Open Banking and Competition in Banks and Fintech: Evidence from Mobile Apps*

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(Job Market Paper)

Abstract

Open banking policies have been introduced by many governments to foster innovation in financial services, yet evidence on their effects on competition remains limited. I construct a novel dataset of fintech app source code and exploit cross-country variation in open banking availability within the same app to identify the impact of open banking on fintechs. I find that open banking significantly boosts fintech app usage and performance, with the strongest gains for data-intensive apps, fintech startups, and during the pandemic when access to traditional banking was limited. Textual analysis of app descriptions shows that incumbent banks most exposed to open banking suffer declines in loan issuance and income but respond strategically by raising fee intensity and improving earning efficiency. The findings are consistent with theories that open banking reduces barriers to entry by weakening banks' monopoly power over consumer data.

Keywords: Open Banking, Mobile Apps, Fintech, Competition

JEL Codes: G23, G50, O33, O36

*I thank Huan Tang, Bo Bian, Dirk Jenter, Daniel Paravisini, Ashwini Agrawal, Constantin Charles, Kim Fe Cramer, Juanita González-Uribe, Cameron Peng, Ulf Axelson, Shiyang Huang, Tong Zhao and seminar participants at the London School of Economics, LBS Trans-Atlantic Doctoral Conference, HEC Paris Finance PhD Workshop, and Warwick PhD Workshop on FinTech. All errors are mine.

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1 Introduction

The past decade has witnessed a profound transformation in the delivery of financial services, driven by rapid advances in digital technology and regulatory reforms aimed at expanding access to financial data. Among these initiatives, open banking has emerged as a particularly disruptive policy, enabling consumers to grant third-party providers secure access to their banking data through standardized application programming interfaces (APIs). Advocates contend that open banking fosters competition and innovation by lowering entry barriers for fintechs and challenging the dominance of traditional banks. Critics, however, warn that it may instead create new distortions, since participation is limited to authorized providers within a tightly regulated "walled garden," potentially reinforcing the advantages of well-connected or better-resourced players. For incumbent banks, open banking could erode their market share by empowering fintech rivals, but it might also spur adaptation—whether by innovating, specializing in certain services, or leveraging data from API calls to better understand customer needs and market conditions. Despite its rapid global adoption, empirical evidence on the actual impact of open banking on competition and market dynamics remains scarce.

This paper provides a large-scale empirical analysis of open banking adoption in Europe and its impact on competition and innovation—both in the mobile finance app ecosystem and among traditional banks. A distinctive feature of this study is the construction of a novel dataset that traces the adoption and integration of open banking by fintech mobile apps. I begin with official authorization records maintained by National Competent Authorities (NCAs)—such as the UK's Financial Conduct Authority (FCA) and Germany's Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin)—together with the European Banking Authority's (EBA) comprehensive register of authorized open banking providers over time. In this context, authorization refers to regulatory approval under PSD2 to access bank account data and initiate payments directly, while non-authorized entities must rely on partnerships with authorized providers to connect to banks. I then assemble historical Android source code packages (APKs) for tens of thousands of finance apps, systematically decompile them, and detect their integration with these authorized providers. This approach enables me to identify not only whether an app adopts open banking but also the precise timing of adoption, even among unauthorized apps. I merge these adoption records with a comprehensive monthly panel of app performance metrics—including downloads, user engagement, and revenue—sourced from a leading app intelligence platform. These app-level data provide standardized and comparable high-frequency measures of market performance for a broad set of financial service providers, most of which are private firms with limited public disclosure.

Using this dataset, I test how adopting open banking affects the performance of financial apps. To identify causal effects, I exploit cross-country variation in open banking availability within the same app. Many fintech apps operate simultaneously across European and non-European markets, but authorization is granted only at the country level within Europe. An app becomes treated in the country where it first receives authorization, and in additional countries once the authorization is passported, typically within one or two months. Its operations in non-authorised countries—both within and outside Europe—serve as controls. Importantly, staggered timing defines only when treatment begins in each country, not how control groups are constructed. This design enables cross-country within-app comparisons that net out app-level shocks, such as product updates, marketing campaigns, or platform changes, thereby isolating the effect of open banking access on app outcomes.

I find that open banking adoption leads to significant improvements in both scale and quality. Apps integrating open banking experience large gains in downloads and revenue, as well as higher user retention and average revenue per user. These results indicate that open banking not only attracts new users but also deepens engagement and monetization among existing ones. Importantly, these benefits extend beyond directly authorized fintechs. Many unaffiliated "fourth-party" apps connect to authorized third parties (such as API aggregators) through SDKs or contractual integrations. With user consent, the authorized third party mediates the bank-API calls and passes permitted data downstream. As a result, even non-authorized fintechs benefit indirectly from improved data access and interoperability, amplifying the reach of open banking across the digital finance ecosystem. Two mechanisms help explain these performance gains. First, open banking reduces customers' switching costs from traditional banks, encouraging users to try alternative providers. Consistent with this channel, smaller and younger fintechs—particularly startups that launched their first app after 2016—experience larger increases in downloads and revenue. Second, open banking enhances service quality through data complementarity. By combining banks' transaction data with proprietary technologies such as AI and advanced analytics, fintechs improve targeting, risk assessment, and personalization, leading to higher revenue per user and stronger retention. Consistent with this mechanism, data-intensive apps benefit more from open banking adoption.

Next, I exploit the COVID-19 pandemic as an exogenous shock that sharply increased demand for digital financial services. Lockdowns restricted in-person banking, while financial strain boosted demand for accessible, low-cost alternatives. I find that during this period, early adopters of open banking experienced significantly larger surges in downloads and user engagement than late adopters and non-adopters, particularly among lending and investment apps. Fintech startups benefited the most, indicating that open banking helped them capture the sudden influx of digital users and bridge gaps in financial access during the pandemic. Leveraging this across-app variation, I further examine whether open banking increases competitive pressure and stimulates innovation. I construct a dynamic competitor network that evolves over time and across countries by measuring textual similarity in app store descriptions using natural language processing, following Hoberg and Phillips (2016). During the COVID-19 period, apps with open banking became more central in the competitor network and face heightened competitive pressure, while concurrently increasing the frequency of app updates. These patterns suggest that open banking fosters a more dynamic and innovative ecosystem, encouraging providers to differentiate through rapid iteration in the fast-evolving mobile finance sector.

Finally, I examine how this surge in fintech activity affects incumbent banks. The net impact is ex-ante ambiguous: banks may lose market share to new entrants, but could also benefit from pressure to innovate or even learn from fintech API interactions. To assess these effects, I construct a novel measure of fintech pressure for each bank, based on the textual similarity between the bank's app and those of authorized and non-authorized open banking providers. The measure captures the degree of overlap in service offerings and target markets, as revealed by app descriptions. Linking it to detailed bank-level data on balance sheets and profitability, I find that banks more exposed to fintech competition reduce both lending and deposits, with lending falling more sharply. On the income side, these banks report lower revenues and costs, consistent with a diminished role for traditional intermediation. At the same time, they reallocate toward non-traditional assets, particularly interbank positions and securities, which partially offset the decline in loans. Greater exposure to open banking is also associated with modest but statistically significant efficiency gains: net interest margins and fee intensity increase, asset yields improve, and cost-to-income ratios decline, while the effect on overall profitability (ROA) remains limited. Taken together, these results suggest that although exposed banks face headwinds in their core lending business, they adapt strategically through diversification, efficiency gains, and asset reallocation.

Taken together, the findings position open banking as a key driver of consumer-facing financial innovation and competition. By enabling new entrants to challenge incumbents and enhancing the responsiveness of fintech apps to user needs, open banking has intensified competition in the financial sector—particularly in lending markets, where traditional banks face growing pressure. However, affected banks respond by diversifying activities and improving cost efficiency, indicating that open banking pressures them to adapt rather than passively absorb losses.

Related Literature This paper contributes to several strands of the literature. First, it adds to the expanding body of research on open banking. While open banking is widely regarded as a catalyst for innovation and increased competition (Awrey and Macey, 2023), theoretical work highlights potential unintended consequences. For example, He et al. (2023) shows that open banking can either foster or hinder competition depending on the initial screening ability gap between banks and fintechs; if fintechs gain excessive competitive advantage through data sharing, both opt-in and opt-out borrowers can be worse off due to weakened competition and adverse selection. Goldstein et al. (2022) incorporates banks' liability-side responses and maturity transformation, finding that open banking can prevent banks from shifting risks to creditors and enhance borrower welfare, though the endogenous adjustment in funding structures may lead to inefficient resource allocation and lower total welfare. Brunnermeier et al. (2022) show that open banking can limit uncollateralized credit because strategic data portability choices create adverse selection—buyers share transaction data while sellers withhold loan information to preserve default options. In empirical research, Babina et al. (2024) document the global rise of open banking and its positive impact on consumer access to financial advice, credit, and small business lending. Their model highlights welfare gains from increased market entry and product innovation. Similarly, Yu (2024) exploits a discontinuity in UK firm eligibility and finds that open banking improves small business lending by easing information frictions and collateral constraints. Nam (2023) use data from a German fintech loan platform to show that riskier borrowers are more likely to share banking data and that data sharing improves inference about borrower credit quality, increases loan approval rates, reduces interest rates, and lowers ex post defaults. Alok et al. (2024), using data from India's open banking infrastructure, shows that credit supply expands for both fintechs and traditional banks through multiple channels. Building on this literature, this paper offers complementary evidence using novel data from mobile applications to study the integration of open banking APIs, focusing on fintech performance as well as the ways in which incumbent banks adjust under competitive pressure.

Second, this paper contributes to the growing literature on bank-fintech competition. Thakor (2020) provides a comprehensive review of fintech's interactions with banking across payment systems, P2P lending, and insurance. Empirical work documents how fintechs expand credit access through technological advantages and regulatory arbitrage. Buchak et al. (2018) show that fintech shadow banks charge higher rates but attract high-quality borrowers through convenience, Fuster et al. (2019) find that fintech lenders process applications faster and adjust capacity more elastically, and Jagtiani and Lemieux (2018) demonstrate that fintechs penetrate underserved markets with high banking concentration and fewer branches. Gopal and Schnabl (2022) and Tang (2019) show that fintechs serve riskier borrowers and complement rather than substitute for bank credit. Studies of strategic interactions find that Benetton et al. (2022) show multi-product banks exploit market power despite cost synergies when competing with specialized non-banks, Parlour et al. (2022) demonstrate that fintech competition for payment flows disrupts banks' information spillovers, and Egan et al. (2022) link deposit and asset productivity to bank value. Banks respond to fintech competition through partnerships and acquisitions; Puri et al. (2024) show banks facing greater competition make venture investments in fintechs with asset complementarities, **?** find acquisitions increase banks' deposits and lending, and Sarkisyan (2023) demonstrates that instant payment systems intensify deposit competition by reducing large banks' payment convenience advantage. This paper adds to this literature by examining how fintechs integrate open banking APIs and how incumbent banks adjust under competitive pressure.

Third, this paper contributes to the growing literature on data economy and ownership, which conceptualizes data as a production input that enhances predictive accuracy and firm value. Jones and Tonetti (2020) argue that data's nonrivalrous nature generates increasing returns and welfare gains from consumer data rights. Bergemann et al. (2022) examine value creation through network effects and information externalities, while Cong et al. (2021) analyze how data enables firm competition and shapes economic growth under privacy considerations. Prior work studies data value across multiple dimensions: information acquisition and trading strategies (Farboodi and Veldkamp, 2020), firm growth (Farboodi et al., 2022), market power and risk (Eeckhout and Veldkamp, 2022), payment market competition (Parlour et al., 2022), borrowing and lending decisions (He et al., 2023), liquidity transformation (Goldstein et al., 2022), and decentralized finance (Cong et al., 2022). Empirical evidence remains limited, though Demirer et al. (2024) and Babina et al. (2024) document data's effects on production efficiency and AI investment returns. This paper provides causal empirical evidence that enhanced access to consumer financial data through open banking increases fintech app adoption and intensifies competition with incumbent banks, demonstrating the real-world economic value of data access in financial services.

Lastly, this paper contributes to the growing literature on the interaction between finance and technology adoption. The relationship between technological innovation and financial services has been extensively studied. Philippon (2019) documents the declining cost of financial intermediation driven by technological progress. Howell et al. (2024) shows that process automation can reduce racial disparities in credit access by facilitating small loans, extending banks' geographic reach, and minimizing human bias in decision-making. De Roure et al. (2022) finds that fintech lenders, such as peer-to-peer platforms, serve broader and more vulnerable populations, particularly in regions with limited traditional bank presence. Similarly, Erel and Liebersohn (2022) shows that banks do not easily substitute fintech services in underserved areas, highlighting a complementary relationship between fintech and traditional financial institutions. Fuster et al. (2019) demonstrates that algorithmic lending accelerates loan processing without increasing default risk, and responds more flexibly to demand shocks. Babina et al. (2024) emphasizes the role of AI adoption in driving firm innovation and growth. Building on this literature, this paper offers a new perspective on the interaction between finance and technology by examining mobile applications and open banking APIs. It highlights how technological infrastructure in digital finance, particularly through mobile app ecosystems, shapes competition and access, especially during periods of elevated demand.

The remainder of the paper is organized as follows. Section 2 outlines the institutional background. Section 3 describes the data sources and sample characteristics. Section 4 examines consumer demand responses to open banking and their implications for fintech. Section 5 analyzes the impact on bank performance and strategic responses. Finally, Section 6 concludes.

2 Institutional Background

2.1 Open Banking

Open banking is a financial framework that enables customers to share their banking data with third-party financial service providers through secure and regulated Application Programming Interfaces (APIs), contingent upon their explicit consent. Traditionally, in the closed banking model, data flows only between the customer and their individual banks, with each institution holding siloed information. By contrast, open banking enables data to circulate between banks and authorized TPPs, creating an interconnected system where customer information can be securely shared and leveraged across multiple providers.[1]. The primary objectives of open banking include enhancing competition, reducing barriers to entry, and fostering financial innovation by expanding consumer choice and improving access to financial products and services. Potential benefits include the development of personalized financial management tools, streamlined lending processes, and more efficient payment mechanisms. As financial regulators worldwide recognize its implications, open banking has gained increasing global adoption, with jurisdictions implementing regulatory frameworks to guide its development.

The United Kingdom (UK) has been an early adopter of open banking, establishing a regulatory-driven framework aimed at standardizing financial data sharing across institutions. The UK's initiative was set in motion by the Competition and Markets Authority (CMA), which, in 2016, mandated the country's nine largest banks to develop and maintain open APIs for account information services (AIS) and payment initiation services (PIS). The UK's open banking framework was officially launched in January 2018, aligning with

[1]See Figure A.1 for illustration of data flow difference between Closed Banking and Open Banking.

the implementation of the European Union's revised Payment Services Directive (PSD2). However, while PSD2 provided a legal foundation for open banking across the EU, the UK adopted a more structured regulatory approach by creating the Open Banking Implementation Entity (OBIE). The OBIE was tasked with establishing technical API standards, ensuring regulatory compliance, and facilitating adoption among financial institutions and third-party providers. Figure A.2 presents statistics of API Usage in the UK, Panel A reports the volume of successful API calls by service type. Calls for Account Information Services (AIS) dominate throughout the sample, yet Payment Initiation Services (PIS) calls have grown steadily since 2022, accounting for an increasing share of total activity. By late 2024, combined monthly calls exceeded 1.6 billion. Panel B plots average monthly API response times (bars, left axis) together with availability rates (lines, right axis) for AIS and PIS. Response times improved markedly, falling from around 750 ms in 2020 to about 350 ms by 2024, while availability remained consistently high—generally above 95%. A further breakdown of open banking API calls by individual banks is shown in Figure A.3. Together, these patterns highlight the rapid scale-up of open banking activity in the UK, which has been underpinned by the country's structured regulatory approach.

In the European Union (EU), open banking was formally introduced through PSD2, which came into effect in January 2018. Unlike the UK's regulatory-driven framework, PSD2 established broad principles for open banking but allowed national regulators and industry-driven initiatives to shape its implementation. This decentralized approach has led to variability in adoption across EU member states and differences in the technical standards for API integration. While some countries have implemented robust frameworks, others have seen slower adoption due to regulatory fragmentation and differing interpretations of PSD2 guidelines. To address these inconsistencies, initiatives such as the Berlin Group's NextGenPSD2 API standard have emerged, aiming to create a more uniform technical standard across EU financial institutions. Despite these challenges, PSD2 has played a key role in expanding access to financial data, allowing for greater innovation in financial services while maintaining data security and consumer protection standards.

Open banking frameworks developed in the UK and EU have influenced policy discussions in other jurisdictions, with several countries adopting either a regulatory-driven or market-led approach to facilitate financial data sharing. Countries such as Australia, Canada, and Japan have introduced open banking regulations tailored to their financial markets, often incorporating elements from both the UK's centralized model and the EU's decentralized approach. In the United States, efforts to formalize open banking regulations have accelerated in recent years. In October 2024, the Consumer Financial Protection Bureau (CFPB) issued final rules governing Personal Financial Data Rights under Section 1033 of the Dodd-Frank Act, marking a significant step toward regulatory oversight of open banking in the US. While the US has historically relied on market-driven data-sharing agreements, the introduction of formal regulations reflects a shift toward greater consumer data protection and standardized financial data access. Globally, open banking initiatives continue to expand. According to Babina et al. (2024), who compiled a comprehensive database of open banking policies across 168 countries, as of October 2021, 80 countries had at least a nascent open banking initiative, while 49 had adopted key open banking policies. These figures highlight the growing importance of open banking as a global financial infrastructure, with governments and regulatory bodies working to balance innovation, competition, and data security in financial markets.

2.2 Authorized Providers and Non-authorized Providers

Open banking service providers can be broadly classified into authorized and non-authorized entities based on their regulatory status and operational scope. Authorized providers are firms that have obtained formal regulatory approval from financial authorities such as the Financial Conduct Authority (FCA) in the UK or national regulators in EU member states, allowing them to offer account information services (AIS) and payment initiation services (PIS) directly. These firms must comply with capital requirements, operational risk management, and customer protection standards. Upon authorization, they are listed in regulatory registers such as the FCA's Financial Services Register or the European Banking Authority (EBA) Payment Institutions Register, ensuring transparency and oversight. Among authorized providers, two key categories exist: Account Information Providers (AIPs) and Payment Initiation Providers (PIPs). AIPs are entities authorized to access and aggregate financial data from customer accounts, provided they have obtained the customer's explicit consent. They do not execute transactions but instead offer services such as personal financial management tools, credit risk assessment, and financial analytics platforms that help users track spending, manage budgets, or receive tailored financial product recommendations[2]. PIPs, in contrast, are authorized to initiate payments on behalf of customers by directly connecting to their bank accounts. Instead of relying on traditional card networks or manual bank transfers, PIPs facilitate direct account-to-account transactions, often reducing processing costs and improving payment efficiency. For example, when a consumer pays through a fintech app using open banking, the app redirects them to their bank's secure interface to authenticate the transaction, after which the payment is executed directly from the bank account. This has led to the emergence of alternative payment solutions that offer faster, more secure, and lower-cost payment mechanisms for consumers and businesses.

In contrast, non-authorized providers operate within the open banking ecosystem without direct regulatory approval but can still offer services by partnering with authorized firms[3]. One common approach is the agent model, in which a non-authorized firm acts as an agent of an authorized Payment Service Provider (PSP) and offers open banking services under the principal firm's authorization. In this arrangement, the authorized provider retains full legal responsibility for compliance and consumer protection, while the agent delivers services under the authorized firm's regulatory umbrella. A second category of non-authorized providers includes Technical Service Providers (TSPs), which support open banking infrastructure without directly engaging in payment initiation or account information services.

[2]Detailed TPP outcome areas and its distribution can be seen in Table A.1 and Figure A.8

[3]See FCA guidance: https://www.fca.org.uk/firms/agency-models-under-psd2

These firms provide services such as API aggregation, fraud prevention, and authentication solutions but do not handle customer funds or process transactions. Because they operate purely as intermediaries, they are not required to obtain direct authorization under PSD2. Last, non-authorized firms may also participate in open banking through white-label or outsourcing arrangements, in which an authorized provider licenses its infrastructure and regulatory status to another entity. In such cases, the non-authorized firm manages the customer interface, while financial transactions and compliance remain under the control of the authorized institution.

The coexistence of authorized and non-authorized providers highlights the diverse ways in which firms participate in open banking—either by obtaining direct regulatory approval or by leveraging partnerships with authorized institutions. While authorized providers are subject to greater regulatory scrutiny, non-authorized models offer a more flexible route for fintech firms to engage in open banking while relying on authorized institutions for compliance.

3 Data and Sample

3.1 Data

Open Banking Authorization To assemble the universe of entities authorized to provide open-banking services, I rely on official regulatory registers: the UK Financial Conduct Authority (FCA) and the European Banking Authority (EBA). For the UK, I retrieve all account-information service providers (AISPs) and payment-initiation service providers (PISPs) from the FCA Register[4]. I cross-check each entity against the Open Banking Implementation Entity (OBIE) list[5] and archived snapshots (Wayback Machine) to capture removals or lapsed authorizations. For each provider, I extract regulatory status, permission scope, and firm identifiers from the FCA site. For the EU, I use the EBA's official JSON dataset[6], which consolidates payment-institution authorizations across Member States. I re-

[4] https://register.fca.org.uk/s/search?predefined=AIPISP

[5] https://www.openbanking.org.uk/regulated-providers/

[6] https://euclid.eba.europa.eu/register/pir/search

tain only entities explicitly authorized to provide AIS and/or PIS. The dataset includes the authorization date, home country, and passporting destinations. Because the EBA Register reports the initial authorization date, which may precede AIS/PIS permissions, I cross-check each entity against the relevant NCA register and revise the date to the earliest AIS/PIS-specific authorization; see Table A.3. for details. Where multiple grants exist, I keep the earliest date on which AIS and/or PIS permissions were granted. Panel A of Figure 1 plots cumulative domestic and passporting authorizations over time, while Figure A.4 illustrates the volume and direction of passporting flows. Figure A.5 presents the geographic distribution of authorized providers.

App Performance Data App downloads, revenue, and related metrics provide real-time indicators of firm performance, particularly for private firms whose financial statements are not publicly available. To track activity in the finance category, I collect app-level characteristics and weekly estimates of downloads and revenue from Apptopia[7] , a leading provider of mobile app intelligence. Apptopia estimates key performance indicators such as downloads, revenue, monthly and daily active users (MAU, DAU), average revenue per user (ARPU), and engagement by combining public app store ranking histories with proprietary data from partner apps. It also aggregates metadata from the Apple App Store and Google Play, including app categories, developer information, content ratings, and update histories. To enrich historical coverage, I supplement Apptopia data with web-scraped archives from sources such as the Wayback Machine, AppFigures, F-Droid, and APKMirror.

Beyond open banking related apps, the analysis focuses on widely used, high-traffic finance apps. Although millions of apps exist, only a small fraction capture the majority of user activity. For example, the top 0.3% of U.S. apps account for roughly 80% of downloads and 90% of revenue (Bian et al., 2021). I construct a comprehensive sample of leading finance apps by selecting the top 1,000 apps in monthly download rankings from the Apple

[7] https://apptopia.com/en/.

App Store for the UK and 19 EU countries between January 2018 and October 2023.[8] Each app is uniquely identified by its store-specific identifier, such as *284882215* for Facebook on iOS and *com.facebook.katana* on Android. These identifiers remain constant across versions, enabling consistent tracking over time. They also facilitate linkage across data sources, including source code archives for Android apps and unified cross-platform identifiers that match iOS and Android versions of the same app, allowing integration of performance, metadata, and technical characteristics. For the empirical analysis, I aggregate weekly data to the monthly level and focus on key characteristics summarized in Table 1.

Android App Source Code An APK (Android Package) is the standard file format used for distributing and installing applications on Android devices. It is essentially a compressed archive that contains all the necessary components required for an app to function, including the compiled application code (DEX files), resources (images, layouts, and XML files), manifest file (AndroidManifest.xml), and digital signatures for verification. APK files follow a structure similar to ZIP archives and can be extracted or modified using specialized tools. When a user downloads and installs an APK, the Android operating system unpacks the package, verifies its integrity, and installs the app in the device's system. While most users install APKs through the Google Play Store, APKs can also be sideloaded from third-party sources, allowing for manual installation of apps that are not available on official app stores. Developers often use APK packages for testing before deploying apps to public distribution platforms, and advanced users may extract APKs to analyze an app's structure, permissions, or embedded libraries.

I obtain historical Android application packages (APKs) from the AndroZoo Archive Allix et al. (2016), a large-scale repository of Android APK files maintained for research purposes. AndroZoo collects millions of APKs from various sources, including Google Play, third-party app stores, and alternative APK hosting platforms. The dataset is continuously updated,

[8] Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Spain, and Sweden.

granting researchers access to both current and historical versions of Android applications. As of now, AndroZoo contains over 25 million APKs, primarily used for malware detection and security research. Additionally, for a subset of APKs, AndroZoo provides metadata and static information, such as download counts, review numbers, and rating distributions at the time of collection.

I construct my dataset in two stages. First, I compile a library of technical signatures for authorized open banking providers. I begin with a list of authorized providers in the UK and EU and collect seed APKs from fintechs that publicly report using them. Each seed APK is decompiled using Android Asset Packaging Tool (AAPT) and JADX-GUI to extract manifests, resources, and executable code. From these samples, I compile metadata on network domains, package names, and redirect schemes, which I use to build a provider-specific signature library containing distinctive SDK namespaces, API endpoints, and OAuth patterns. In the second stage, I sample the top 1,000 finance apps per country per month and retrieve all available APK versions for each app from AndroZoo. Each APK is scanned against the provider signature library to detect potential open banking integrations. For example, I identify the "TrueLayerOpenbankingProvider" class within the DEX files of the Freetrade APK, indicating the use of the TrueLayer API (see Figure 2). Weighted detection scores determine whether an app integrates a given provider, and by comparing versions over time, I detect the earliest instance of adoption[9]. Panel B of Figure 1 presents the number of top finance apps that have adopted open banking APIs. In addition, AAPT extracts version information, target and minimum SDK versions, and requested permissions. I merge these details with app metadata, web-scraped data, and performance metrics to create a monthly panel dataset that serves as the basis for my empirical analysis.

[9]Some third-party APIs or functions may not necessarily serve open banking purposes (e.g., the American Express API). In such cases, I classify them as non-open banking APIs and exclude those apps from the open banking API adopter sample.

World Bank Global Findex The Global Findex database[10], compiled by the World Bank in collaboration with Gallup, provides the most comprehensive global source of microdata on financial inclusion and the use of financial services. It is based on nationally representative surveys of adults aged 15 and above, covering over 140 countries in each wave (2014, 2017, 2021, and 2024) and roughly 140,000 individuals per round. The surveys collect detailed information on how people save, borrow, make payments, and manage risk, including the use of mobile money, digital payments, and formal financial institutions. The data are comparable across countries and years, allowing consistent measurement of access to and usage of financial services, as well as the identification of gender, income, and regional gaps in financial inclusion.

Bank Accounting Metrics To capture the financial health and performance of banks operating in these countries, I combine institution-level accounting data from Orbis BankFocus (Bureau van Dijk) and S&P Capital IQ. Orbis BankFocus provides standardized balance sheet, income statement, and regulatory ratio information for commercial, cooperative, and savings banks across both developed and emerging markets, while Capital IQ offers additional coverage for publicly listed banks, including detailed breakdowns of revenue composition, capital adequacy, and profitability metrics. Together, these sources provide harmonized measures of bank size, capitalization, liquidity, and risk exposure over time.

Historical App Description I collect textual data from mobile app descriptions obtained through large-scale web scraping of the Apple App Store and Qimai.cn[11], a leading mobile analytics platform that archives historical versions of app metadata in China and other markets. For each app, I retrieve its title, update notes, and full description as displayed to users at the time of each version release. These texts provide rich qualitative information on product positioning, functionality, and target users, capturing how developers communicate

[10] https://www.worldbank.org/en/publication/globalfindex.

[11] https://qimai.cn/.

the app's value proposition and technological capabilities over time. By applying natural language processing techniques—including tokenization, keyword extraction, and similarity measures—I quantify the overlap in service offerings across apps and track the evolution of business focus and innovation dynamics at the firm level.

3.2 Descriptive statistics

My empirical analyses rely on two distinct app samples. The main sample consists of the top 1,000 finance apps, as previously defined, and is referred to as the top 1,000 UK and EU sample. The second sample includes all UK finance apps tracked by Apptopia, which I refer to as the UK sample.

Table 1 presents descriptive statistics on key app performance metrics. Several observations are noteworthy. First, the finance mobile app market exhibits a highly skewed distribution. The top 1% of finance apps receive over 10,000 downloads per month per country, whereas the median app records just over 100 downloads per month per country. This stark contrast underscores the intense competition within the mobile finance app ecosystem. Second, more than 95% of finance apps are free to download, and the revenue figures reported in the dataset likely underestimate actual earnings from downloads and in-app purchases. Many freemium (free to download with paid upgrade options) finance apps operate their own websites, allowing them to bypass app store transactions and avoid commissions of 15% to 30% charged by platforms such as the Apple App Store and Google Play Store. Third, unlike gaming and shopping apps, which rely heavily on in-app advertising, a relatively small proportion of finance apps integrate ads or connect to ad networks. This suggests that finance apps predominantly generate revenue through alternative monetization strategies, such as subscriptions, transaction fees, and premium services. Finally, the median version age of apps in the sample is approximately 1.6 months, reflecting frequent updates and continuous development. This further highlights the dynamic and competitive nature of the mobile finance app market, where regular updates may be necessary to maintain security, regulatory compliance, and user engagement.

3.3 Determinants of Participation of Open Banking

To better understand the key factors that drive open banking adoption among finance mobile apps, I examine the relationship between app characteristics and the likelihood of adopting open banking services. This analysis includes both authorized providers and non-authorized apps that integrate an authorized provider's API.

To ensure a comprehensive assessment of adoption decisions while avoiding duplicate observations, I focus on the UK sample for the regression analysis. For each year, I define a binary adoption variable, indicating whether an app adopts open banking in that year. Apps that adopted open banking in previous years are excluded from the sample in subsequent years, ensuring that in each year, the sample consists only of new adopters and non-adopters. I then regress the adoption indicator on various app characteristics to identify significant predictors. Additionally, I examine early adoption (adopted open banking in 2018) and late adoption (adopted open banking after 2020) by constructing separate binary outcome variables and running the same regression.

The results, presented in Table 2, reveal several patterns. Each regression is estimated both with year fixed effects (even-numbered columns) and without year fixed effects (odd-numbered columns) to control for time-specific factors. The findings indicate that apps adopting open banking tend to be younger, operate across a broader audience, and demonstrate strong past performance. Specifically, apps that support multiple languages and operate across multiple platforms are significantly more likely to adopt open banking, as evidenced by the positive and significant coefficients on these indicators. The results for early adopters follow a similar pattern. In contrast, late adopters do not exhibit strong past performance, suggesting that their adoption may be driven by strategic response to intensified competition. Overall, these findings suggest that relatively young, competitive apps with a strong recent performance history are more likely to adopt open banking—particularly at an early stage of its implementation. This aligns with the idea that more innovative and growth-oriented firms are the first movers in adopting new financial technologies.

4 Consumers' Reaction to Open Banking Adoption

To understand how consumers respond to open banking, I examine the demand-side effects when a financial service provider adopts open banking, either by obtaining direct authorization or by integrating with an authorized third-party provider. I use three empirical strategies to capture different dimensions of consumer response. First, I conduct an event study to trace the dynamic effects around the time of adoption. Second, I compare the same app across countries with and without authorization to isolate the causal effect of open banking. Third, I use the COVID-19 pandemic as an exogenous shock to compare consumer behavior between early and late adopters.

4.1 Event Study

I implement a standard event-study framework to trace the temporal pattern of consumer response before and after a provider becomes involved in open banking. The specification is as follows:

$$Demand_{ict} = \sum_{\tau \neq 0} \beta_\tau OBEvent_{ic\tau} + \delta_c + \delta_i + \delta_t + \varepsilon_{it} \tag{1}$$

where i indexes apps, c countries, and t months. The dependent variable $Demand_{ict}$ is the log-transformed monthly download volume, specifically using the transformation $\log(1 + y)$ to accommodate the highly skewed distribution of downloads and the presence of zeros. The event variable $OBEvent_{ic\tau}$ is a set of month-relative-to-event indicators, excluding the month of adoption ($\tau = 0$). For authorized open banking providers, the event is defined as the month of receiving authorization. For non-authorized providers that integrate with an authorized API provider, the event is defined as the month in which the integration first occurs. The coefficients β_τ thus capture the dynamic treatment effects on consumer demand surrounding open banking involvement. To control for confounding factors, I include app fixed effects (δ_{ic}), country fixed effects (δ_c), and month fixed effects (δ_t) to account for aggregate shocks and seasonal trends.

The estimated event-time coefficients for authorized open banking providers are shown in Figure 3. Consumer demand rises gradually following authorization, becoming statistically significant within a year for downloads, while effects on daily active users (DAU) and revenue are positive but more muted. This pattern suggests that the benefits of open banking unfold progressively rather than through an immediate surge. A likely explanation is limited consumer awareness or understanding of open banking, which delays behavioral responses. The weaker response in revenue further indicates that new user acquisition does not immediately translate into higher monetization. The widening confidence intervals over time point to substantial heterogeneity in post-authorization outcomes, implying that the effectiveness of open banking adoption varies considerably across providers.

The corresponding event-study coefficients for non-authorized open banking providers are presented in Figure 4. Unlike authorized providers, these apps exhibit a more immediate and noticeable increase in consumer demand after integrating with an authorized API provider. Downloads rise by roughly 5% within a year—smaller in magnitude but more abrupt than for authorized providers. This pattern likely reflects the greater agility of smaller fintech firms, which can quickly translate new data access into consumer-facing features. Despite the quick growth in downloads, the impact on revenue is much smaller, underscoring the challenges of converting additional users into monetization.

4.2 Identification Using Cross-country Heterogeneity

To strengthen the causal interpretation of the impact of open banking, I exploit cross-country heterogeneity in authorization status to compare outcomes for the *same* app across countries with and without authorization. This approach builds on the logic of Khwaja and Mian (2008), who compare within-firm borrowing behavior across markets with different credit supply shocks. Analogously, I compare within-app consumer demand where the supply-side conditions—namely, access to customer bank data via open banking—differ across countries. The key identifying assumption is that differences in authorization status across countries for the same app are exogenous to unobserved, time-varying app-level factors. That is, any differential performance must stem from variation in the treatment (authorization), rather than from confounding changes in the app itself. The following Difference-in-Differences specification is estimated:

$$Demand_{ict} = \beta_1 OBAuth_{ic} \times Post_{ict} + \gamma X_{ict} + \delta_{ic} + \delta_{it} + \delta_{ct} + \varepsilon_{ict} \tag{2}$$

where $Demand_{ict}$ is the log-transformed measure of monthly downloads, revenue, monthly active users (MAU), daily active users (DAU), user engagement, or average revenue per user (ARPU) for app i in country c and month t. The transformation $\log(1 + y)$ is used to handle skewed distributions and zero values. The variable $OBAuth_{ic}$ is a binary indicator for whether app i is authorized as an open banking provider in country c, and $Post_{ict}$ is an indicator equal to 1 in all months following the earliest authorization date of the app. The interaction term $OBAuth_{ic} \times Post_{ict}$ captures the causal effect of open banking authorization on app performance. To ensure comparisons are made within the same app across countries, I include app-month fixed effects (δ_{it}), which absorb time-varying app-specific shocks (e.g., version updates). I also control for app-country fixed effects (δ_{ic}), capturing persistent cross-country differences in app usage—for example, apps that are popular in the UK but less adopted elsewhere. Finally, I include country-month fixed effects (δ_{ct}) to absorb time-varying country-level shocks, such as macroeconomic fluctuations or regulatory changes. Controls for each app's advertising campaign at the country-month level are also included to capture apps' advertisement strategy in different countries. Standard errors are clustered at the country and month levels to allow for arbitrary correlation within these dimensions. In later analyses, I further incorporate triple-interaction terms to explore the mechanisms underlying the observed effects.

4.2.1 Baseline Result

Increase in Quantity The most immediate benefit of open banking authorization manifests in app demand quantity. The regression results for downloads and revenue are reported in Table 3. From columns (1)-(3) for downloads and columns (4)-(6) for revenue, the estimated coefficients decline in magnitude but remain positive and statistically significant as progressively richer sets of fixed effects are introduced. When the full set of fixed effects is included, open banking authorization is associated with a 17.4% increase in app downloads and a 19.5% increase in app revenue, relative to the same app's performance in countries where it has not yet been authorized. The declining magnitude of the coefficients underscores the importance of granular fixed effects: without them, part of the estimated impact would reflect the app's overall expansion strategy (captured by the app-country fixed effects) or broader fintech trends within each country (captured by the country-month fixed effects), rather than the causal effect of open banking itself. It is also worth noting that downloads mainly capture the acquisition of new users, while revenue reflects demand from both new and existing users, which helps explain the slightly larger magnitude for revenue. These findings motivate further exploration of the underlying drivers of this demand increase. The dynamic estimates are presented in Figure 5. The absence of pre-trends prior to open banking authorization suggests that selection concerns are largely addressed by the granular fixed effects.

Improvement in Quality The positive impact of open banking extends beyond quantity—improving app quality and contributing to the overall performance gains. The results for quality-related outcomes are presented in Table 4. Open banking authorization leads to a 19.2% increase in monthly active users (MAU) and a 14.2% increase in daily active users (DAU). Furthermore, user engagement, measured as the ratio of DAU to MAU, rises by 0.8%. Although this magnitude is smaller than that of the quantity effects, it represents higher user retention and sustained usage—key indicators of improved app quality. A similar pattern emerges for average revenue per user (ARPU), which increases by 3% following authorization. This suggests that higher revenue is not driven solely by a larger user base but also by greater willingness to pay among existing users. Taken together, these results indicate that open banking enhances both the extensive margin (user acquisition) and the intensive margin (user engagement and monetization), reflecting meaningful improvements in both the reach and quality of fintech apps.

Extended Benefit to Non-authorized Provider Beyond authorized providers, similar benefits in both quantity and quality are also observed among non-authorized fourth-party providers. I estimate the same regression for this group, defining treatment by the earliest integration with an authorized third-party provider rather than by the app's own authorization. In other words, the treatment captures exposure to open banking through a partner's authorization status rather than the app's direct adoption. This approach provides a more exogenous source of variation, as the timing of third-party authorization is largely outside the control of fourth-party providers. However, this design may introduce measurement error in the treatment date and intensity, which could bias the estimated effects downward. The results, presented in Table 5, show that non-authorized fourth-party providers experience similar, though smaller, improvements in both user quantity and quality compared with their authorized counterparts. The smaller magnitudes are consistent with the event-study evidence in Section 4.1, confirming that the benefits of open banking extend beyond authorized participants and generate broader spillovers across the fintech ecosystem.

4.2.2 Mechanisms

To better understand the sources of the observed benefits from open banking, I extend the baseline specification by adding an additional layer of interaction terms that capture app characteristics and publisher types. The goal is to identify whether the gains are primarily driven by data complementarity, where apps benefit from enhanced access to user financial data, or by lower switching costs, which make it easier for consumers to move between financial service providers.

Data Complementarity I measure each app's data intensity using a textual analysis of its store description. The measure is based on the presence of keywords related to data usage, such as machine learning, analytics, personalization, and aggregation. Each app receives an overall score reflecting how frequently such data-related terms appear, with higher values indicating greater reliance on user data. Apps with an overall score above zero are classified as data-intensive. Panel A of Table 6 shows that these data-intensive apps experience substantially larger increases in downloads, engagement, and active users after open banking authorization, while the effects on revenue are positive but smaller. This pattern supports the data complementarity channel: apps that depend more on user financial data benefit most from expanded data access.

Lower Switching Costs Panel B of Table 6 examines how the impact of open banking differs across publisher types, which proxy for variation in user switching costs. The results show that traditional banks experience a decline in demand following authorization relative to fintechs, while fintechs—particularly fintech startups—benefit significantly. This pattern reflects how open banking lowers informational and procedural barriers that previously locked customers into incumbent institutions. By enabling users to share transaction data and account histories directly with alternative providers, open banking reduces the effort and uncertainty involved in switching. Fintechs and startups, being more agile and data-driven, can quickly incorporate these APIs into user-facing services such as budgeting tools, account aggregation, or instant credit scoring. Consequently, they capture users who are newly able to compare and adopt innovative financial products, while incumbents face intensified competition for their existing customer base.

4.3 COVID-19 as a Catalyst for Open Banking

In this section, I exploit COVID-19 as an exogenous shock to consumer behavior in financial services to examine how the pandemic affected adoption trajectories of open banking and non-open banking apps. The pandemic generated a large demand shock as lockdowns and mobility restrictions forced consumers to shift from in-person to digital financial services. At the same time, income losses and financial uncertainty increased demand for convenient and low-cost financial solutions. COVID-19 also acted as a saliency shock, raising awareness of digital tools for financial management. During the crisis, the need for efficient, secure, and integrated financial services became more evident, potentially accelerating the uptake of open banking applications. To study these effects, I compare adoption patterns of open banking and non-open banking apps using data as of the end of 2019, just before the pandemic. This design allows a cleaner identification of whether the COVID-19 shock differentially boosted the adoption of apps with open banking capabilities.

4.3.1 Baseline Result

To examine the impact of COVID-19 on the demand for open banking financial services, I employ a difference-in-differences (DiD) approach, estimating the following regression specification:

$$Demand_{ict} = \beta_1 OB_{ic} \times PostLockdown_t + X'_{ict}\gamma + \delta_{ic} + \delta_{it} + \epsilon_{ict} \tag{3}$$

in which the subscript i, c, and t denote app, country, and month respectively. The COVID-19 lockdown indicator, $PostLockdown_t$ equals one for all months following the first lockdown in the UK and EU, which began in March 2020[12]. The key treatment variable, OB_{ic}, is an indicator equal to one for open banking adoption observations and zero otherwise. The outcome variable, $Demand_{ict}$ is the logarithm of the monthly downloads, revenue, monthly active users (MAU), daily active users (DAU), or the level of engagement and ARPU of app

[12] All EU countries in the sample, as well as the UK, implemented initial lockdown measures in mid-to-late March 2020.

i in country c in month t. I scale the outcome variables using $log(1 + y)$ transformation as the distribution of downloads and revenue numbers are highly skewed, as shown in Table 1.

Panel A of Table 7 shows the results for authorized third-party providers (TPPs). Following the lockdown, their monthly downloads rose by roughly 15 percent relative to non-authorized finance apps, with consistent but smaller increases in activity measures such as MAU and DAU. Effects on engagement and ARPU are weaker, indicating that users rapidly adopted these apps but did not immediately increase usage intensity or spending. This pattern suggests that COVID-19 primarily triggered a surge in new users rather than a broad improvement in service quality, in contrast to the results in Section 4.2. The dynamic estimates in Panel A of Figure 6 show a persistent upward trajectory, with demand continuing to rise several months after the initial lockdown.

Panel B extends the analysis to non-authorized providers that integrated open-banking APIs. These apps also saw strong post-lockdown growth—downloads, MAU, and DAU rose by about 17-18 percent on average—while revenue increased by roughly 5 percent. As with authorized providers, engagement and ARPU effects remain limited, suggesting that user acquisition did not immediately translate into monetization. The dynamic results in Panel B of Figure 6 show an immediate 5 percent jump in downloads following the lockdown, reflecting consumers' rapid shift toward digital financial solutions when physical banking access became restricted. Together, these findings indicate that the COVID-19 shock accelerated adoption of both authorized and non-authorized open-banking apps, highlighting consumers' growing reliance on digital, accessible, and data-driven financial services.

4.3.2 Heterogeneity

Service Type The baseline regression results suggest that consumer demand for open banking services increased following the onset of COVID-19. But what specific types of services did users turn to? To answer this question, I explore whether the increase in demand varies by the type of service provided. I classify apps into five categories based on their app descriptions: payment, lending, investment, insurance, and miscellaneous. For multifunction apps, I assign the most salient or prominently featured service type based on their description. Each service type is represented by a binary indicator, and I add a triple interaction term to Equation 3 and estimate the heterogeneous effects across apps with different service types.

The regression results are presented in Panel A of Table 8. I find that the overall increase in demand is primarily driven by lending and investment apps, which experienced 24.5% and 20.1% greater increases, respectively, compared to other open banking apps. In contrast, payment apps saw a relative decrease of 18.9%. This decline may reflect the overall slowdown in economic activity and a sharp drop in in-person retail transactions during lockdowns. Notably, online purchases (e.g., on Amazon or other e-commerce platforms) are not captured as demand for payment apps in my data, as these transactions often happen outside of the payment apps. For insurance and miscellaneous service categories, I find no statistically significant additional increase in demand. These results underscore the role of open banking—particularly lending apps—as a substitute for traditional credit channels during times of financial stress. While I cannot directly observe the outcomes of the lending (e.g., repayment, default, or financial well-being), the observed surge in demand suggests that consumers faced widespread and unmet borrowing needs during the pandemic. Whether this response enhanced consumer welfare remains an open question, but it clearly reveals the critical role of fintech platforms in filling the gap left by conventional banking institutions during crisis periods. The strong demand in borrowing providers is also supported by individual-level Global Findex survey data, the results are shown in Table 10.

Provider Type To further explore heterogeneity in the demand for open banking services, I divide apps by provider type into three main categories: traditional banks, neo-banks, and fintechs. Among fintech providers, I distinguish between incumbents and startups, where startups are defined as publishers that launched their first app after 2016. The list of neo-banks is compiled from publicly available sources including Neobanks.app[13] and The

[13] https://neobanks.app.

Financial Brand[14]. Using a similar regression design, I test for differences in pandemic-driven demand across these provider types.

The results shown in Panel B of Table 8 indicate that the surge in demand for open banking services is primarily driven by fintech apps, rather than by apps from traditional banks or neo-banks. In fact, downloads for bank and neo-bank apps show little to no increase during the pandemic period. One possible explanation is that traditional banks and neo-banks were already widely adopted before the pandemic, leaving less room for new user acquisition during the crisis. Additionally, traditional banks may have faced operational hurdles in onboarding new customers during the lockdown, such as requirements for in-person identity verification or more cumbersome account setup processes, which fintech platforms are typically better positioned to streamline through digital channels. A particularly interesting finding is that fintech startups experienced 9.9% higher growth in app downloads relative to fintech incumbents. This suggests that COVID-19 served as a catalyst for emerging fintech players, offering them a unique growth opportunity amid changing consumer needs and preferences. The increase in adoption of startup apps highlights both the agility of newer entrants and the unmet demand for alternative financial services during times of crisis. It underscores the important role fintech startups play in enhancing financial access and innovation when traditional channels fall short.

4.3.3 Impact on Competition and Innovation

The previous sections show that open banking apps, particularly those developed by fintech firms, played a key role in meeting customer needs during the COVID-19 pandemic. A more fundamental question, however, is whether open banking also influences competition and innovation within the broader financial app ecosystem. To provide preliminary evidence, I extend the baseline specification in Equation 3, shifting the focus from consumer demand to competitive dynamics. I use network centrality measures as proxies for the competitive pressure faced by each app in the top 1,000 sample. The competitor network is constructed

[14] https://thefinancialbrand.com/list-of-digital-banks.

monthly for each country in the UK and EU using historical app descriptions. Following the text-based industry classification approach of Hoberg and Phillips (2016), I compute TF-IDF weighted cosine similarity scores between app descriptions to identify pairs of apps with overlapping functionalities or markets. These similarity links form a dynamic network that evolves as apps enter or exit the top rankings. From this network, I derive degree, betweenness, and clustering coefficients, which capture each app's market position and exposure to competition. The following regression is then estimated:

$$Competition_{ict} = \beta_1 OB_{ic} \times PostLockdown_t + X'_{ict}\gamma + \delta_{ic} + \delta_t + \epsilon_{ict} \tag{4}$$

where $Competition_{ict}$ refers to one of three competitor network centrality metrics for app i in country c at month t. I employ both unweighted centrality (reported in odd-numbered columns) and cosine similarity-weighted versions (reported in even-numbered columns). The specification includes app-country and month fixed effects, with standard errors two-way clustered. As shown in panel A of Table 9, open banking apps face increased competitive pressure after the pandemic shock across all centrality metrics and specifications, though the effect size is modest. This provides suggestive evidence that open banking fosters greater competition among financial service providers.

To explore innovation, I shift to the publisher level and examine three outcomes: the frequency of version updates, the number of newly launched apps, and the number of discontinued apps. These outcomes are measured across the publisher's entire portfolio, including both finance and non-finance apps.[15] The regression follows the same structure as before:

$$Innovation_{pt} = \beta_1 OB_p \times PostLockdown_t + X'_{pt}\gamma + \delta_p + \delta_t + \epsilon_{pt} \tag{5}$$

where $Innovation_{pt}$ denotes the frequency of version updates, number of new apps, or number of delisted apps for publisher p in month t. Results in Table 9 indicate that open banking publishers are significantly more active in updating their existing apps—both in terms of

[15]Finance app publishers often develop apps in other categories such as productivity, retail, or business.

overall and major updates—following the lockdown. However, there is no evidence of increased app launches among these publishers, whether in finance or other categories. One possible explanation is that maintaining open banking services involves ongoing compliance and API-related costs, prompting firms to focus resources on existing apps rather than new development. Regarding app discontinuation, there is little evidence that open banking apps are more or less likely to be delisted. Nevertheless, the consistently negative coefficients suggest these apps may be more resilient in a competitive market, potentially benefiting from stronger product-market fit or sustained user demand.

5 Open Banking's Impact on Banks and Their Reactions

This section presents micro-level evidence on how banks are potentially affected by open banking, details the construction of a measure capturing each bank's exposure to open banking, and examines how open banking influences banks' performance and strategic responses.

5.1 Micro Evidence

I draw inspiration of the bank's potential impact using individual-level microdata from the World Bank's Global Findex survey—a triennial, nationally representative survey on how adults save, borrow, make payments, and manage financial risk. The harmonized individual-level data across countries and years make it particularly suitable for evaluating the impact of financial regulation in a cross-country setting. I use this dataset to examine whether open banking adoption is associated with changes in household financial behavior, particularly in savings and borrowing. Specifically, I use the 2014, 2017, 2021, and 2024 waves of the Global Findex microdata (Development Research Group, Finance and Private Sector Development Unit, 2022) to estimate the following regression:

$$Y_{ict} = \alpha + \beta \text{ Open Banking}_c \times \text{Post}_t + \gamma_1 \text{Control}_{it} + \gamma_2 \text{Control}_{ct} + \theta_{Rt} + \delta_c + \lambda_t + \varepsilon_{ict} \quad (6)$$

The dependent variable is a binary indicator based on whether the individual used a specific savings or borrowing channel—either a formal financial institution or an informal provider—in the past 12 months. *Open Banking* is a dummy equal to 1 if the respondent's country had adopted open banking regulation by the end of 2020. *Post* equals 1 for the 2021 and 2024 wave and 0 for earlier waves. Individual-level controls include age, gender, income quintile, and education level. Country-level controls, sourced from the World Bank World Development Indicators, include inflation rate and GDP per capita. Control variables include region-year fixed effects (θ_{Rt}), country fixed effects (δ_c), and year fixed effects (λ_t).

Table 10 presents the regression results. Panel A reports estimates for all survey participants, while Panel B restricts the sample to individuals who reported any savings or borrowing activity within the past 12 months. Across both panels, the interaction term *Open Banking* $\times$ *Post* is positive for informal borrowing and negative and significant for borrowing from formal financial institutions. Conditional on having any borrowing, this contrast becomes even more pronounced. These results indicate a substitution from formal to informal borrowing following open banking adoption. This substitution pattern is concentrated among the bottom 80% of the income distribution and grows stronger as income decreases, whereas higher-income individuals increase their borrowing from both formal and informal sources. On the savings side, open banking also appears to crowd out deposits in formal financial institutions: as banks and other regulated entities experience declines in savings, informal providers record modest gains. However, conditional on having savings, the estimated effects for formal institutions are small and statistically insignificant (though negative in sign), suggesting that bank deposits are more persistent than borrowing relationships, and that fintech or informal providers have greater difficulty substituting for banks on the savings side.

Taken together, these findings suggest that open banking has the potential to materially affect banks' intermediation role—particularly through competitive pressures in lending markets, where fintech and informal providers appear to capture market share from traditional institutions. A caveat is that the survey definitions of "informal providers" and "financial institutions" are somewhat ambiguous, leaving room for potential misclassification or heterogeneous interpretation by respondents.

5.2 Measuring Banks' Open Banking Exposure

Motivated by the micro-level evidence, I use app descriptions to construct a measure of banks' exposure to open banking-induced competitive pressure, proxied by the degree of functional overlap between banking and fintech apps. To quantify this overlap, I calculate pairwise textual similarities based on their app store descriptions. Each app description is first transformed into a numerical vector using the Term Frequency-Inverse Document Frequency (TF-IDF) approach. TF-IDF is a standard technique in natural language processing that captures the relative importance of each word within a document compared to its frequency across the entire corpus. Words that appear frequently in a given description but infrequently elsewhere receive higher weights, allowing the measure to emphasize distinctive features of each app's functionality.

The construction of TF-IDF involves two components: term frequency (TF) and inverse document frequency (IDF). The TF component captures how frequently a word appears in a specific app description. For any word w in description d, the term frequency is defined as:

$$\mathrm{TF}_{wd} = \frac{f_{wd}}{\sum_{w' \in d} f_{w'd}} \tag{7}$$

where f_{wd} denotes the number of times word w appears in app d, and the denominator sums over all word occurrences in that description. This normalization ensures that TF values are comparable across documents of different lengths. The IDF component down-weights common terms and up-weights rare ones, helping to distinguish words that are particularly informative. It is computed as:

$$\mathrm{IDF}_{w} = \log\left(\frac{N}{1 + |\{d \in D : w \in d\}|}\right) \tag{8}$$

where N is the total number of app descriptions in the corpus, and $|\{d \in D : w \in d\}|$ is the number of descriptions in which word w appears. The addition of 1 in the denominator prevents division by zero. The final TF-IDF score for word w in description d is given by:

$$\text{TF-IDF}_{wd} = \text{TF}_{wd} \times \text{IDF}_w \tag{9}$$

With each app description now represented as a TF-IDF vector, I compute the similarity between any two apps using cosine similarity:

$$\text{CosineSimilarity}(A, B) = \frac{\vec{v}_A \cdot \vec{v}_B}{\|\vec{v}_A\| \cdot \|\vec{v}_B\|} \tag{10}$$

where $\vec{v}_A$ and $\vec{v}_B$ denote the TF-IDF vectors of app descriptions A and B, respectively. Cosine similarity ranges from 0 to 1, where higher values indicate greater textual overlap.

To construct a bank-level measure of open banking exposure, I take the average cosine similarity between each bank's app and all authorized open banking providers' apps. A higher value reflects greater similarity in the services described, indicating that the bank potentially overlaps more with fintech offerings and may face stronger exposure from open banking. Specifically, I construct the exposure measure by comparing the earliest available app descriptions of banks in 2018 with the latest app descriptions of authorized third-party providers in 2023. This timing choice is intentional. By anchoring bank app descriptions in 2018—prior to widespread third-party entry—I avoid capturing banks' potential responses to competitive pressure in the form of strategic changes to their app content. At the same time, using 2023 app descriptions for authorized third parties ensures that the features of fully developed open banking apps are adequately reflected. Notably, in 2018, the number of authorized third-party providers was small and largely limited to the UK, and their app features may not yet have represented the broader open banking ecosystem. For visualization, Figure 7 shows the country-level mean exposure across banks; darker shades indicate higher exposure. The most exposed countries include Germany, the United Kingdom, France, Italy, and Sweden.

5.3 Open Banking's Impact on Bank Performances

One natural outcome variable sets are the performance from accounting data issued by banks annually. To causally capture the impact on banks, I employ the following regression

$$Y_{bct} = \beta Post_{ct} \times HighOBExposure_b + \gamma Controls_{bt} + \delta_{ct} + \lambda_b + \varepsilon_{bct} \tag{11}$$

where Y_{bct} denotes the outcome of bank b in country c at time t. $Post_{ct}$ equals 1 for years 2019 and onward[16]. $HighOBExposure$ is defined as the indicator for above-average TF-IDF cosine similarity, as described in Section 5.2, between bank b's app and all authorized third-party apps.[17] Country-year fixed effects and bank fixed effects are included to control for country-specific macroeconomic trends and unobserved bank-specific characteristics.

Table 11 presents the results. Panel A focuses on banks' balance sheets. Compared to banks less exposed to fintech challengers, those with greater open banking exposure experience a significant contraction in size. Moving from low to high exposure, the average bank records a 12.5% decline in gross loans and a 9.3% decline in total deposits. Total assets, debt, and equity also show consistent decreases, most statistically significant at the 1% level. The stronger impact on loans relative to deposits suggests that alternative lending models offered by open banking fintechs —particularly those relying less on traditional credit records —pose a direct threat to banks' core lending activities, with effects visible on the balance sheet. Panel B reports results on income and expenses. Operating income declines by 5.3% for more exposed banks, while operating expenses fall by an even larger 8%. Interest income shows a sharp decrease, consistent with the contraction in loans. Interest expense, while negative, is not statistically significant, indicating that banks' interest-bearing liabilities continue to require stable interest payments even as deposits shrink. A possible explanation is non-decreasing (or rising) interest expenses on investments or other interest-bearing liabilities. At the per-employee level, income and expenses are not significantly affected, though the

[16] $Post_{ct}$ equals 1 for years 2018 and onward for UK

[17] As robustness checks, I also use Bag-of-Words cosine similarity and the maximum across TF-IDF cosine similarity scores.

signs of the coefficients align with aggregate results. This suggests that while banks face shrinking asset pools and revenues, per-employee productivity is maintained, pointing to potential efficiency gains that we examine later. Panel C examines the composition of bank assets. For highly exposed banks, loans make up a smaller share of total assets, earning assets, and deposits. In particular, the loan-to-asset ratio declines by 1.6%. By contrast, the shares of cash held at the central bank, securities, and other non-traditional assets (including interbank assets and miscellaneous earning assets) increase by about 1.5%, with the changes statistically significant at the 5% level. These results suggest that banks respond to the open banking threat by reducing reliance on loans and reallocating toward alternative asset classes. Panel D turns to profitability and efficiency. Greater exposure to open banking is associated with a modest but statistically significant 0.1% increase in net interest margin, measured as net interest income scaled by average earning assets, indicating improved efficiency in generating interest income. Consistent evidence appears in columns (3) and (4), where exposed banks show small but significant increases in asset yield and net interest spread,[18] driven primarily by stronger returns on earning assets. Fee intensity, measured as net fee income relative to net interest income, also rises by 0.1% and is significant. Furthermore, the operating cost-to-income ratio declines by 2.4%, reflecting improved cost efficiency. ROA likewise shows a small but significant increase. Taken together, these results suggest that although highly exposed banks face adverse effects on the loan side, they also adapt strategically through greater diversification and enhanced cost efficiency. Overall, the effects are statistically robust but economically modest in scale.

To examine which banks are more affected by open banking, I separate the sample based on banks' pre-open banking size, dividing them into groups above and below the median. The results, reported in Table 12, reveal a clear heterogeneity by size. Across all panels, the adverse effects are concentrated among larger banks, which experience sharper contractions

[18] Asset yield is defined as interest income divided by average earning assets. Net interest spread is defined as the difference between asset yield and interest expenses scaled by the sum of deposits and other interest-bearing liabilities.

in lending and income, as well as more pronounced shifts in asset allocation. In contrast, smaller banks appear largely unaffected, with weaker and often statistically insignificant estimates across most outcome variables. These patterns suggest that open banking intensifies competitive pressure primarily on large incumbents, whose existing customer bases and product portfolios face greater substitution by fintech entrants. Smaller banks, by contrast, may either occupy niche markets less directly contested by fintech firms or benefit from partnership opportunities facilitated by open banking. Overall, the results imply that the distributional impact of open banking within the banking sector is asymmetric-posing greater challenges to dominant players while leaving smaller institutions relatively insulated.

5.4 Open Banking's Impact on Bank Apps

A natural next step is to examine whether open banking affects the performance of banking apps directly. However, the results from this analysis are less stable and generally inconclusive, with estimated effects that vary in sign and magnitude across specifications. To further investigate, and following a similar approach to that used in the micro-level evidence, I extend the analysis to a broader set of countries for which bank app data are available. Rather than focusing on app performance metrics, I instead analyze app store rankings to gain a clearer view of banks' relative competitiveness in the mobile channel. Specifically, I estimate the following regression:

$$Y_{bct} = \alpha + \beta \text{ Open Banking}_c \times \text{Post}_t + \delta_c + \lambda_{bt} + \varepsilon_{bct} \tag{12}$$

where Y_{bct} denotes various metrics related to the ranking performance of bank apps. Table 13 reports the corresponding regression results. Panel A focuses on several indicators of app competitiveness: the average ranking, ranking volatility, peak (best) ranking, and the probability of appearing in the top 50 or top 100 charts. To reduce truncation bias—since bank apps are often less visible in foreign markets—I restrict attention to each bank's app ranking within its home country. The results show that the average ranking increases by

3.3%, implying a deterioration in relative popularity because higher rankings correspond to lower competitive standing. Ranking volatility also rises following open banking adoption, indicating that the competitive landscape has become more dynamic and uncertain, with stronger fluctuations potentially driven by the entry and success of high-quality fintech apps. In addition, bank apps achieve lower peak rankings and appear less frequently in the top 50 and top 100 lists. Together, these results suggest that open banking fosters a more competitive and fluid app market, where incumbent banks face increased pressure from agile fintech entrants. Panel B repeats the specification but splits the sample based on the 2017 Global Findex (pre-open banking), using the cross-country median as a cutoff. The negative effects of open banking on bank app performance are concentrated in countries with above-median Findex scores, where the fintech ecosystem is more developed and consumers are more digitally engaged. In contrast, the effects are muted in countries with lower Findex scores, suggesting that the competitive impact of open banking depends on the maturity of the local fintech infrastructure and user readiness.

6 Conclusion

This paper provides large-scale empirical evidence on how open banking reshapes competition in European financial services. I show that open banking intensifies competition by boosting the performance of fintech apps, with effects extending beyond directly authorized firms and diffusing competitive pressure across the broader market.

Exploiting within-app cross-country variation in authorization status, I provide causal evidence that open banking adoption leads to meaningful gains in both demand quantity and service quality among fintechs. Two mechanisms underpin these effects: (i) reduced switching costs, which disproportionately benefit less established entrants, and (ii) data complementarity, which favors data-intensive fintechs. These advantages became especially pronounced during the COVID-19 pandemic, particularly among lending and investment apps and fintech startups, highlighting open banking's role in sustaining digital financial access when traditional channels were disrupted. Moreover, authorized apps exhibit higher update frequency, consistent with accelerated innovation and heightened competitive responsiveness.

For banks, the competitive pressures unleashed by open banking generate meaningful spillover effects. Institutions facing greater fintech competition experience contractions in balance sheet size and revenue, driven by reduced loan issuance and lower deposits. At the same time, highly exposed banks adjust their business models by reducing reliance on traditional lending, increasing fee-based income, and reallocating assets toward interbank positions and securities. These banks also achieve higher cost efficiency and wider net interest margins, while overall profitability remains largely unchanged. In sum, open banking emerges as a catalyst for financial access, competition, and innovation, transforming how banks operate and compelling them to adapt to an increasingly open and data-centric financial landscape.

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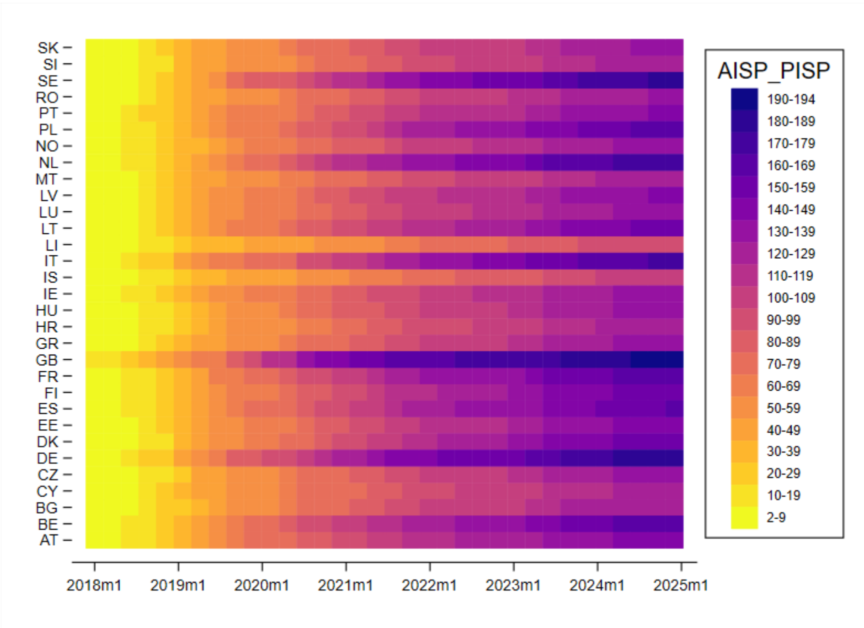
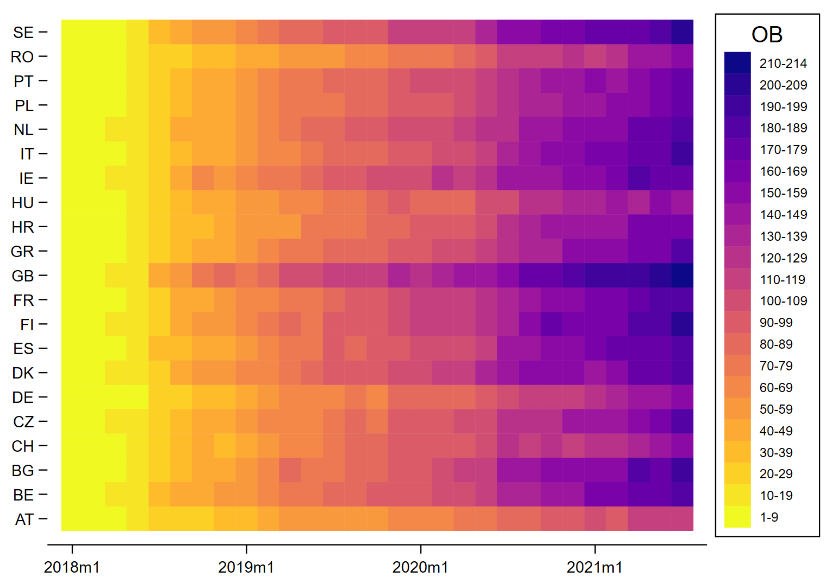
Figure 1: Numbers of Authorized and Non-authorized Providers in UK & EU

(a) Cumulative Authorized Provider

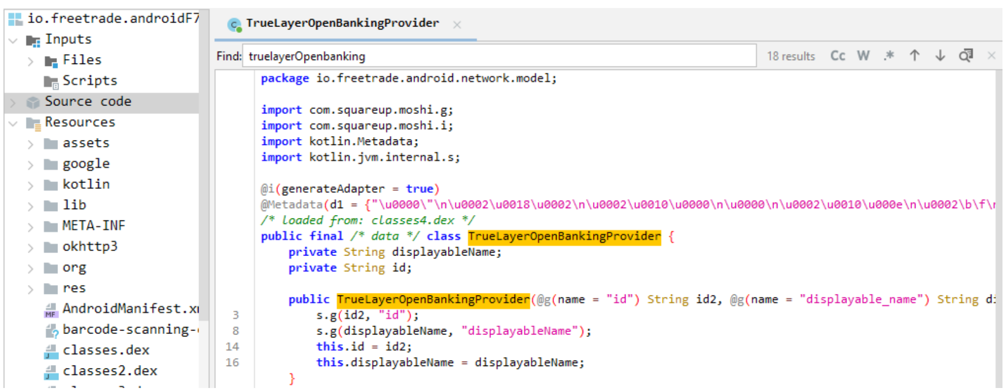


(b) Non-authorized Provider in Top 1,000



NOTE.— This figure displays the evolution of authorized and non-authorized open banking providers over time. Panel A plots the cumulative number of authorized providers across all UK and EU countries. Panel B shows the number of top 1,000 finance apps in each country (covered by Apptopia) that have integrated an API from an authorized provider.

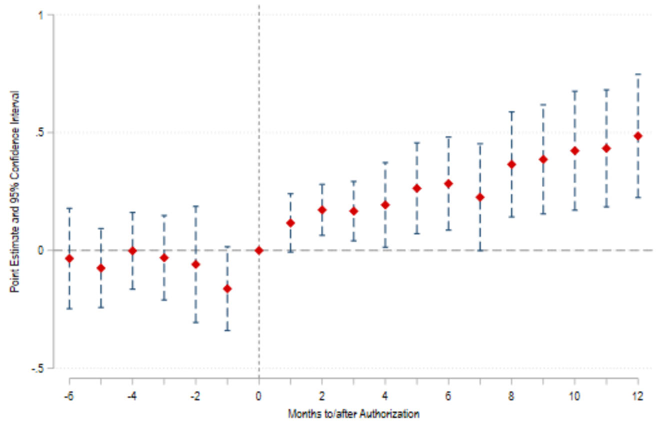
Figure 2: Screenshot for APK Source Code of the Freetrade App



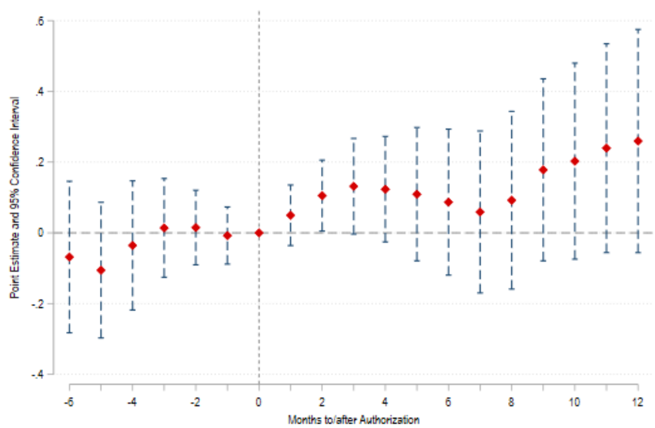
Note.— This figure presents the decompiled content of a historical version of the Freetrade app's APK using JADX-GUI. The highlighted section shows the presence of the class "TrueLayerOpenBankingProvider", which provides direct evidence that the app had integrated with the open banking provider TrueLayer, allowing us to infer open banking adoption by the Freetrade app.

Figure 3: Demand Response to Open Banking: Authorized Provider

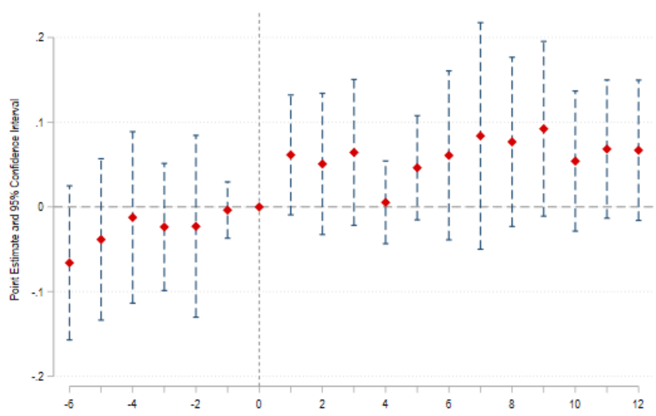
(a) Downloads



(b) Daily Active User



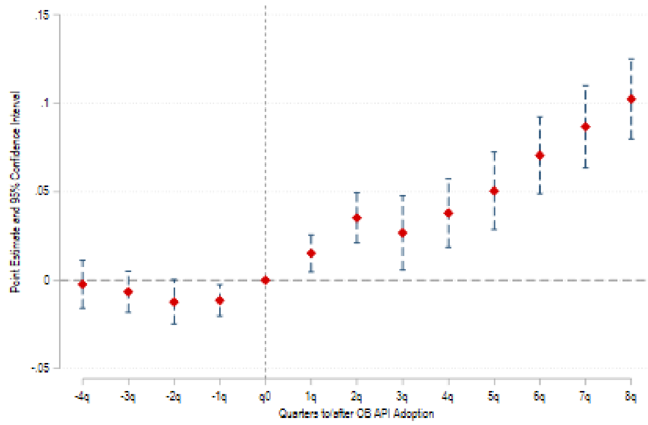
(c) Revenue



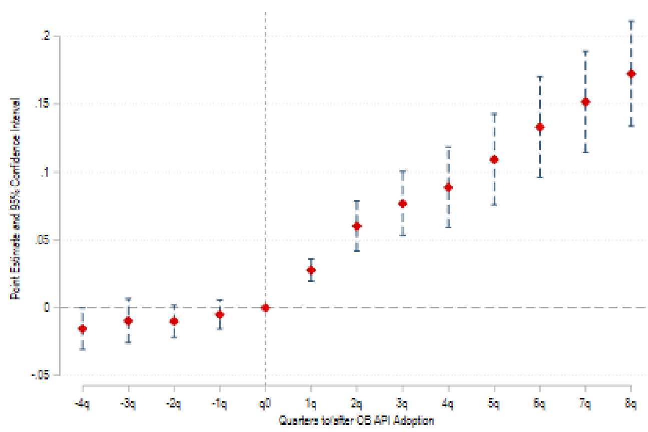
Note.— This figure presents event study coefficients in Equation 1 around the authorizations of open banking for authorized third-party providers. Panels A, B, and C show the event study coefficients of downloads, average daily active users, and revenue.

Figure 4: Demand Response to Open Banking:
Non-authorized Provider

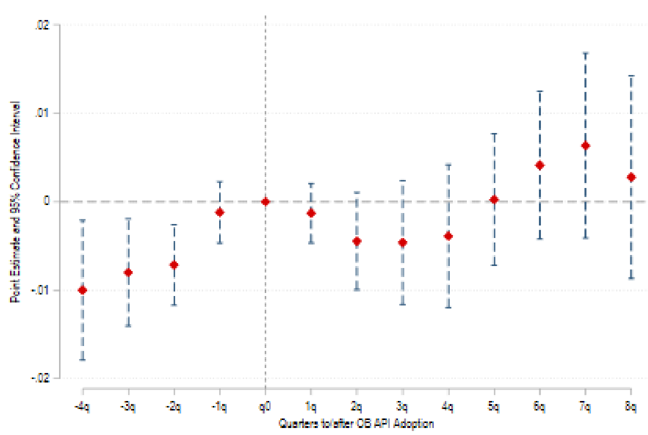
(a) Downloads



(b) Daily Active User



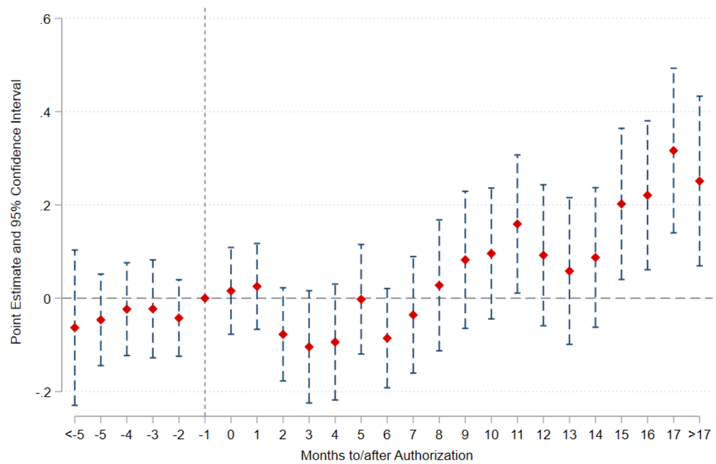
(c) Revenue



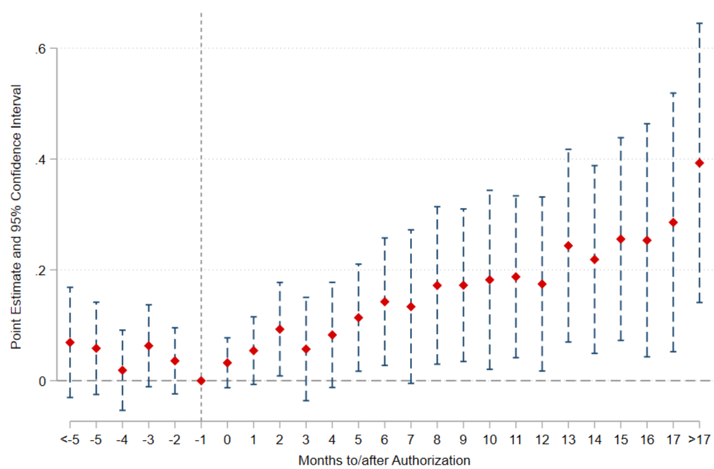
NOTE.— This figure presents event study coefficients in Equation 1 around the adoption of open banking for non-authorized providers. Panels A, B, and C show the event study coefficients of downloads, average daily active users, and revenue.

Figure 5: Dynamic Effects of Authorization on Demand: Authorized Third-Party Provider

(a) Downloads



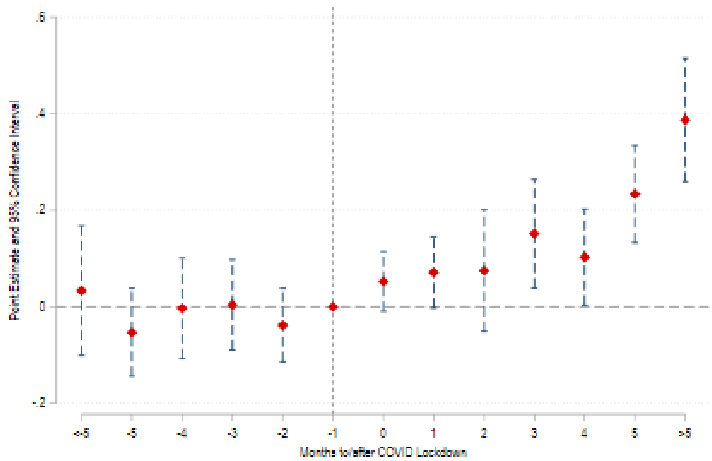
(b) Revenue



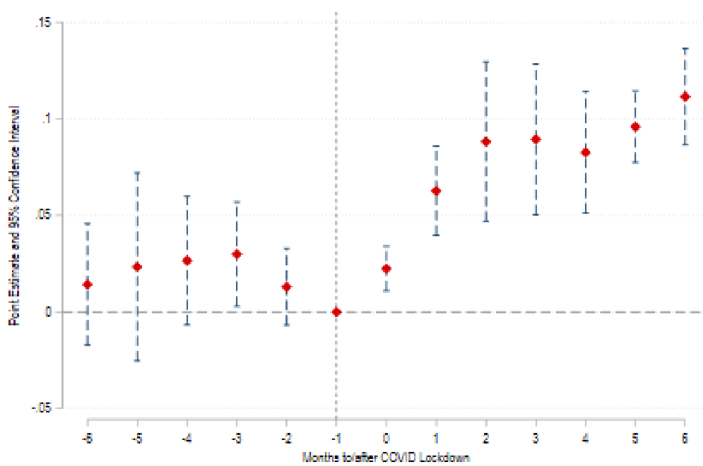
NOTE.— This figure presents the dynamic coefficients from the Difference-in-Differences specification in Equation 2, capturing the impact of Open Banking authorization. Panel A reports the estimates for downloads, and Panel B reports those for revenue.

Figure 6: Dynamic Effects of COVID-19 on Demand for Open Banking Apps Providers

(a) Authorized Provider

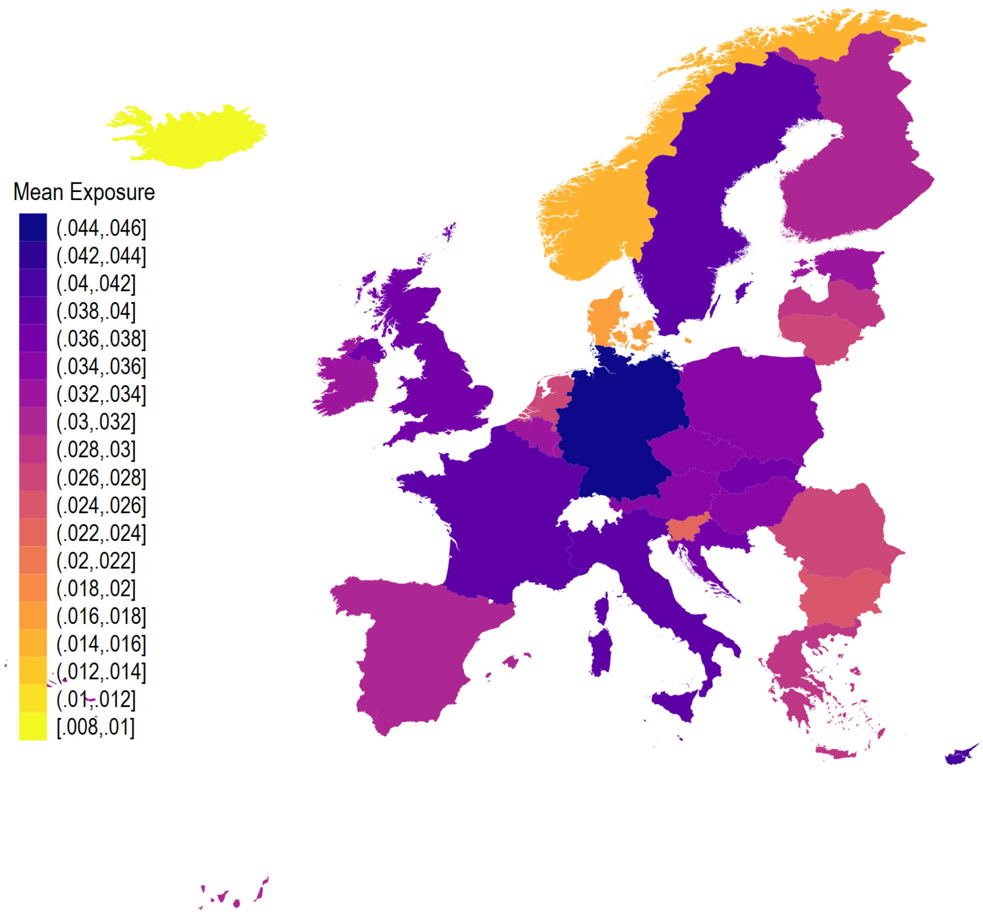


(b) Non-authorized Provider



NOTE.— This figure presents the Difference-in-Differences regression coefficients capturing the impact of COVID-19 in Equation 3. Panel A plots the dynamic interaction coefficients for authorized open banking providers. Panel B shows the corresponding dynamic coefficients for non-authorized apps that integrated with an authorized open banking API.

Figure 7: Mean Open Banking Exposure by Country



Note.— This figure presents the mean value of open banking exposure for each country in Europe. Open banking exposure is calculated as described in Section 5.2. For each country, exposure is averaged across all sampled banks (ignoring missing values). Shading reflects equal-width bins shown in the legend; darker colors indicate higher average exposure faced by banks.

Table 1: Summary Statistics

	mean	*sd*	*p1*	*p50*	*p99*	*count*
Downloads	725.78	5221.45	1.00	102.00	10872.00	902, 893
Revenue	71.30	701.22	0.00	0.00	1182.00	902, 893
DAU	927.76	9499.20	0.00	68.87	14599.11	902, 893
MAU	2831.29	18919.38	0.00	382.60	43147.68	902, 893
ARPU	0.66	4.45	0.00	0.00	9.99	902, 893
Engagement	0.18	0.14	0.00	0.17	0.50	902, 893
Age (month)	57.50	36.14	2.00	53.00	140.00	902, 893
In-App Purchases	0.18	0.38	0.00	0.00	1.00	902, 893
In-App Advertising	0.44	0.50	0.00	0.00	1.00	902, 893
Same publisher apps	9.37	20.72	1.00	3.00	107.00	902, 893
# Past versions	22.02	22.86	0.00	17.00	107.00	902, 893
Version age (month)	7.95	14.09	0.00	1.60	65.57	902, 893

Note.—This table presents summary statistics for the top 1,000 finance apps in the UK and EU on the iOS App Store, covering the period from January 2018 to July 2021. DAU denotes average daily active users, MAU refers to monthly active users, and ARPU represents average revenue per user. Engagement, defined as the ratio of DAU to MAU, serves as a proxy for how frequently the average user opens the app.

Table 2: Determinants of Open Banking Adoption

	Adoption		Early Adoption		Late Adoption	
	(1)	(2)	(3)	(4)	(5)	(6)
Age	−0.004***	−0.004***	−0.001***	−0.001***	−0.001***	−0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age squared	0.000***	0.000***	0.000**	0.000***	0.000***	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
In-app Purchases	0.002	0.001	0.000	0.001	−0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Multi-language	0.015***	0.014***	0.005***	0.006***	0.004***	0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Multi-platform	0.026***	0.026***	0.010***	0.010***	0.008***	0.008***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Multi-category	−0.001	−0.001	−0.000	−0.001**	−0.000	0.001*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
App portfolio	−0.004***	−0.003**	0.001	−0.001	−0.002***	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Past Downloads	0.094***	0.095***	0.047***	0.045***	0.004	0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Year FE		Y		Y		Y
Observations	71,316	71,316	71,316	71,316	71,316	71,316
R-sq.	0.015	0.016	0.005	0.012	0.004	0.019

Note.—This table reports the characteristics of open banking adopters. For each year, the sample consists of apps that adopt open banking within that year and those that have not yet adopted, excluding any apps that adopted in previous years. The annual samples are then pooled across years. Early adopters are defined as those who adopted open banking in 2018, while late adopters are those who adopted in 2020 or later.

Table 3: Demand Response to Open Banking Authorization: Quantity

	Downloads			Revenue		
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.524**	−0.187	−0.101	−0.067	−0.337**	−0.337**
	(0.21)	(0.13)	(0.10)	(0.10)	(0.14)	(0.14)
OBAuth × Post	0.519***	0.227***	0.174**	0.293***	0.219***	0.195**
	(0.19)	(0.08)	(0.09)	(0.09)	(0.08)	(0.09)
Mean of dep. var.	3.381	3.389	3.389	0.162	0.163	0.163
Controls	Y	Y	Y	Y	Y	Y
App × Month FE	Y	Y	Y	Y	Y	Y
App × Country FE		Y	Y		Y	Y
Country × Month FE			Y			Y
Observations	161,754	160,751	160,751	161,754	160,751	160,751
R-sq.	0.540	0.890	0.905	0.608	0.837	0.848

Note.—This table reports the estimated coefficients from Equation 2, using app downloads and revenue as the outcome variables. The variable *OBAuth* is a binary indicator equal to one if the app is authorized as an open banking provider in a given country. The identification relies on within-app comparisons across countries with and without authorization, holding app-level characteristics constant. Standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Demand Response to Open Banking Authorization: Quality

	(1) Engagement	(2) MAU	(3) DAU	(4) ARPU
Post	0.003	0.166	0.132	−0.026**
	(0.00)	(0.18)	(0.11)	(0.01)
OBAuth × Post	0.008*	0.192*	0.142*	0.030***
	(0.00)	(0.10)	(0.08)	(0.01)
Mean of dep. var.	0.089	2.971	2.228	0.013
Controls	Y	Y	Y	Y
App × Month FE	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y
Country × Month FE	Y	Y	Y	Y
Observations	160,751	160,751	160,751	160,751
R-sq.	0.904	0.923	0.945	0.804

NOTE.—This table reports the coefficients from estimating Equation 2, using app Engagement, MAU, DAU, and ARPU as the outcome variables. The variable $OBAuth$ is a binary indicator equal to one if the app is authorized as an open banking provider in a given country. The identification relies on within-app comparisons across countries with and without authorization, holding app-level characteristics constant. Standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Demand Response to Open Banking Authorization: Non-authorized Providers

	(1) ln(Download)	(2) Engagement	(3) ln(Revenue)	(4) ln(MAU)	(5) ln(DAU)	(6) ln(ARPU)
Post	−0.160**	−0.006**	−0.023**	−0.165*	−0.107**	−0.004***
	(0.02)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)
OBAuth × Post	0.031***	0.002**	0.024***	0.091***	0.045***	0.003***
	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Mean of dep. var.	2.971	0.067	0.145	2.328	1.678	0.014
Controls	Y	Y	Y	Y	Y	Y
App × Month FE	Y	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y	Y
Country × Month FE	Y	Y	Y	Y	Y	Y
Observations	3,214,357	3,214,357	3,214,357	3,214,357	3,214,357	3,214,357
R-sq.	0.847	0.850	0.846	0.883	0.913	0.834

Note.—This table reports the coefficients from estimating Equation 2 for non-authorized fourth-party providers, using app Downloads, Revenue, Engagement, MAU, DAU, and ARPU as the outcome variables. The variable *OBAuth* is a binary indicator equal to one if the app is authorized as an open banking provider in a given country. The identification relies on within-app comparisons across countries with and without authorization, holding app-level characteristics constant. Standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Demand Response to Open Banking Authorization: Mechanisms

Panel A. Data Complementarity

	(1) ln(Download)	(2) Engagement	(3) ln(Revenue)	(4) ln(MAU)	(5) ln(DAU)	(6) ln(ARPU)
OBAuth × Post	0.000	0.001**	−0.000	0.067***	0.021***	−0.000
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
OBAuth × Post × HighData	0.066***	0.002***	0.023***	0.050***	0.052***	0.006***
	(0.01)	(0.00)	(0.00)	(0.02)	(0.01)	(0.00)
Controls	Y	Y	Y	Y	Y	Y
App × Month FE	Y	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y	Y
Country × Month FE	Y	Y	Y	Y	Y	Y
Observations	3,214,357	3,214,357	3,214,357	3,214,357	3,214,357	3,214,357
R-sq.	0.847	0.850	0.846	0.883	0.913	0.834

Panel B. Lower Switching Cost

	(1)	(2)	(3)	(4)	(5)
OBAuth × Post	0.071***	0.027**	−0.028***	0.018**	0.011
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
OBAuth × Post × Bank	−0.123***				
	(0.01)				
OBAuth × Post × Neobank		0.053***			
		(0.01)			
OBAuth × Post × Fintech			0.099***		
			(0.01)		
OBAuth × Post × Fintech Incumbent				0.037***	
				(0.01)	
OBAuth × Post × Fintech Startup					0.088***
					(0.01)
Controls	Y	Y	Y	Y	Y
App × Month FE	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y
Country × Month FE	Y	Y	Y	Y	Y
Observations	3,214,357	3,214,357	3,214,357	3,214,357	3,214,357
R-sq.	0.847	0.847	0.847	0.847	0.847

NOTE.— This table reports the results from triple interaction regressions that examine the mechanisms behind the observed growth effects. The variable *OBAuth* is a binary indicator equal to one if the app is authorized as an open banking provider in a given country. Panel A presents interactions with data intensity, measured using textual analysis of app descriptions, while Panel B presents interactions by publisher entity type. Standard errors are clustered at the country level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Impact of COVID-19 on Open Banking Provider Demand: Baseline

Panel A. Authorized Provider

	(1) Download	(2) Engagement	(3) Revenue	(4) MAU	(5) DAU	(6) ARPU
OBAuth × PostLockdown	0.155***	0.015***	0.274***	0.119***	0.119***	0.039***
	(0.02)	(0.00)	(0.01)	(0.03)	(0.02)	(0.00)
App × Year-Month FE	Y	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y	Y
Observations	124,119	124,119	124,119	124,119	124,119	124,119
R-sq.	0.879	0.888	0.821	0.918	0.942	0.759

Panel B. Non-authorized Provider

	(1) Download	(2) Engagement	(3) Revenue	(4) MAU	(5) DAU	(6) ARPU
OB × PostLockdown	0.170***	0.008***	0.054***	0.185***	0.183***	−0.000
	(0.01)	(0.00)	(0.01)	(0.02)	(0.02)	(0.00)
Year-Month FE	Y	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y	Y
Observations	459,056	459,056	459,056	459,056	459,056	459,056
R-sq.	0.887	0.853	0.911	0.900	0.916	0.916

NOTE.—This table presents the impact of COVID-19 on demand for open banking apps. The variable *OBAuth* is a binary indicator equal to one if an app is authorized as an open banking provider in a given country as of the end of 2019. The variable *OB* is a binary indicator equal to one if an app has integrated the open banking API of an authorized provider by the end of 2019. Panel A reports the coefficients from estimating Equation 3, while Panel B reports the coefficients from **??**. Standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Heterogeneity in the Impact of COVID-19 on Open Banking Providers

Panel A. Service Type

	(1)	(2)	(3)	(4)	(5)
OB × PostLockdown	0.273***	0.124***	0.066***	0.165***	0.150***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
OB × PostLockdown × Payment	−0.189***				
	(0.03)				
OB × PostLockdown × Borrowing		0.245***			
		(0.04)			
OB × PostLockdown × Investment			0.201***		
			(0.03)		
OB × PostLockdown × Insurance				−0.027	
				(0.05)	
OB × PostLockdown × Miscellaneous					−0.027
					(0.03)
Year-Month FE	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y
Observations	459,056	459,056	459,056	459,056	459,056
R-sq.	0.887	0.887	0.888	0.887	0.887

Panel B. Provider Type

	(1)	(2)	(3)	(4)	(5)
OB × PostLockdown	0.240***	0.163***	0.042**	0.134***	0.128***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
OB × PostLockdown × Bank	−0.275***				
	(0.03)				
OB × PostLockdown × Neobank		−0.154*			
		(0.07)			
OB × PostLockdown × Fintech			0.213***		
			(0.03)		
OB × PostLockdown × Fintech Incumbent				0.072***	
				(0.02)	
OB × PostLockdown × Fintech Startup					0.171***
					(0.03)
Year-Month FE	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y
Observations	459,056	459,056	459,056	459,056	459,056
R-sq.	0.887	0.887	0.887	0.887	0.888

NOTE.—This table reports the estimated impact of COVID-19 on demand for open banking apps. The variable *OB* is a binary indicator equal to one if an app was authorized as an open banking provider or had integrated the service of an authorized provider by the end of 2019. Panel A presents results by service type, and Panel B by provider type. Standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Impact on Competition and Innovation Among Open Banking Apps

Panel A. Competition

	Degree		**Betweeness**		**Clustering**	
	(1) Unweighted	(2) Weighted	(3) Unweighted	(4) Weighted	(5) Unweighted	(6) Weighted
OB × PostLockdown	0.026**	0.026**	0.000***	0.000***	0.007**	0.005***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Year-Month FE	Y	Y	Y	Y	Y	Y
App × Country FE	Y	Y	Y	Y	Y	Y
Observations	459,056	459,056	459,056	459,056	459,056	459,056
R-sq.	0.874	0.874	0.428	0.401	0.608	0.636

Panel B. Innovation

	Updates		**New apps**		**Dead apps**	
	(1) Major Updates	(2) All Updates	(3) Finance	(4) Non-finance	(5) Finance	(6) Non-finance
OB × PostLockdown	0.031***	0.092**	0.002	−0.000	−0.007*	−0.001
	(0.01)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)
Year-Month FE	Y	Y	Y	Y	Y	Y
Publisher FE	Y	Y	Y	Y	Y	Y
Observations	102,649	102,649	150,696	150,696	150,696	150,696
R-sq.	0.465	0.582	0.075	0.138	0.129	0.217

Note.—This table reports the coefficients from Equation 4 and Equation 5 in Panels A and B, respectively. In Panel A, the outcome variables include degree centrality, betweenness centrality, and the clustering coefficient, calculated from the competitor network constructed using the top 1,000 finance apps in the UK and EU. The network is based on textual similarity of app descriptions following the methodology of Hoberg and Phillips (2016). Odd-numbered columns report results using unweighted measures, while even-numbered columns use cosine similarity weights. Panel B examines innovation outcomes, measured by the frequency of version updates and the introduction of new apps. "Dead app" refers to delisted or inactive apps. New and dead apps are measured as binary indicators, and updates as a count variable. All regressions are estimated at the publisher level. In both panels, standard errors are clustered by country and year-month, and are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10: Open Banking and Borrowing and Saving Provider Decision

Panel A. All Respondents

	Borrowing		Saving	
	(1) Bank & Financial Institution	(2) Informal Provider	(3) Bank & Financial Institution	(4) Informal Provider
Open Banking × Post	−0.049***	0.002*	−0.094***	0.005**
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.000	0.000	−0.000	−0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	−0.002**	−0.003***	0.001	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (21% - 40%)	0.014***	0.005***	0.032***	0.020***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (41% - 60%)	0.019***	0.010***	0.062***	0.034***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (61% - 80%)	0.028***	0.013***	0.092***	0.046***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (81% - 100%)	0.038***	0.012***	0.150***	0.062***
	(0.00)	(0.00)	(0.00)	(0.00)
Education (Secondary)	0.027***	0.006***	0.082***	0.033***
	(0.00)	(0.00)	(0.00)	(0.00)
Education (Tertiary)	0.074***	0.007***	0.204***	0.047***
	(0.00)	(0.00)	(0.00)	(0.00)
Inflation Rate	−0.002***	−0.002*	−0.007***	−0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP per capita	−0.000***	−0.000	−0.000***	−0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Region × Year FE	Y	Y	Y	Y
Observations	519,584	519,584	519,584	519,584
R-sq.	0.051	0.070	0.212	0.171

Panel B. Respondents with Borrowing or Saving

	Borrowing		Saving	
	(1) Bank & Financial Institution	(2) Informal Provider	(3) Bank & Financial Institution	(4) Informal Provider
Open Banking × Post	−0.056***	0.009***	−0.011	0.017***
	(0.01)	(0.00)	(0.01)	(0.00)
Age	0.001***	0.000***	0.001***	−0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Female	−0.002	−0.006***	0.006***	0.017***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (21% - 40%)	0.028***	0.006**	0.029***	0.010***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (41% - 60%)	0.038***	0.014***	0.056***	0.016***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (61% - 80%)	0.055***	0.020***	0.082***	0.018***
	(0.00)	(0.00)	(0.00)	(0.00)
Income (81% - 100%)	0.072***	0.018***	0.143***	0.020***
	(0.00)	(0.00)	(0.00)	(0.00)
Education (Secondary)	0.035***	0.005**	0.097***	−0.006**
	(0.00)	(0.00)	(0.00)	(0.00)
Education (Tertiary)	0.090***	0.002	0.208***	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Inflation Rate	−0.001	−0.001	−0.006***	0.002
	(0.00)	(0.00)	(0.00)	(0.00)
GDP per capita	−0.000***	0.000***	0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Region × Year FE	Y	Y	Y	Y
Observations	240,296	240,296	256,854	256,854
R-sq.	0.096	0.099	0.271	0.315

NOTE.—This table reports estimates of Equation 12. The dependent variables are binary indicators constructed from responses to the World Bank Global Findex survey. Panel A uses the full sample, while Panel B restricts the sample to respondents who reported saving or borrowing in the past 12 months. Standard errors, clustered at the year level, are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11: Impact of Open Banking on Bank Performances

Panel A. Balance Sheet

	(1) Net Loan	(2) Gross Loan	(3) Total Asset	(4) Total Deposit	(5) Total Debt	(6) Total Equity
Post × HighOBExposure	−0.117***	−0.125**	−0.121***	−0.093***	−0.150***	−0.107***
	(0.02)	(0.04)	(0.02)	(0.02)	(0.04)	(0.02)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	5,179	5,179	5,179	5,179	5,179	4,876
R-sq.	0.950	0.909	0.960	0.955	0.934	0.950

Panel B. Income & Expense

	Operating		**Interest**		**Per Employee**	
	(1) Income	(2) Expense	(3) Income	(4) Expense	(5) Income	(6) Expense
Post × HighOBExposure	−0.053***	−0.080***	−0.095***	−0.065	0.009	−0.023
	(0.01)	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	4,856	4,855	4,844	4,754	4,648	4,598
R-sq.	0.950	0.962	0.951	0.935	0.870	0.908

Panel C. Asset Allocation

	Loan			**Other Asset**		
	(1) Loan/Asset	(2) Loan/Deposit	(3) Loan Share	(4) Cash Share	(5) Security Share	(6) Non-Trd. Share
Post × HighOBExposure	−0.016***	−0.020***	−0.011*	0.019**	0.000***	0.015**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Bank FE		Y	Y	Y	Y	Y
Country × Year FE		Y	Y	Y	Y	Y
Observations	4,836	4,881	4,881	4,840	4,791	5,179
R-sq.	0.879	0.871	0.837	0.707	0.831	0.816

Panel D. Profit Efficiency

	(1) Net Int. Margin	(2) Fee Intensity	(3) Asset Yield	(4) Net Int. Spread	(5) Cost to Income	(6) ROA
Post × HighOBExposure	0.001***	0.001**	0.001***	0.001***	−0.024**	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	4,845	4,822	4,842	4,833	4,839	4,856
R-sq.	0.835	0.710	0.870	0.821	0.709	0.660

NOTE.—This table presents the estimated impact of open banking on bank performance. The variable *FintechExposure* is defined as the average TF-IDF cosine similarity between each bankâs 2018 app description and the app descriptions of all authorized open banking providers in 2023. Details on the construction of this exposure measure are provided in Section 5.2. The variable *Post* is a binary indicator equal to one for years 2019 and onward. Standard errors are clustered at the year level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12: Subsample Analysis for Bank Performance

Panel A. Balance Sheet

	Large Bank			Small Bank		
	(1) Gross Loan	(2) Total Deposit	(3) Total Asset	(4) Gross Loan	(5) Total Deposit	(6) Total Asset
Post × HighOBExposure	−0.140***	−0.109***	−0.139***	−0.087*	−0.035	−0.048**
	(0.04)	(0.02)	(0.02)	(0.04)	(0.03)	(0.02)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	2,811	2,811	2,811	2,295	2,295	2,295
R-sq.	0.875	0.926	0.932	0.839	0.930	0.946

Panel B. Income & Expense

	Large Bank			Small Bank		
	(1) Op. Inc	(2) Op. Exp	(3) Int. Inc	(4) Op. Inc	(5) Op. Exp	(6) Int. Inc
Post × HighOBExposure	−0.121**	−0.115***	−0.117***	0.068*	0.010	0.005
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	2,592	2,592	2,590	2,202	2,201	2,192
R-sq.	0.908	0.931	0.923	0.929	0.963	0.920

Panel C. Asset Allocation

	Large Bank			Small Bank		
	(1) Loan Share	(2) Cash Share	(3) Non-Trd. Share	(4) Loan Share	(5) Cash Share	(6) Non-Trd. Share
Post × HighOBExposure	−0.024***	0.011	0.027***	0.029***	0.052***	−0.026***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	2,616	2,608	2,811	2,203	2,168	2,295
R-sq.	0.837	0.728	0.799	0.894	0.748	0.885

Panel D. Profit Efficiency

	Large Bank			Small Bank		
	(1) Net Int. Margin	(2) Net Int. Spread	(3) ROA	(4) Net Int. Margin	(5) Net Int. Spread	(6) ROA
Post × HighOBExposure	0.000	0.000	−0.000	0.003***	0.003***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bank FE	Y	Y	Y	Y	Y	Y
Country × Year FE	Y	Y	Y	Y	Y	Y
Observations	2,591	2,586	2,592	2,192	2,185	2,202
R-sq.	0.847	0.837	0.732	0.858	0.841	0.657

Note.—This table presents the estimated impact of open banking on bank performance by bank size pre-open banking. The variable *FintechExposure* is defined as the average TF-IDF cosine similarity between each bankâs 2018 app description and the app descriptions of all authorized open banking providers in 2023. Details on the construction of this exposure measure are provided in Section 5.2. The variable *Post* is a binary indicator equal to one for years 2019 and onward. Standard errors are clustered at the year level and reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 13: Impact of Open Banking on Bank Apps

Panel A. App Ranking

	(1) Avgerage Rank	(2) Rank Volatility	(3) Highest Rank	(4) Top 50	(5) Top 100
OB × Post	0.033***	0.085***	0.018*	−0.004**	−0.011***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
Year-Month FE	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y
Observations	167,928	167,928	167,928	167,928	167,928
R-sq.	0.968	0.924	0.949	0.907	0.912

Panel B. Subsample Analysis

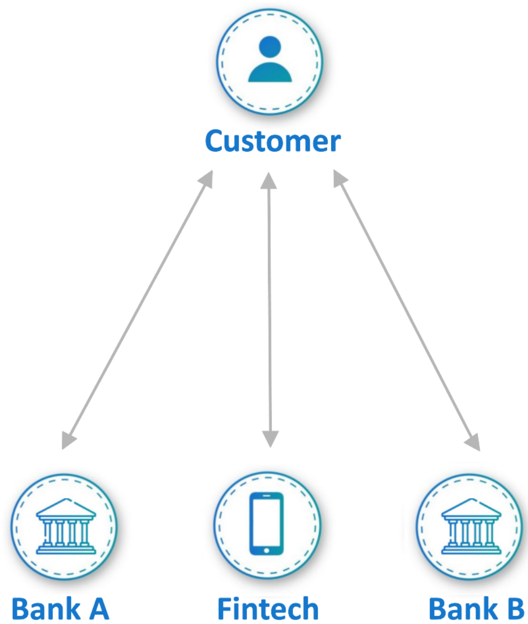
	High Findex			**Low Findex**		
	(1) Downloads	(2) Rank Volatility	(3) Top 50	(4) Downloads	(5) Rank Volatility	(6) Top 50
OB × Post	−0.122***	0.112***	−0.010***	−0.005	0.009	−0.003
	(0.02)	(0.02)	(0.00)	(0.01)	(0.02)	(0.00)
Year-Month FE	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Observations	91,644	91,644	91,644	76,284	76,284	76,284
R-sq.	0.937	0.920	0.911	0.933	0.928	0.904

NOTE.—This table presents the estimated impact of open banking on bank app performance. The variable *OB* is a binary indicator equal to one if a country has implemented an open banking policy. Panel A presents results for app rankings within each app's native country. Panel B shows results from a subsample analysis based on the 2017 Global Findex, which proxies for a country's level of financial inclusion. Standard errors, clustered at the country and year-month levels, are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

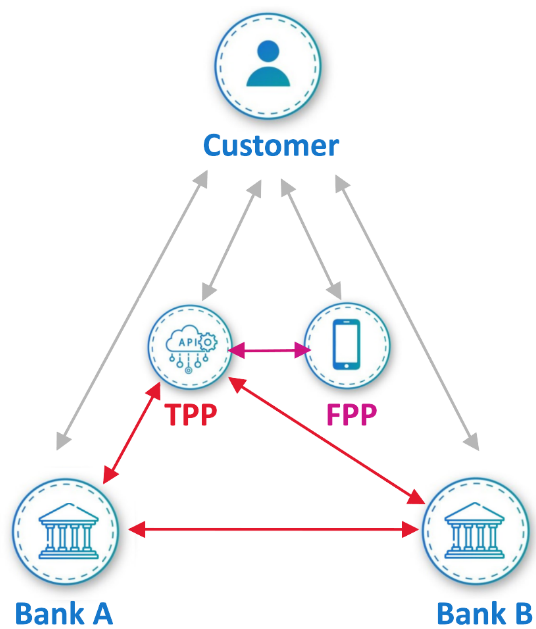
A Additional Figures & Tables

Figure A.1: Data Flow Comparison between Closed and Open Banking

(a) Closed Banking



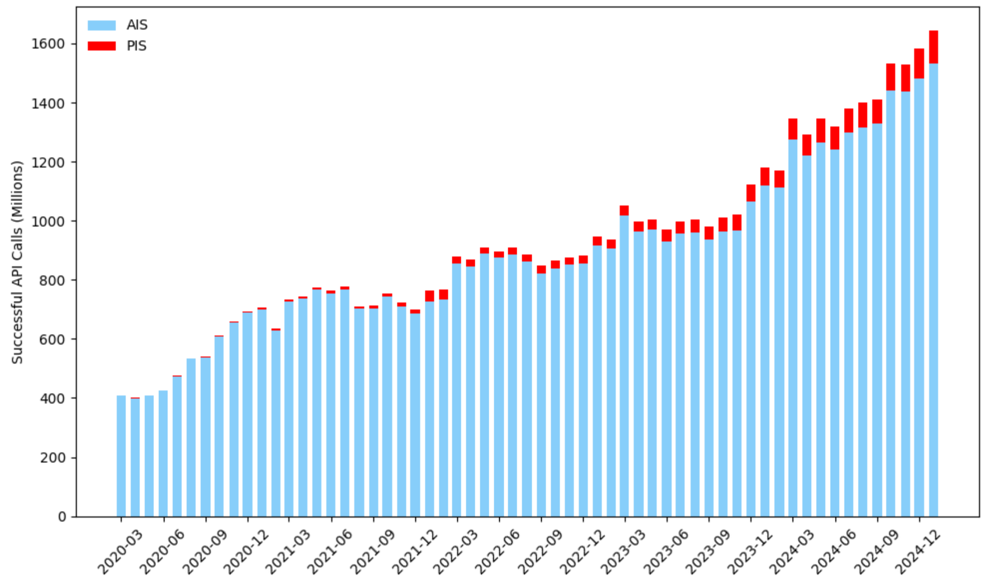
(b) Open Banking



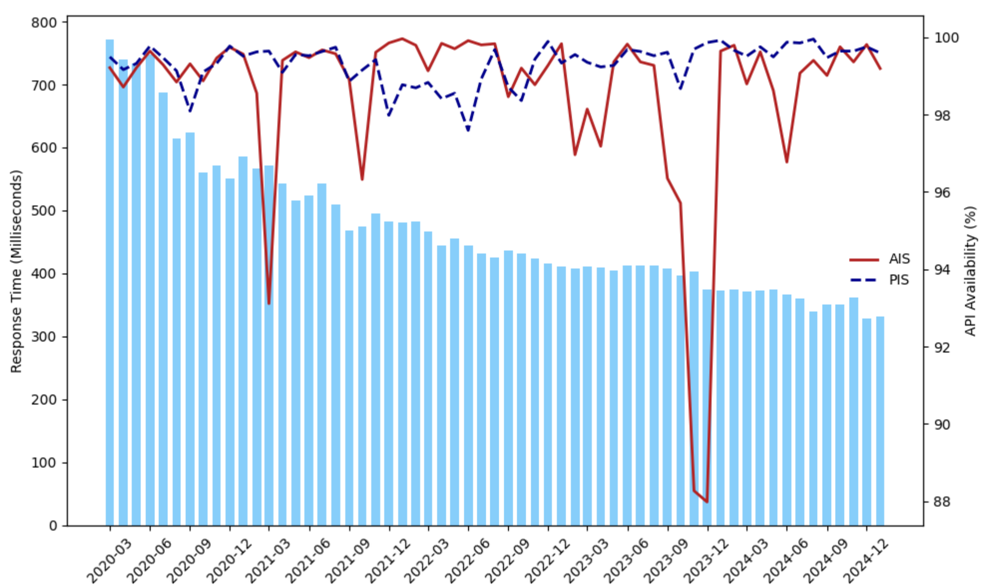
NOTE.— This figure illustrates data flows between entities in closed banking (Panel A) and open banking (Panel B). Arrows denote the direction of data exchange. In Panel B, the central nodes are authorized third-party providers (TPPs), and banks may also obtain TPP authorization.

Figure A.2: UK Open Banking API Call Numbers, Availability, and Response Time

(a) Successful API Calls



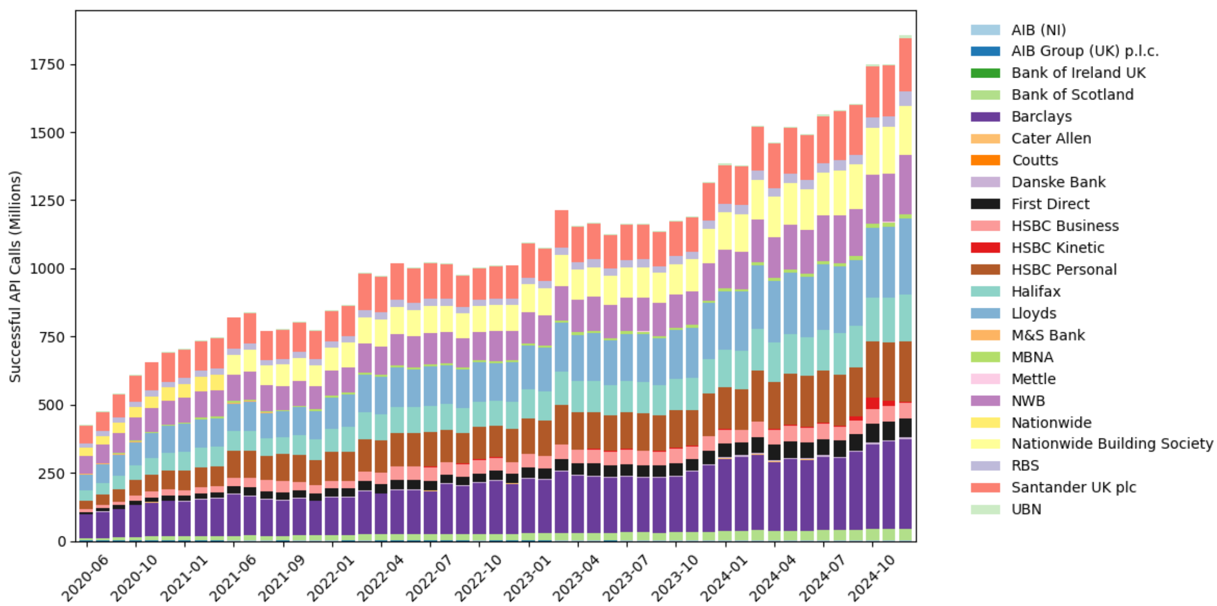
(b) Response Time and API Availability



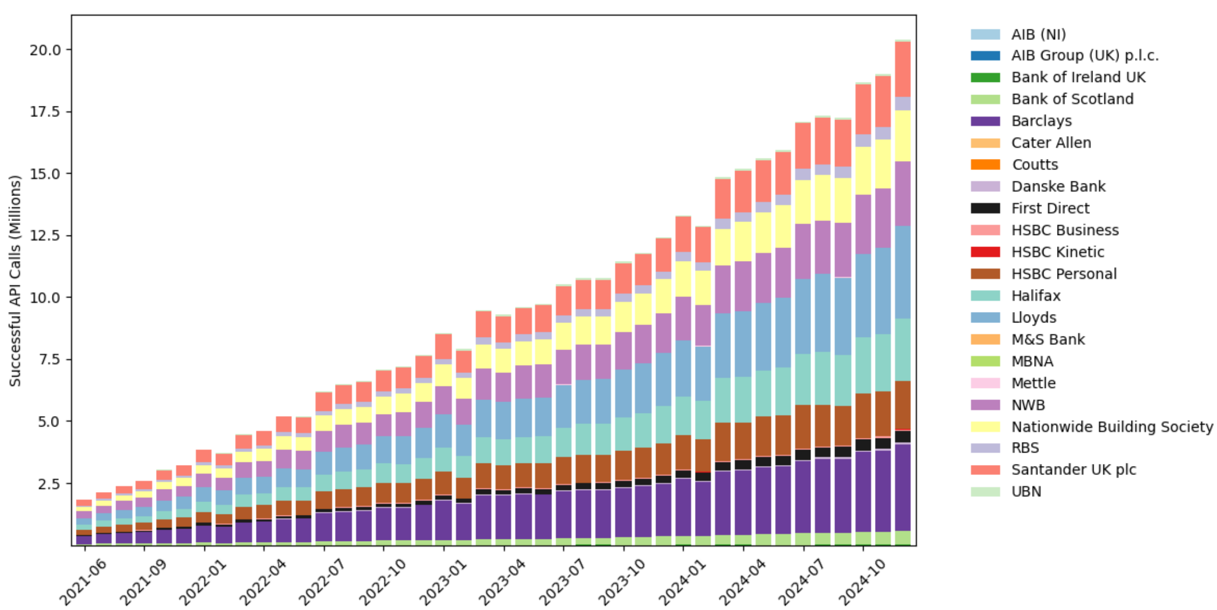
Note.— This figure illustrates the development of open banking APIs in the UK. Panel A presents the monthly aggregate number of successful API calls initiated by authorized third-party providers (TPPs), broken down into Account Information Service (AIS) and Payment Initiation Service (PIS) calls. Panel B shows the trends in average response time and average availability percentage for banks' open banking APIs over the same period. The data is sourced from UK's Open Banking Implementation Entity (OBIE).

Figure A.3: UK Open Banking API Calls By Major Banks

(a) Successful API Calls

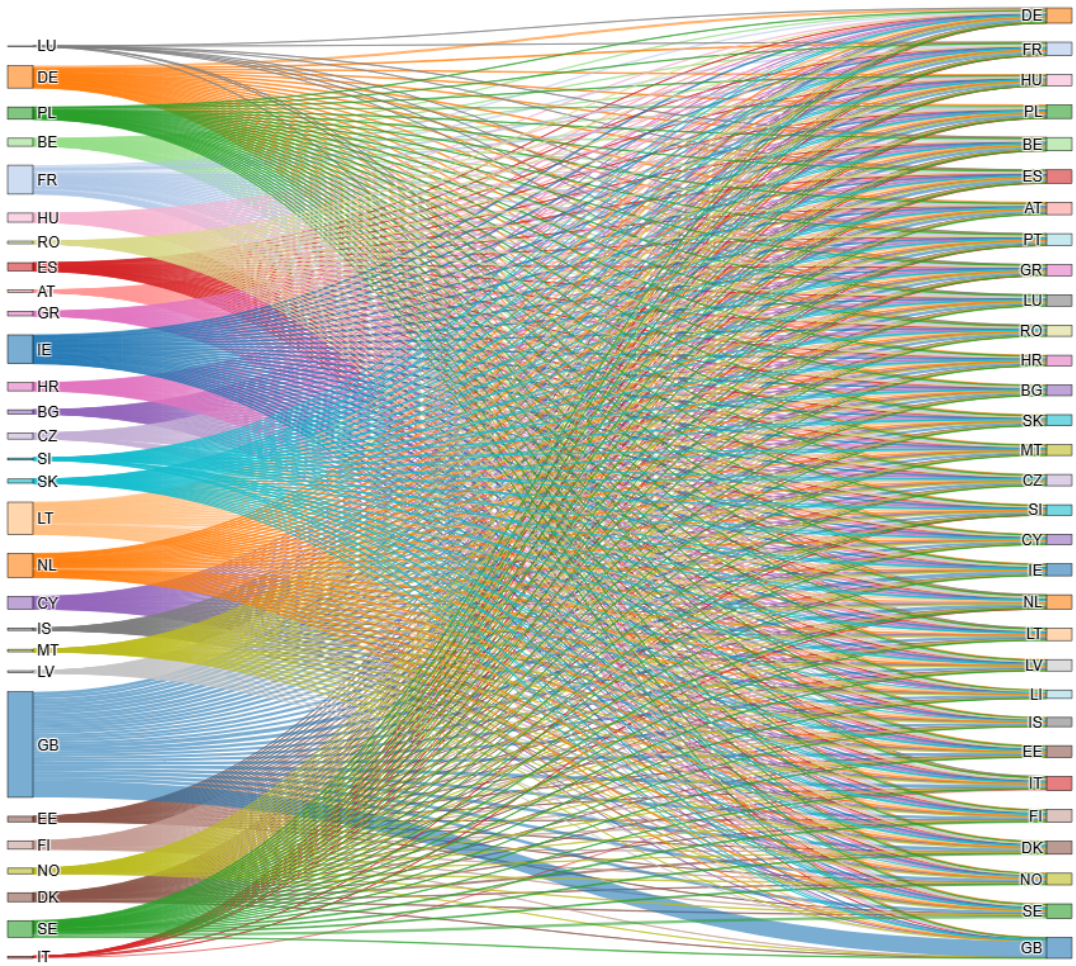


(b) Payment Requests API Calls



Note.— This figure presents the breakdown of open banking API calls by UK banks. Panel A displays the total number of successful API calls received by each bank, while Panel B focuses specifically on calls related to payment initiation services. The data is sourced from UK's Open Banking Implementation Entity (OBIE).

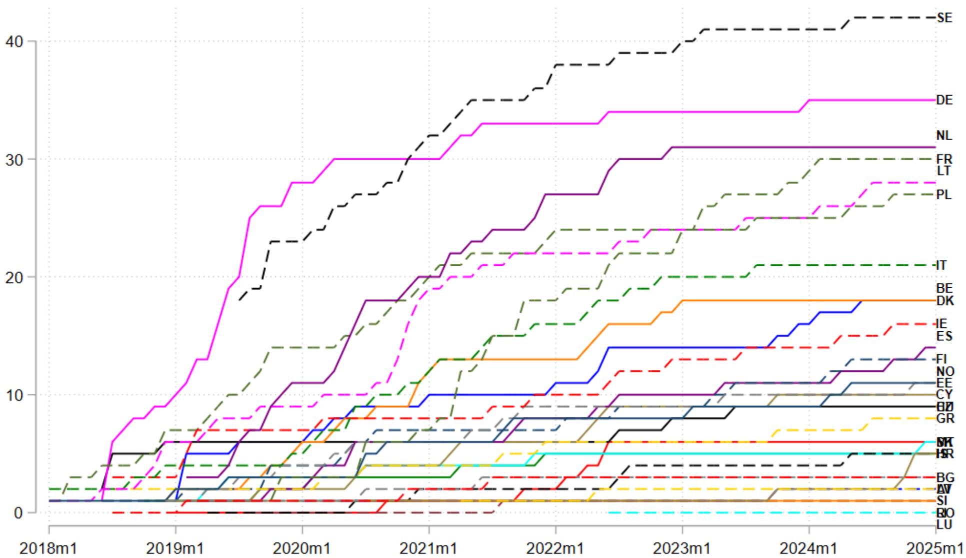
Figure A.4: Sankey Diagram of Open Banking Passporting in Europe



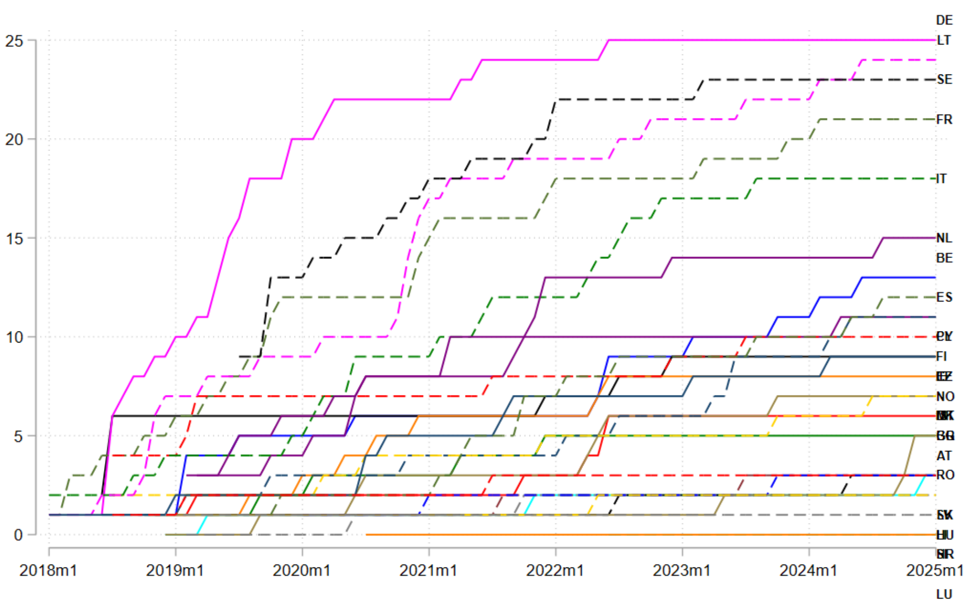
Note.— This Sankey diagram illustrates cross-border open banking passporting relationships between countries. The left side represents the country of the service provider (passporting out), while the right side shows the country receiving the service (passporting in). The width of each flow corresponds to the number of passporting arrangements from providers in one country to recipients in another. The data is sourced from the UK Financial Conduct Authority (FCA) and the European Banking Authority (EBA) register.

Figure A.5: Non-UK Third-party Authorization Over Time

(a) Account Information Service Provider



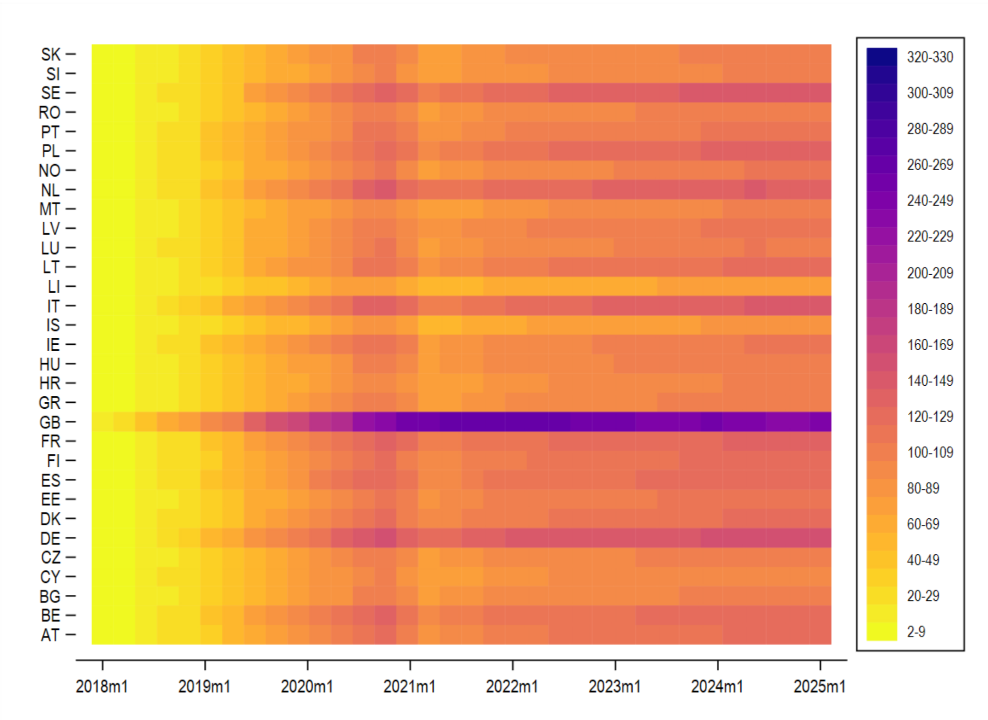
(b) Payment Initiation Service Provider



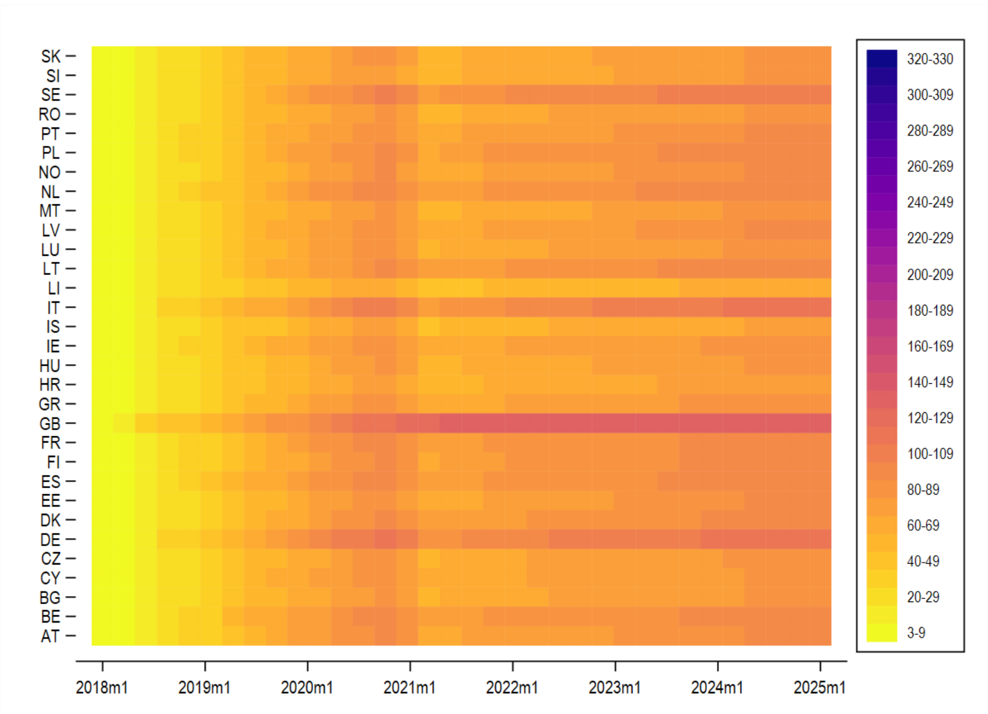
Note.— This figure plots the cumulative number of domestic (non-UK) third-party authorizations across EU countries over time. Passported authorization is not included. Panel A reports authorizations for Account Information Services, while Panel B reports those for Payment Initiation Services.

Figure A.6: Active Third-party Authorization Over Time

(a) Account Information Service Provider



(b) Payment Initiation Service Provider



Note.— This figure shows the number of active authorized providers in each country over time. Providers may drop out either due to non-compliance with regulations or the impact of Brexit on passporting activities. Panel A reports figures for Account Information Services, while Panel B reports those for Payment Initiation Service providers.

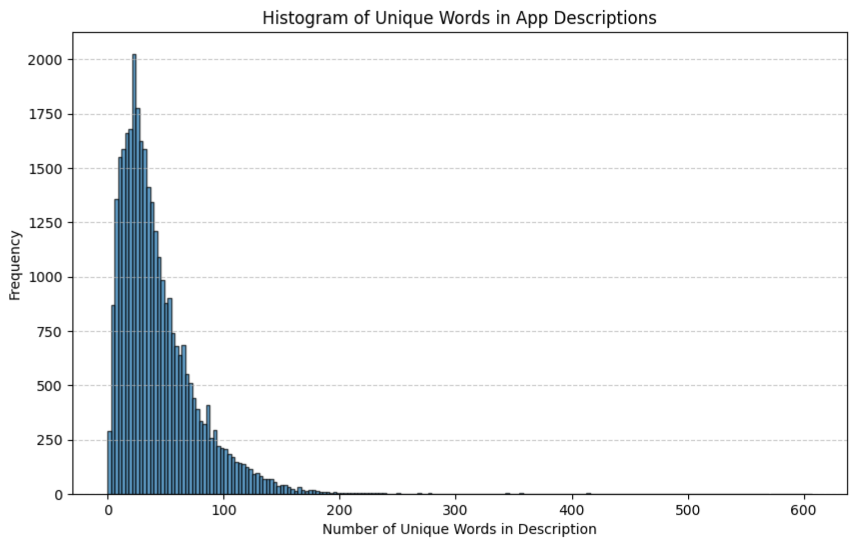
Figure A.7: Word Cloud of UK and EU TPP App Descriptions

Note.— This figure displays a word cloud generated from the app descriptions of authorized third-party providers (TPPs) in the UK and EU. Word size reflects the relative frequency of terms. Non-English descriptions were translated into English using the Google Translator API.

Figure A.8: Distribution of UK Third-Party Providers Across Outcome Areas

Note.— This graph shows the distribution of UK's TPP outcome areas defined by UK's Open Banking Implementation Entity (OBIE). The figures in the graph are not weighted. Detailed outcome area explanations are in Table A.1.

Figure A.9: Distribution of Word Frequency in App Descriptions



NOTE.— This figure shows the distribution of word counts in app descriptions for the top 1,000 finance apps in the UK and EU sample. Following the methodology of Hoberg and Phillips (2016), I convert each description into a vector of nouns and proper nouns, excluding high-frequency words that appear in more than 20% of apps. The distribution indicates that app descriptions contain a sufficient number of informative words to construct meaningful text vectors for identifying competitors.

Table A.1: OBIE Outcome Areas and Related Open Banking Propositions

Outcome Area	Outcome Area Explanation	Related Propositions
Improved financial decision-making	Individuals and small businesses are actively engaged with their finances and routinely use open banking-enabled account services to review and control their finances seamlessly.	• Personal finance manager • Income and expenditure analysis • Small business financial management
Increased access to advice and guidance	Individuals and small businesses conveniently access timely debt advice, financial advice or help with tax or welfare.	• Legal aid and welfare support services • Income maximisation • IFA services • Roboadvice • Tax advice • Referrals to Money Helper • Cashflow management
Better borrowing	Individuals and small businesses benefit from using open banking-enabled cost-effective credit when they need it and can manage the burden of any debts they have.	• Consumer lending • Invoice financing • Asset financing • Small business finance • Debt advice • Automatic overdraft lending • Affordability analysis • Account sweeping • Affordable credit
Increased saving and investments	Individuals and small businesses are actively engaged in using open banking to help them with saving and asset-building. They put money aside, maximise their balances and/or returns by accessing the most appropriate savings and investment products and tools.	• Micro savings • Non-advised savings and investment • Account sweeping
Expanded payments choice	Individuals and small businesses are using the best open banking-enabled payment solutions meeting their needs for low cost, speed, convenience, control, visibility and security.	• E-Commerce payments • P2P payments • International payments • Card top-ups • Request to pay • Bill payment • Fraud detection • Rewards and loyalty management
Increased switching	Individuals and small businesses are getting better deals by confidently comparing financial services and household bills and subscriptions. They receive reminders and nudges to shop around, as a result of easier and more convenient personalised propositions.	• Subscription management • Financial product comparison services • Bill comparison and switch services • Other product comparison services

Note.—This table presents the outcome areas of TPPs defined by Open Banking Implementation Entity.

Table A.2: List of National Competent Authority and Register Link

Country	National Competent Authority & National Register Link
United Kingdom	Financial Conduct Authority https://register.fca.org.uk/
Germany	Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) https://portal.mvp.bafin.de/database/ZahlInstInfo/suche.do
Sweden	Financial Conduct Authority https://www.fi.se/en/our-registers/company-register/
France	Autorité de Contrôle Prudentiel et de Résolution (ACPR) Regafi https://www.regafi.fr/spip.php?rubrique3
Netherland	De Nederlandsche Bank (DNB) https://www.dnb.nl/en/public-register/
Belgium	National Bank of Belgium (NBB) https://www.nbb.be/fr/supervision-financiere/controle-prudentiel/domaines-de-controle/etablissements-de-paiement-et-1
Lithuania	Bank of Lithuania (LB) http://www.lb.lt/en/sfi-financial-market-participants?market=1
Denmark	Finanstilsynet (FSA) https://virksomhedsregister.finanstilsynet.dk/virksomhedsomraader-en.html
Poland	Komisja Nadzoru Finansowego (KNF) https://e-rup.knf.gov.pl/index.html
Spain	Banco de Espana (BDE) http://app.bde.es/ren_www/InicioSesion
Finland	Finanssivalvonta (FIN-FSA) https://www.finanssivalvonta.fi/en/registers/supervised-entities/
Ireland	Central Bank of Ireland (CBI) http://registers.centralbank.ie/DownloadsPage.aspx
Italy	Banca d'Italia https://infostat.bancaditalia.it/GIAVAInquiry-public/ng/banche
Czech Republic	Czech National Bank (CNB) https://jerrs.cnb.cz/apljerrsdad/JERRS.WEB15.BASIC_LISTINGS?p_lang=en
Hungary	Magyar Nemzeti Bank (MNB) https://intezmenykereso.mnb.hu/en/Home/Index
Bulgaria	Bulgarian National Bank https://www.bnb.bg/RegistersAndServices/RSPIPublicRegisters/index.htm

Table A.2: List of National Competent Authority and Register Link - Continued

Country	National Competent Authority & National Register Link
Estonia	Finantsinspektsioon (FSA) https://www.fi.ee/en/payment-services
Norway	Finanstilsynet (FSA) https://www.finanstilsynet.no/en/finanstilsynets-registry/
Austria	Financial Market Authority (FMA https://www.fma.gv.at/en/search-company-database/
Cyprus	Central Bank of Cyprus (CBC) https://www.centralbank.cy/en/licensing-supervision
Croatia	Hrvatska Narodna Banka (HNB) https://www.hnb.hr/en/core-functions/payment-system/registers-and-records/register-of-payment-service-providers-and-electronic-money-issuers
Liechtenstein	Finanzmarktaufsicht Liechtenstein (FMA) http://register.fma-li.li/
Luxembourg	Commission de Surveillance du Secteur Financier (CSSF) https://searchentities.apps.cssf.lu/search-entities/search
Slovakia	Narodna Banka Slovenska (NBS) https://subjekty.nbs.sk/?ll=en
Slovenia	Banka Slovenije (BSI) https://www.bsi.si/en/financial-stability/institutions-under-supervision
Iceland	Fjármálaeftirlitíð (FME) https://en.fme.is/supervision/supervised-entities/
Latvia	Finansu un Kapital Tirgus Komisija (FKTK) https://www.fktk.lv/en/market/
Malta	Malta Financial Services Authority (MFSA) http://www.mfsa.com.mt/pages/licenceholders.aspx
Portugal	Banco de Portugal https://www.bportugal.pt/en/entidades-autorizadas
Romania	Banca Nationala a Romaniei (BNR) https://www.bnro.ro/Public-Registers-and-Lists-1701.aspx
Greece	Bank Of Greece https://www.bankofgreece.gr/en/main-tasks/supervision/supervised-institutions

Note.—This table lists, for each EEA country and the United Kingdom, the National Competent Authority (NCA) and a link to its public register(s) of payment service providers (PSPs) and account information service providers (AISPs). If a link fails or has moved, navigate from the NCA's homepage using the site search or relevant register keywords.

Table A.3: List of API Aggregators Used

API Aggregator	Authorized Third Party Provider	Headquarter Country
Ibanity	Isabel	Belgium
Salt Edge	Salt Edge Limited	United Kingdom
TrueLayer	TrueLayer (Ireland) Limited; TrueLayer Limited	Ireland; United Kingdom
enable:Banking	Enable Banking Oy	Finland
Enfuce	Enfuce License Services Oy	Finland
Budget Insight	Powens	France
Bridge	Perspecteev	France
OpenWrks	OpenWrks (acquired by Tink)	United Kingdom
BanqUP	Banqup SA	Belgium
Neonomics	Neonomics AS	Norway
Fintecture	Fintecture	France
Tink	Tink AB, Tink Germany GmbH	Sweden; Germany
Token.io	Token GmbH; Token.io Limited	Germany; United Kingdom
Bud	Bud Financial Limited	United Kingdom
Aiia	Mastercard OB Services Europe A/S	Denmark
Klarna	Klarna Financial Service UK Limited	United Kingdom
Yolt	Yolt Technology Services Limited	United Kingdom
Moneyhub	Moneyhub Financial Technology Limited	United Kingdom
FriendlyScore	Friendly Score UK Limited	United Kingdom
Unnax	Unnax Regulatory Services, EDE, SL	Spain
Yapily	Yapily Connect UAB; Yapily Connect Limited	Lithuania; United Kingdom
Open Payments	Open Payments Europe AB	Sweden
Yodlee	Yodlee Inc. UK Branch	United Kingdom
OpenPayd	SettleGo Solutions Limited	United Kingdom
Finexer	Finexer Ltd	United Kingdom
Noda.live	Noda Holding Limited; NaudaPay Limited	Cyprus; United Kingdom
GoCardless	GoCardless Limited	United Kingdom
Trustly	Trustly Group AB	Sweden
Mmob	Mmob Limited	United Kingdom
DirectID (Atto)	The IDCO. Limited	United Kingdom

Table A.3: List of API Aggregators Used - Continued

API Aggregator	Authorized Third Party Provider	Headquarter Country
Figo RegShield	Figo GmbH	Germany
Pollen	Pollen Technologies Limited	United Kingdom
WorldPay	WorldPay AP Limited	United Kingdom
Pomelo	Pomelo Group Limited	United Kingdom
PayPoint	PayPoint Payment Services Limited	United Kingdom
Paysafe	Paysafe Payments Solutions Limited	Ireland
OneID	OneID Limited	United Kingdom
Wonderful	Wonderful Payments Limited	United Kingdom
Plaid	Plaid, B.V.; Plaid Financial Limited	Netherlands; United Kingdom

Note.—This table lists API aggregators and their corresponding authorized entities, including cases that have been closed or deauthorized.