending rate for consumption loans. Similar to the behaviour of the multipliers, heterogeneity decreased when asset purchases ended after mid-2022.

4.2. The speed of adjustment

To provide a more complete picture of the pass-through, we also present the speed of adjustment coefficients for all countries and periods. Tables 11–18 present the relevant coefficient values, which, as expected, display significant heterogeneity. In Table 10 (lending rate for house purchase), the majority of countries have an adjustment speed that ranges from -0.1 to -0.3, which means that a disequilibrium between house lending rates and market rates of 100 basis points induces a 10-30 basis point adjustment towards the equilibrium in the next period. Lower adjustment rates of around 2–5 basis points are observed in quite a few countries (e.g. Belgium, Cyprus, Greece, Lithuania, Italy, Portugal, and the Netherlands). With regards to consumer lending rates (Table 11), the coefficients are usually larger, suggesting that deviations from the equilibrium

takes place more often here, something that is in line with the multiplier values observed in the previous analysis. In either case, there appears to be no impact from unconventional monetary policy.

Moving on to the NFCs lending rates in Table 13, the coefficients tend to fluctuate between -0.1 and -0.4. There is significant heterogeneity across countries, with some (Austria, Latvia, Lithuania, Greece, Italy, Portugal, Slovenia, and Spain) exhibiting a downwards trend while in countries such as Belgium, Germany, Luxembourg, the Netherlands, and Slovakia, an upwards trend can be seen, especially after 2018. Similar trends are also present in the case of long-run NFC lending rate (Table 14), even though in this case the adjustment coefficients appear to be more stable for the majority of the countries.[6]

Tables 15 and 16 present the speed of adjustment for overnight deposit rates for households and enterprises for the 19 euro area countries. The majority of them follow a similar path in both tables, with the coefficients moving around 0.1 and 0.3 in absolute terms. Naturally, there are some outliers (e.g. Slovakia) where the coefficient implies that there is full adjustment after one period in the country.

On the other hand, in Table 17, the speed of adjustment for deposit rates with maturity up to one year for households tends to be relatively larger than for overnight rates. With the exception of Greece, Estonia, Luxembourg, and Malta the speed of adjustment appears to move between 0.1 and 0.4, with the trend either on a downward path or relatively stable over time. Table 18 (NFCs) shows similar paths with most of the countries exhibiting a negative trend. In general, there does not seem like there is a big difference between the two deposit rate categories.

[6] As in previous mentions, Malta is missing from Table 12 due to data availability issues.

4.3. Discussion

To sum up the findings from this section, we note that, for both house purchase and NFCs lending rates, the pass-through increased because of unconventional monetary policy actions. For example, from March 2015 until November 2019 when the ECB's Asset Purchase Programme (APP) was active and being a net purchaser in the bond market, the pass through appears to have risen in most countries, with the largest five economies in the euro area exhibiting an almost identical path. This result is in line with the literature (Von Borstel et al., 2016; Horvath et al., 2018; Blot and Labondance, 2022), that suggests that central banks have amplified the monetary policy pass through via unconventional measures. The change was not immediate though, as it appears that it took around three years of asset purchases for the pass-through to pose a meaningful change. Furthermore, it appears that asset purchases materially increased the heterogeneity of the pass-through across countries.

The introduction of the Pandemic Emergency Purchase Programme (PEPP), in addition to the reduction of the interest rate to -0.50% during the Covid-19 pandemic further boosted the pass-through. Up until early 2022, when both the PEPP (March) and the APP (June) ended, the pass-through of policy continued to rise, reflecting the further easing of financing conditions and the on-going decline of bank rates, in contrast to the relative stability of the market rate. From mid-2022 onwards, when all unconventional policies ended and interest rates began their increase, the pass-through appears to have returned to its initial levels, with heterogeneity also declining. In general, the results support the conclusions reached by the literature on the impact of unconventional policy measures on the pass-through, especially since it has returned to the usual values after the end of the asset purchase programmes in the euro area.

Furthermore, the pass through to lending rates appears to be higher than the pass through to deposit rates, especially for households, with this being more evident after 2018 when the asset purchase programmes took place. This is related to the ample conditions in that point in time, which banks entering a profit-making modus operandi and allowing their lending rates to become more reactive to changes. The difference in the lending/deposit pass-through decreased with the end of the unconventional monetary policy measures and the rate hikes in the 2022-2023 period.

The above results point to the conclusion that Quantitative Easing (QE) operations, which lower bond yields and thus ease financing conditions allow for bank lending rates to further decline, even though their impact on the real economy may be more limited (Louka and Michail, 2023). However, the increase in the pass through appears to hold more for specific categories, such as house purchase, implying that banks are highly likely to have increased lending in those categories that they saw as the safest (Michail, 2023). This could potentially have had certain repercussions to the economy, including the increase in house prices over the period, which led to worries for the case of a potential reversal in the rates (Di Casola et al., 2022).

5. Determinants of the pass-through

Following up from the previous section, we aim to examine for a potential relationship between various macroeconomic and financial indicators and the policy pass-through. However, since the indicators we use have a limited time span (2012-2021 on an annual basis) no individual country estimations cannot be performed. To this end, we employ a panel regression model that aims to estimate the effects on the beta term, as obtained in section 4, from financial and bank-specific indices. In effect, the panel regression model can be specified as:

$$\theta_{i,t} = \alpha_{i,t} + \beta_1 \Delta MR_{i,t} + \beta_2 CR_{i,t} + \beta_3 \Delta GDP_{i,t} + \beta_4 \Delta HP_{i,t} + \beta_5 CR5_{i,t} + \beta_6 EL_{i,t} + \beta_7 HH_{i,t} + e_{i,t}$$

where $\theta_{i,t}$ is the dependent variable (here the relevant beta for each country), $MR_{i,t}$ is the market interest rate (i.e., Euribor 3-month), $CR_{i,t}$ represents a variable that captures credit risk, $GDP_{i,t}$ is real GDP, $HP_{i,t}$ is the house price index, $CR5_{i,t}$ is the CR5 index, $EL_{i,t}$ is excess liquidity, and $HH_{i,t}$ the Herfindahl-Hirschman index. Given our sample, *i=1,…,19*, an indicator for each country and *t=1,…,T* for each time period. β is a *(k x 1)* vector of parameters and Δ is the first difference indicator.

The indicators cover both bank-specific and macro factors and are used in line with the relevant literature on the topic in order to assess their effects on the transmission of monetary policy. To capture credit risk, we use the loans to total assets ratio risk, which allows us to capture how exposed a banking sector is, and in effect, also assess how banks' risk appetite (see Michail et al., 2021). To capture the effects from bank competition, we use both the CR5 and the Herfindahl-Hirschman indices, which measure banking sector concentration and can be used as proxies for bank market power (Holton and d'Acri, 2018; Leroy and Lucotte, 2015; Durrani et al., 2022). As per economic intuition, we expect that when credit risk and concentration is higher, betas will move further away from one, given that higher credit risk may entice banks to pass changes to a higher extent, to have an additional cover for higher risk.

Further to these, we also employ the deposits to loans ratio to capture bank excess liquidity. Excess liquidity is expected have boosted the pass through, as per the estimates in the previous section and the related literature.[7] With regards to macroeconomic factors, GDP and house prices are employed as proxies for loan

[7] Bank excess reserves were considered as an indicator, however, as the data only show meaningful changes from 2016 onwards, the estimation period was significantly reduced.

demand (Kok and Werner, 2006). Since a rise in loan demand allows banks to reduce the interest rate adjustment, especially for rate cuts, higher GDP and home prices should have a negative influence on the adjustment.

Table 19 presents the estimation results from our panel setup. The six columns indicate the betas of the different bank interest rates that we have already estimated in the previous section. In general, the Euribor rate does not seem to have any significant impact on the multiplier, other than the NFCs deposits rate, with bank concentration also not having a statistically significant effect. Similarly, GDP growth is only significant for lending for house purchase, and to a small extent.

On the other hand, credit risk appears to have the largest positive impact compared to any other variable and, as expected, it is only significant for the housing and NFCs lending rates. House prices, have a positive (lending to NFCs), as well as a negative (deposit rates) effect on betas. This finding appears to explain, at least to some extent, the reason behind a slower adjustment for deposit rates across the euro area.

The most consistent factor that appears to have an impact on the policy rate multiplier is excess liquidity, which has a strong positive impact in both lending rates for NFCs and housing loans, as well as for the relevant deposit rates. In the case of deposit rates, it is by far the most prominent factor, suggesting that, as banks have higher liquidity, the pass through of policy rates to bank interest rates is likely to increase, as the previous section suggested. Given the large amounts of excess liquidity observed since 2016, with the onset of the asset purchase programmes, it is thus clear why the pass through to deposit rates appears to be low in the euro area.

6. Conclusions

The transmission of monetary policy to bank interest rates has been relatively constant throughout time prior to the use of unconventional policy measures. With the

introduction of asset purchase programmes and their subsequent boosting during the pandemic, the pass-through increased, and more so for loans compared to deposits. Furthermore, given that the effects were not equally distributed across countries, heterogeneity increased. These results hold for both NFCs and housing loans, and to a lesser extent for consumption loans.

As such, is appears that Quantitative Easing (QE) operations, which lower bond yields and thus ease financing conditions allow for bank lending rates to further decline. This also suggests that banks are highly likely to have passed monetary policy changes in the loan categories that they saw as the safest (e.g. house purchase) in an effort to boost lending (see Michail, 2023). This could potentially have had certain repercussions to the economy, including the increase in house prices over the period (Di Casola et al., 2022)

Credit risk and excess liquidity appear to have played a major role in determining the bank rates pass-through. Both variables appear to have a positive impact on the pass-through for lending rates, whereas excess liquidity also has a positive effect on the deposit rate pass-through. As such, asset purchase programmes are likely to have a longer-lasting impact on the pass-through, given that higher excess liquidity would affect the policy multiplier over a longer period and prevent it from returning to its "normal" value.

As a conclusion, it appears that the pass-through of policy to bank rates changes dramatically when unconventional policy measures are introduced, with their effects being longer lasting, especially when taking excess liquidity created into consideration. Naturally, further research is required to improve our understanding of the interest rate pass-through in the euro area, using bank level data, while the identification of potential explanatory elements for the observed heterogeneity would also be beneficial.

Conflict of interest statement

No conflicts of interest exist

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Table 1: Pass through for house purchase lending rates

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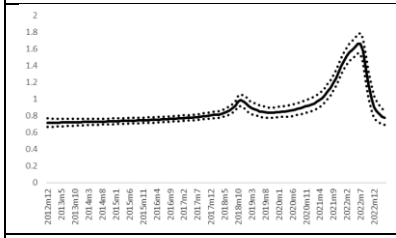
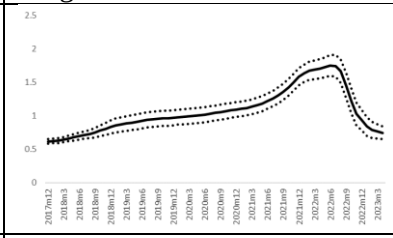
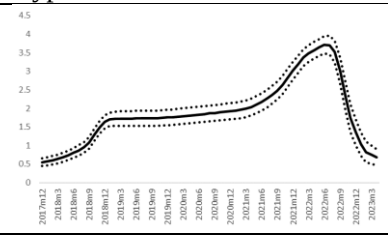
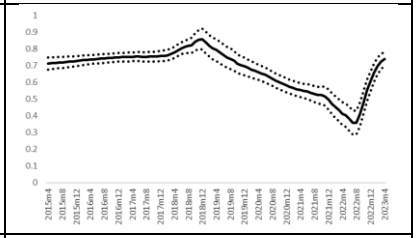
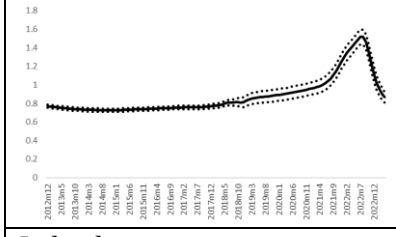
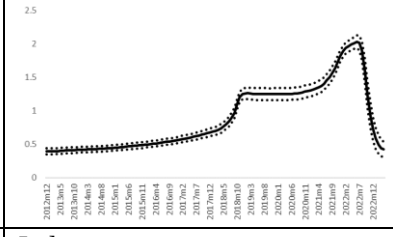
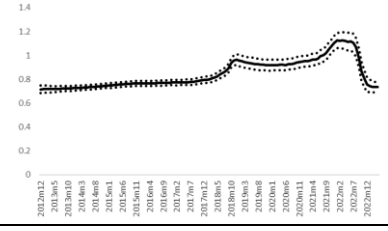
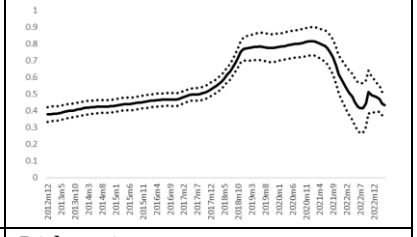
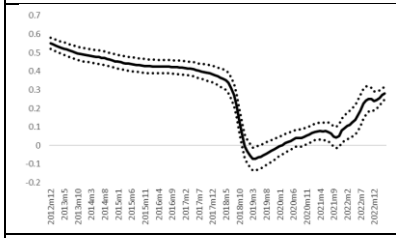
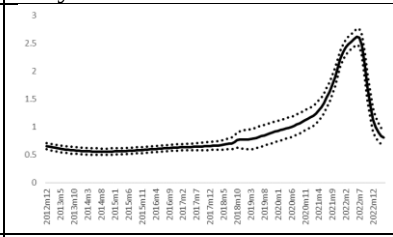
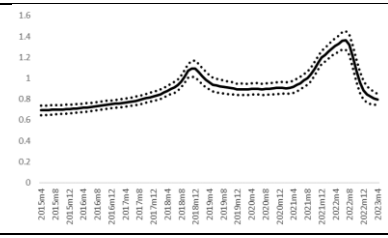
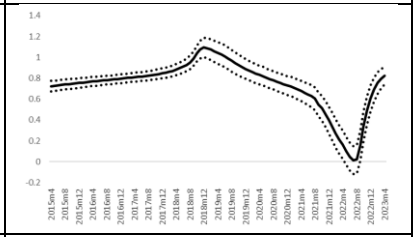
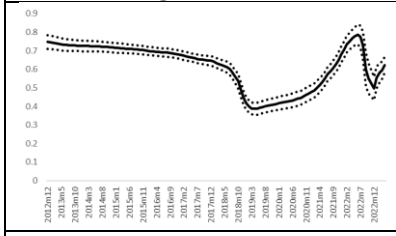
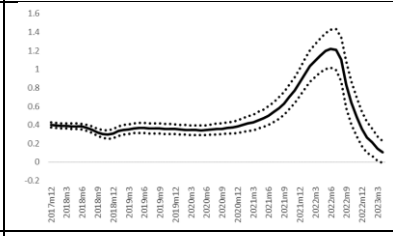
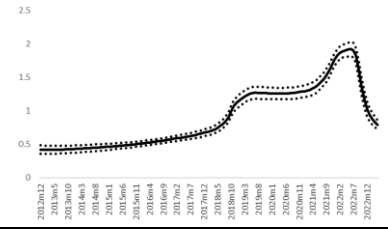
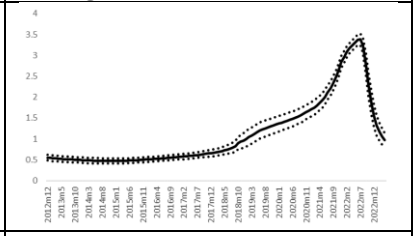
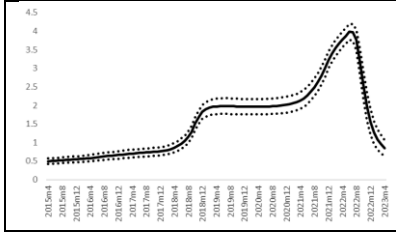
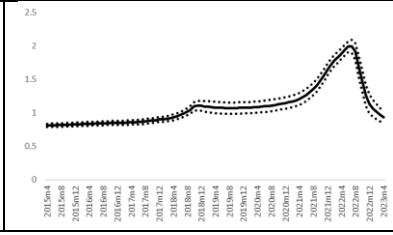
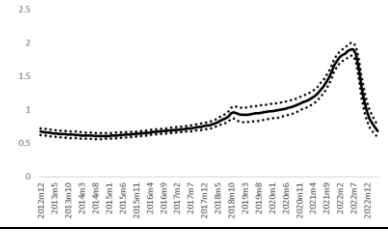
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 2: Pass through for consumption lending rates

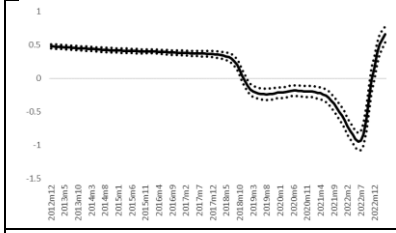
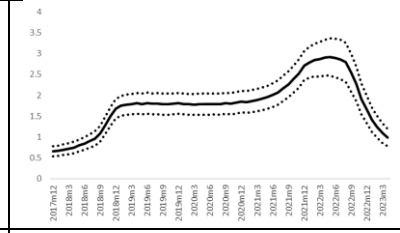
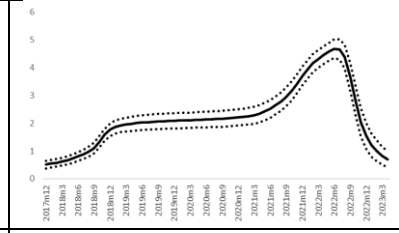
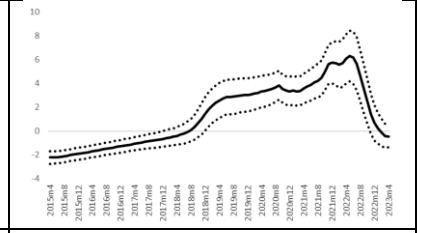
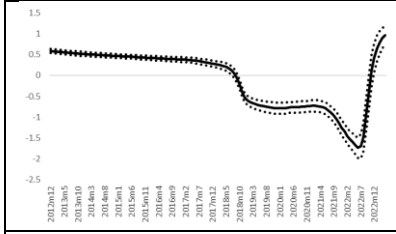
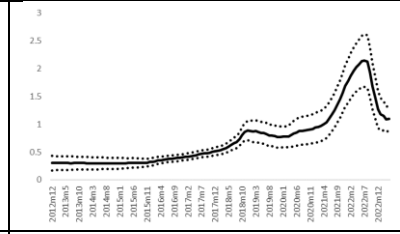
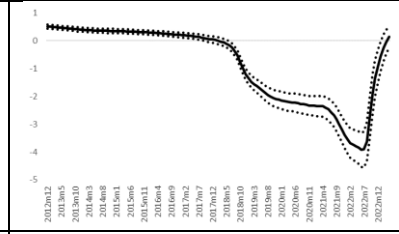
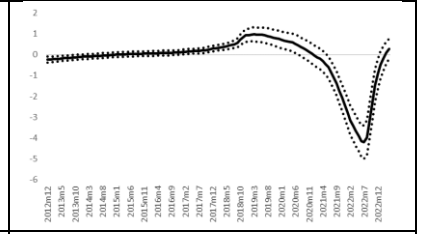
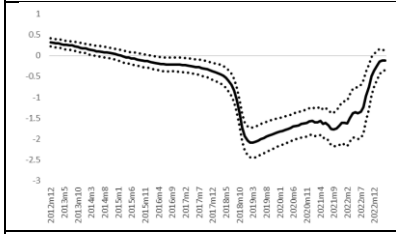
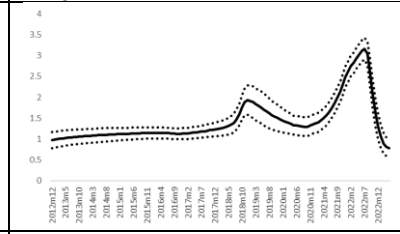
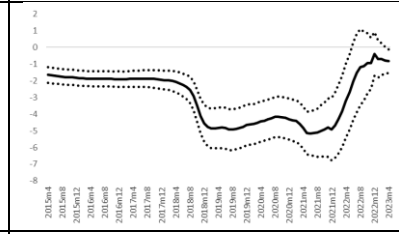
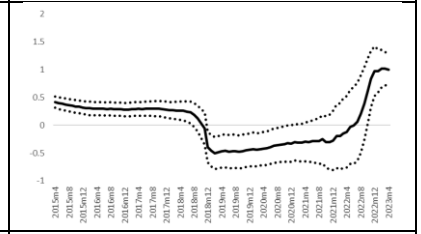
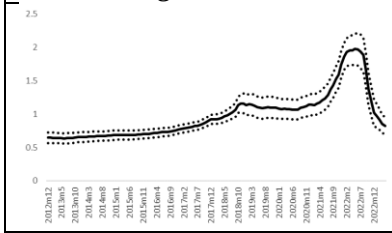
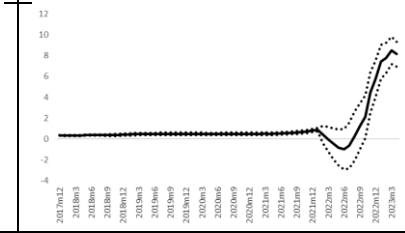
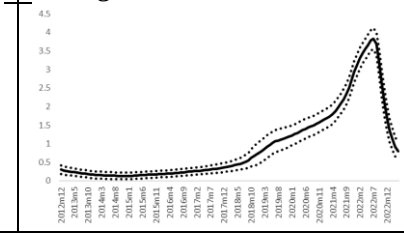
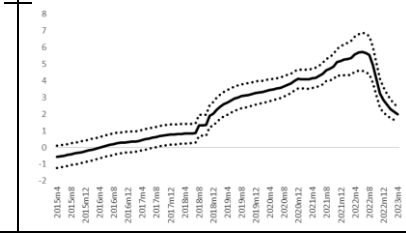
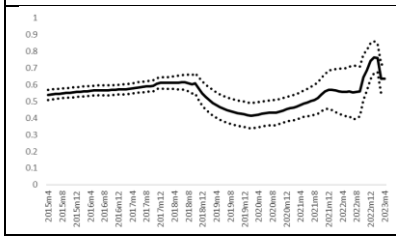
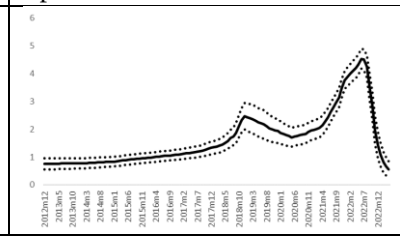
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Portugal**	**Slovakia**
			
Slovenia	**Spain**		
			

Table 3: Pass through for short-run NFC lending rates

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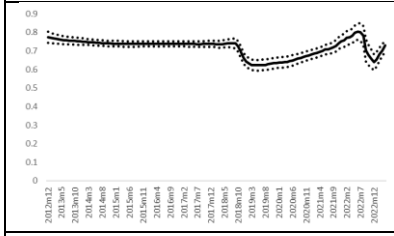
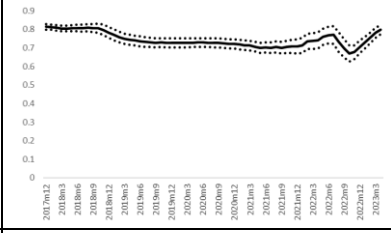
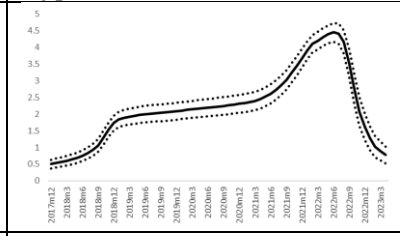
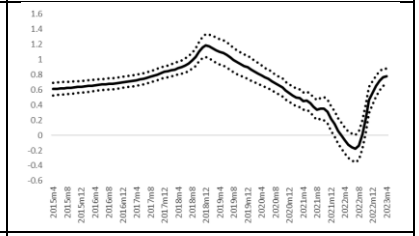
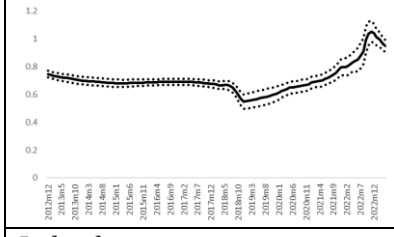
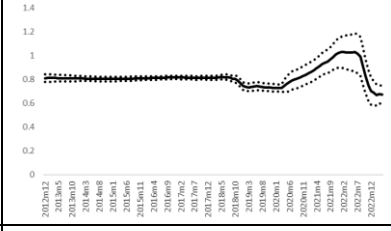
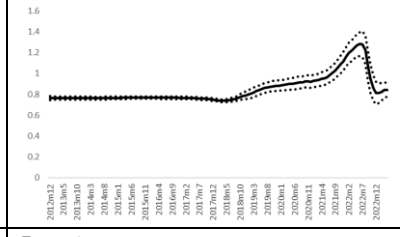
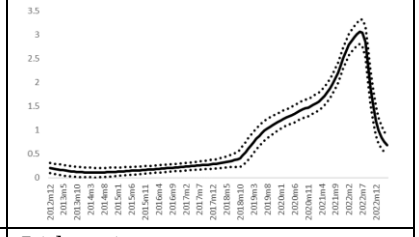
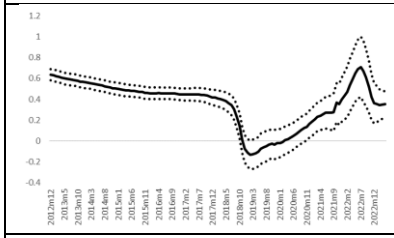
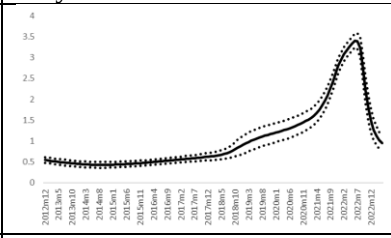
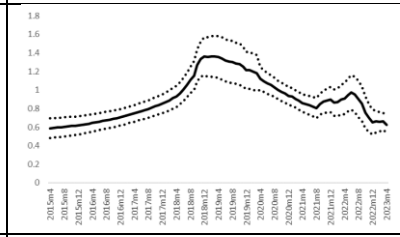
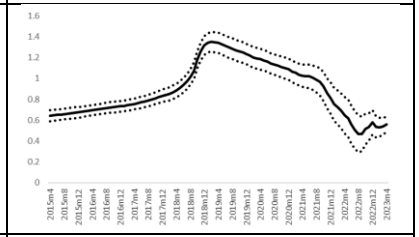
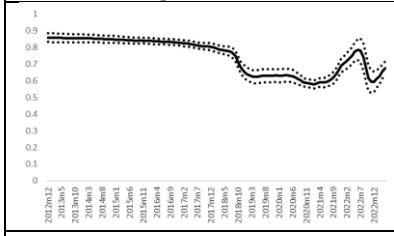
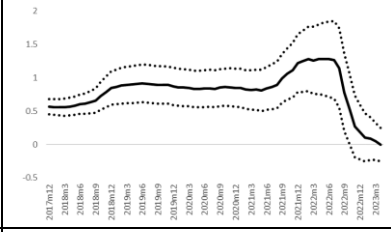
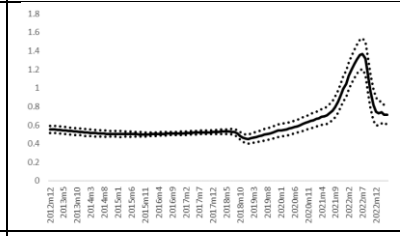
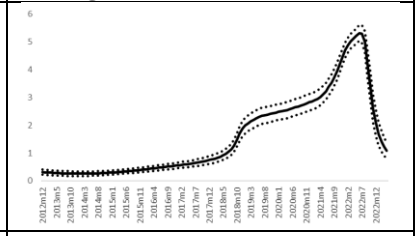
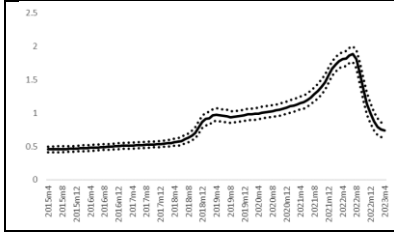
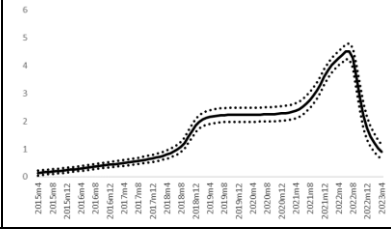
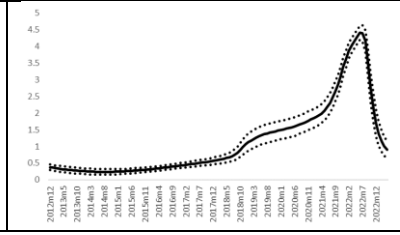
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 4: Pass through for long-run NFC lending rates

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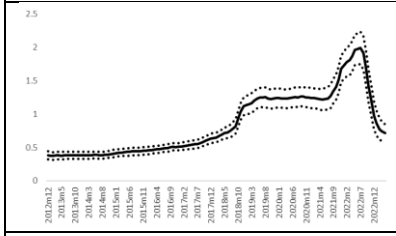
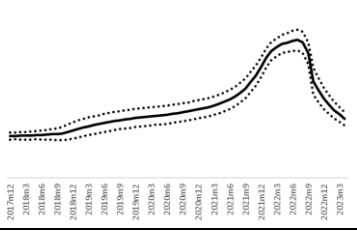
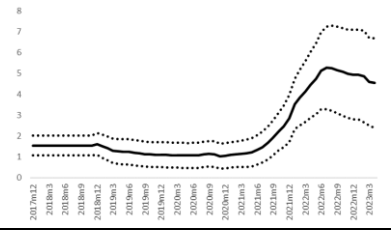
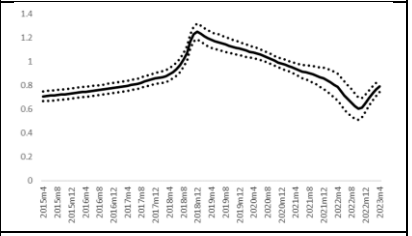
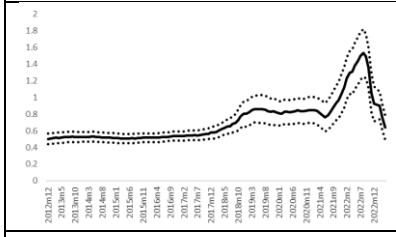
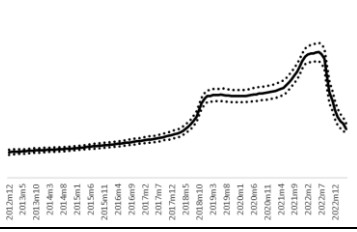
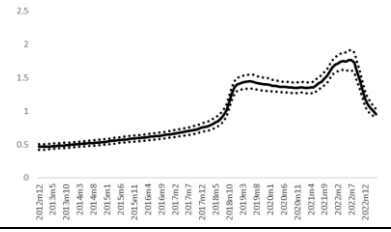
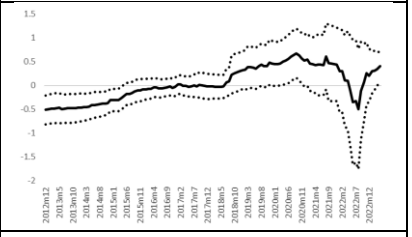
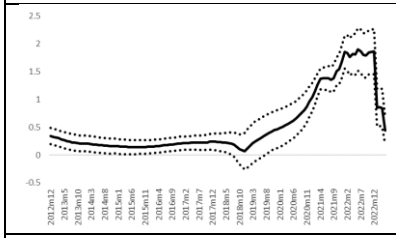
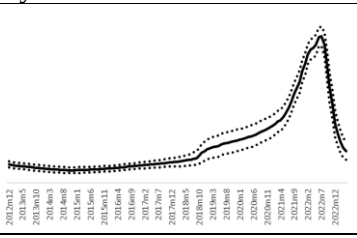
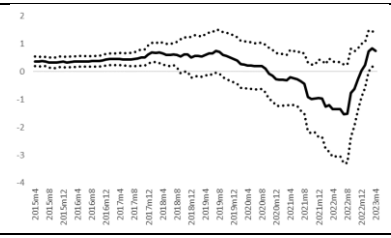
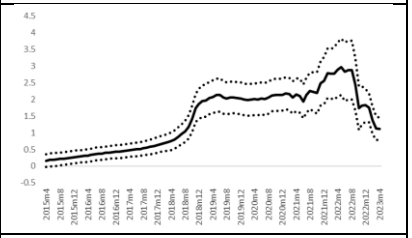
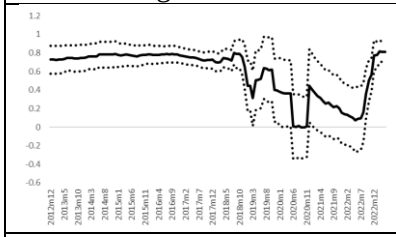
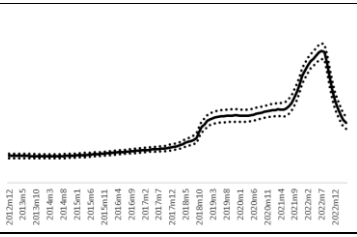
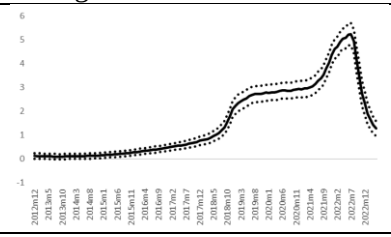
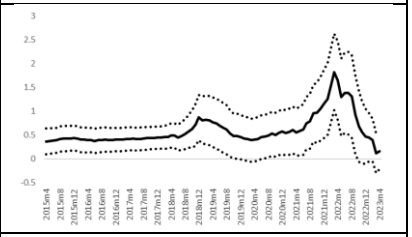
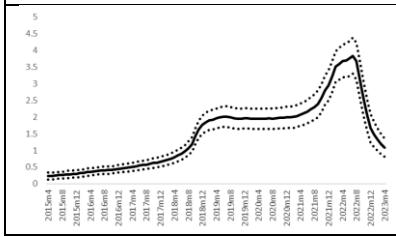
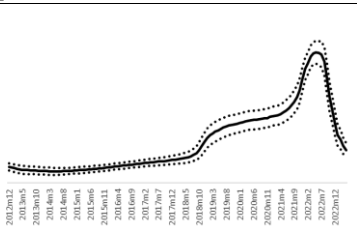
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Netherlands**	**Portugal**	**Slovakia**
			
Slovenia	**Spain**		
			

Table 5: Pass through for households' overnight deposit rate

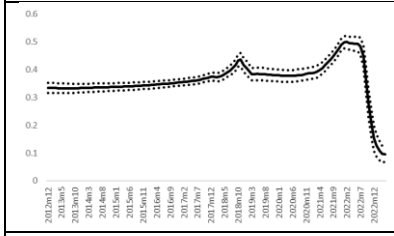
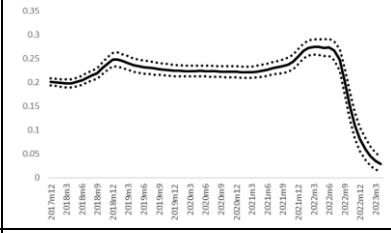
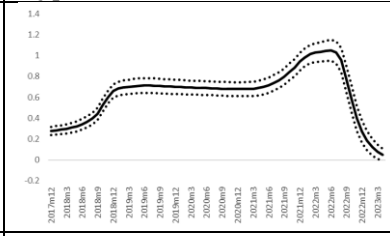
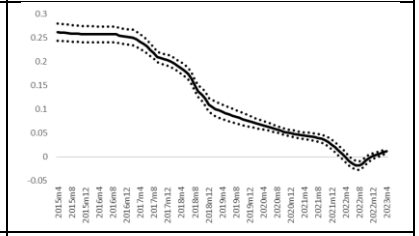
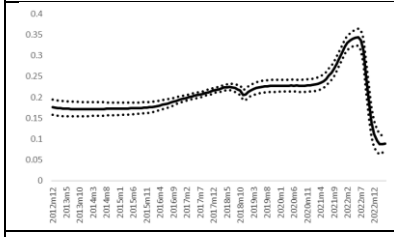
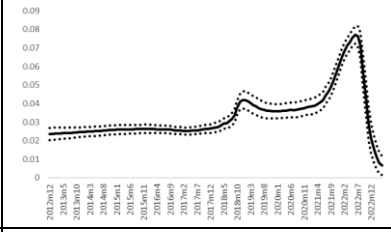
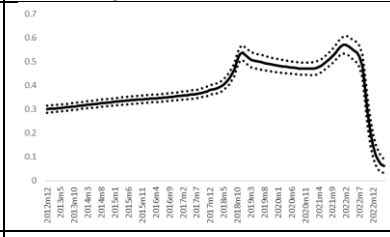
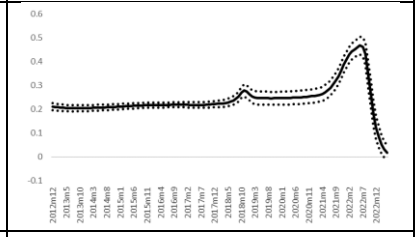
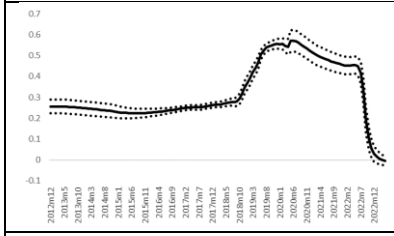
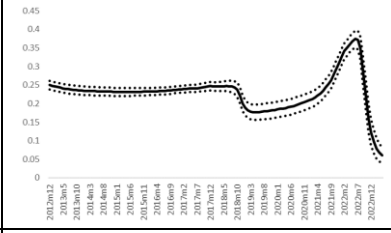
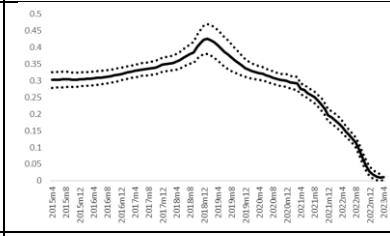
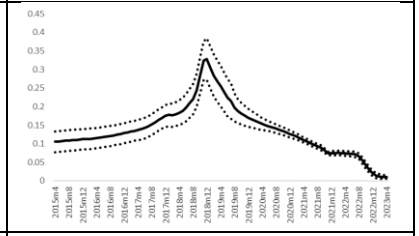
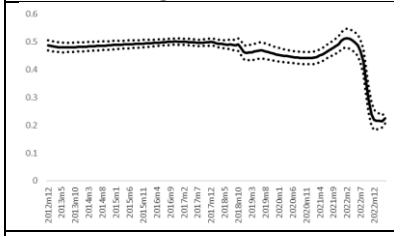
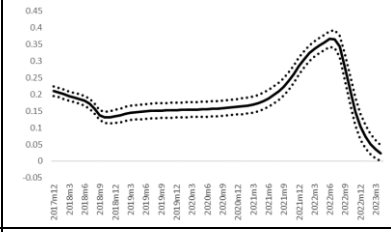
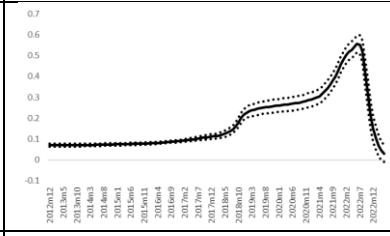
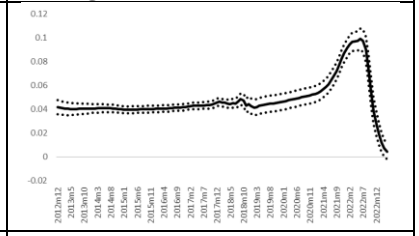
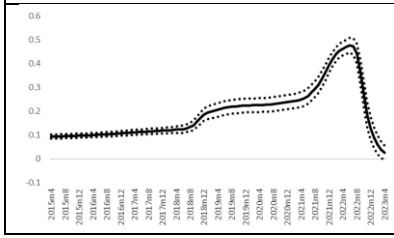
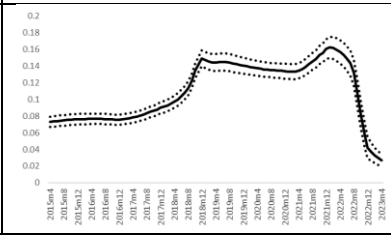
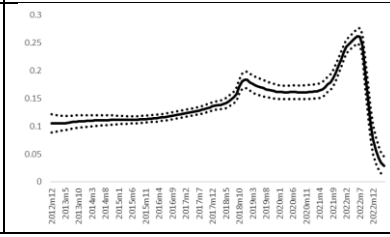
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 6: Pass through for non-financial corporations' overnight deposit rate

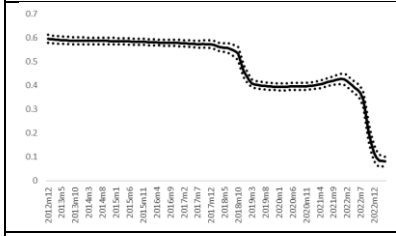
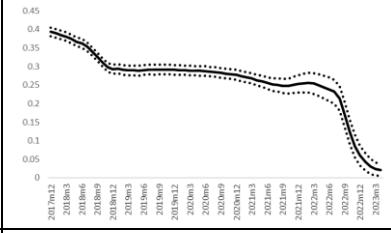
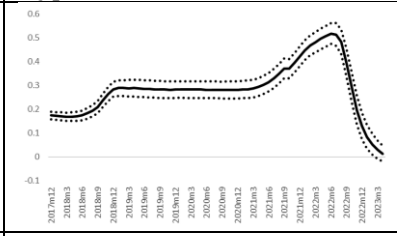
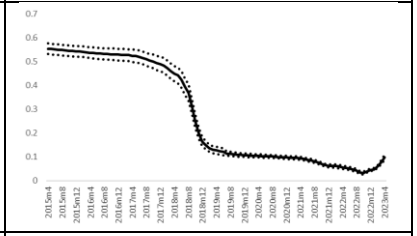
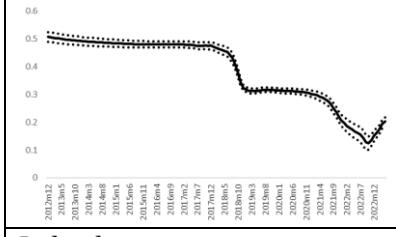
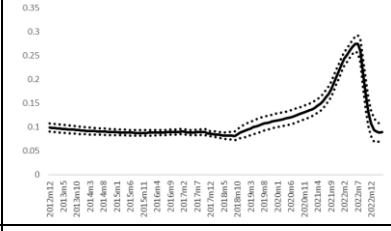
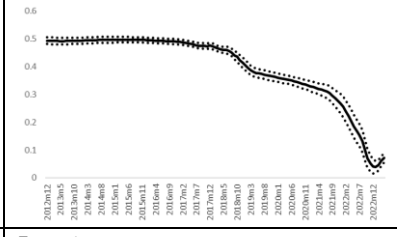
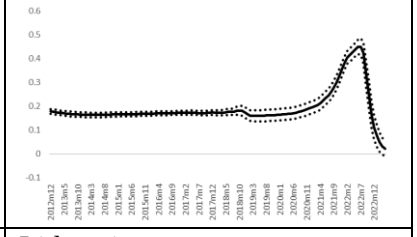
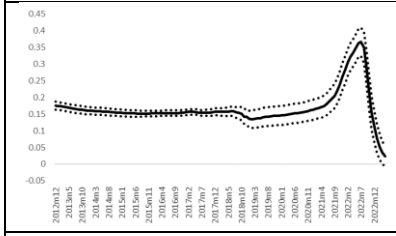
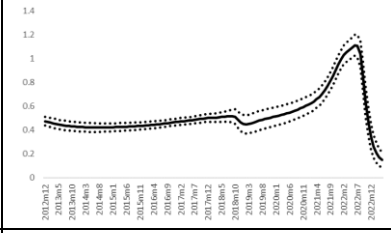
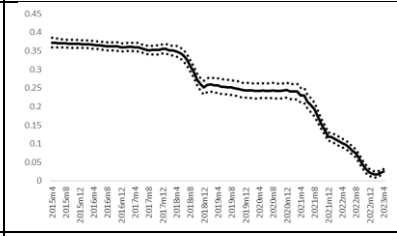
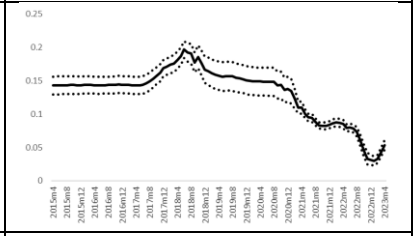
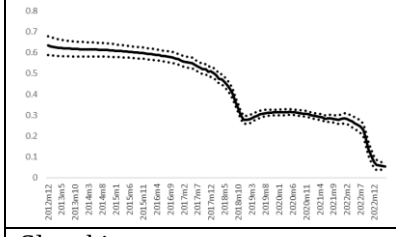
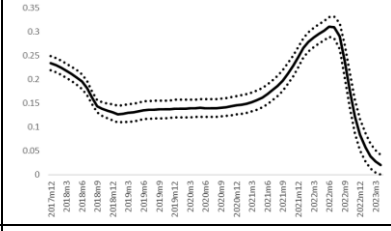
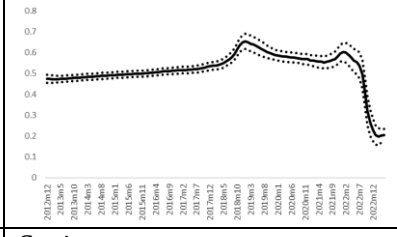
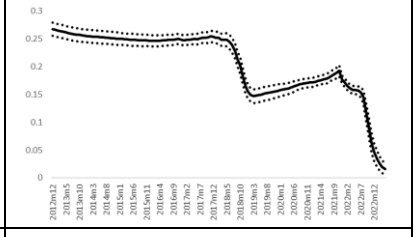
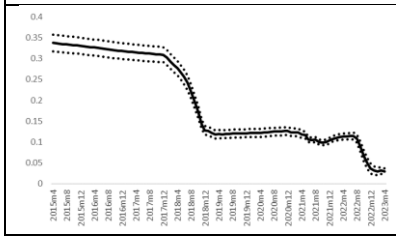
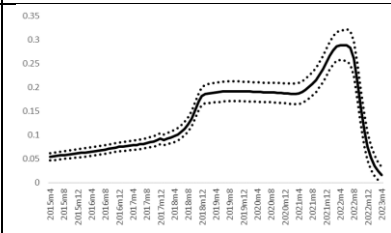
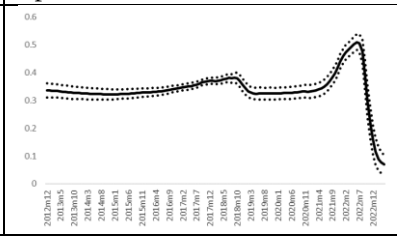
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 7: Pass through for households' deposit rate with maturity up to 1 year

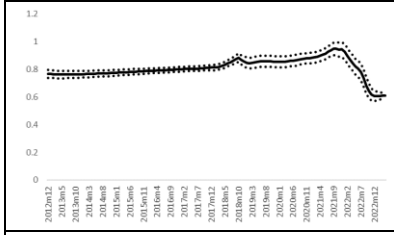
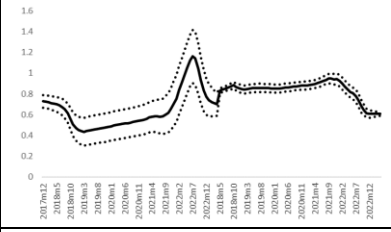
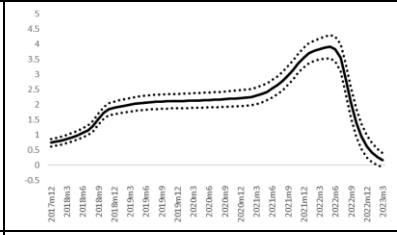
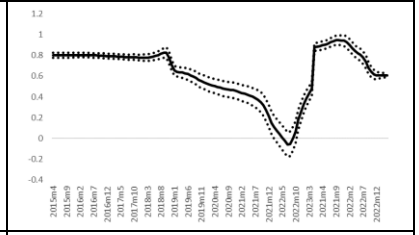
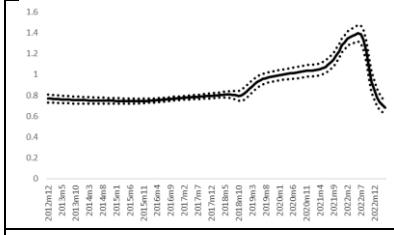
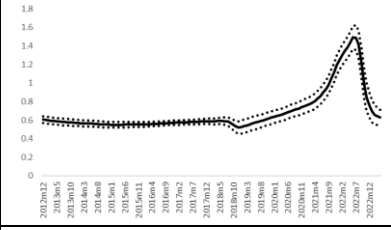
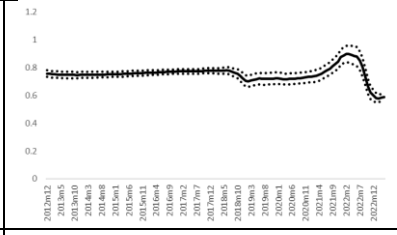
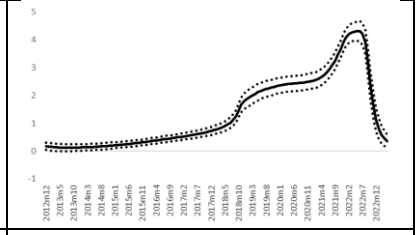
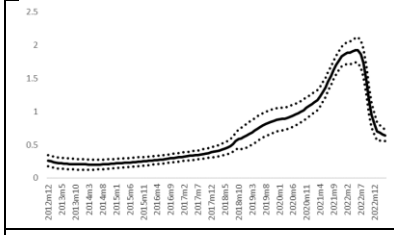
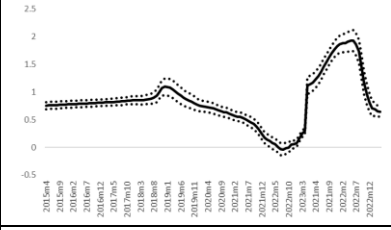
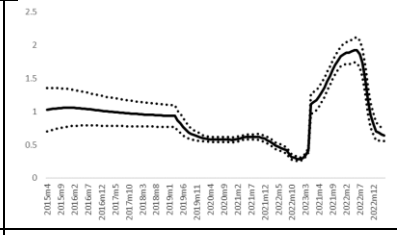
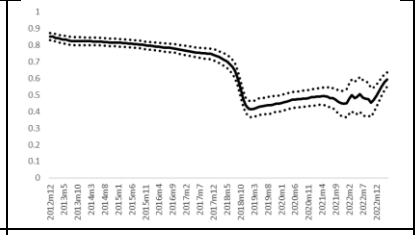
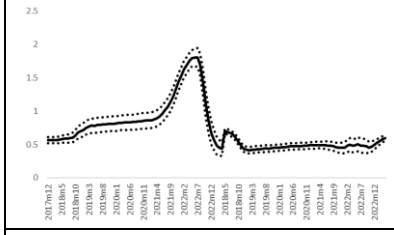
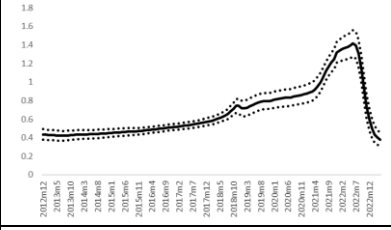
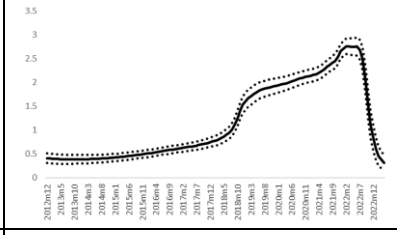
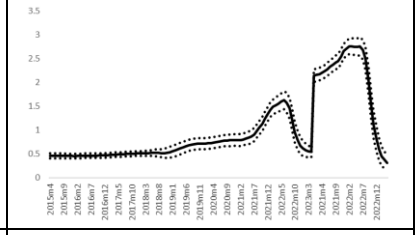
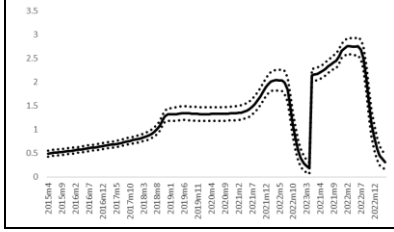
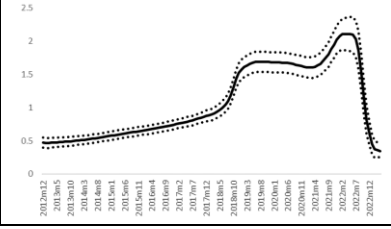
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Italy	**Latvia**	**Lithuania**	**Luxembourg**
			
Malta	**Netherlands**	**Portugal**	**Slovakia**
			
Slovenia	**Spain**		
			

Table 8: Pass through for non-financial corporations' deposit rate with maturity up to 1 year

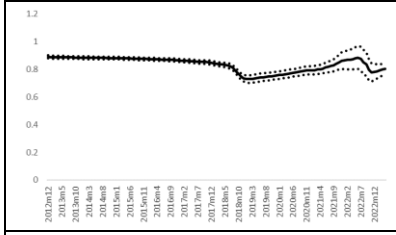
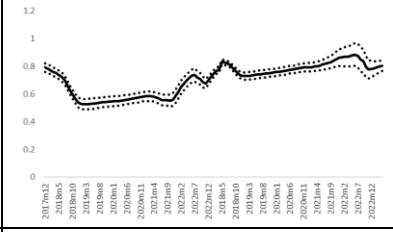
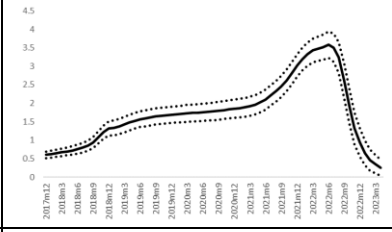
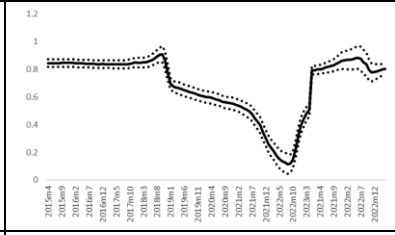
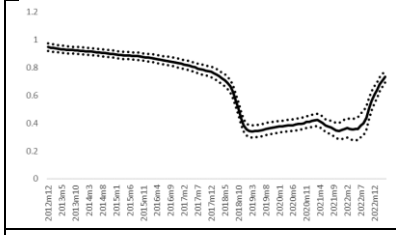
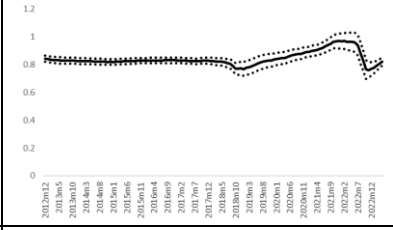
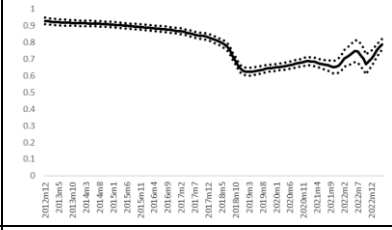
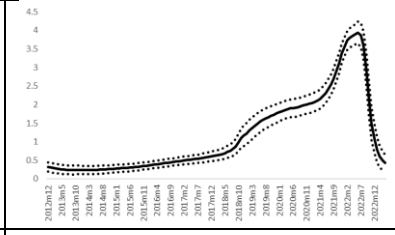
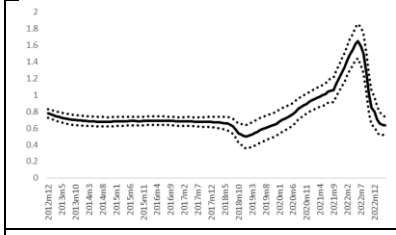
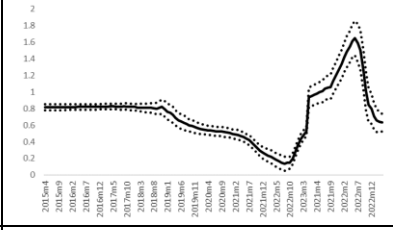
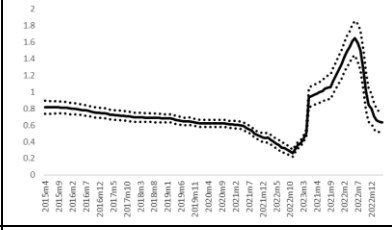
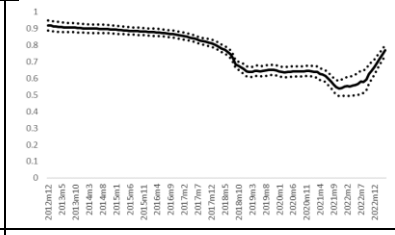
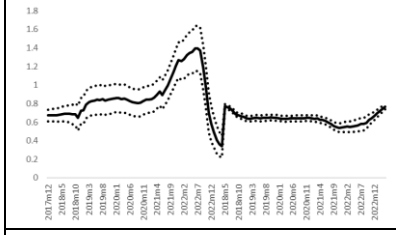
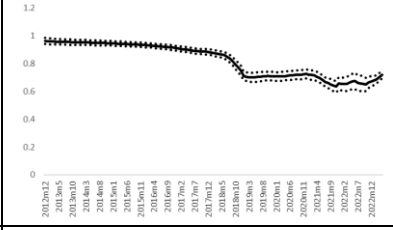
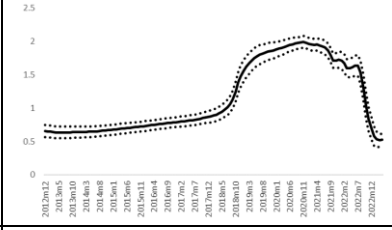
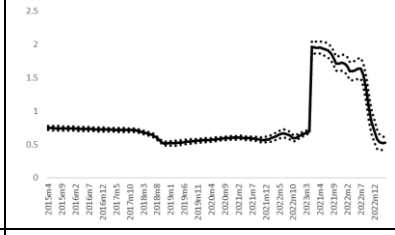
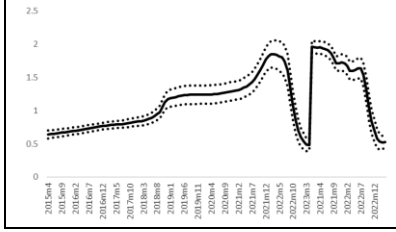
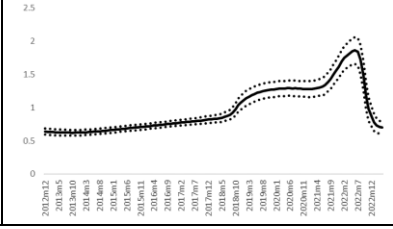
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Italy	**Latvia**	**Lithuania**	**Luxembourg**
			
Malta	**Netherlands**	**Portugal**	**Slovakia**
			
Slovenia	**Spain**		
			

Table 9: Deposits to Loans Beta Ratio

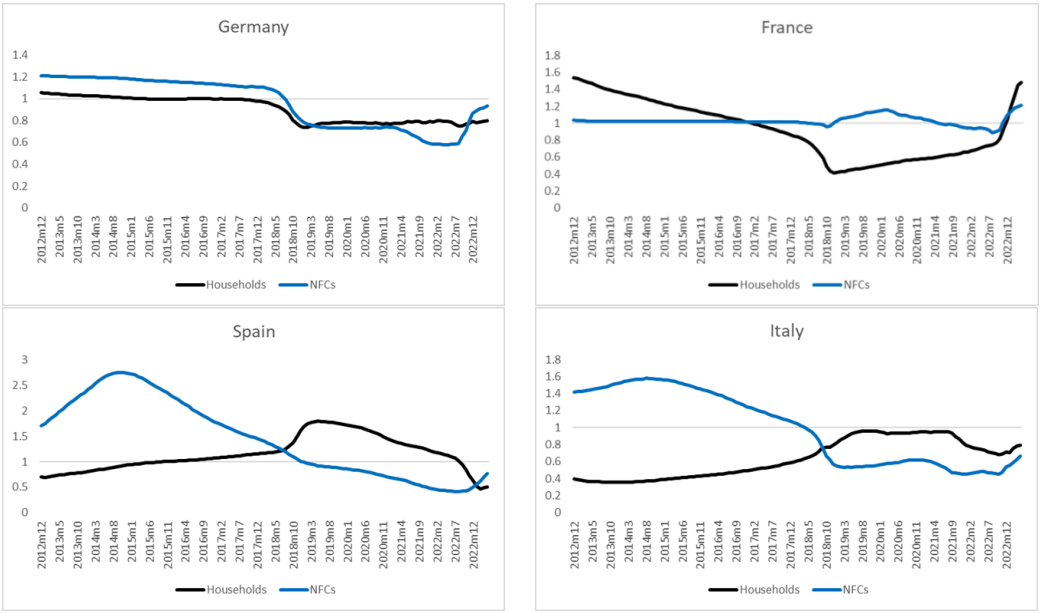
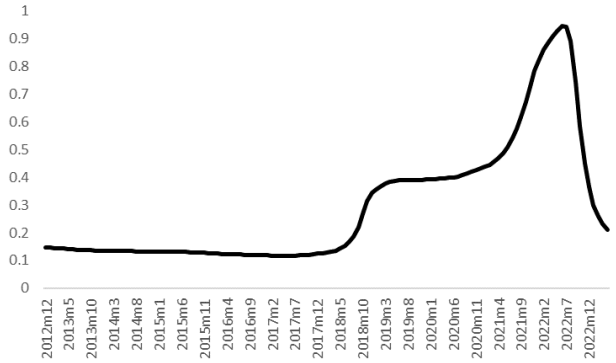
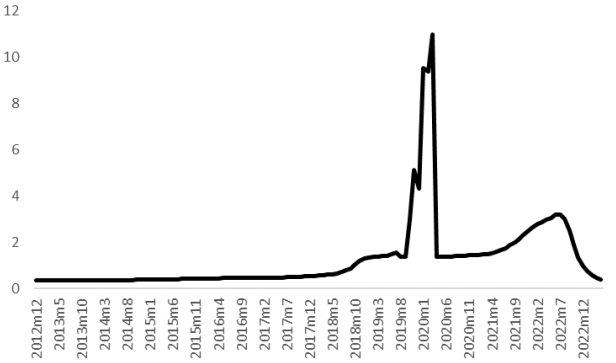


Table 10: Standard deviation of the multipliers

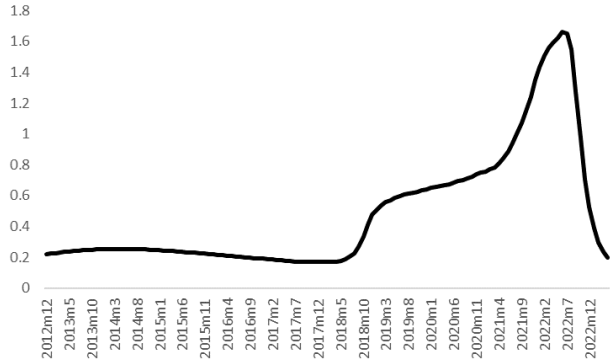
House purchase lending rate



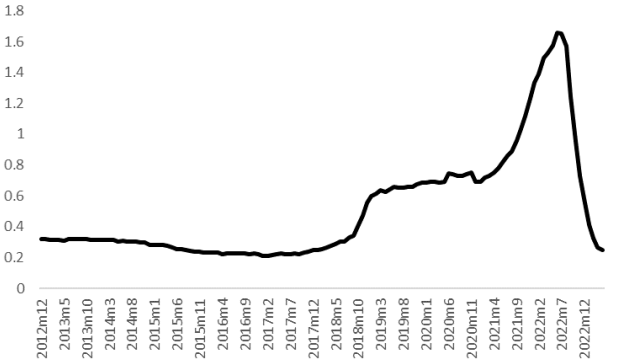
Consumption lending rate



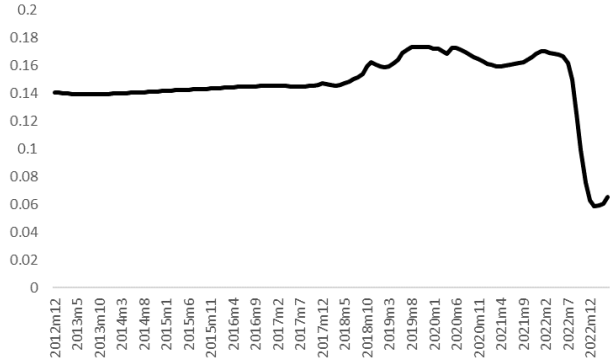
NFCs lending rate with a maturity for up to 1 year



NFCs lending rate with a maturity for over 5 years



Households deposit rate



NFCs deposit rate

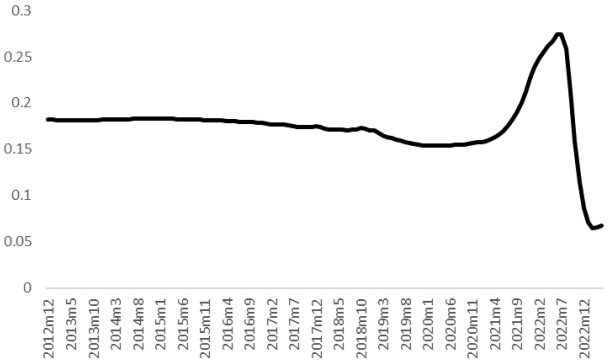


Table 11: Speed of adjustment for house purchase lending rate

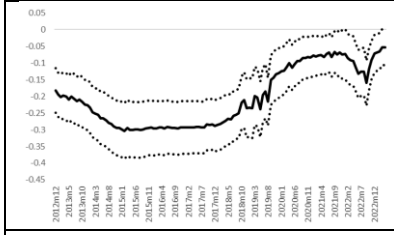
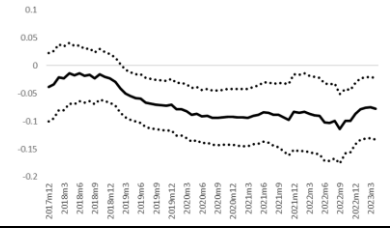
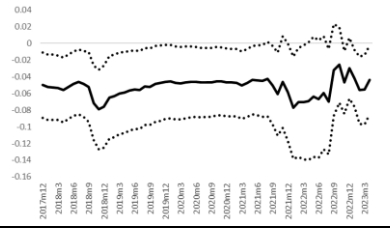
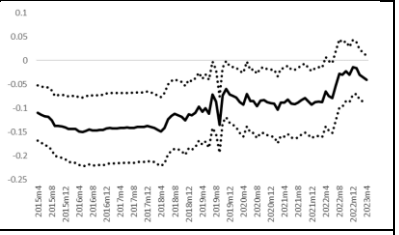
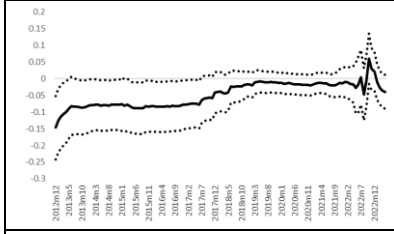
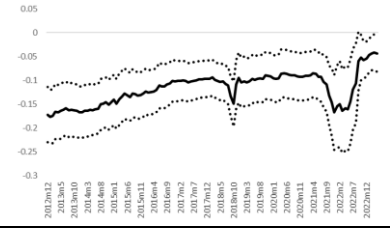
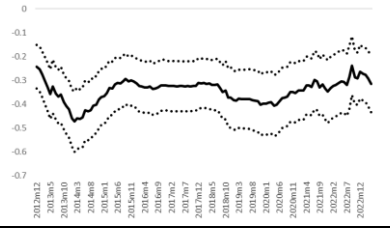
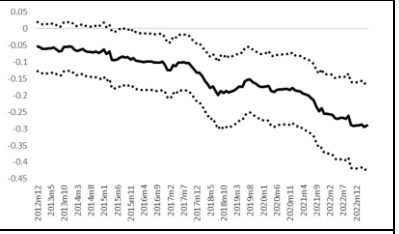
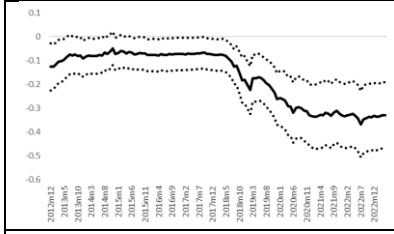
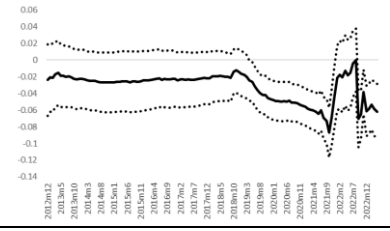
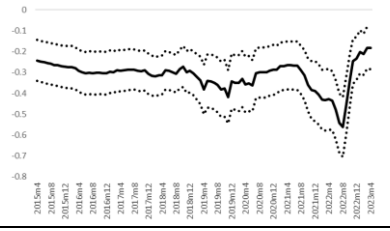
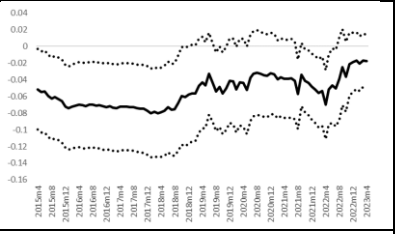
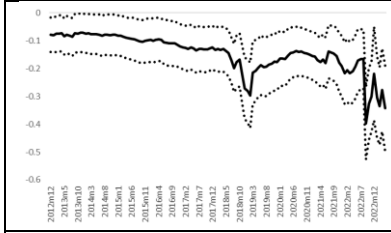
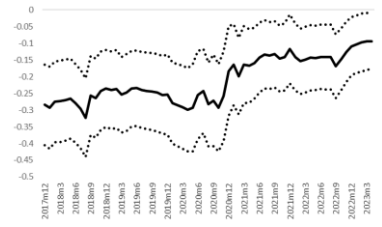
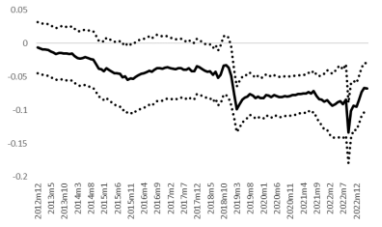
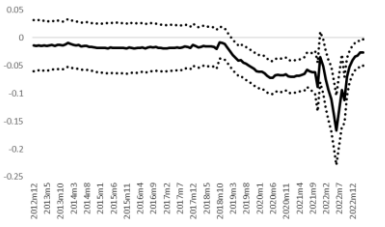
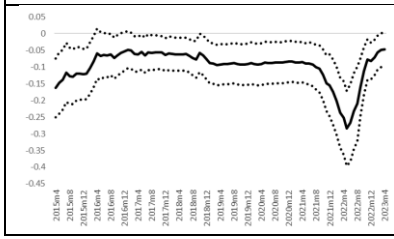
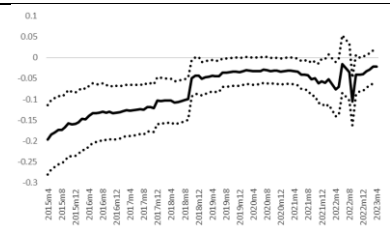
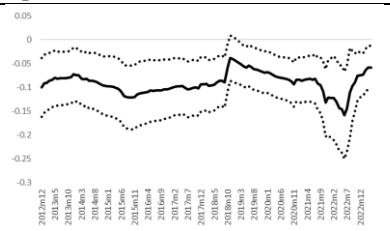
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 12: Speed of adjustment for consumption lending rate

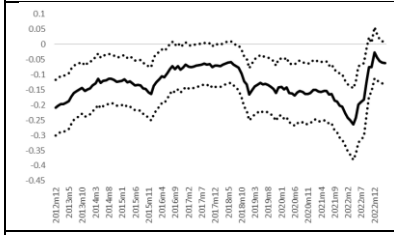
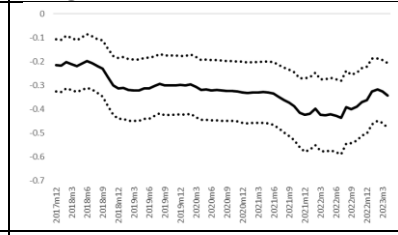
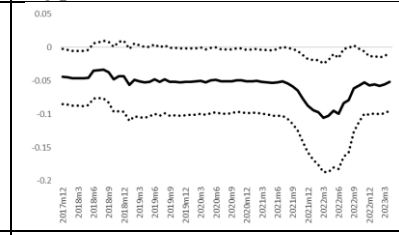
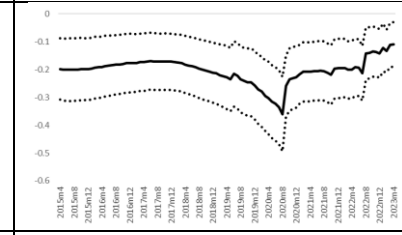
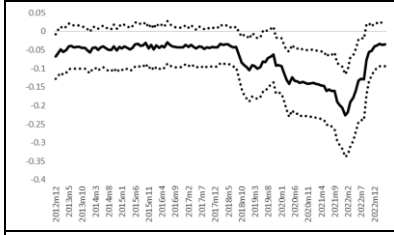
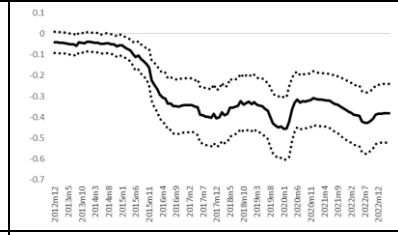
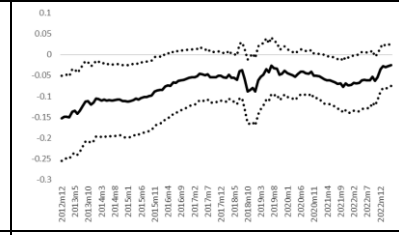
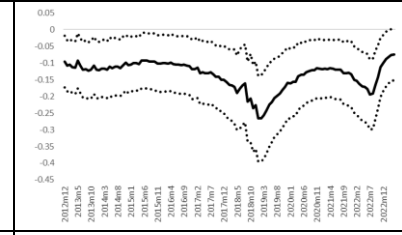
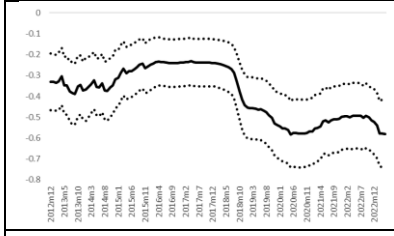
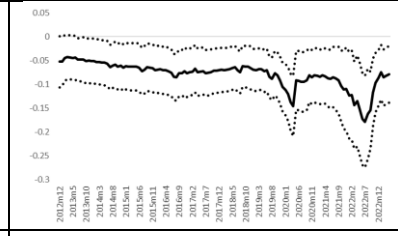
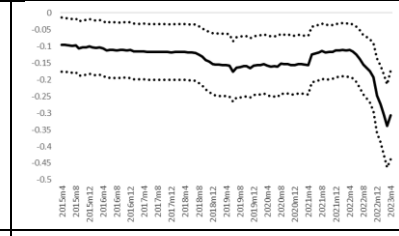
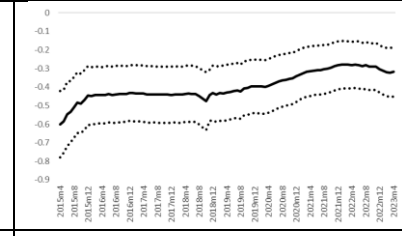
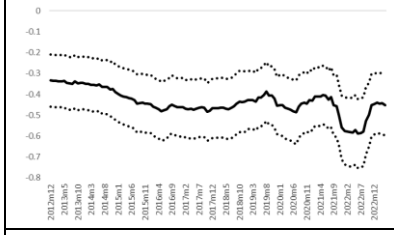
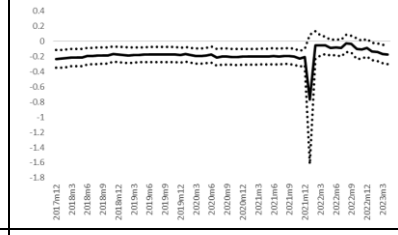
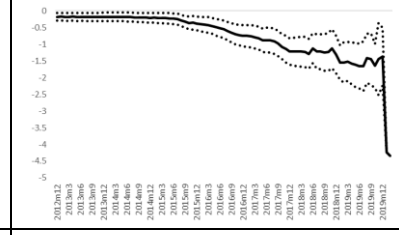
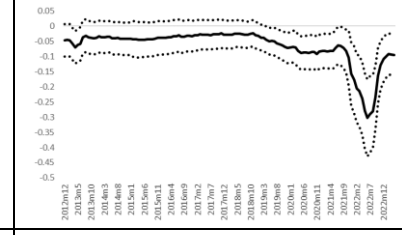
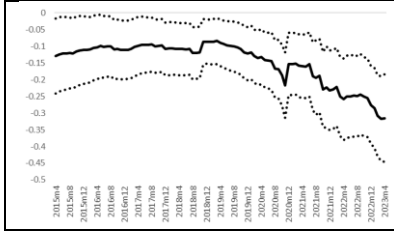
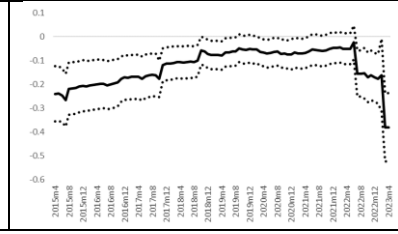
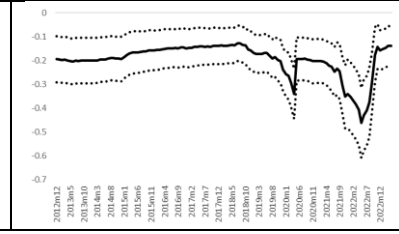
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 13: Speed of adjustment for short-run NFC lending rate

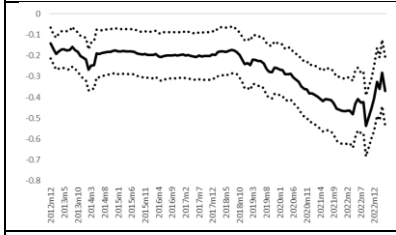
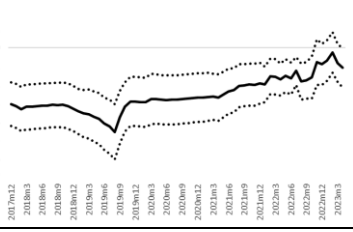
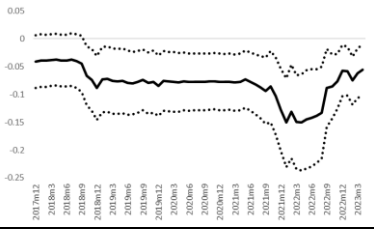
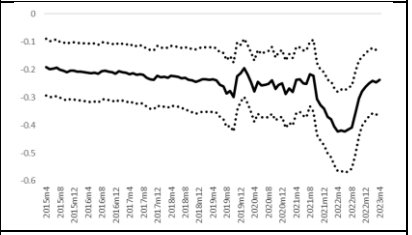
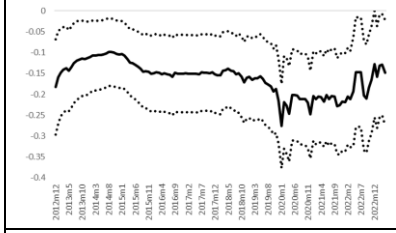
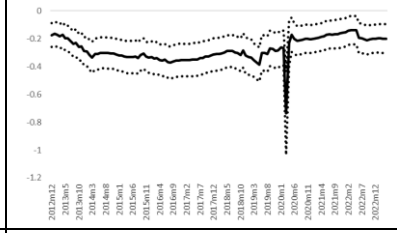
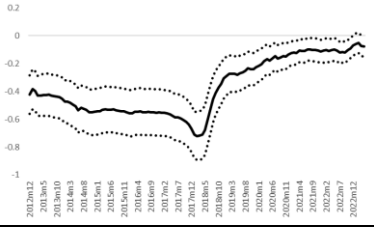
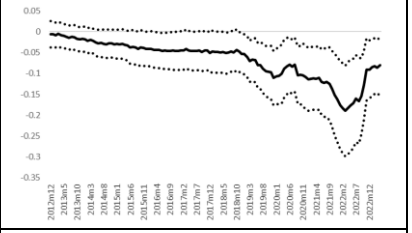
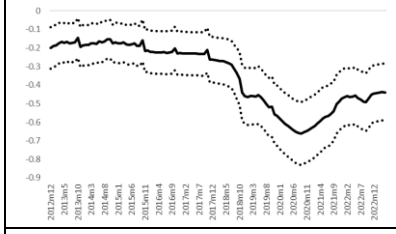
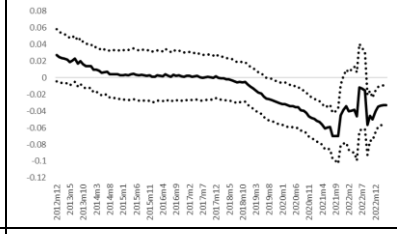
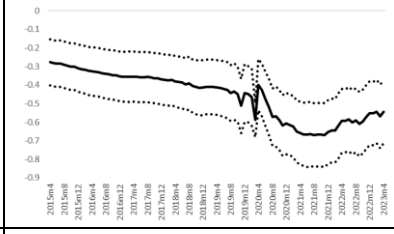
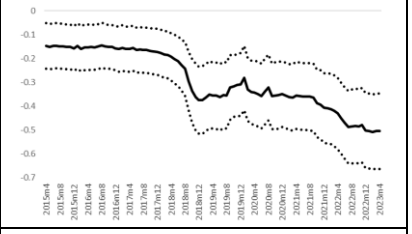
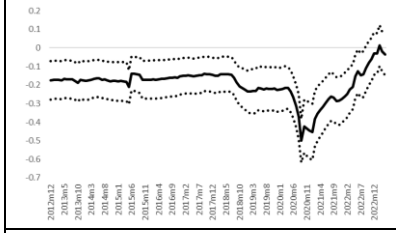
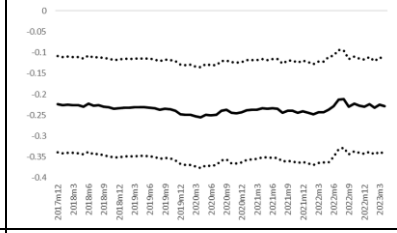
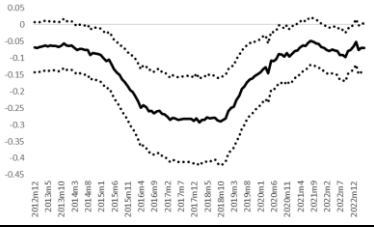
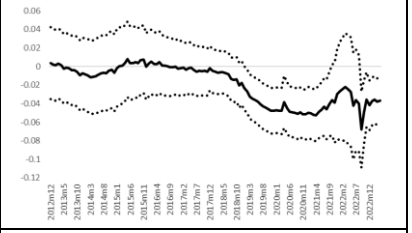
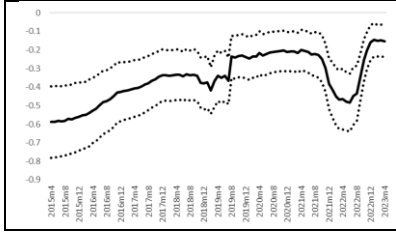
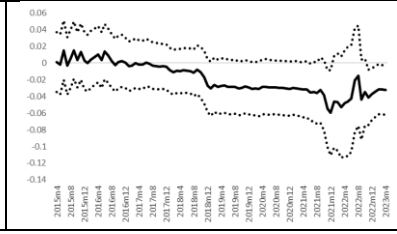
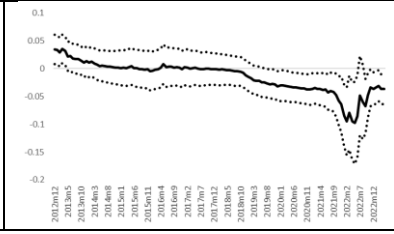
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 14: Speed of adjustment for long-run NFC lending rate

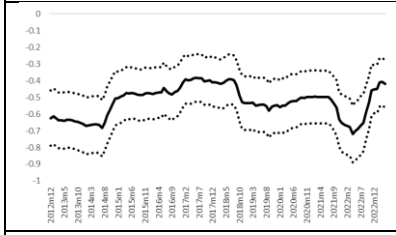
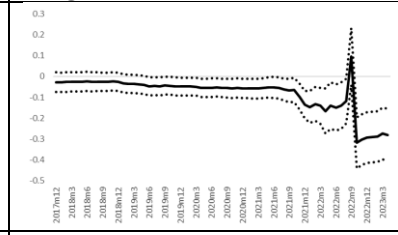
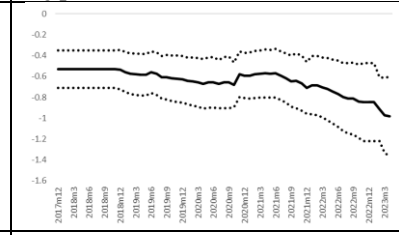
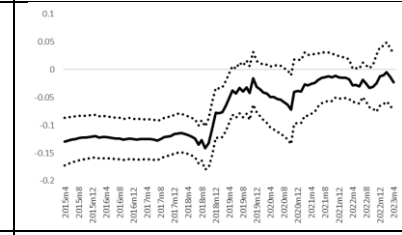
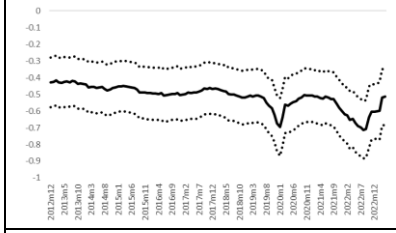
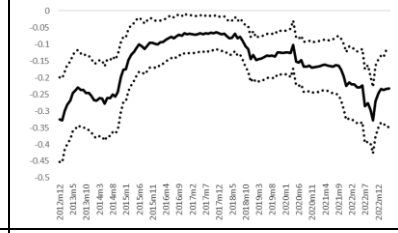
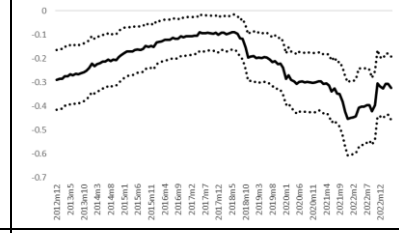
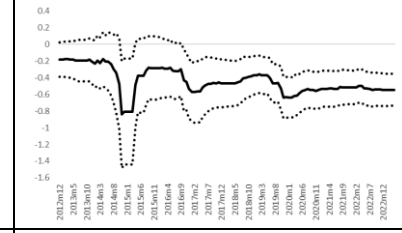
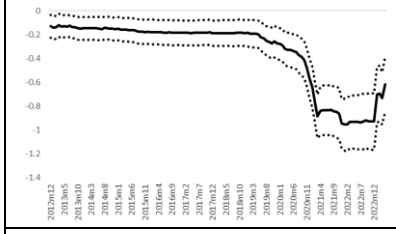
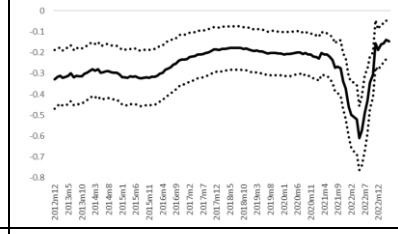
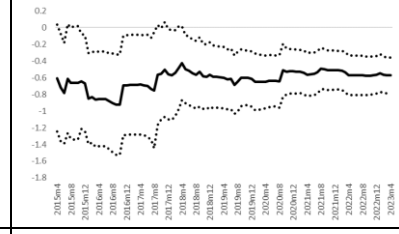
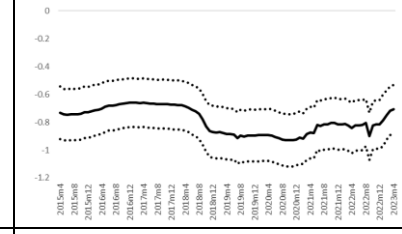
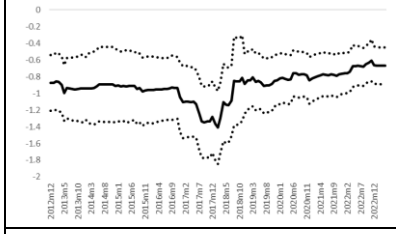
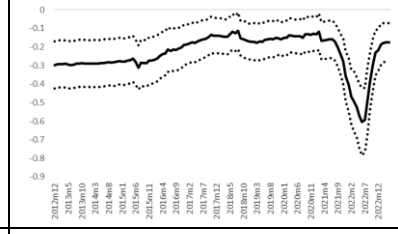
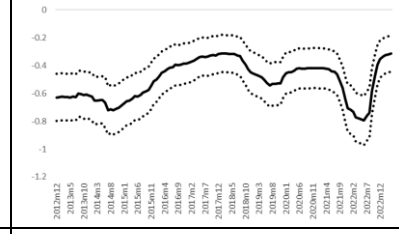
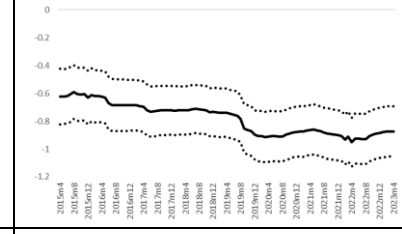
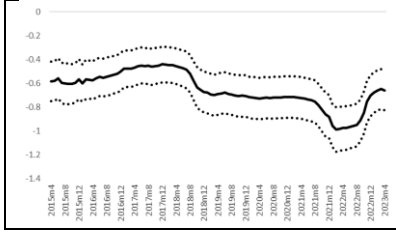
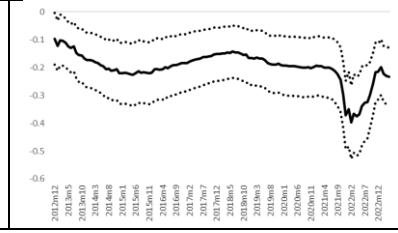
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Netherlands**	**Portugal**	**Slovakia**
			
Slovenia	**Spain**		
			

Table 15: Speed of adjustment for households' deposit rate

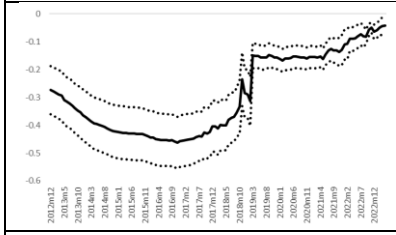
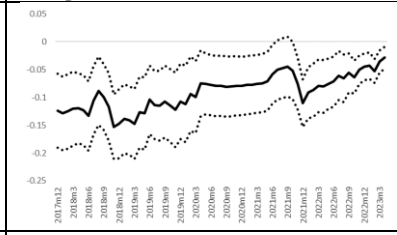
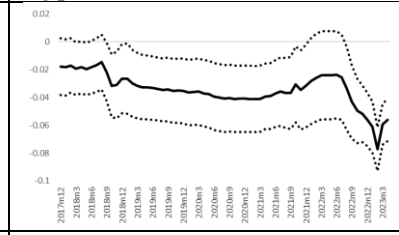
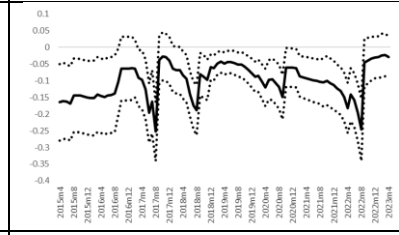
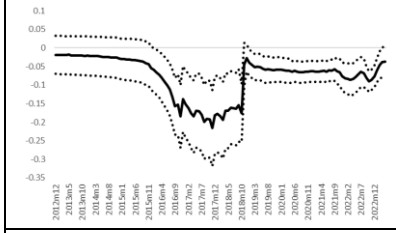
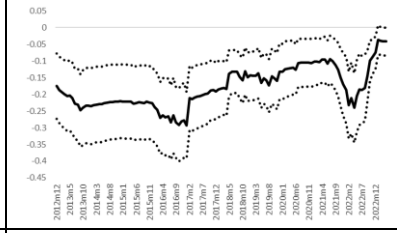
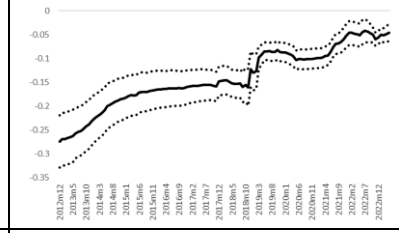
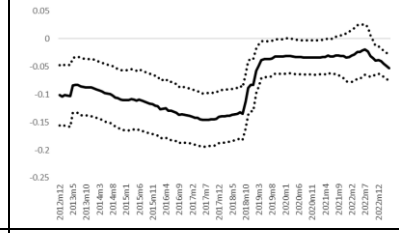
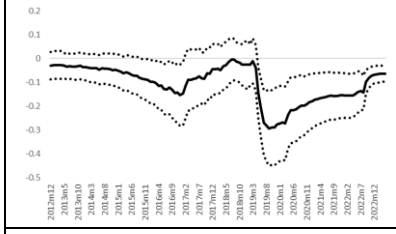
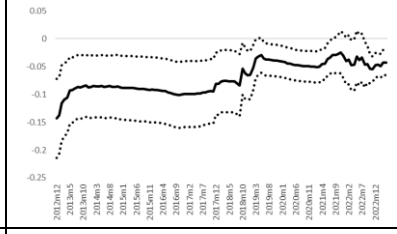
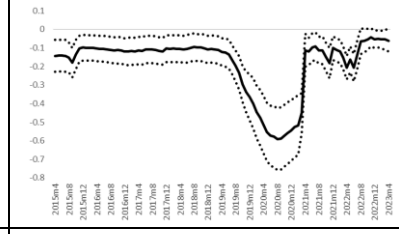
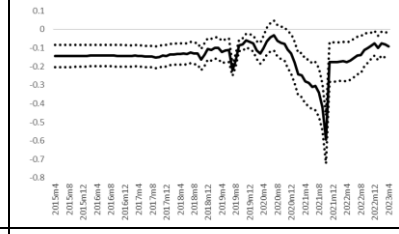
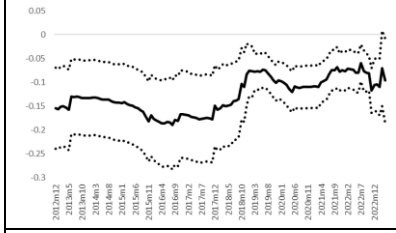
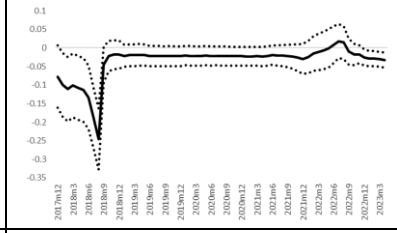
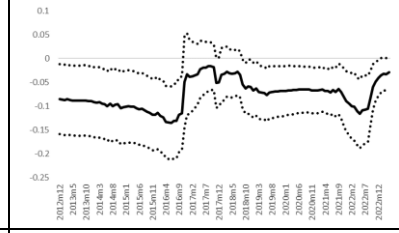
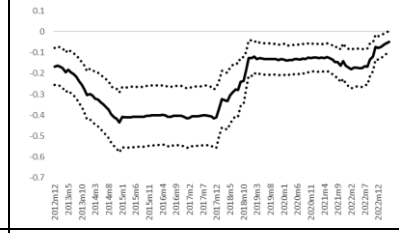
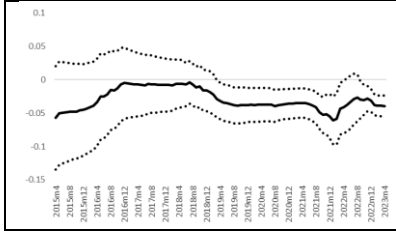
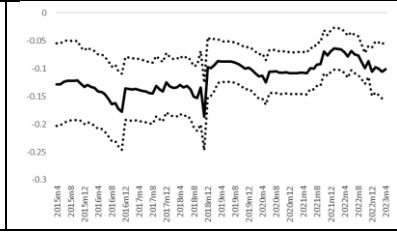
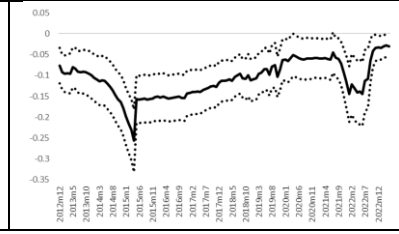
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 16: Speed of adjustment for non-financial corporations' deposit rate

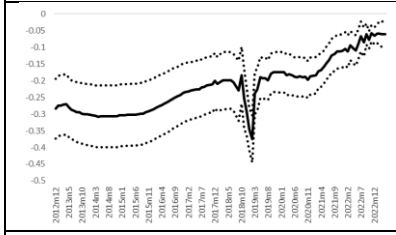
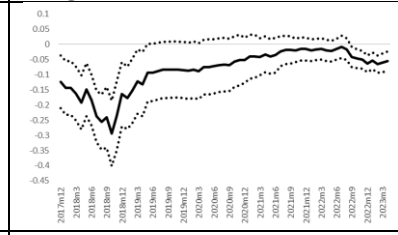
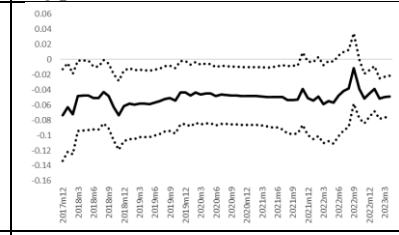
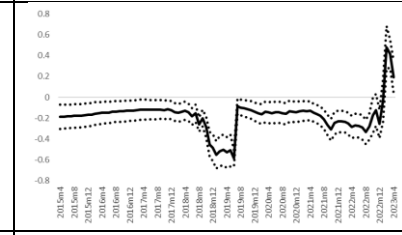
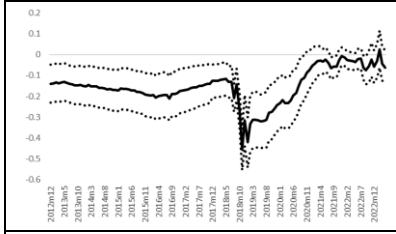
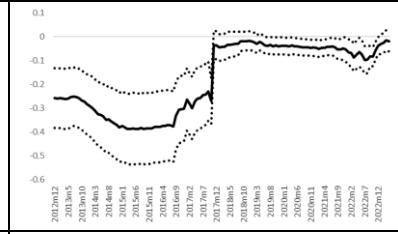
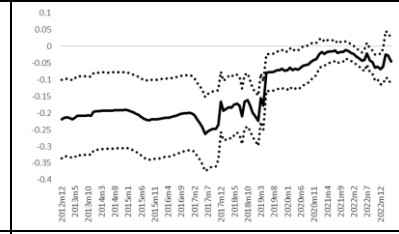
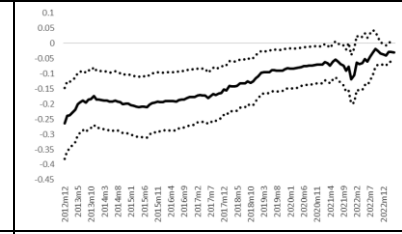
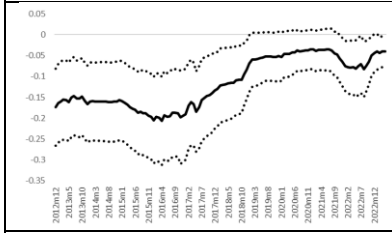
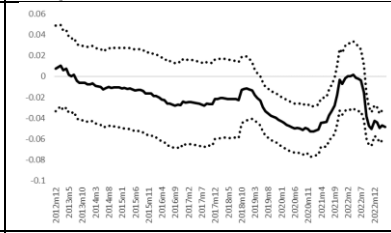
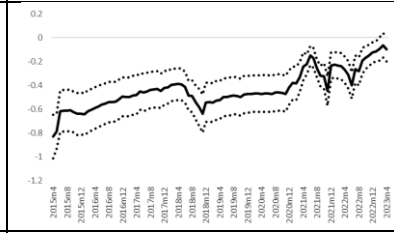
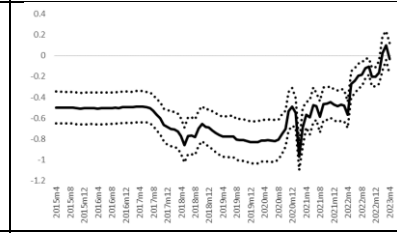
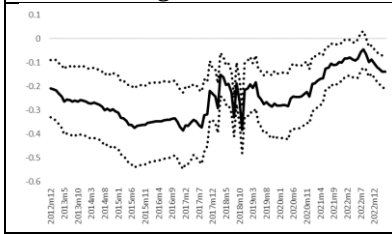
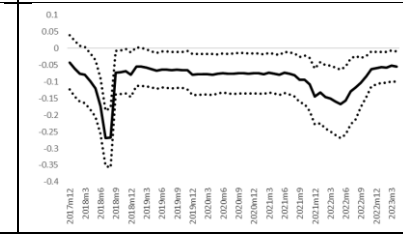
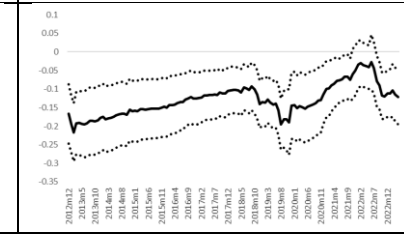
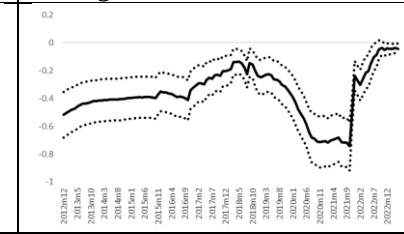
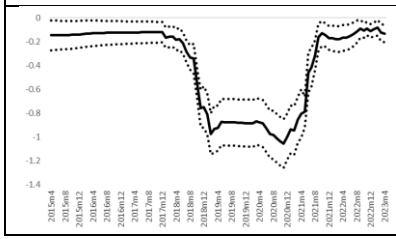
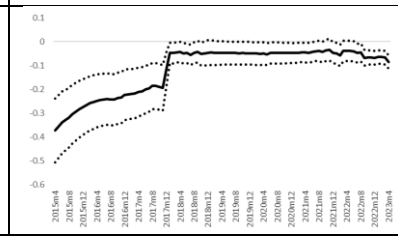
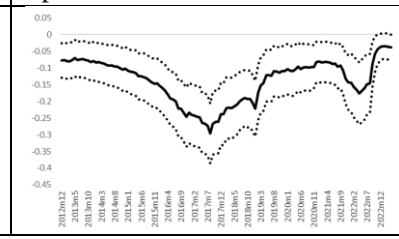
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 17: Speed of adjustment for households' deposit rate with maturity up to 1 year

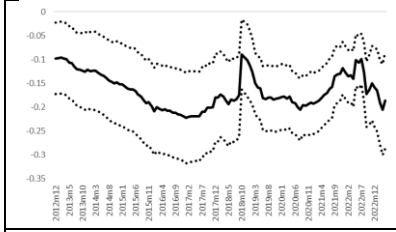
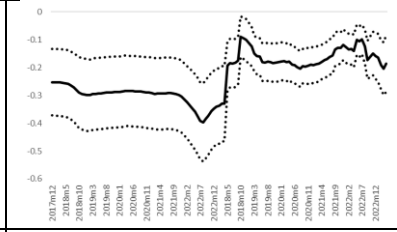
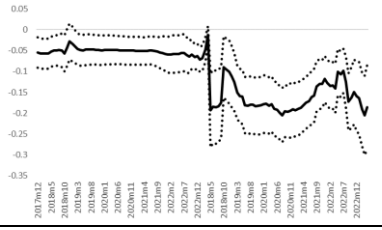
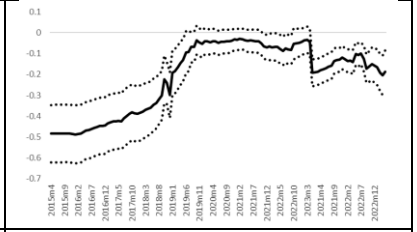
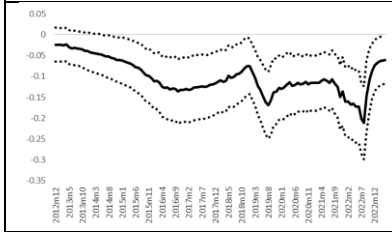
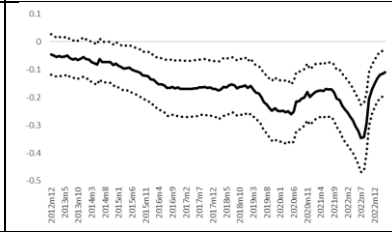
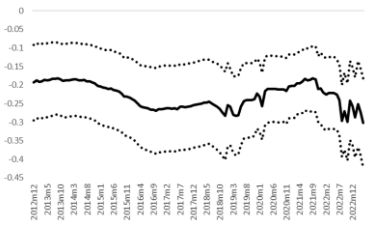
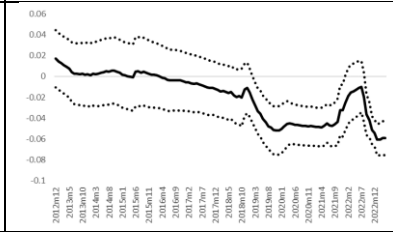
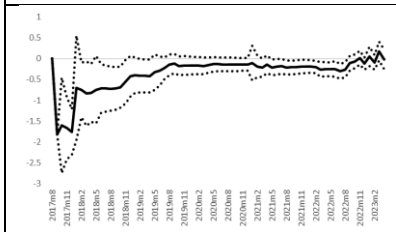
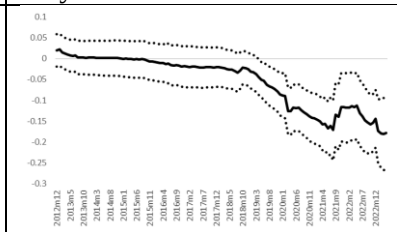
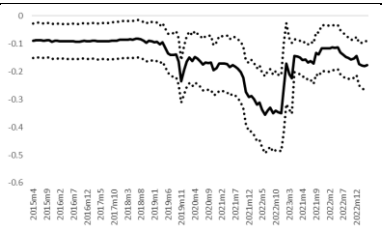
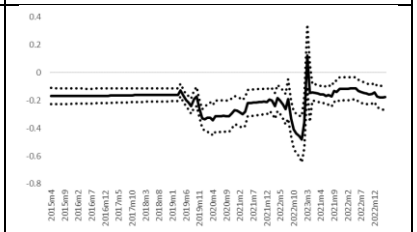
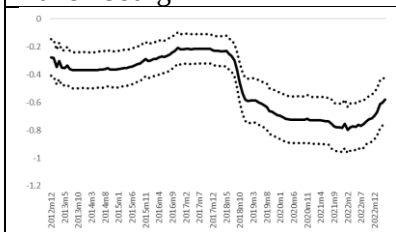
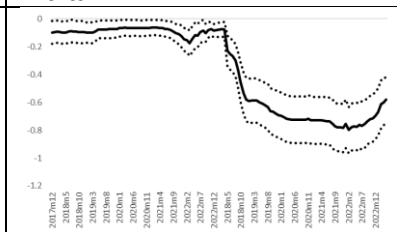
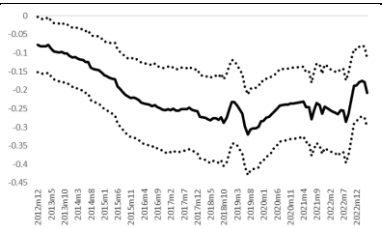
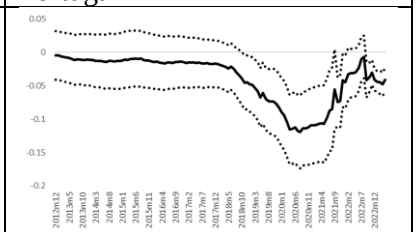
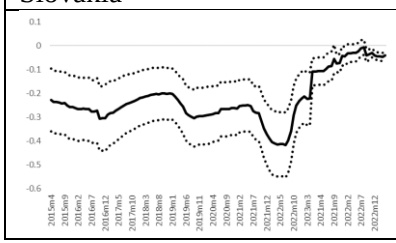
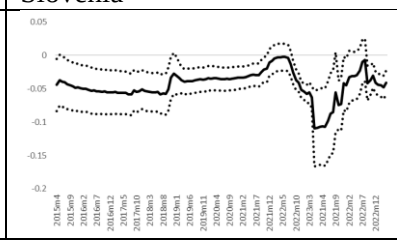
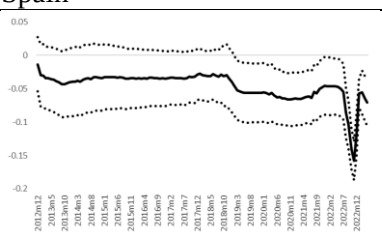
Austria	Belgium	Cyprus	Estonia
			
Finland	**France**	**Germany**	**Greece**
			
Ireland	**Italy**	**Latvia**	**Lithuania**
			
Luxembourg	**Malta**	**Netherlands**	**Portugal**
			
Slovakia	**Slovenia**	**Spain**	
			

Table 18: Speed of adjustment for non-financial corporations' deposit rate with maturity up to 1 year

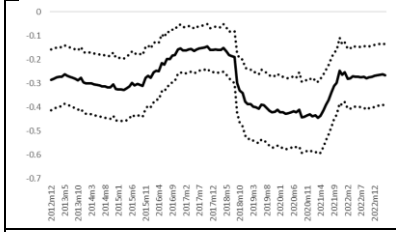
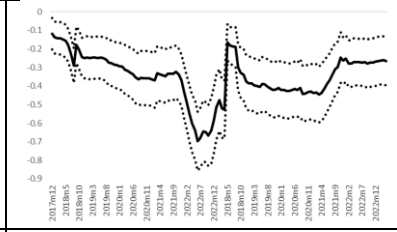
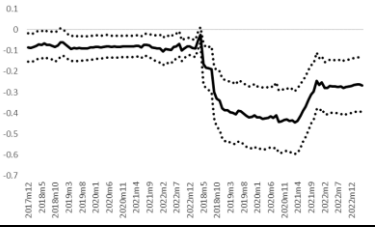
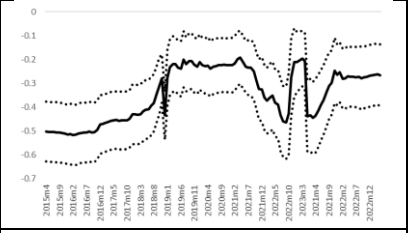
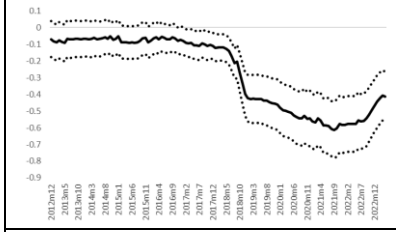
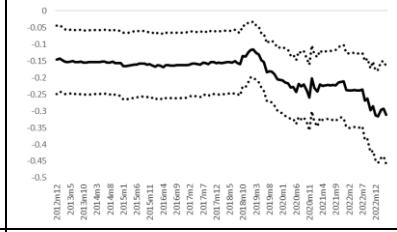
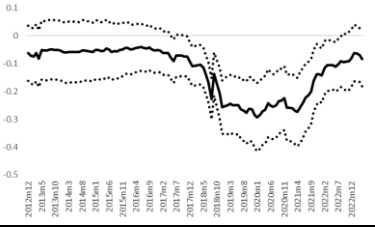
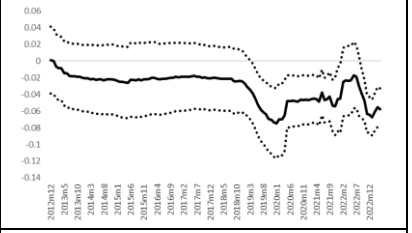
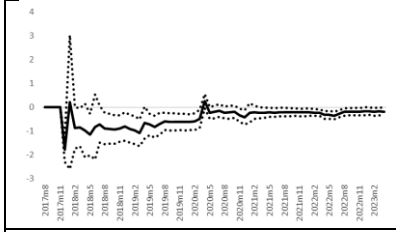
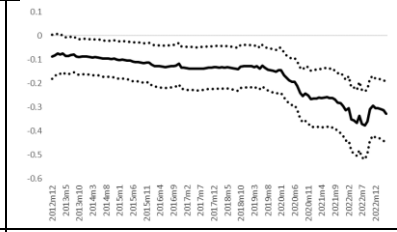
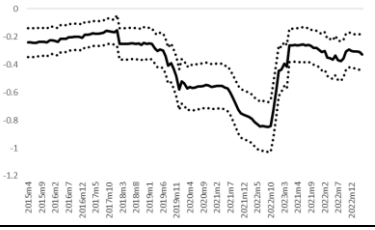
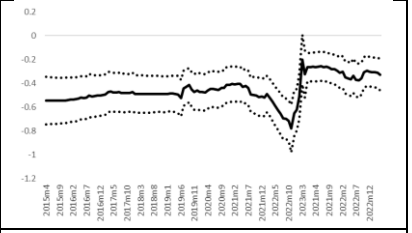
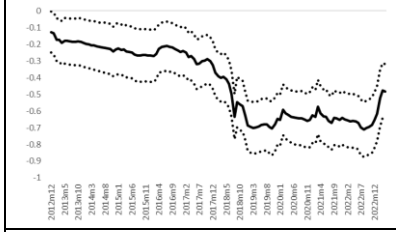
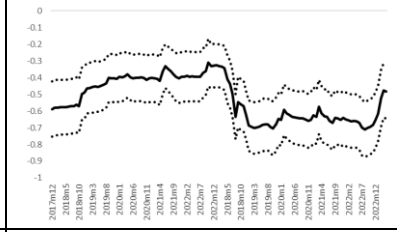
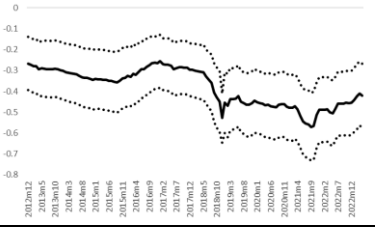
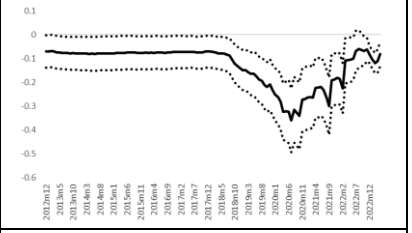
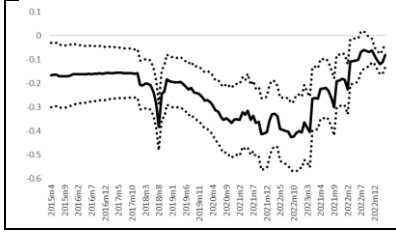
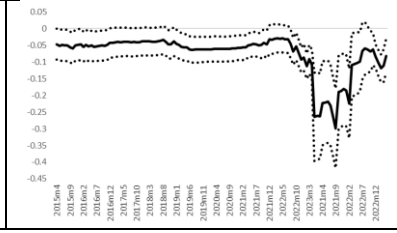
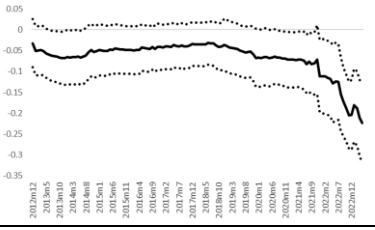
Austria	Belgium	Cyprus	Estonia
			
Finland	France	Germany	Greece
			
Ireland	Italy	Latvia	Lithuania
			
Luxembourg	Malta	Netherlands	Portugal
			
Slovakia	Slovenia	Spain	
			

Table 19: Panel Regression Estimates

	(1) Lending for house purchase	(2) Lending for consumption	(3) Lending to NFCs (up to 1 year)	(4) Lending to NFCs (over 5 years)	(5) Deposit rate up to 1 year for NFCs	(6) Deposit rate up to 1 year for HHs
Euribor	0.306	-2.172	0.323	3.065	-0.185	0.433**
	(0.223)	(1.696)	(0.226)	(2.117)	(0.268)	(0.213)
ΔHouse prices	0.004	-0.006	-0.003	0.013**	-0.009***	-0.008***
	(0.003)	(0.020)	(0.004)	(0.006)	(0.002)	(0.003)
GDP growth	-0.005*	0.049	-0.003	-0.026	0.002	0.001
	(0.003)	(0.041)	(0.004)	(0.020)	(0.003)	(0.004)
Credit risk	1.179**	5.278	1.385**	-5.326	1.038	1.337
	(0.580)	(3.515)	(0.672)	(6.325)	(0.644)	(0.993)
Herfindahl index	0.302	9.209	1.533	-15.351	1.910	1.075
	(1.245)	(8.855)	(1.715)	(16.605)	(1.554)	(2.114)
CR5	0.001	-0.056	-0.0003	0.085	-0.003	0.003
	(0.006)	(0.052)	(0.010)	(0.084)	(0.007)	(0.011)
Excess liquidity	0.462*	1.169	1.179***	0.217	0.995**	1.239**
	(0.246)	(0.747)	(0.419)	(0.988)	(0.395)	(0.488)
Constant	-0.297	-1.348	-1.261*	-0.093	-0.864	-1.521*
	(0.426)	(1.771)	(0.681)	(1.443)	(0.756)	(0.805)
Number of obs	**141**	**140**	**141**	**141**	**137**	**137**
Number of groups	**19**	**19**	**19**	**19**	**19**	**19**
Log likelihood	**0.1283**	**0.0487**	**0.1514**	**0.0577**	**0.1351**	**0.1605**

Notes: Table 17 shows the results from a panel regression model. For each specification (1) to (6), a different dependent variable is used. ***, **, * denote significance at 1%, 5%, and 10% level respectively.