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BANKS' OPERATIONAL RESILIENCE DURING PANDEMICS

by Cristina Demma*, Giovanni Ferri§, Andrea Orame¥, Valerio Pesic❖ and Valerio Vacca**

Abstract

Using the unanticipated and exogenous Covid-19 shock as a unique laboratory, we address the topic of business continuity at banks, where limitations to social mobility hindered the provision of branch-executed services. Namely, we conjecture that business resilience was higher if a bank had previously invested heavily in IT to increase its degree of digitalization, shifting more customers from branch- to online-executed services. In particular, we speculate that such investments should unfold greater readiness in migrating retail customers towards online payments during the pandemic, confirming that IT investments contribute to operational resilience. Exploiting thinly disaggregated supervisory data, our empirical analyses provide robust support to our hypothesis. Hence, digitalization seems to breed resilience at banks against unforeseen natural events; this corroborates the usefulness of technological investments also as an insurance against unpredictable risks and indirectly confirms the complementarity of the twin Green-Digital transition.

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1. Introduction

The Covid-19 crisis managed to promptly attract the interest and the efforts of the economic research community. This may be descending from the nature of the crisis, which was first and foremost human and health-related, but with very significant economic consequences. The resulting economic crisis has, in fact, been compared to the Great Crash of 1929 and to the Global Financial Crisis (GFC) of 2008, with which it shares some characteristics that make it particularly insightful for researchers. Indeed, all crises represent exogenous shocks, which can be investigated by researchers as quasi-natural experiments, to properly address endogeneity problems (Berger and Demirgüç-Kunt, 2021).
Accordingly, the Covid-19 crisis stands out vis-à-vis all preceding crises, as it was even more global than the GFC, it featured the largest and most unanticipated external economic shock of all times, and it hit both industrialized and developing countries. Covid-19 spread recessions all around the world, prompting a quick, broad and bold array of public policy responses.
The actions taken to limit the diffusion of the disease were the most important interventions, forcing many governments to implement various forms of lockdown and having a significant impact on all economic activities that depended on interpersonal relationships.
For this reason, the Covid-19 crisis provides a quasi-natural experiment with a significant exogenous shock capable of affecting the worldwide real economy and financial sector. More specifically, due to the impacts it has caused in terms of reduction in traditional banking operations carried out through branches, we investigate how banks were able to react promptly to the lockdown conditions, (further) moving customer services to digital channels.
Indeed, the specific features of the Covid-19 shock led to a situation endangering the business continuity of the banking activities. The limitations to social mobility caused by total or partial lockdowns made it impossible or more difficult for a bank to keep serving the customers through branch-executed services. Thus, we conjecture that business continuity could have been enhanced if the bank had previously made heavy IT investments to increase its degree of digitalization. Digitalization would make bank's service provision more resilient because of two main reasons. First, the bank would have shifted its organizational structure and product mix in a way to intensify the supply of digital services, whose functionality was unaffected by social distancing. Second, together with that shift, the bank would have likely educated and nudged its customers to move from branch- to online-executed services.

Against that background, this paper asks a simple question: Were more digitalized banks better able to withstand the Covid-19 perturbation and to enjoy business continuity?

The issue of business continuity is as relevant as it is difficult to investigate, as it is not easy to find exogenous shocks that can affect several banks simultaneously and almost homogeneously, in such a way as to verify how the different organizations have managed to react. The Basel Committee on Banking Supervision (BCBS) published its Principles for Operational Resilience – POR in March 2021 (see BCBS, 2021). They are based on the previous BCBS (2011) document "Principles for the sound management of operational risk" which was first released in 2011 and has since undergone numerous revisions. Whilst the 2011 Principles set up a more general framework for operational risk management, the POR aim to advance a principles-based approach to improving operational resilience as a result of effectively managing operational risks that may arise from disruptions like pandemics, natural disasters, cyberattacks, or technological failures. That latter approach clearly reflects banks' experiences during the Covid-19 pandemic and the critical role that banks play for the provision of financial services.

By and large, banks demonstrated great organizational adaptation during Covid-19 in response to new dangers and hazards that arose in various parts of their organization. Banks' operational resilience evolved along with their capacity to withstand, adapt to, and recover from a number of those threats. This capacity enables banks to limit detrimental impacts as a result of the wide range of solutions provided for guaranteeing business continuity during the pandemic.

BCBS (2021) defines operational resilience as a bank's ability to deliver critical operations in the face of disruption. By this perspective, an operationally resilient bank is less prone to incur untimely lapses in its operations and losses from disruptions, thus lessening the impact of incidents on critical operations and related services, functions and systems. This operational resilience is influenced by various factors, including the degree of process automation and the extent to which technology is used in the financial services industry as a whole, and at single banks. In spite of being itself a source of potential operational risk (e.g. due to cyber-attacks or systems' unavailability), technology could have enabled the ongoing provision of services to clients and enhanced banks' capacity to carry on business throughout the epidemic.

Awareness of the relevance of technology in bank management goes back a long way. Disruptive innovation in the banking industry is becoming more and more likely thanks to the rise in Internet usage and other quickly developing technologies like cloud computing or artificial intelligence. The ways in which financial services are offered and sought for are changing as a result of advancements in information technology tools and infrastructure. While new tech competitors enter the market and use their path-breaking operational and business models to gain ground in traditional banking activities, such as lending and payment services, incumbent banks embrace digital transformation to remain competitive.

Although technology adoption in the Italian financial sector is spreading quickly, banks' use thereof it is greatly heterogeneous (Bank of Italy, 2021). While big intermediaries have heavily invested on digitization, smaller institutions are also making major strides to keep up with technological changes (Arnaudo et al., 2022). All banks struggle to stay up with rapid innovation due to a variety of issues, such as the need to cope with legacy systems, to invest in staff training and in technological capabilities, and to adjust organizational structures.

The Covid-19 pandemic has provided a real-world test for banks' digital proficiency. Financial institutions were compelled to reconsider their staffing strategy and a distribution network that could no longer meet client expectations due to infection risk and compliance with social segregation rules. The pandemic-caused crisis offers the perfect context for determining where banks are on the scale of digital preparedness and the implications this has for their provision of financial services.

Substantial changes in many economic sectors, including financial services, occurred within the spreading of Covid-19 in Italy, which has had a significant impact on the evolution of consumer spending behavior (Buono and Conteduca, 2020). During the second quarter 2020, bank branches recorded up to 90% fewer operations in contrast to an increase in engagement on digital channels as a result of the forced migration to online channels. Financial institutions' resilience has been subjected to considerable pressure, and institutions have had to evaluate their operating procedures to maintain the effectiveness of even the most basic operations in a novel situation.

On March 9, 2020, Italy entered a state of "lockdown" entailing social distancing measures. This is a path similar to other countries, although in Italy the restrictiveness of government policies has been often recognized as stronger than in other countries (Conteduca et al. 2020). The lockdown marked the beginning of a process that would profoundly alter how people lived their everyday lives and, consequently, how they interacted with one another and made their purchases. Covid-19's first effects impacted people's basic necessities, which in turn affected how consumers perceived their own and others' health. Consumers' concern then centered on the detrimental economic effects of this time period and on job security, in part owing to the considerable media debate that erupted concerning the effects of the lockdown on the country's

economy. As a result, consumer purchasing decisions have been influenced by these economic worries; customers also realized that they must quickly alter their purchasing patterns in order to replace services they previously used in-person at the branch with new online channels. This is also true with regard to the use of banking services. Some needs could be considered as discretionary, for which the restrictions due to the pandemic led to less use by banking customers, but, by contrast, some more pressing needs (e.g. to perform daily payments) required a conversion to digital also by users who until that time had not yet used this channel.

Our view is that banks that in the pre-Covid years had increased their degree of digitalization could respond to the change more quickly, offering a replacement service as soon as their physical branches had to shut down. The other banks possibly managed to reduce the gap with some delay. However, in our opinion, having a shorter adaptation lag is a crucial factor to be evaluated, notably when basic banking services like payments are concerned, and can serve as a first indication of operational resilience, i.e. a capability to avoid pausing the distribution of financial services.

This level of response must, of course, be assessed in the context of the key role that the branch formerly had for clients as a preferred commercial channel, particularly for the handling of complex requests, for specialized consulting and for the less technologically and financially educated customers. After the Covid outbreak, Italian banks were exposed to simultaneous and contrasting pressures: the operational restrictions came at a moment where banks were required to increase, rather than reduce, the provision of some services, notably the extension of credit, including state-guaranteed loans, to support firms' and households' liquidity in lockdown. Italian banks were compelled to drastically limit both the number of branches they could keep open during the shutdown, and the number of customers allowed to simultaneously access the branch, which had a direct impact on how many transactions consumers made in person. In other words, the need to deal with pressures aimed at encouraging the banking system to disburse credit, as well as the requirement to ensure the ability to carry out daily customer support activities remotely, has required a leap forward in the adoption of digital solutions in customer relationships.

Moving from this perspective, our paper explores the role of a bank's digitalization in boosting its operational resilience and business continuity during the pandemic. In particular, looking at (otherwise comparable) banks with varying levels of pre-pandemic digitalization, we focus on the most basic services provided by banks to their customers, as those where the ability to rapidly switch to online supply might concretely represent the concept of operational resilience. In particular, we examine whether pre-pandemic digitalization correlates with the share of online bank transfers made by retail customers during the crisis as a proxy for the ability of banks to satisfy retail consumers' desire for an effective payment system even during the pandemic crisis.

In order to achieve this, we present a new database with comprehensive data on bank propensity to innovate. We merge these data with the number of retail bank transfers performed during the peak of the Covid-19 pandemic. We have considered retail transfers rather than corporate ones, as the former have reacted more strongly than the latter to the pandemic crisis. This can certainly be traced back to the difficulties of physical access to branches experienced by retail customers during the lockdown, while corporates already exploited the online channel more intensively before the pandemic. Therefore, the lower degree of diffusion of the online channel among retail customers before the pandemic crisis, together with the severity of the measures that have been put in place to contain infections, contribute to making our analysis relevant to verify empirically how bank digital preparedness contribute to their capacity and operational continuity.

Since the increase in the share of online bank transfers is linked to the trend of the effects of the pandemic, we decided to include a check aimed at verifying how much this increase is due to the increased demand from customers. For this reason, these data are integrated with the

information collected by Google Trends, which enables us to check the intensity of the demand for banking services recorded in Italian areas during the various phases of the management of the pandemic crisis. Through the analysis of the most researched words amid the most acute phases of pandemic, we are able to verify which banks were ready to respond more promptly for requests of payment services with the online channel.
The present paper aims to provide different novel contributions to the economics and banking literature (see also the next Section). First, we add to literature that has recently analyzed the impacts of Covid-19 on the operations and profitability of banks. So far, this literature has focused on the impacts that the health crisis, and the restrictive measures adopted to contain the contagion, have determined above all on the lending capacity and on the quality of credit portfolios. In our case, we focus on the effects that the health crisis has had in terms of shifting a relatively large part of its customer relationships from branch- to online-executed services. Second, we contribute to the literature aiming to assess the impact that investments in technology can determine for banking activity in order to improve operational performance and productivity. In this regard, although the literature over the years has above all analyzed the impacts of technology on banks' efficiency and productivity, the acceleration in technological change which has affected the banking system in recent years requires further investigation. Third, by considering the exogenous shock determined by Covid-19, with its limitations to social mobility caused by total or partial lockdowns, we provide a quasi-natural experiment to test the operational resilience of banks. We consider the degree of digitalization reached by Italian banks in the previous years, as it is represented in a survey by the Bank of Italy among a large sample of banks, in order to investigate how the digital transformation supported the resilience of the Italian banking industry during the Covid-19 crisis.
We consider the Italian case, which in our view is able to provide general insights for two reasons. First, bank branches constitute a fundamental element of the commercial strategy of the Italian banks, with a capillary positioning on the territory, which is particularly useful for carrying out an analysis of how the lockdown has impacted on different territories. Second, Italy from the first months of 2020 was one of the countries most severely affected by the pandemic, and became the first European country to implement unprecedented measures to restrict individual mobility, and to promote social distancing (Pepe et al., 2020). Those initiatives recorded a different intensity in the various Italian regions according to the need to mitigate the pressure on national health systems (Vinceti et al., 2020), and can be considered as a measure of the intensity of the lockdown, in order to verify the banks' operational resilience capacity leveraging the heterogeneity of the local environments where banks worked.
The remainder of the paper is organized as follows. In Section 2 we provide a brief summary of the literature developed around the Covid-19 theme. Section 3 describes the data used in our study and provides summary statistics concerning the impact of Covid-19 upon the diffusion of digital payments in Italy. In Section 4 we describe the methodology of our study and the results of our empirical analyses, whose robustness is checked in Section 5. Section 6 concludes bearing the main evidence of our estimations to their policy implications.

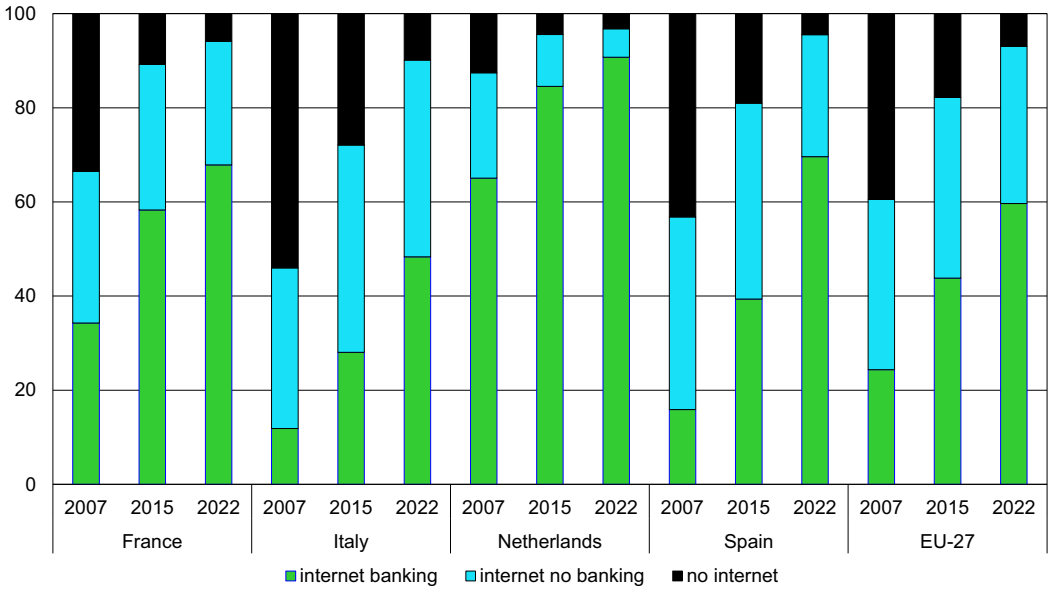
2. Covid-19 in banking economic literature

Despite the short time span, the Covid-19's significant impact on the global economy contributed to attract interest from the economic literature (Berger and Demirgüç-Kunt, 2021). A first line of research can be traced back to the objective of evaluating the general impacts that Covid-19 has had on the economic and financial systems. In these terms, several papers have analyzed how Covid-19 is expected to impact banks' behaviors, since financial sector, and banks in particular, have been requested to play a key role by supplying funding to corporate

sector (Acharya and Steffen, 2020; Borio, 2020; Albanese and Ciocchetta, 2021; Kahn and Wagner, 2021; Park and Shin, 2021; Temesvary and Wei, 2021; ICC, 2022). Others highlighted how banks' stocks underperformed relative to other publicly traded companies and to non-bank financial institutions (Aldasoro et al., 2020; Borio, 2020; Gormsen and Koijen, 2020; Ramelli and Wagner, 2020; Rizwan et al., 2020; Acharya et al., 2021; Demirgüç-Kunt et al., 2021). Several papers outlined how Covid-19 could potentially impact banks' loans quality (Carletti et al., 2020b; Özlem Dursun-de Neef and Schandlbauer, 2021; Couaillier et al., 2022), although it is largely acknowledged that credit deterioration tends to surface with a significant lag (Gourinchas et al., 2020; Banerjee et al., 2021, Tan et al., 2021). Other papers have focused on a broader perspective, analyzing the impacts of Covid-19 on consumer consumption and highlighting across different countries a spending drop mostly concentrated on goods and services whose supply was directly restricted by the shutdown or examining consumption habit changes on the way consumers use services (Baker et al., 2020; Buono and Conteduca, 2020; Coibon et al., 2020; Chetty et al., 2020; IMF, 2020; Carvalho et al., 2021; Chen et al., 2021; Andersen et al., 2022).

These changes in consumer habits have naturally also affected the way in which banking services are used, with a significant shift from the traditional to the online channel. This change seems to have been particularly significant in Italy, where retail customers featured one of the lowest propensities towards the digital channel among European countries (Figure 1). As can be deduced from the most recent Eurostat statistics, this gap appears to have been considerably reduced after 2020, testifying that Italian banks were able to cope with the new demand for technological services from their customers.

Figure 1. The diffusion of internet and internet banking among the European countries



Source: Eurostat

(1) The data concerns the main EU-countries for which perfectly comparable data over the period 2007-2022 are available.

The banks' ability to cope with the changed demand for services from customers must certainly be put into relation with the investments in technology made by the banks in previous years (Arnaudo et al., 2022). A second stream of the literature has analyzed how business models characterized by a higher degree of technological innovation have managed to ensure greater continuity in credit supply (Mocetti et al., 2017; Berg et al., 2020; Branzoli et al., 2023). Some of these studies have assessed whether the role of Fintech has contributed to generating greater

bank resilience (Carletti et al., 2020a; Barkley and Schwitzer, 2021; Schmidt-Jessa, 2022; Stulz, 2022). To the best of our knowledge, this is the first paper aiming to investigate empirically the impact that Covid-19, with its limitations to social mobility caused by total or partial lockdowns, determined by shifting a relatively large part of banks' customer relationships from branch- to online-executed services.

According to the literature, it could be argued that the need to manage the pandemic crisis has been a factor in proof of how digitalization has contributed to improving banks' operations. In the past the issue of technology had been analyzed above all with regard to the ability to contribute to the greater efficiency of banking organizations (Casolaro and Gobbi, 2007; Borello et al., 2022) and to the improvement of their performance, in terms of profitability or productivity (Berger, 2003; Beccalli, 2007; Martin-Oliver and Salas-Fumas, 2007; Scott et al., 2017).

Finally, Covid-19 has broadened the perspective. The increased awareness of how technology is relevant to ensure business continuity during a crisis of particular impact has given rise to a new stream of analysis, building on the extant body of research (Coelho and Prenio, 2020; Cicchiello et al., 2021; Dadoukis et al., 2021). Whilst Coelho and Prenio (2020) discuss theoretically the implications of ICT for ensuring financial institutions' business continuity, Cicchiello et al. (2021) and Dadoukis et al. (2021) investigate how ICT diffusion among European banks contributed to reduce stock market volatility. Within this context, our paper represents the first attempt to investigate how ICT investments contribute ensuring business continuity from an operational perspective.

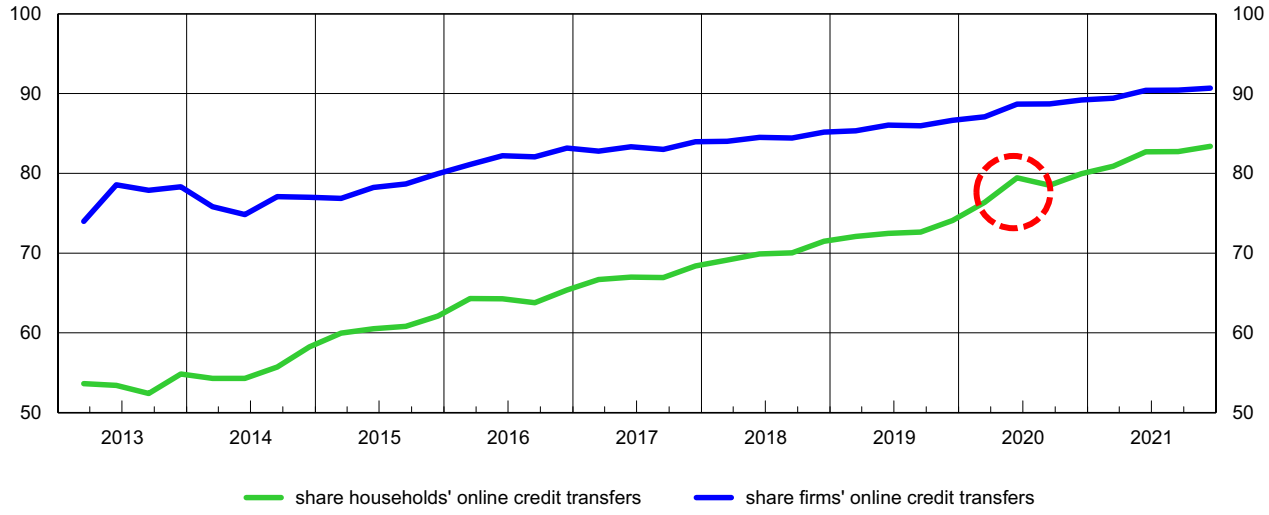
The papers that have analyzed the impacts of Covid-19 on banks have evaluated the financial and operational performance of the banks, without addressing the changes that the pandemic have determined on customers' attitude towards banking services. Conversely, our work, through the analysis of the share of online transfers, aims to concretely analyze the operational resilience demonstrated by the banks thanks to the degree of digitalization they had achieved. This evidence could be useful to inform policymakers' efforts: following the emergence of the pandemic crisis, the BCBS began working to stimulate banks to reflect on the main reinforcements to be undertaken to guarantee adequate operational resilience. The Principles for Operational Resilience (BCBS, 2021) are therefore to be considered as the beginning of a potential supervisory path in order to enhance, in the coming years, banks' ability to manage disruptive events impacting their ability to deliver critical operations.

3. Description of the dataset and methodology of analysis

In this work, we use quarterly data on online credit transfers ordered by households in Italy between 2019 and 2020. Thus, we can test bank operational resilience during the Covid-19 crisis, erupted in the second quarter 2020, in serving customers. Households increasingly relied on remote banking in 2020, as social distancing measures and free movement limits were imposed to contain the spread of the virus. In fact, Figure 2 shows that in 2020 the share of households' online credit transfers over total credit transfers increased above and beyond the long-run upward trend. In other words, habits were forced to change by the Covid-19 shock, even for customers that would have never, or only slowly, changed their preferred means of using bank services. Therefore, we focus our attention specifically on this second quarter 2020, in order to assess how banks were able to react promptly to the lockdown conditions, ensuring that retail customers were able to use online bank transfers instead of the traditional branch activity. Banks' performance in later quarters can be deemed to be affected by the unfolding of some catching up from the part of the 'technological laggards', as longer periods after the unexpected shock allowed some degree of adaptation to a changed environment. Hence, looking at longer time periods would blur the quasi-natural experiment represented by the

sudden break-up of the contagion. Moreover, the interpretation of data from the second quarter 2020 as a test for operational resilience is indirectly confirmed by the fact that the share of on line transfers receded in the third quarter of that year, when mobility restrictions were somewhat loosened.

Figure 2. The share of online credit transfers
(percentage values)



Source: Bank of Italy's Supervisory Reports

To perform our empirical analysis, we build a rich bank-province-time dataset combining different sources of information.
Our dependent variable is the share of online credit transfers on total transfers ordered by Italian households, which is drawn from the Bank of Italy's Supervisory Reports. In order to assess the role of banks' digitalization in boosting operational resilience and business continuity during the pandemic, we could have looked at the capacity of banks to supply different services such as firm or household credit. We have chosen not to analyze loans to households given that both mortgages and consumer credit significantly slowed down during the most acute phase of the Covid-19 pandemic, essentially driven by weak demand. While the literature had already focused on the relationship between IT investments and firm credit, that sharply increased during the pandemic (Branzoli et al., 2023), we focus on the payment segment since the need of customers to make payments to settle economic transactions continued to be pressing also during the pandemic.
To explore the determinants of the share of technologically advanced transfers, we combine these data with: a) the degree of bank digitalization, computed through the results of the Regional Bank Lending Survey (RBLS)[1] carried out by Bank of Italy; b) bank-level data (drawn from the Bank of Italy's Supervisory Reports) to control for banks' structural features and performances; c) the restrictions imposed by national and regional Governments to face the spread of Covid-19; d) population's digital skills in the relevant areas, to control for the ability of people to use Internet to make payments; e) information on the online search for digital payment services, drawn from Google trends data, to control for demand-driven factors.
We estimate the following model:

[1] The RBLS is a survey conducted by the Bank of Italy's regional branches on a sample of around 280 Italian banks which covers almost 90 percent of deposits and 85 percent of loans to firms and households. A section of the RBLS focuses on the digital transformation of the banking system and includes questions on the relationship with the Fintech industry.

$$Online\_credit\_transfer\_share_{b,p,t} = \alpha + \beta_1 Online\_credit\_transfer\_share_{b,p,t-1} + \beta_2 Online\_credit\_transfer\_share_{b,p,t-2} + \sigma Fintech_{b,a-1} + \lambda Lockdown_t + \delta X_{b,a-1} + \Delta Demand_{p,t-1} + \varepsilon_{b,p} \quad (1)$$

where:

- b is the bank, p is the province, t denotes each quarter during the period 2019-2020, while a denotes each year of the period of analysis;
- the dependent variable *Online_credit_transfer_share* is the share of online credit transfers on total credit transfers ordered by households, that is an information drawn from Bank of Italy's Supervisory Reports. Every quarter banks and financial intermediaries have to report to Bank of Italy data on cashless payments made in each province by their customers and, among these, credit transfers detailed by execution channels (online vs other channels);
- *Fintech* is the key explanatory variable we focus on and is a dummy variable, drawn from the RBLS, assuming the value 1 if the bank invested in Fintech projects in a given year *a-1* and 0 otherwise. Therefore, the key coefficient we are interested in is σ, for which we expect a positive sign;
- *Lockdown* is a dummy variable taking the value 1 during the second quarter of 2020 and 0 for the other quarters. As a first approximation, we use a homogeneous lockdown indicator across the Italian regions, while we employ finer regional-specific dummies for robustness checks (see next section [5]);
- X is a vector of bank-level yearly controls related to banks' features, which according to the extant literature could affect the dependent variable. These control variables are: size (as the log of total assets), capitalization (as the total capital ratio), profitability (measured by Return on Assets, ROA), portfolio riskiness (measured by the NPL ratio), liquidity (measured by the ratio between cash – cash on hand, balances at central bank and other demand deposits – and total assets) and the composition of retail funding (share of bank deposits held by households on total bank deposits);
- *Demand* is a vector of controls for demand of digital payments that increases as mobility restrictions during Covid and population's digital skills increase. Furthermore, searching the web for information about the possibility of making payments or relying on an online bank is a direct measure of the demand for banking services. More in detail, for each quarter of the period of analysis we use: a) *Internet_daily* that is the share of people using daily Internet provided at regional level by Eurostat; b) *Credit_transfers_google, Online_account_google, Online_bank_google* that measure respectively how often the Italian words for "credit transfers", "online account" and "online bank" are searched on Google every quarter in each region (data drawn from Google trends). In order to avoid collinearity, we use alternatively the three Google trends indicators;
- $\varepsilon_{b,p}$ denotes the bank fixed effect, the province fixed effect and the error term. Errors are clustered at province level.

Please note that, among the potentially available regressors, we choose not to employ bank-specific ICT investment data, since we lack the information on whether the ICT investment is directed to provide new services to customers (which would have an impact in our analysis) or to other purposes, e.g., to strengthen the internal bank procedures, with no consequences on bank-customer relationships. On the opposite, the *Fintech* variable is more directly linked to projects for the development of new products and services with customers, very often in the field of e-money and payments, as can be verified from a series of surveys that the Bank of Italy carries out since a few years in the Italian banking system (Bank of Italy, 2021). The main

descriptive statistics of our variables are shown in Table 1. Since our dependent variable is characterized by high persistence, we estimate equation (1) using the generalized method of moments (GMM) estimator proposed by Arellano and Bond (1991), an approach that also takes care of endogeneity due to reverse causality and unobserved heterogeneity.

4. Main results

Table 2 (Columns (I)-(IV)) shows the estimates of Equation (1). The *Fintech* variable always has a positive and statistically significant sign, showing that banks that spent money in new technologies are able to offer better remote services to their customers, at least as proxied by online credit transfers. Note that the coefficient on *Lockdown,* a dummy that is equal to one in the second quarter of 2020, when the Covid crisis erupted and social distancing measure were introduced, has a positive and statistically significant coefficient. Not surprisingly, the crisis made remote banking even more important, as people were not allowed to move freely. As expected, the estimates indicate a strong persistence of the dependent variable.
The results are robust to the inclusion of additional variables aimed at controlling for the demand of online services, as approximated by Google searches of some keywords. In particular, we selected the word "bank transfers", "bank account" and "online bank" to construct our Google-based demand proxy. Not surprisingly, the coefficient is positive (Columns (II)-(IV)). In Columns (V)-(VIII) we further interact our measure of bank digitalization, *Fintech*, with the *Lockdown* dummy to capture how digital banks were able to support their customers during the Covid crisis with respect to less digital banks. The interaction coefficients turn out to be positive and significant: we interpret those estimates as a sign that banks that invest more in new technologies are not only ready to offer better services in normal times, but that they are also able to better support their customer when facing large and unexpected shocks like the Covid, making the entire economy more resilient to unexpected and adverse events. The sign of the coefficient suggests that the Covid shock widened the gap between heavy investors in Fintech and other banks in terms of enabling their customers to access online payment services.

5. Robustness checks

5.1 Alternative definitions of the key explanatory variable

We test the robustness of our main results using two alternative definitions of our key explanatory variable measuring the degree of bank digitalization, in addition to *Fintech*.
To this end, Table 3 shows the estimates of Equation (1) where the variable *Fintech* is substituted by *Digital_Supply*, that is the metric of digital transformation proposed by Arnaudo et al. (2022) using RBLS information. More in detail, *Digital_Supply* is an index ranging between 0 and 1 for each bank and grows with the number of digital services provided; the indicator is calculated as the equally-weighted average of seven dichotomous variables, one for each service considered in the RBLS (on-line payments, peer-to-peer payments, smartphone applications, asset management, mortgages to households, consumer credit and firm loans): these variables take the value of 1 if, in the relevant year, the bank supplies the service taken into consideration online and 0 otherwise. The index implicitly assigns the same importance to every service provided. To avoid simultaneous endogeneity problems, the variable *Digital_Supply* is lagged one year.
Our main findings are largely confirmed, showing that the online access to payment services was stronger for digital banks both in normal times and during the pandemic.
In unreported regressions the key explanatory variable *Fintech* is further substituted by the 1-year lagged value of another indicator of bank digital supply that is built departing from the metric proposed by Arnaudo et al. (2022). For each bank, this measure is computed as the

equally-weighted average of two dummy variables taking the value of 1 if the bank supplies, respectively, on-line or peer-to-peer payments and 0 otherwise, i.e. a subset of the variables used by Arnaudo et al. (2022). Again, our main findings are confirmed; however, the interaction between this metric and *Lockdown*, although positive, is not statistically significant.

5.2 Alternative definitions of Covid restrictions

We run Equation (1) also replacing *Lockdown* with $Red\_zone_{r,t}$, the share of days over the quarter in which each Italian region *r* was classified as red zone, i.e. the extreme-social-distancing periods. This variable, computed according to information of the Italian Ministry of Health, has the advantage of varying not only over time but also across regions.
Results are reported in Tables 4 and 5 and largely confirm our findings; note that the coefficient of the interaction between *Fintech* and *Red_zone* becomes not significant (Table 4, Columns (V)-(VIII)) while the interaction between *Digital_Supply* and *Red_zone* continue to be statistically significant[2].

5.3 Alternative time-period

We focus on a shorter period, between the second and the third quarter of 2020, when Covid restrictions were harder and the share of online credit transfer significantly increased.
Including only two quarters in our estimate time span, we can no longer estimate a dynamic panel model. We therefore estimate equation (1) using a pooled panel model where the dependent variable is again the share of online credit transfers on total transfers ordered by Italian households, while the key explanatory variable is alternatively *Fintech* or *Digital_Supply*.
Columns (I)-(VIII) of Tables 6 and 7 report the results where the variable measuring Covid restrictions is *Lockdown*, a dummy variable taking the value of 1 or 0 during the second quarter and the third quarter of 2020, respectively. The estimates largely confirm our main results: digital banks have succeeded more than the others to support the payments' activity of their customers during the pandemic with respect to less digital banks.
Our findings are confirmed also substituting *Lockdown* with the share of days over the quarter in which each region was classified as red zone (Tables 6 and 7, Columns (IX)-(XVI)).

6. Conclusions

Using the unanticipated exogenous Covid-19 shock as a unique laboratory, we addressed the topic of business continuity at banks, where limitations to social mobility hindered the provision of branch-executed services. Thus, we conjectured that business resilience could have been enhanced if the bank had previously made heavy IT investments to increase its degree of digitalization, shifting (or being ready to shift) a relatively large part of its customer relationships from branch- to online-executed services. In particular, we speculated that such an advantage should unfold greater timeliness in migrating retail customers towards online payments once the pandemic broke out, so to confirm the role of IT investments for ensuring their operational resilience.
In order to perform this analysis, we presented a new bank-province level database with comprehensive data on bank propensity to innovate. We merged these data with the number of retail bank transfers performed during the peak of the Covid-19 pandemic. We considered retail transfers rather than corporate ones, as the former have reacted more strongly than the latter to the pandemic crisis.

[2] In unreported regressions, also the interaction term between *Red_zone* and the metric measuring bank digitalization in payment services discussed in section 5.1 turns to be positive and statistically significant.

Since the increase in the share of online bank transfers is linked to the trend of the effects of the pandemic, we included a check aimed at verifying how much this increase is due to increased demand by customers. For this reason, these bank-province level data were integrated with the information collected by Google Trends, which enabled us to check the intensity of the customers' demand for banking services recorded in Italian areas during the various phases of the pandemic crisis.

The present paper aims to provide various novel contributions to the economics and banking literature. First, we add to literature that has recently analyzed the impacts of Covid-19 on the operations and profitability of banks. So far, this literature has focused on the impacts that the health crisis, and the restrictive measures adopted to contain the contagion, have determined above all on the lending capacity and on the quality of credit portfolios. In our case, we focus instead on even more basic bank-supplied services, and therefore on the effects that the health crisis has had in terms of shifting a relatively large part of its customer relationships from branch- to online-executed services. Second, we contribute to the research aiming to assess the impact that investments in technology can determine for the banking activity in order to improve operational performance and productivity. In this regard, although the literature over the years has mainly analyzed the impacts of technology on banks' efficiency and productivity, the acceleration in technological change which has affected the banking system in recent years requires further investigation. Third, by considering the Covid-19 exogenous shock, with its limitations to social mobility caused by total or partial lockdowns we provide a quasi-natural experiment to test the operational resilience of banks. We consider the degree of digitalization reached by Italian banks in previous years, as recorded in a Bank of Italy survey on a large sample of banks, in order to investigate how the digital transformation supported the resilience of the Italian banking industry during the Covid-19 crisis.

We interpret our estimates – which are unscathed by various robustness checks – as a sign that banks that invest more in new technologies not only manage to offer better services in normal times, but are also able to better support their customers when facing large and unexpected shocks like the Covid, thus making the financial system and the entire economy more resilient to unexpected and adverse events.

Hence, digitalization seems to breed resilience at banks against unforeseen natural events, thus indirectly confirming the complementarity of the twin Green-Digital transition. As far as the policy implications are concerned, our results suggest that authorities should encourage technological advancement in banking and finance also beyond short-term considerations in terms of profitability and competitive advantages; they should be cognizant that the benefits of ICT investments might surface in the (very) long run and as a response to inherently unforeseeable events. Such a long-run perspective is supported by our findings and could rationalize the proactive role that several public authorities are taking in recent years in catalyzing Fintech investments in their jurisdictions or at international level.

Tables

Table 1. Descriptive statistics

Variable	Year	Mean	Min	25° percent.	50° percent.	75° percent.	Standard deviation	Max	Number of observations	Frequency	Level	Source
Online_credit_transfers	2019	0,67	0,00	0,56	0,69	0,82	0,23	1,00	10.356	quarterly	bank-province	Supervisory reports
Online_credit_transfers	2020	0,74	0,00	0,66	0,77	0,87	0,22	1,00	10.170	quarterly	bank-province	Supervisory reports
Fintech	2019	0,29	0,00	0,00	0,00	1,00	0,45	1,00	274	yearly	Bank	RBLS
Fintech	2020	0,34	0,00	0,00	0,00	1,00	0,48	1,00	257	yearly	Bank	RBLS
Digital_Supply	2019	0,57	0,00	0,43	0,57	0,71	0,18	1,00	247	yearly	Bank	RBLS
Digital_Supply	2020	0,58	0,00	0,43	0,57	0,71	0,18	1,00	243	yearly	Bank	RBLS
Digital_Payments_Supply	2019	0,87	0,00	1,00	1,00	1,00	0,22	1,00	247	yearly	Bank	RBLS
Digital_Payments_Supply	2020	0,91	0,00	1,00	1,00	1,00	0,20	1,00	243	yearly	Bank	RBLS
Red_zone	2019	0,00	0,00	0,00	0,00	0,00	0,00	0,00	84	quarterly	region	Ministry of Health
Red_zone	2020	0,21	0,00	0,04	0,24	0,37	0,59	0,17	84	quarterly	region	Ministry of Health
Internet_daily	2019	0,71	0,62	0,67	0,74	0,75	0,05	0,77	21	yearly	region	Eurostat
Internet_daily	2020	0,72	0,63	0,69	0,75	0,76	0,06	0,80	21	yearly	region	Eurostat
Share_households_deposits	2019	0,74	0,00	0,59	0,95	1,00	0,36	1,00	32.618	quarterly	bank-province	Supervisory reports
Share_households_deposits	2020	0,74	0,00	0,61	0,94	1,00	0,35	1,00	30.323	quarterly	bank-province	Supervisory reports
ROA	2019	0,01	-0,02	0,01	0,01	0,01	0,00	0,03	275	yearly	Bank	Supervisory reports
ROA	2020	0,01	-0,03	0,01	0,01	0,01	0,01	0,03	257	yearly	Bank	Supervisory reports
Total_capital_ratio	2019	0,18	0,09	0,14	0,16	0,20	0,07	0,73	275	yearly	Bank	Supervisory reports
Total_capital_ratio	2020	0,19	0,08	0,15	0,17	0,22	0,07	0,64	257	yearly	Bank	Supervisory reports
NPL_ratio	2019	0,11	0,00	0,08	0,11	0,15	0,06	0,41	275	yearly	Bank	Supervisory reports
NPL_ratio	2020	0,09	0,00	0,06	0,09	0,11	0,05	0,45	256	yearly	Bank	Supervisory reports
Liquidity	2019	0,08	0,00	0,03	0,05	0,10	0,09	1,06	275	yearly	Bank	Supervisory reports
Liquidity	2020	0,09	0,00	0,03	0,06	0,11	0,10	0,98	257	yearly	Bank	Supervisory reports
Ln(Assets)	2019	7,13	3,79	6,25	6,92	7,64	1,50	13,18	275	yearly	Bank	Supervisory reports
Ln(Assets)	2020	7,17	3,96	6,32	6,94	7,63	1,47	13,24	257	yearly	Bank	Supervisory reports
Credit_transfers_google	2019	0.020	0.000	0.013	0.019	0.028	0.036	0.009	84	quarterly	region	Google trends
Credit_transfers_google	2020	0.025	0.000	0.017	0.024	0.033	0.052	0.013	84	quarterly	region	Google trends
Online_account_google	2019	0.028	0.000	0.021	0.027	0.037	0.051	0.013	84	quarterly	region	Google trends
Online_account_google	2020	0.020	0.000	0.013	0.019	0.028	0.036	0.009	84	quarterly	region	Google trends

Table 2: Online credit transfers and Fintech investments (1)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Fintech	0.008***	0.006**	0.007***	0.007***	0.007***	0.005**	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Lockdown	0.022***	0.021***	0.020***	0.021***	0.018***	0.018***	0.017***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Fintech*Lockdown					0.005*	0.004*	0.005*	0.004*
					(0.002)	(0.003)	(0.003)	(0.003)
L.online_credit_transfers_share	0.446***	0.494***	0.481***	0.479***	0.446***	0.493***	0.480***	0.478***
	(0.039)	(0.041)	(0.041)	(0.042)	(0.038)	(0.040)	(0.041)	(0.041)
L2.online_credit_transfers_share	0.097***	0.090***	0.096***	0.098***	0.097***	0.090***	0.096***	0.098***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Internet_daily	0.219***	0.196***	0.214***	0.211***	0.218***	0.196***	0.213***	0.210***
	(0.047)	(0.046)	(0.047)	(0.047)	(0.047)	(0.046)	(0.047)	(0.047)
Share_households_deposits	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	0.047	0.010	0.036	0.045	0.067	0.032	0.059	0.067
	(0.382)	(0.363)	(0.377)	(0.383)	(0.384)	(0.365)	(0.380)	(0.385)
Total_capital_ratio	-0.036	-0.046*	-0.039	-0.034	-0.035	-0.045*	-0.038	-0.034
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
NPL_ratio	-0.344***	-0.313***	-0.337***	-0.349***	-0.346***	-0.315***	-0.339***	-0.351***
	(0.045)	(0.044)	(0.045)	(0.045)	(0.045)	(0.044)	(0.045)	(0.045)
Liquidity	-0.044***	-0.038**	-0.043***	-0.045***	-0.044***	-0.037**	-0.042***	-0.045***
	(0.016)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Ln(Assets)	0.098***	0.085***	0.094***	0.098***	0.098***	0.085***	0.094***	0.099***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
Credit_transfers_google		0.380***				0.379***		
		(0.042)				(0.041)		
Online_account_google			0.229***				0.229***	
			(0.039)				(0.038)	
Online_bank_google				0.240***				0.238***
				(0.052)				(0.052)
Constant	-0.746***	-0.640***	-0.732***	-0.773***	-0.748***	-0.644***	-0.736***	-0.776***
	(0.141)	(0.139)	(0.142)	(0.143)	(0.143)	(0.141)	(0.144)	(0.145)
Arellano Bond test for AR(1)	-6.590	-6.737	-6.628	-6.598	-6.533	-6.679	-6.570	-6.539
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Arellano Bond test for AR(2)	-1.002	-0.764	-0.912	-0.950	-1.018	-0.779	-0.926	-0.966
P value	0.316	0.445	0.369	0.342	0.309	0.436	0.354	0.334
Observations	11,438	11,438	11,438	11,438	11,438	11,438	11,438	11,438

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Arellano-Bond estimates with robust standard errors reported in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.
Estimate period: first quarter 2019 – fourth quarter 2020.

Table 3. Online credit transfers and banks' digital supply (1)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Digital_Supply	0.303***	0.288***	0.296***	0.300***	0.303***	0.288***	0.297***	0.300***
	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)
Lockdown	0.017***	0.017***	0.016***	0.017***	0.010***	0.011***	0.009**	0.010**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)
Digital_Supply*Lockdown					0.009**	0.008*	0.009*	0.008*
					(0.004)	(0.005)	(0.005)	(0.005)
L.online_credit_transfers_share	0.523***	0.573***	0.563***	0.563***	0.521***	0.570***	0.561***	0.560***
	(0.044)	(0.046)	(0.047)	(0.048)	(0.044)	(0.046)	(0.047)	(0.048)
L2.online_credit_transfers_share	0.070**	0.059*	0.066**	0.068**	0.069**	0.059*	0.066**	0.068**
	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)
Internet_daily	0.062	0.041	0.058	0.056	0.061	0.040	0.057	0.055
	(0.080)	(0.080)	(0.081)	(0.081)	(0.081)	(0.080)	(0.081)	(0.081)
Share_households_deposits	-0.004**	-0.005**	-0.005**	-0.005**	-0.004**	-0.005**	-0.005**	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	1.396***	1.387***	1.404***	1.408***	1.479***	1.472***	1.491***	1.493***
	(0.512)	(0.499)	(0.509)	(0.513)	(0.521)	(0.509)	(0.518)	(0.523)
Total_capital_ratio	-0.044	-0.057**	-0.049*	-0.042	-0.046	-0.059**	-0.051*	-0.044
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.030)
NPL_ratio	-0.475***	-0.439***	-0.465***	-0.480***	-0.476***	-0.440***	-0.466***	-0.481***
	(0.058)	(0.057)	(0.059)	(0.059)	(0.059)	(0.058)	(0.059)	(0.059)
Liquidity	-0.056***	-0.052***	-0.055***	-0.057***	-0.055***	-0.050***	-0.053***	-0.056***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Ln(Assets)	0.023	0.013	0.020	0.023	0.025	0.015	0.022	0.026
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Credit_transfers_google		0.401***				0.399***		
		(0.042)				(0.042)		
Online_account_google			0.263***				0.261***	
			(0.036)				(0.036)	
Online_bank_google				0.294***				0.290***
				(0.052)				(0.052)
Constant	-0.152	-0.070	-0.150	-0.187	-0.171	-0.091	-0.171	-0.207
	(0.175)	(0.175)	(0.176)	(0.176)	(0.173)	(0.173)	(0.174)	(0.175)
Arellano Bond test for AR(1)	-4.705	-4.820	-4.766	-4.725	-4.712	-4.826	-4.773	-4.732
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Arellano Bond test for AR(2)	-1.442	-1.199	-1.335	-1.377	-1.428	-1.190	-1.324	-1.367
P value	0.149	0.231	0.182	0.169	0.153	0.234	0.186	0.172
Observations	10,476	10,476	10,476	10,476	10,476	10,476	10,476	10,476

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Arellano-Bond estimates with robust standard errors in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.
Estimate period: first quarter 2019 – fourth quarter 2020.

Table 4: Online credit transfers and Fintech investments: alternative definition of Covid restrictions (1)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Fintech	0.011***	0.006**	0.008***	0.009***	0.011***	0.007**	0.009***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Red_zone	0.003**	0.009***	0.006***	0.006***	0.004	0.011***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Fintech*Red_zone					-0.000	-0.002	-0.001	-0.001
					(0.002)	(0.002)	(0.002)	(0.002)
L.online_credit_transfers_share	0.414***	0.471***	0.475***	0.463***	0.410***	0.468***	0.470***	0.459***
	(0.039)	(0.042)	(0.042)	(0.044)	(0.039)	(0.042)	(0.042)	(0.043)
L2.online_credit_transfers_share	0.070**	0.071**	0.075***	0.077***	0.070**	0.071**	0.075***	0.077***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Internet_daily	0.273***	0.189***	0.234***	0.232***	0.275***	0.193***	0.236***	0.236***
	(0.050)	(0.049)	(0.050)	(0.051)	(0.050)	(0.049)	(0.050)	(0.051)
Share_households_deposits	0.004	0.004*	0.003	0.003	0.004	0.004*	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	0.064	-0.030	0.021	0.037	0.060	-0.073	-0.001	0.014
	(0.425)	(0.368)	(0.396)	(0.407)	(0.429)	(0.371)	(0.400)	(0.412)
Total_capital_ratio	-0.019	-0.055*	-0.037	-0.029	-0.019	-0.055*	-0.037	-0.029
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
NPL_ratio	-0.399***	-0.294***	-0.350***	-0.373***	-0.400***	-0.292***	-0.350***	-0.372***
	(0.056)	(0.054)	(0.055)	(0.056)	(0.056)	(0.054)	(0.055)	(0.056)
Liquidity	-0.059***	-0.036**	-0.048***	-0.052***	-0.059***	-0.038**	-0.049***	-0.053***
	(0.018)	(0.016)	(0.017)	(0.018)	(0.018)	(0.017)	(0.017)	(0.018)
Ln(Assets)	0.122***	0.080***	0.101***	0.109***	0.123***	0.080***	0.101***	0.110***
	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)
Credit_transfers_google		0.308***				0.308***		
		(0.049)				(0.049)		
Online_account_google			0.274***				0.276***	
			(0.049)				(0.049)	
Online_bank_google				0.147**				0.147**
				(0.065)				(0.065)
Constant	-0.984***	-0.568***	-0.804***	-0.877***	-0.989***	-0.565***	-0.807***	-0.879***
	(0.172)	(0.160)	(0.169)	(0.173)	(0.173)	(0.161)	(0.170)	(0.174)
Arellano Bond test for AR(1)	-7.641	-7.595	-7.545	-7.569	-7.659	-7.611	-7.559	-7.585
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Arellano Bond test for AR(2)	1.175	0.786	0.707	1.014	1.199	0.811	0.729	1.038
P value	0.240	0.432	0.480	0.311	0.231	0.417	0.466	0.299
Observations	11,438	11,438	11,438	11,438	11,438	11,438	11,438	11,438

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Arellano-Bond estimates with robust standard errors reported in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.
Estimate period: first quarter 2019 – fourth quarter 2020.

Table 5: Online credit transfers and banks' digital supply: alternative definition of Covid restrictions (1)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Digital_Supply	0.242***	0.242***	0.241***	0.242***	0.242***	0.242***	0.241***	0.242***
	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)
Red_zone	0.064***	0.060***	0.065***	0.064***	0.036***	0.037***	0.036***	0.036***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.012)	(0.012)	(0.012)	(0.012)
Digital_Supply					0.036***	0.033***	0.038***	0.036***
*Red_zone					(0.011)	(0.011)	(0.011)	(0.011)
L.online_credit_transfers	0.628***	0.633***	0.625***	0.625***	0.625***	0.630***	0.622***	0.622***
_share	(0.047)	(0.048)	(0.048)	(0.049)	(0.047)	(0.048)	(0.048)	(0.049)
L2.online_credit_transfer	0.052	0.049	0.052	0.052	0.052	0.049	0.052	0.052
s_share	(0.032)	(0.033)	(0.032)	(0.032)	(0.032)	(0.033)	(0.032)	(0.032)
Internet_daily	-0.097	-0.087	-0.100	-0.096	-0.099	-0.090	-0.102	-0.098
	(0.080)	(0.079)	(0.080)	(0.080)	(0.080)	(0.079)	(0.080)	(0.080)
Share_households_depos	-0.005*	-0.005*	-0.005*	-0.005*	-0.004*	-0.004*	-0.004*	-0.004*
its	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	1.502***	1.499***	1.501***	1.502***	1.674***	1.673***	1.672***	1.675***
	(0.480)	(0.481)	(0.479)	(0.480)	(0.487)	(0.488)	(0.487)	(0.487)
Total_capital_ratio	-0.114***	-0.112***	-0.115***	-0.114***	-0.119***	-0.116***	-0.120***	-0.119***
	(0.028)	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)
NPL_ratio	-0.294***	-0.298***	-0.291***	-0.292***	-0.296***	-0.301***	-0.293***	-0.295***
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)
Liquidity	-0.024*	-0.025*	-0.024*	-0.024*	-0.021	-0.022	-0.021	-0.021
	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.013)
Ln(Assets)	-0.028	-0.027	-0.029	-0.029	-0.025	-0.023	-0.025	-0.025
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Credit_transfers_google		0.086*				0.086*		
		(0.049)				(0.049)		
Online_account_google			-0.033				-0.031	
			(0.044)				(0.044)	
Online_bank_google				-0.017				-0.016
				(0.060)				(0.060)
Constant	0.436**	0.412**	0.450**	0.440**	0.402**	0.377**	0.415**	0.405**
	(0.179)	(0.178)	(0.180)	(0.178)	(0.180)	(0.179)	(0.181)	(0.179)
Arellano Bond test for AR(1)	-5.017	-5.020	-4.998	-4.978	-5.009	-5.012	-4.990	-4.971
P value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Arellano Bond test for AR(2)	-0.952	-0.912	-0.954	-0.952	-0.933	-0. 892	-0. 935	-0.933
P value	0.341	0.362	0.340	0.341	0.351	0.372	0.350	0.351
Observations	10,476	10,476	10,476	10,476	10,476	10,476	10,476	10,476

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Arellano-Bond estimates with robust standard errors reported in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.
Estimate period: first quarter 2019 – fourth quarter 2020.

Table 6. The impact of Fintech during the second and the third quarter of 2020

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)	(XIII)	(XIV)	(XV)	(XVI)
Fintech	0.206***	0.206***	0.206***	0.206***	0.199***	0.199***	0.199***	0.199***	0.206***	0.206***	0.206***	0.206***	0.199***	0.199***	0.199***	0.199***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Fintech*Lockdown					0.016***	0.016***	0.016***	0.016***								
					(0.003)	(0.003)	(0.003)	(0.003)								
Lockdown	0.012***	0.013***	0.013***	0.014***	-0.000	0.000	0.000	0.001								
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)								
Fintech*Red_zone													0.042***	0.042***	0.042***	0.042***
													(0.008)	(0.008)	(0.008)	(0.008)
Red_zone									0.033***	0.035***	0.035***	0.036***	-0.000	0.001	0.001	0.003
									(0.003)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)	(0.008)	(0.007)
Internet_daily	-0.261***	-0.264***	-0.264***	-0.272***	-0.261***	-0.263***	-0.263***	-0.272***	-0.261***	-0.264***	-0.264***	-0.272***	-0.261***	-0.263***	-0.263***	-0.272***
	(0.069)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.069)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)
Share_households_deposits	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	0.274	0.276	0.276	0.276	0.269	0.270	0.271	0.271	0.270	0.272	0.272	0.272	0.265	0.267	0.267	0.267
	(0.693)	(0.693)	(0.693)	(0.693)	(0.694)	(0.694)	(0.694)	(0.694)	(0.693)	(0.693)	(0.693)	(0.693)	(0.694)	(0.694)	(0.694)	(0.694)
Total_capital_ratio	-0.203**	-0.202**	-0.202**	-0.202**	-0.205**	-0.205**	-0.205**	-0.204**	-0.203**	-0.202**	-0.203**	-0.202**	-0.205**	-0.205**	-0.205**	-0.204**
	(0.087)	(0.086)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.086)	(0.086)	(0.087)	(0.086)	(0.087)	(0.087)	(0.087)	(0.087)
NPL_ratio	-1.153***	-1.153***	-1.153***	-1.155***	-1.158***	-1.159***	-1.158***	-1.160***	-1.153***	-1.153***	-1.153***	-1.154***	-1.158***	-1.158***	-1.158***	-1.160***
	(0.128)	(0.128)	(0.128)	(0.128)	(0.129)	(0.129)	(0.129)	(0.129)	(0.128)	(0.128)	(0.128)	(0.128)	(0.129)	(0.129)	(0.129)	(0.129)
Liquidity	-0.435***	-0.434***	-0.434***	-0.434***	-0.435***	-0.434***	-0.434***	-0.434***	-0.435***	-0.435***	-0.435***	-0.434***	-0.435***	-0.435***	-0.435***	-0.434***
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Ln(Assets)	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Credit_transfers_google		-0.051				-0.043				-0.051				-0.043		
		(0.058)				(0.058)				(0.058)				(0.058)		
Online_account_google			-0.031				-0.029				-0.031				-0.029	
			(0.045)				(0.045)				(0.045)				(0.045)	
Online_bank_google				-0.108				-0.111				-0.108				-0.111
				(0.074)				(0.073)				(0.074)				(0.073)
Constant	0.814***	0.816***	0.816***	0.824***	0.820***	0.822***	0.822***	0.830***	0.814***	0.816***	0.816***	0.823***	0.820***	0.822***	0.822***	0.830***
	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.062)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.061)	(0.062)
Observations	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959	4,959

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Pooled panel estimates with robust standard errors in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.
Estimate period: second – third quarter 2020.

Table 7. The impact of banks' digital supply during the second and the third quarter of 2020

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)	(XIII)	(XIV)	(XV)	(XVI)
Digital_Supply	0.112***	0.112***	0.112***	0.112***	0.104***	0.104***	0.104***	0.104***	0.112***	0.112***	0.112***	0.112***	0.104***	0.104***	0.104***	0.104***
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Digital_Supply *Lockdown					0.016***	0.015***	0.016***	0.016***								
					(0.005)	(0.005)	(0.005)	(0.005)								
Lockdown	0.008***	0.009***	0.008***	0.009***	-0.003	-0.003	-0.003	-0.003								
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)								
Digital_Supply* Red_zone													0.042***	0.041***	0.042***	0.042***
													(0.012)	(0.012)	(0.012)	(0.012)
Red_zone									0.022***	0.023***	0.022***	0.024***	-0.009	-0.008	-0.009	-0.007
									(0.003)	(0.005)	(0.005)	(0.005)	(0.011)	(0.012)	(0.012)	(0.012)
Internet_daily	-0.293***	-0.295***	-0.294***	-0.301***	-0.293***	-0.295***	-0.294***	-0.301***	-0.293***	-0.295***	-0.294***	-0.301***	-0.293***	-0.295***	-0.294***	-0.301***
	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)	(0.074)
Share_households_deposits	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	-4.918***	-4.917***	-4.917***	-4.916***	-4.921***	-4.920***	-4.920***	-4.919***	-4.918***	-4.917***	-4.917***	-4.916***	-4.921***	-4.920***	-4.920***	-4.919***
	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)	(1.127)
Total_capital_ratio	0.264**	0.264**	0.264**	0.264**	0.263**	0.264**	0.263**	0.264**	0.264**	0.264**	0.264**	0.264**	0.263**	0.264**	0.263**	0.264**
	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)	(0.104)
NPL_ratio	-0.525***	-0.525***	-0.525***	-0.526***	-0.525***	-0.525***	-0.525***	-0.526***	-0.525***	-0.525***	-0.525***	-0.526***	-0.525***	-0.525***	-0.525***	-0.526***
	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)	(0.113)
Liquidity	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***	-0.437***
	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)
Ln(Assets)	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Credit_transfers_google		-0.033				-0.031				-0.033				-0.031		
		(0.053)				(0.053)				(0.053)				(0.053)		
Online_account_google			-0.010				-0.009				-0.010				-0.009	
			(0.041)				(0.041)				(0.041)				(0.041)	
Online_bank_google				-0.079				-0.080				-0.079				-0.080
				(0.067)				(0.067)				(0.067)				(0.067)
Constant	0.689***	0.691***	0.690***	0.696***	0.695***	0.696***	0.695***	0.702***	0.689***	0.691***	0.690***	0.696***	0.695***	0.696***	0.695***	0.702***
	(0.069)	(0.069)	(0.069)	(0.070)	(0.069)	(0.069)	(0.069)	(0.070)	(0.069)	(0.069)	(0.069)	(0.070)	(0.069)	(0.069)	(0.069)	(0.070)
Observations	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341	4,341

(1) The dependent variable is the share of online credit transfers on total credit transfers ordered by households. Pooled panel estimates with robust standard errors in brackets. *, ** and *** denote significance at 10, 5 and 1 percent, respectively.

Estimate period: second – third quarter 2020.

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