Decoding Corporate Depositor Behavior - Examining the Impact of Bank-Customer Relationships on Liquidity Management

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Abstract

This research project examines the dynamics between corporate deposit flows and deposit rates for a central European bank operating in three distinct countries. We make use of a comprehensive panel data set that encompasses customer-level data, capturing aspects such as sight deposit volumes, deposit rates, and other specific customer attributes. Our goal is to provide an understanding of how banks and their corporate clientele adjust deposit flows and rates in response to fluctuating economic conditions, employing a dynamic panel methodology. Furthermore, we delve into the ramifications of the Covid-19 crisis on corporate customers within their individual economies. Through our investigation, we uncover that corporate customer groups, exhibit diverse reactions across different countries. Notably, our findings reveal contrasting patterns compared to earlier studies that analyzed private bank customers, highlighting unique behaviors exhibited by the corporate customers in our study.

Keywords: COVID-19 Pandemic, Dynamic Panel Data, Financial Stability, Depository Institutions, Firm-Level-Data
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1. Introduction

The role of deposits as a fundamental source of liquidity for banks cannot be overstated. In the intricate interplay of financial markets, depositors wield a unique form of power, with the potential to withdraw their deposits at any moment. Among these depositors, firms occupy a pivotal position, often maintaining substantial deposit holdings and exhibiting a proactive stance in optimizing their financial resources. Surprisingly, despite the profound impact they can exert on the banking sector, there remains a significant gap in our understanding of how firms behave as depositors. In this study, we embark to bridge this knowledge gap, by providing a comprehensive insight into the behavior of institutional depositors.

Our investigation leverages a comprehensive data set that encompasses institutional deposits held within an Austrian banking group. This data set contains a significant number of depositors within the Austrian bank and comprises a representative sample of depositors for two subsidiary branches situated in Hungary and Romania, spanning the years from 2018 to 2020. It tracks the monthly fluctuations in deposit volumes for each customer, alongside data such as deposit rates and firm-specific information. By estimating dynamic panel models, we gain valuable insights into the determinants of institutional depositor behavior. Our analysis emphasizes the significant role of the bank-customer relationship. Due to data availability, most academic literature focuses on private bank customers. We use their findings as a foundation to derive hypotheses for our analysis and by this are able to contribute to the understanding of the behavior of corporate depositors. As our data set spans the initial stages of the COVID-19 crisis, it affords us the opportunity to examine the behavior of institutional depositors during this pivotal period. Furthermore, our study delves into cross-country disparities, shedding light on variations in the use of sight deposits across different regions. To facilitate a more comprehensive understanding, we calculate the deposit spread, signifying the difference between the deposit rate and the respective money market rate. Notably, we discern that the Hungarian subsidiary's deposit spread exhibits more pronounced fluctuations compared to the others. In a broader context, our research reinforces the premise that institutional depositors, while sharing some similarities with household depositors, often exhibit divergent deposit behaviors compared to those seen in household depositors. This exploration marks an important step in unraveling the intricate dynamics of institutional depositors' decision-making processes.

This article makes a valuable contribution to the current body of empirical research on depositor behavior in several key ways. Firstly, it offers a pioneering

glimpse into the course of action of institutional depositors within the context of well-established savings banks operating in three European countries. Secondly, it expands the traditional analytical frameworks by incorporating a comprehensive firm-level data set, offering fresh perspectives and insights. Thirdly, the study delves into the influence of deposit insurance on the behavior of institutional customers, shedding light on a critical factor that has so far received limited attention. While the evidence presented here is drawn from the experiences of specific banks, we anticipate that our findings hold relevance for other financial institutions with similar market shares and depositor bases. Thus, this research contributes to a deeper understanding of depositor behavior and offers valuable insights for a broader spectrum of banks operating within similar contexts.

The outcomes of this research carry the potential to augment various regulatory instruments, particularly impacting minimum standards for funding liquidity, such as the Liquidity Coverage Ratio (LCR). The LCR is designed to bolster the short-term resilience of banks' liquidity risk profiles and is computed by dividing the "stock of high-quality liquid assets" by "the total net cash outflows anticipated over the next 30 calendar days". Significantly, the deposit amounts scrutinized in this study directly contribute to the calculation of "net cash outflows over the next 30 calendar days" (BCBS (2013)). In the computation of LCR, the Basel Committee on Banking Supervision (BCBS) assigns run-off rates to each relevant deposit, with higher run-off rates indicating an increased perceived risk of withdrawal during a crisis. Notably, the BCBS allocates the lowest run-off rate primarily to fully insured customers, where 100% of the deposit amount is covered by an effective deposit insurance scheme. The subsequent run-off rates are assigned to those without full coverage under an effective deposit insurance scheme, with the highest run-off rates designated for corporate customers lacking deposit insurance coverage. This analysis underscores the significant influence of the assumed riskiness of customers on the LCR ratio. Specifically, the results of this study may unveil additional factors beyond the scope of applicable deposit insurance that contribute to the assessment of depositor risk.

The remainder of the paper is organized as follows. Section 2 reviews the literature, with a specific focus on the different veins of literature on depositor behavior. Section 3 states the used model and methodology. Section 4 provides an in-depth exploration of the Market Overview and Temporal Specifics that characterized our study's time frame. Section 5 presents our hypotheses. Section 6 describes the data set and other sources of information utilized in this study. Section 7 describes and discusses the empirical results. Finally, Section 8 presents

concluding remarks.

2. Literature review

Our research contributes to the literature analyzing the behavior of depositors in financial systems. This literature originated from the analysis of bank runs and deposit insurance. This has led to various regulatory changes and forms a significant part of today's regulatory environment. Diamond and Dybvig (1983) seminal work is a cornerstone in this literature. They developed a model that investigates the mechanics of bank runs, particularly focusing on runs triggered by widespread panic. Additionally, they introduced the concept of deposit insurance within this context, arguing that such insurance can effectively mitigate the occurrence of bank runs. Subsequent to Diamond and Dybvig's work, several researchers have delved into various drivers behind bank runs. Chari and Jagannathan (1988) found that asymmetrical information regarding a bank's condition, as reflected in its fundamentals, can be a driving force behind these runs. The role of asymmetric information among depositors as a catalyst for bank runs is further explored in the studies of Jacklin and Bhattacharya (1988) and Chen (1999). Subsequent research and advancements in this domain, are summarized by Gorton and Winton (2003).

An important driving factor for bank runs is the bank's risk level. If depositors perceive a too large risk appetite of the bank, they can undertake multiple actions responding to this behavior. This mechanism is referred to as market discipline. Bliss and Flannery (2002) elaborate on market discipline, outlining it in two main steps. Firstly, participants in the market must be able to gather information about the degree of risk associated with a bank's actions. Secondly, these participants should have the capability to take influential actions based on this information. These actions typically manifest as either deposit withdrawals or demands for improved contractual terms. Billett et al. (1998) found that different customer types use their discipline power differently. They show that based on Moody's downgrades, failing banks tend to lose especially uninsured depositors. Consequently, these banks witness a shift towards a higher proportion of insured deposits and are more dependent on those customers. Similarly, Jordan et al. (2000) had analogous outcomes for banks in New England during the 1990s. Goldberg and Hudgins (1996) revealed that in the case of US thrifts, depositors actively adjust their holdings of uninsured deposits when they perceive banks to be failing.

On the flip side of this scenario, banks might adopt a more risk-averse stance due to concerns about a reduction in uninsured deposits. This cautious reaction

is illustrated by the works of Calomiris and Kahn (1991) and Flannery (1994).
While the above studies analyze how customers discipline a bank's risk appetite by deposit withdrawals, contracted deposit rates are another instrument. One can interpret the interest rate received by uninsured depositors as an indication of the bank's condition as introduced by Baer et al. (1986). Studies looking at the bank-level interest rates paid by depositors show that uninsured depositors carry out a stronger form of market discipline (Hannan and Hanweck (1988), Ellis and Flannery (1992), and Demirgüç-Kunt and Huizinga (2004)).
If available, researchers often examine both interest rates and deposit amounts simultaneously. For instance, Park (1995) and Park and Peristiani (1998) employ comprehensive panel data sets from thrift institutions to explore how insured depositors respond to banks' conditions. They found a negative correlation between the level of risk and the growth of uninsured deposits, alongside a positive connection between risk and yields.
Similar results are obtained in the works of Iyer and Puri (2012) and Iyer et al. (2016) while using a different method. They draw inspiration from the field of epidemiology, linking bank runs to the propagation of a virus. In their approach, they establish various metrics to quantify the relationship between depositors and banks, such as the distance of each depositor to the bank and whether they have connections to individuals employed by the bank. Through their analyses, they found evidence suggesting that, beyond specific customer-bank associations, a higher level of deposit insurance indeed diminishes the likelihood of depositors engaging in a run.
In addition to the aforementioned studies, several other empirical papers have contributed to this field. One example is the work of Martinez Peria and Schmukler (2001), which focused on customers in three American countries: Argentina, Mexico, and Chile. Their investigation spanned the 1980s and 1990s. They discovered a robust presence of market discipline in these countries, and intriguingly, their findings did not indicate any substantial differences in the behavior of insured and uninsured depositors. It's worth mentioning that although their research exhibits certain parallels with our analysis, there is a notable distinction in the selection of variables, as their study concentrates on bank fundamentals. Additionally, Martinez and Schmuker's study employed bank-level data from different nations. Further, Hadad et al. (2011a) delved into the behavior of depositors in several commercial Indonesian banks during the period from 1995 to 2009. They constructed a measure for the price of deposits and employed the Generalized Method of Moments (GMM) for a dynamic panel analysis. Their findings suggested that limited guarantees had a mitigating effect on deposit in-

surance. Karas et al. (2013) conducted a seminal study investigating the impact of deposit insurance on depositor behavior. Employing a difference-in-difference estimation approach, they examined the behavior of newly insured depositors in comparison to uninsured counterparts. Their findings revealed that the introduction of deposit insurance had a significant effect, leading to a reduction in households' sensitivity to banks' riskiness.

Some recent studies shifted their focus away from the classical market discipline approach. For instance, Hasan et al. (2013) examined the behavior of depositors in Central European countries, using estimations of dynamic panel models of deposit growth rates. Their research brought forth a noteworthy finding that depositors were more responsive to press rumors than to the underlying financial health of the banks. Furthermore, Drechsler et al. (2017) contributed to this evolving field by emphasizing the intricate relationship between monetary policy and depositor behavior. Their study argued that monetary policy influences households through deposits, particularly through the interest rates received by households. In the study of Imbierowicz et al. (2021), the focus is on a fintech platform that orchestrates auctions in which firms select the banks for their deposit placements. Through this micro-level examination, their research reveals that firms are disciplining banks in this specific process.

The examination of depositor behavior has garnered renewed attention in recent years, yet the body of empirical literature in this field remains relatively modest. This occurrence likely stems from two primary factors. Firstly, the literature concerning private customers has reached a high level of maturity, with contemporary studies predominantly concentrating on novel influences. Secondly, the challenge of data availability persists, particularly when it comes to acquiring corporate customer data, which is relatively scarce. Some studies resort to leveraging fintechs as proxies for savings banks, drawing conclusions about the behavior of corporate customers in traditional savings banks from these comparisons. However, it is crucial to highlight that, to the best of our knowledge, there are currently no existing studies that specifically investigate corporate depositors' behavior at the firm level, particularly in OECD (Organization for Economic Cooperation and Development) countries. This represents a significant gap in the literature, and our research aims to address this void

3. Methodology

To conduct a dynamic analysis of our panel data, we utilize the Generalized Method of Moments (GMM) estimator. The GMM estimator is especially suitable for dynamic models of panel data because it addresses challenges like

endogeneity, heteroscedasticity, and autocorrelation, frequently found in financial data sets Arellano and Bond (1991). We execute the model for two distinct dependent variables, one to understand what affects deposit flows and one to analyze deposit rate changes. Each data point is specific to a customer i at time t. Our model specification is:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-l} + \beta_2 X_{i,t} + \beta_3 X_{i,t-1} + \alpha_i + \varepsilon_{i,t}, \tag{1}$$

where the $Y_{i,t}$ denotes the dependent variable, with $Y_{i,t-l}$ being its l-th lagged version, encompassing the model's dynamic nature. The $X_{i,t}$ signifies a vector of control variables that spans customer attributes, macroeconomic indicators, and other control variables. For some macroeconomic parameters, we also consider their lagged counterparts, $X_{i,t-1}$. The coefficients are symbolized by the βs, with β_0 acting as the intercept. The α_i represents the unseen individual effect, capturing the unobserved variability across clients. The term ε_{it} is the error component.

Endogeneity concerns related to the lagged dependent variable and other predictors are tackled using the GMM estimator. This technique leverages lagged versions of the dependent variable and differences of the independent variables as instrumental variables. We employ an iterative GMM estimator Arellano and Bond (1991), which is tailored for data sets with heteroscedasticity. Initially, by first-differencing the variables, unobserved individual effects are negated. The model then applies lagged levels and differences as instruments. Subsequently, residuals from this step are used to estimate the variance-covariance matrix, which then weights the moment conditions to enhance efficiency. The GMM estimator's legitimacy relies on two key assumptions:

- The lack of serial correlation in the differentiated errors.
- The suitability of the instruments.

For the first, we use the Arellano-Bond test for autocorrelation. For the second, the Hansen overidentification test (J-Test) is employed Arellano and Bond (1991). We also deploy the Wald test to determine the joint significance of multiple coefficients in the regression. By leveraging the GMM estimator, we can explore the dynamic link between customer account balances and various factors. Differences in the final model specifications among each country are chosen such that the best fitting model is ensured.

4. Market Overview and Temporal Specifics

4.1. Market Overview

In our study, we use data from an Austrian financial service provider with private as well as corporate customers. The core markets are in seven countries, which include among others Austria, Hungary, and Romania. Therefore, it is crucial to understand the banking system and regulations applicable to our study in those countries. For our study, it is an integral part of understanding the deposit insurance scheme for each country we analyze.

The banking system in Austria is a universal banking system that enables a high degree of risk mitigation and flexible adjustment regarding changes in the financial environment. Joint-stock banks, housing construction banks, and specialized credit institutions have a single-tier structure whereas saving banks and Volksbanken are two-tier organizations. The only banks with a three-tier structure are the Raiffeisen banks. In this study, we specifically focus on savings banks. Starting in the late nineties there was a wide expansion of Austrian banks to Central Eastern and Southeastern Europe. Therefore, many subsidiaries of Austrian banks are distributed in different countries.

In this study, we will investigate a bank with subsidiaries in Hungary and Romania besides Austria.

The Romanian banking sector is dominated by foreign-controlled banks, which hold over 60% market share. The specialty of the Romanian financial economy is that, compared to other countries, a small number of people even hold bank accounts. With only 69% of people with a bank account in 2021.

Similarly in Hungary, only 77% of people held a bank account in 2021. The Hungarian financial system is similar with a two-tier banking system and the financial market and capital transaction market being fully liberalized.

In Austria, the supervision of the banks is a joint task of the European Central Bank (ECB), the Financial Market Supervision (FMA), the National Bank of Austria (OeNB), and the Austrian Ministry of Finance. The ECB is responsible for the supervision of banks across the euro area. While it directly supervises significant banks, less significant banks are supervised by national competent authorities, which are supervised by the ECB. The ECB directly supervises our bank's Austrian credit institutions. The FMA is an Austrian supervisory authority that monitors compliance with relevant regulations. The OeNB is responsible for monitoring financial stability in Austria. In addition to the four institutions, the European Banking Authority (EBA) plays an important role in the banking system. The EBA is an independent EU agency that regulates the entire European banking sector, including non-euro area EU countries.

The two other countries in our database are not participants in the European Banking Union, and consequently, they do not adhere to the Single Supervisory Mechanism or the Single Resolution Mechanism. Additionally, they are not part of the European Banking Supervision, which means that the two subsidiaries we are examining are not subject to direct oversight by the ECB, as no banks in these countries are. However, being members of the European Union, they do operate under regulatory frameworks rooted in EU directives and regulations. Furthermore, all two countries are part of the European System of Central Banks.
The Central Bank of Hungary or Magyar Nemzeti Bank (MNB) supervises the financial markets in Hungary in cooperation with the Hungarian Financial Supervisory Authority. There are two regulatory institutions for the banking sector in Romania, the National Bank and the Financial Supervisory Authority. The Autoritatea de Supraveghere Financiara (ASF), is in charge of the oversight and regulation of the Romanian Financial Services Industry.
Deposit protection in Austria applies to all customers, excluding financial institutions, pension funds, and government agencies such as the federal and state governments. The European deposit guarantee policy stipulates that at least up to 100,000 euros per customer are secured. Deposit insurance covers all balances in all interest-bearing or non-interest-bearing accounts or savings accounts, as well as foreign currency balances. This is ensured by an institutional protection scheme organized by a specific limited liability company.
In Hungary, the deposits opened at Hungarian banks are protected by the National Insurance Fund (OBA/ NDIF). Credit institutions with headquarters in Hungary are bound to join this deposit insurance system. In Romania, the deposits opened at Romanian banks are guaranteed by the Bank Deposit Guarantee Fund (FGDB), the only guarantee scheme approved by the National Bank of Romania (NBR). In the two countries, the respective institution compensates up to an equivalent of EUR 100,000 per depositor per bank/credit institution.

4.2. Temporal Specifics

To gain a more comprehensive understanding of the context in which the data is situated, we will now provide an overview of the events that unfolded in each country during our observation period. In Austria, due to the coronavirus crisis, the Federal Government provided various financial support in 2020. In March 2020 the Federal Government provided financial support to Austrian microenterprises, self-employed workers, and one-person companies, among others, with subsidies - the so-called *Härtefall*-Fond. This funding consisted of two phases. The first phase included a funding of 500-1000 euros, and in the second phase,

a maximum of 2000 euros was provided for a maximum of three months. In addition, domestic exporters were supported with credit funds in the same month with a total amount of 3 Mio. Euros. The primary goals were to ensure the liquidity of export companies and to secure jobs. Furthermore, from April 2020, companies with a registered office in Oberösterreich could apply for a subsidy for interest on bridging loans until December 2020. This funding took the form of non-repayable grants, with the exception of the existence of a clawback situation based on applicable regulations (e.g. EU state aid law), which could lead to clawbacks. In June 2020, the Austrian federal government announced that there would be an investment premium for companies funding tangible and intangible new investments in the depreciable fixed assets of a company at Austrian locations that are subject to capitalization with the aim to create incentives for companies to invest. The range of the funding volume was 5000 Euros – 50 Mio. Euros (excluding VAT) per company. Furthermore, there was support for the ongoing fixed costs of companies of all sizes with a registered office in Austria that carry out significant operational activities in Austria (excluding the companies in the financial and insurance sector). This fixed-cost subsidy was divided into three tranches which companies could apply for in May, August, and November 2020. End September 2020, the US Treasury Department raised a similar suspicion in which Austrian banks, were suspected of smuggling suspicious transfers through the banking system. Austria experienced a series of three nationwide lockdowns. The initial lockdown occurred from mid-March 2020 to early May 2020. The second lockdown was implemented in mid-November 2020, lasting until early December 2020. The third lockdown was initiated at the end of December 2020, extending beyond the timeframe of our data until early February 2021.

In response to the economic impact of the pandemic, the Hungarian government took measures such as imposing a moratorium on the payment of capital, interest, and fees for all private and corporate loans until the end of 2020. Additionally, a decree aimed at providing tax relief worth over 200 billion Forint (equivalent to 564.7 million EUR) was approved, resulting in a reduction of the income tax rate by 2 percentage points to 15.5%, effective from July 2020. The government offered tax cuts and financial assistance to businesses; the hospitality industry received 50% of gross wages, while hotels got 80% of lost revenues until the end of January 2021. Subsequently, the Hungarian Central Bank took further action to support the economy by lowering the interest rate to 0.6%. During the first Lockdown, which spanned from March 11 to June 18, 2020, an emergency law granted Prime Minister Orban indefinite decree powers, raising concerns about

the erosion of the rule of law. The second Lockdown began on November 4, 2020, and concluded during the spring of 2021, a period that falls outside the critical timeframe for our analysis. At the end of 2020, the government deemed the planned merger of Budapest Bank, MKB Bank, and MTB Savings Bank as a national strategic interest. The government decree stated that the measure was needed to boost the competitiveness of the Hungarian banking sector since banking services and loans were too expensive.
In 2019, the Romanian government introduced a special tax, a so-called "Greed Tax", for banks, after a political campaign against banks. The tax was lifted a few weeks after its introduction. Addressing the pandemic, the Romanian government implemented a measure of 75% short-time work allowance in March 2020. After the first lockdown which took place from 22nd of March until April 2020, the government provided a monthly compensation of 41.1% of the gross wage for three months once restrictions were lifted. Furthermore, there were incentives for employers to hire young unemployed individuals between 16 and 29 years old until December 31, 2020, granting employers 50% of the employee's salary, capped at 2,500 RON (500 EUR) per month. Employers were also eligible to receive a Home Office allowance of 2,500 RON (500 EUR), and day laborers received an additional 35% over three months. In order to mitigate the economic effects of the pandemic the Romanian Central Bank reduced its policy interest rate by 0.50 percentage points to 2.0% in March 2020. Additionally, tax payments could be postponed, with payments due on March 21, 2020, being eligible for deferral until October 25, 2020. From March 11 to 20, 2020, withdrawals from credit institutions at the Romanian National Bank (NBR) reached a record high of 4.4 billion Lei, doubling December 2019's withdrawals during the winter holiday period, subsequently decreasing afterwards. A second lockdown was implemented on November 6th, 2020, with the end exceeding our observation period.

5. Hypotheses

In this chapter, the focus is on developing hypotheses about how the bank-customer relationship influences the liquidity flows of corporate customers. The chapter draws on existing academic literature that primarily explores these dependencies for private customers. By leveraging these academic findings, we formulate hypotheses for corporate customers derived from private customers. The goal is to identify potential similarities or differences in behaviors between private and corporate customers through econometric analysis. This approach seeks to deepen the understanding of bank-customer dynamics in the corporate

sector, contributing valuable insights into liquidity management and customer behavior in the banking industry.
Prior research outlines the significance of the customer-bank relationship in the banking industry, with a specific focus on individual depositors. Households, for instance, have shown a propensity to maintain loyalty to their banks, even during economic crises, owing to the strength of their customer relationships (Iyer and Puri (2012)). Based on this we hypothesize that a similarly strong customer-bank relationship may be positively linked to increased deposit volumes, reflecting the influence of this relationship on depositor behavior in the corporate sector. We assess the strength of a customer-bank relationship through two key indicators: the firm's headquarters location within the country and the duration of the firm's tenure as a customer with the bank. Consequently, we propose the following two hypotheses, denoted as H1 and H2:

> **H1**: Bank customers having the headquarters in the same country as the bank, are associated with higher inflows.
>
> **H2**: Bank customers with a long-term relationship are associated with higher inflows.

As discussed above, a robust customer-bank relationship is highly valued by both depositors and banks. Thus, we anticipate that financial institutions will offer more favorable deposit conditions to customers who have demonstrated reliability and longevity in their banking relationships. In this context, we narrow our focus to the interest rate aspect of deposit contracts and, accordingly, propose the following two hypotheses, labeled as H3 and H4:

> **H3**: Bank customers having the headquarters in the same country as the bank, are expected to receive a higher interest rate.
>
> **H4**: Bank customers with a long-term relationship are expected to receive a higher interest rate.

In particular, one potential explanation for less favorable contract conditions for foreign companies could be the elevated costs incurred by the bank in the event of any contractual breaches by the customer. This added risk factor may lead banks to adopt a more cautious approach, resulting in less attractive terms for customers whose operations are based abroad.
It is worth mentioning that many businesses received government stimulus payments during the crisis. Additionally, considering the insights from Bernanke (2005), it is conceivable that there may have been instances of liquidity hoarding at the outset of the crisis, further supporting our H5:

H5: During corona, we expect inflows for the sight deposits.

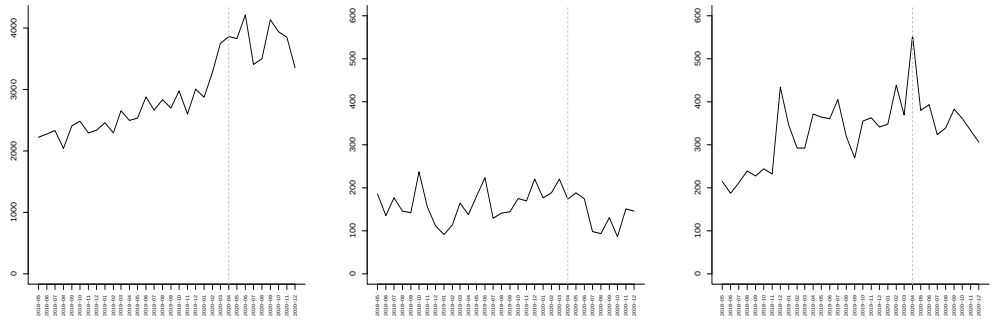
6. Data Overview

6.1. Data Set

The primary database employed for our study originates from a leading Austrian bank with an extensive presence in Eastern Europe. While the data set includes a representative sample of corporate customers' sight deposits from the parent institution in Austria as well as the branches in Hungary and Romania, we also observe the amount of time deposits but do not have any further information concerning the time deposit rate or other contract modalities. Furthermore, we do not have access to the entirety of the bank's data but the portion we possess is indicative of the bank's overall landscape. Our observations span a monthly frequency, covering Q2 2018 through Q4 2020.
For each client, we observe the following:

- End-of-month balance across all sight deposit accounts;
- Total amount in sight deposits;
- Average deposit rate for each account;
- Location of the company's headquarters;
- Date of the client's inaugural account opening with the bank.

The above described client attributes are observed for each bank individually. However, from the database, we cannot infer whether a bank customer who holds a sight deposit account in one bank also has a sight deposit account in one of the other banks. It is important to note that our analysis lacks information about whether a client has a loan from the respective bank. While we observe the number of different currencies in which the customer holds sight deposits, the account balances are always reported in Euros. Figure 1 depicts the aggregate sight deposit amounts in Euros for each bank. Notably, while Austria's deposits maintain the highest level and further expand during our observation period, deposits in Hungary remain relatively stable, and those in Romania exhibit modest growth. Recognizing the economic implications of the coronavirus crisis, we demarcate its commencement as 1st March 2020 for all three countries. This date aligns with our earlier explanation in Section 4, which highlighted that all three governments had implemented their initial stringent public restrictions by that time. Around this date, we observed a significant surge in deposits for Austria



(a) Austria (b) Hungary (c) Romania

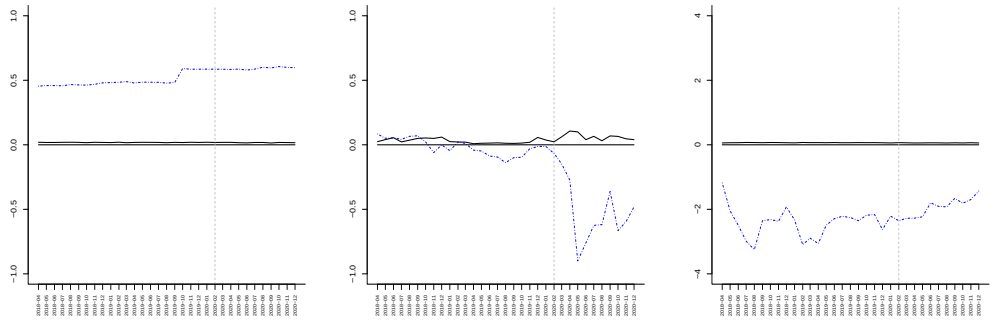
Figure 1: All values are plotted on a monthly basis. The solid black lines represent the summed-up deposits for the whole bank in millions of euros. The dashed grey lines mark the beginning of the Covid-19 crisis.

and Romania. For Austria, following the surge, the deposits exhibit fluctuations, though on a higher plateau. However, in Romania, it is followed by a subsequent decline. In contrast, Hungary demonstrates a different pattern, with no surge observed at the onset of the COVID-19 crisis but a decrease instead.

Figure 2 depicts the average deposit rate, represented by the black solid line. For Austria, this rate remains just above the 0% benchmark. A similar pattern is observed in Romania. The deposit rate in Hungary aligns with those of Austria and Romania, albeit with slightly more volatility and an increase around the beginning of Covid-19. Furthermore, there is an increase in the deposit rate coinciding with the onset of the Coronavirus pandemic. Additionally, the figure offers insight into the institution-specific deposit spread. This measure is calculated by determining the difference between the average deposit rate of the institutions and the overnight money market rate for the respective country. In line with Hutchison (1995), this can be viewed as a proxy for depositors' opportunity costs or the profitability of deposits for the banks.

Note that Austria's deposit spread consistently remains positive, at around 0.5%, in contrast to Hungary, where it fluctuated around zero pre-COVID and spiked to almost -1.0% at the start of COVID, later stabilizing at around -0.5%. In Romania, the deposit spread is consistently negative, around -2.0%, throughout the entire observation period.

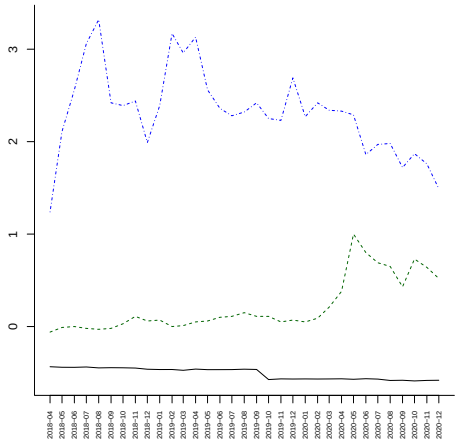
While our study mainly focuses on the relationship between deposit flows and customer relationship, we add additional controls to our analysis. To assimilate macroeconomic influences, our data set incorporates the quarterly GDP growth



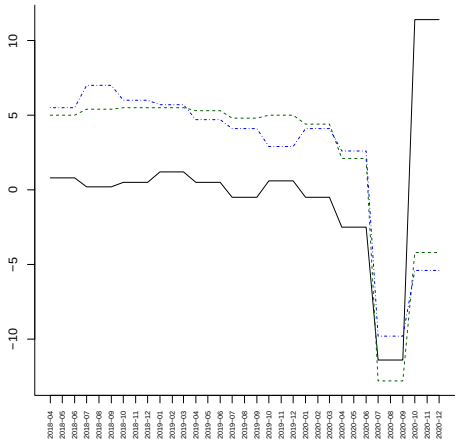
(a) Austria (b) Hungary (c) Romania

Figure 2: All values are plotted on a monthly basis. The solid black lines represent the average deposit rate each bank pays their customers. The dot-dashed blue lines are the deposit spread. The dashed grey lines mark the beginning of the Covid-19 crisis.

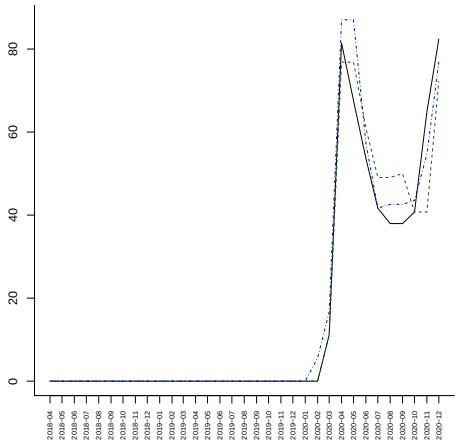
rate sourced from Refinitiv, in alignment with Hadad et al. (2011b).
Since our observation period encompasses a significant portion both before the start of the Corona crisis and after it, this presents a valuable opportunity to analyze the effects of the crisis on depositors. To account for these effects, we use a country-specific stringency index, developed by Mathieu et al. (2020), which indicates the severity of the respective government responses to the prevailing Corona situation. The index ranges from 0 (no strict response) to 100 (very strict response) and is composed of nine metrics: school closures; workplace closures; cancellation of public events; restrictions on public gatherings; closures of public transport; stay-at-home requirements; public information campaigns; restrictions on internal movements; and international travel controls. Figure 3 Panel (a) presents the country-specific overnight money market rate, sourced from Refinitiv. This rate remains static and negative for Austria but displays increased dynamism in Romania and post-2018 Hungary. Panel (b) illustrates the GDP growth rate. Pre-corona, all three countries show a marginal GDP decline. With the onset of the pandemic, all three nations experienced a GDP downturn, recuperating over time. Where the GDP growth for Hungary and Romania is less pronounced than the growth rate for Austria. Panel (c) showcases the stringency index. For all three countries, we observe a severe increase in March 2020, which then eases during the summer before rising again at the start of winter towards the end of 2020. This aligns seamlessly with our observations in chapter 4.2, particularly highlighting the occurrence of two lockdowns in each country within our specified time frame. In Panel (d), the bank's market share for each country



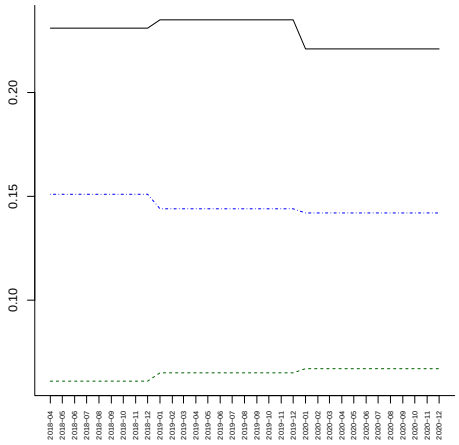
(a) Each countries money market rate.



(b) Each countries quarterly GDP growth rate.



(c) Each countries stringency index.



(d) Each subsidiaries market share.

Figure 3: All values are plotted on a monthly basis. The solid black lines represent the Austrian values, dashed green lines represent Hungary, and the dotted dashed blue lines are the Romanian values.

is presented. Given the lack of precise data on corporate deposit accounts, we utilize the market share of corporate loans, as indicated in the annual report, as an approximation. The data illustrates a different pattern for each institution: the market share for the Hungarian institution increases while it decreases for the

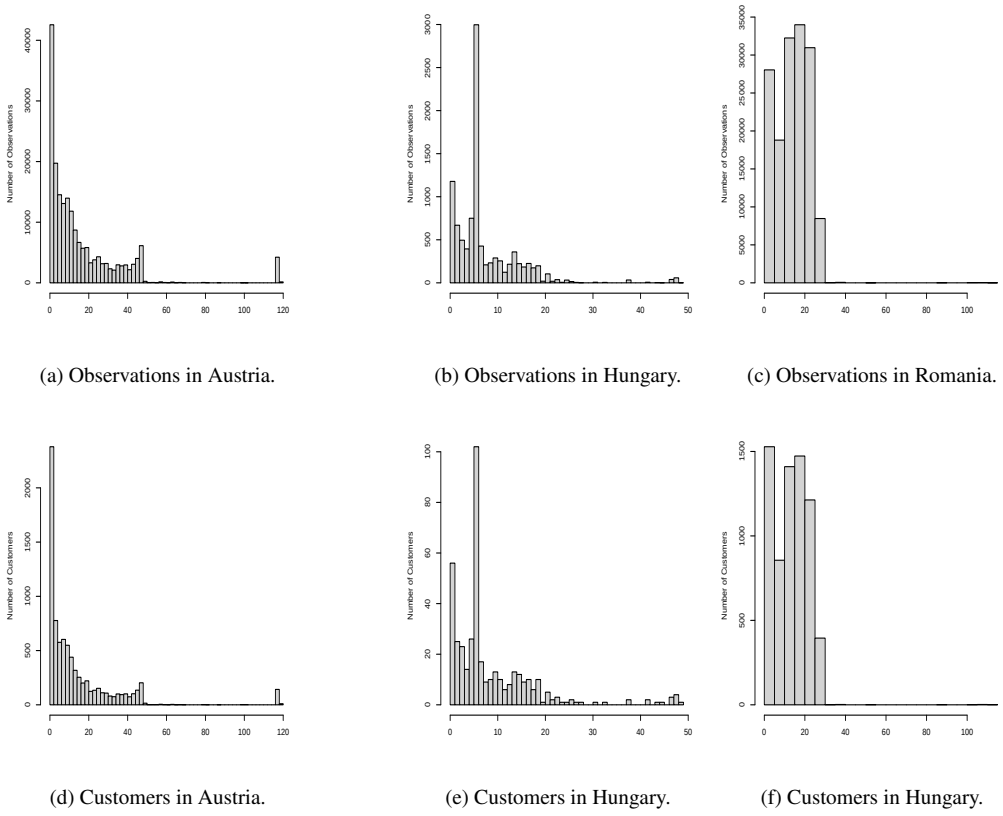
Romanian counterpart. In comparison, Austria experienced an initial rise after 2018, followed by a more pronounced decline after 2019.

6.2. Data Selection and Preprocessing

Given the broad range of variables in our data set, each with different scales, we apply data preprocessing steps to ensure the variables are on a comparable scale for our econometric analysis. Our analysis primarily involves two different regression models: one determining the factors affecting deposit flows and the other analyzing changes in deposit rates. For the deposit flow regression, we observe a wide range of bank account balances, spanning from 10 digits down to single-digit Euro amounts. To address this disparity, we applied a logarithmic transformation to the account balances before differencing. Since deposit rates vary widely, from zero to 8.0% as shown in Figure A.1, we winsorize our data, setting limits at 1.0% at both the top and the bottom. Furthermore, to ensure stationary variables we difference the variables if necessary.

Since our objective extends to understanding the deposit flow behaviors exhibited by specific customer groups. In line with the methodology presented in Iyer and Puri (2012), we account for the relationship between the depositor and the bank with two variables. First, we introduced a variable to monitor the duration of the customer-bank relationship. The foundation for this variable is sourced from our base data, which contains a field indicating the date when customers first initiated an account with the bank. Utilizing this date, we computed the time that has elapsed between this initial account opening and the commencement of our observations. For scaling reasons, we opt to present this information in years. This variable has been designated as "Date Customer Since". Figure 4 illustrates how this distribution manifests across the countries under study. Second, we incorporated a dummy variable, "Domestic Headquarter", to discern whether a company's headquarters is domiciled in the same nation as the bank. The specifics of this inclusion are detailed in Table 1, which highlights that the subsidiaries primarily engage in depository relationships with domestic firms.

The Basel Accords mandate specific regulations for different corporate customer groups. In our analysis, we focus exclusively on corporate customers, excluding those from the small and medium enterprise (SME) retail sector and financial sector entities. This exclusion was made to ensure a concentrated analysis on institutional customers. Small SMEs, as defined in the regulatory implementation EU (2013) of the Basel III guidelines, are often perceived to exhibit behavioral patterns similar to households. Consequently, not all subsidiaries consider SMEs within the category of corporate customers, leading to significant variations in



(a) Observations in Austria. (b) Observations in Hungary. (c) Observations in Romania.

(d) Customers in Austria. (e) Customers in Hungary. (f) Customers in Hungary.

Figure 4: Histograms counting the occurrences for the variable Date Customer Since in years. the upper row counts the number of observations and the lower row the number of customers.

the data set's information and making their inclusion problematic. Additionally, financial customers, especially depositors, have a unique dynamic with banks that warrants a separate study. Furthermore, our evaluation is limited to accounts maintained in major currencies: EUR, USD, GBP, CHF, HUF, RON, and CZK, which constitute the majority of currencies in our data set. However, for the purposes of our analysis, all customer balances are converted to EUR.

In accordance with Section 4, we classify each customer in our data set based on their first observation as i) deposit insured, meaning the customer holds less than 100,000 Euros in deposits at the bank and is not a public customer; ii) partially insured, meaning the customer holds more than 100,000 Euros at the bank and is not a public customer; or iii) not insured, which applies to public customers. Based on this classification, we also calculate the uninsured deposit amount for each customer. Since the deposit rate is used to calculate the deposit spread, the

Table 1: Number of Customers with Domestic Headquarters by Country

	Austria	Romania	Hungary
Domestic Headquarter (No)	1012	50	2
Domestic Headquarter (Yes)	7096	6834	410

variable deposit spread is solely utilized in the model analyzing deposit flows. Respectively, the variable uninsured deposit amount is exclusively employed in the model analyzing deposit rates. The independent variables GDP, money market rate, and market share used in our regression model as standardized, by subtracting the mean and divide by the standard deviation.

7. Key Findings

In the subsequent section, we present our regression analysis and juxtapose these findings with the hypotheses outlined in Section 5. We begin by discussing the results that utilize the difference in the logarithmic bank account balance as the dependent variable, as presented in Table 2. Following this, we explore the regression results where the deposit rate serves as the dependent variable, as illustrated in Table 3).

Since the deposit flows for customers with high balances differ substantially from those of customers with low account balances, we have divided our sample. Based on the median account balance over time, we have created two data sets for each country. One data set includes the top 20% of customers with high account balances (80-100th percentile), and the other data set comprises the remaining 80% of customers with lower account balances (0-80th percentile). **H1** and **H2** suggest that a more profound bank-customer relationship, whether through a domestic headquarters or a long-lasting bank-customer interaction, should lead to increased deposit inflows. Our analysis reveals that in all three countries, only for high-wealth customers we observe a significant effect in regards to a domestic headquarter. While there is a negative relationship in Austria, we can confirm H1 for Hungary and Romania. The duration of the bank-customer relationship is statistically significant in all cases, except for high deposit bank customers in Romania. Besides wealthy customers in Hungary, we observe a positive association; a longer bank-customer relationship leads to increased deposit inflows. Thus, **H2** appears well-founded based on the underlying data.

Furthermore, we control whether the bank utilizes its market share in the re-

spective country. This is measured not only by the market share itself but also by the deposit spread. In Hungary, it appears that market share is correlated with deposit inflows, whereas in Romania, there is a significant negative association for customers with large deposit amounts. The deposit spread illustrates how banks transfer the market rate to their customers. Figure 2 reveals that the deposit spread is positive for Austria and predominantly negative for Hungary, especially after the Corona outbreak, and negative for Romania. The positive deposit spread for Austria indicates that the deposit rate is higher than the market rate. Since the observed coefficient is mostly negative, it suggests that as the deposit spread increases, the deposit flows decrease. For Hungary and Romania, we mostly observe a negative deposit spread. In Hungary, the deposit spread is negatively associated with deposit flows, which also decrease. In conjunction with Figure 2, the Hungarian bank's acceptance of a negative spread could be to increase the deposit inflows. Romania shows a significant reverse effect compared to Hungary, particularly for bank customers belonging to account balances of the lower 80%.

Since our data set covers a substantial portion of the start of the Corona crisis, we also account for this effect using the stringency index. As described in Section 4.2, we hypothesize that due to state aid programs, an increase in deposit inflows is expected. However, the stringency index only proves influential for high-wealth customers in Austria. However, for those customers the effect is as anticipated.

Additionally, with the inclusion of GDP as a macroeconomic influence, we gain insights into how depositors respond to economic fluctuations. Our analysis reveals a negative correlation between the differences and the GDP for less wealthy customers in Hungary and Romania. Intriguingly, this relationship undergoes a shift, manifesting as a positive correlation for all Romanian customers between variations in deposit amounts and GDP lagged by one month. The research by Iyer et al. (2023) illustrates that a downturn in economic activity corresponds to diminished bank liquidity, contributing to heightened deposit withdrawals and increased deposit rates. In our findings, this association is primarily evident with a time lag.

Table 2: **Log Difference Amount Euro as Dependent Variable.**
This table reports the dynamic GMM results with the customer's deposit rate differential as dependent variable. The numbers in parenthesis show the respective z statistic. ***, **, * indicate the significance of the regression coefficients at the 1%, 5% and 10% level. These statistics apply to the horizon between Q2 2018 - Q4 2020.

	Austria		Hungary		Romania	
Coefficients	0-80th Percentile	80-100th Percentile	0-80th Percentile	80-100th Percentile	0-80th Percentile	80-100th Percentile
Money Market Rate	−0.0285	0.0306	−0.0463	0.0827	−0.0190	-0.2294
	(0.0195)	(0.1167)	(0.0627)	(0.3304)	(0.0192)	(0.1481)
Money Market Rate (Lag 1)	0.0111	0.0770	−0.0396	−0.0850	0.0138	0.0433
	(0.0231)	(0.1296)	(0.05)	(0.3309)	(0.0184)	(0.2117)
Quarterly GDP	0.0067	−0.0279	-0.1795^{***}	0.1759	-0.0466^{**}	-0.0723
	(0.0084)	(0.0464)	(0.0434)	(0.2240)	(0.0211)	(0.1098)
Quarterly GDP (Lag 1)	−0.0011	0.0616	0.0369	0.1583	0.0385^{*}	0.3108^{***}
	(0.0088)	(0.0501)	(0.0377)	(0.2525)	(0.0208)	(0.1136)
Deposit Insured	-0.0225^{***}				0.0054	0.55^{***}
	(0.0067)				(0.0132)	(0.1579)
Deposit Part. Insured	0.0099	−0.0193	−0.0012	0.1896	0.0498^{***}	0.2857^{***}
	(0.0079)	(0.0844)	(0.0363)	(0.3984)	(0.0138)	(0.1371)
Domestic Headquarter	0.0125	-0.1080^{*}	−0.277	0.3654^{**}	−0.0170	0.2559^{*}
	(0.0125)	(0.0565)	(0.1768)	(0.1721)	(0.0703)	(0.1516)
Stringency Index	−0.0001	0.0033^{***}	−0.0014	0.0011	−0.0001	-0.0034
	(0.0004)	(0.0017)	(0.0019)	(0.0167)	(0.0005)	(0.0041)
Market Share	−0.0031	0.0262	0.0617^{***}	0.5858^{**}	−0.0174	-0.4106^{***}
	(0.0108)	(0.0592)	(0.0238)	(0.2697)	(0.0128)	(0.1145)
Date Customer Since	0.0002^{*}	0.0102^{***}	0.0058^{***}	-0.0532^{*}	0.0014^{**}	-0.0086
	(0.0001)	(0.0018)	(0.0015)	(0.0293)	(0.0006)	(0.0057)
Deposit Spread	−0.0053	-0.0112^{***}	-0.0098^{***}	-0.0374^{**}	0.0054^{**}	-0.0037
	(0.0013)	(0.0012)	(0.0016)	(0.0155)	(0.0022)	(0.0047)
Months Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Number of Bank Customers	8,318	1,874	439	125	6,797	1458
Number of Observations	176,433	23,873	9,295	962	138,043	15142
Wald Test	$7{,}388.4^{***}$	90.65	$2{,}296.9^{***}$	$23{,}547^{***}$	$8{,}432.4^{***}$	212.89^{***}
J-Test	217.08^{***}	63.130	74.32	8.33	319.79^{***}	82.84
AR(1) Test	-4.901^{***}	−0.71602	-5.6612^{***}	0.4777	-4.7662^{***}	-2.6411^{***}
AR(2) Test	-3.4393^{***}	−1.2037	-1.8275^{*}	−0.7824	-3.9527^{***}	-0.8604
AR(3) Test	-3.2429^{***}	−0.27511	-5.1786^{***}	0.9321	-5.1188^{***}	-2.0777^{**}
AR(4) Test	-4.9962^{***}	−1.108	-2.254^{**}		-8.4949^{***}	1.2506
AR(5) Test	-6.8699^{***}	−0.1021	-1.6758^{*}		-1.7681^{*}	-0.9168
AR(6) Test	−1.6225	−1.0054				

In addition to analyzing the monetary shifts in our sample, we delve deeper into the covariates affecting the deposit rate offered to corporate customers (Table 3). Since we observe customers in our sample not experiencing a change in the deposit rate, we exclude them from our analysis at this point. Similar to our considerations regarding differences in deposit amounts, we posit that variables defining the bank-customer relationship play a pivotal role in determining deposit rates. Specifically, we hypothesize that customers with a prolonged relationship with the bank, and those headquartered in the same country as the bank, should receive higher interest rates (**H3** and **H4**).
In Romania, we observe a statistically significant relation between a domestic headquarters and a higher interest rate, validating H3 in this case. However, the bank-customer relationship duration does not reveal statistically robust results, meaning we cannot confirm H4. Furthermore, we believe that banks might pay

higher deposit rates to customers with larger deposit amounts. Thus, we use the uninsured deposit amount, which is the deposit balance above 100,000 Euros, to control for this effect. We observe significant positive effects for Austria and Hungary, indicating that customers with larger deposit amounts receive higher deposit rates. Two plausible explanations arise from this scenario. Firstly, the bank may be adjusting for the elevated risk to which these customers are exposed. Alternatively, it could be a strategic response to customers exercising higher leverage against the bank, leading to negotiations for higher deposit rates. We also account for the effect of the Corona crisis, proxied by the stringency index, on the deposit rate. But only Hungary shows a slightly positive coefficient. Considering the research by Iyer et al. (2023), our study fails to validate their hypotheses regarding a negative relationship between GDP and deposit rates. In our investigation, the sign of the relationship between the deposit rate and GDP varies across countries.

Table 3: **Average Customer Deposit Rate as Dependent Variable.**
This table reports the dynamic GMM results with the customer's deposit rate differential as dependent variable. The numbers in parenthesis show the respective z statistic. ***, **, * indicate the significance of the regression coefficients at the 1%, 5% and 10% level. These statistics apply to the horizon between Q2 2018 - Q4 2020.

Coefficients	Austria	Hungary	Romania
Money Market Rate	-0.0009^{*}	0.0037	0.0036^{**}
	(0.0006)	(0.0066)	(0.0014)
Money Market Rate (Lag 1)	0.0009^{*}	-0.0441^{***}	−0.0008
	(0.0005)	(0.0085)	(0.0013)
Quarterly GDP	0.0010^{***}	-0.0358^{***}	0.0000
	(0.0002)	(0.0063)	(0.0014)
Quarterly GDP (Lag 1)	-0.0007^{***}	0.0227^{***}	0.0002
	(0.0002)	(0.0040)	(0.0014)
Domestic Headquarter	0.0015	0.0225	0.0159^{***}
	(0.0011)	(0.0259)	(0.0033)
Market share	0.0000	0.0016	0.0015
	(0.0003)	(0.0030)	(0.0010)
Date Customer Since	0.0000^{***}	0.0001	-0.0002^{*}
	(0.0000)	(0.0002)	(0.0001)
Deposit Insured	0.0020^{***}		0.0043
	(0.0007)		(0.0026)
Deposit Part. Insured	0.0031^{***}	−0.0058	0.0036
	(0.0008)	(0.0046)	(0.0026)
Uninsured Deposit Amount	0.0001^{**}	−0.0003	0.0003^{*}
	(0.0001)	(0.0003)	(0.0002)
Stringency Index	0.0000^{**}	0.0009^{***}	0.0000
	(0.0000)	(0.0027)	(0.0000)
Months Dummies	Yes	Yes	No
Intercept	Yes	Yes	Yes
Number of Bank Customers	2,483	157	983
Number of Observations	64,472	4,146	29,301
Wald Test	$29{,}493^{***}$	$1{,}415.4^{***}$	$23{,}625^{***}$
J-Test	147.94	24.198	27.897
AR(1) Test	-4.6708^{**}	−0.018	−0.25858
AR(2) Test	0.74728	−0.421	-1.8303^{*}
AR(3) Test	−0.23416		2.2958^{**}
AR(4) Test	3.6977^{***}		−0.759
AR(5) Test	0.25985		−0.759
AR(6) Test	1.5442		−0.759

8. Conclusion

In this study, we follow these findings derived from prior studies analyzing private bank customers. Through our analysis, we aim to determine whether these findings apply to corporate customers as well. While many of these studies use bank-level data, our unique data set allows us to discern effects at the customer level across three different banks. The timeframe of our data set further enables us to look into the infuence of corona policies on corporate depositors.
Our findings indicate that customer-specific variables, such as the duration of the business relationship and the location of the headquarters, significantly influence both the deposit flows and the deposit rate. While we observe that in most cases a longer bank-customer relationship is positively associated with deposit flows, validating **H2**, a domestic headquarters is primarily associated with deposit inflows for customers with high deposit amounts (**H1**). However, the effects of the banking customer relationship are less pronounced when we control for the deposit rate. In this context, we only observe that in Romania, customers with a domestic headquarters seem to receive a higher deposit rate, while customers with a long-standing business relationship with the bank receive a slightly lower deposit rate. Thus, we cannot validate **H3** and **H4** for corporate customers.
Beyond the variables used to control our initial hypotheses, we introduced additional covariates to examine deposit flows and changes in deposit rates. Deposit flows appear highly responsive to the deposit spread. This is particularly interesting for Hungary, where we observe a decreasing deposit spread overall and a negative coefficient in the panel model. This suggests that as the deposit rate decreases, the difference in account balances rises. Consequently, the bank seems to accept a decreasing deposit spread to achieve higher deposit inflows. A contrasting effect is observed in Romania among customers with lower account balances. In Austria, we also observe a negative coefficient of the deposit spread. Moreover, the Hungarian branch of the bank seems to capitalize on its market share to attract higher deposit inflows. Another notable observation is that in both Austria and Romania, higher bank account balances are associated with higher deposit rates. This indicates that banks might offer more attractive rates to wealthier customers. However, contrary to our initial hypothesis (H5), the Corona crisis does not appear to have a significant impact on either deposit flows or deposit rates.
In summary, our findings suggest that domestic corporate customers with a long-standing relationship with the bank tend to be associated with an increasing amount of deposits, even through an economic crisis, facilitating the bank's liquidity management. This means, that only specific patterns of corporate de-

positors are similar to the ones academic literature found for private customers. Given these findings, there is a compelling case for adjusting regulatory instruments, particularly those related to liquidity risk management. Although the bank cannot directly control deposit flows, it can manage the deposit rate and use it as an incentive to attract customers. While the effects of the customer-relationship variables are less pronounced, banks appear to offer higher deposit rates to wealthy customers.

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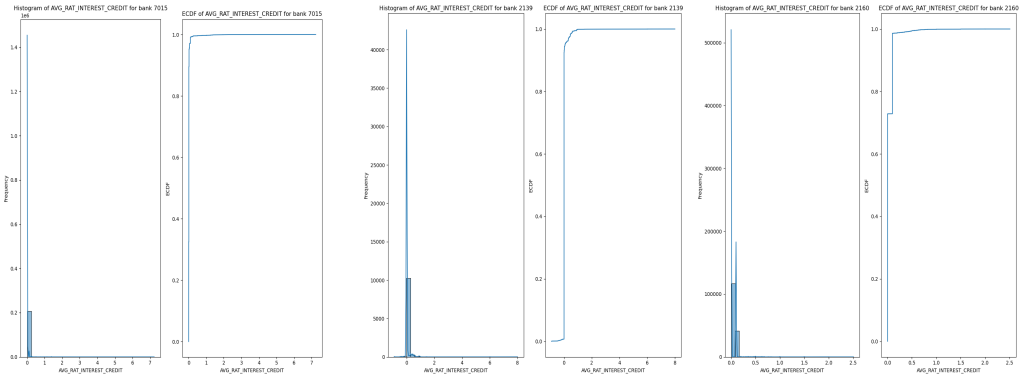
Appendix A. Histograms and Empirical Density Function for i) the Differences in the Month-to-Month Deposit Balance Changes and ii) the Deposit Rate.

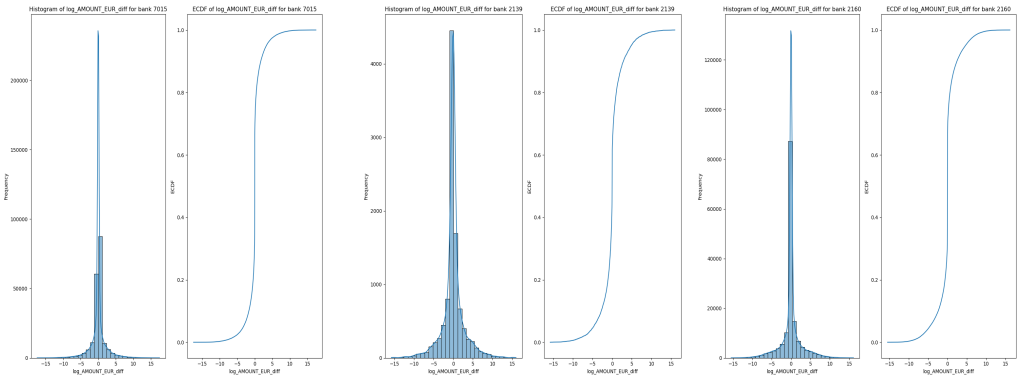


(a) Distribution of the average deposit rate in Austria.

(b) Distribution of the average deposit rate in Hungary.

(c) Distribution of the average deposit rate in Romania.

Figure A.1: Histograms and Empirical Density Function of the Average Deposit Rate for all three Countries.



(a) Distribution of the deposit flows in Austria.

(b) Distribution of the deposit flows in Hungary.

(c) Distribution of the deposit flows in Romania.

Figure A.2: Histograms and Empirical Density Function of the Deposit Flows for all three Countries.