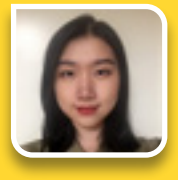
POPULAR MOBILE APPS IN THE PANDEMIC ERA: A GLIMPSE AT PRIVACY AND COMPETITION

BY GINGER ZHE JIN, ZIQIAO LIU & LIAD WAGMAN[1]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COVID-19 changed work and leisure, including more time spent on mobile apps. While this presents an opportunity for new apps to compete with established apps, it is also challenging for new apps to grow and survive, given potentially heightened privacy concerns and ongoing government efforts to tackle data issues. We present descriptive findings from a large database of mobile apps, and discuss how pandemic-amplified demand reshaped app entry and market competition among popular apps. We find that relative to five of the largest EU economies, the U.S. has seen more breakthrough new apps after the onset of the pandemic.

I. INTRODUCTION

According to App Annie (2022), global downloads of mobile apps has reached 230 billion in 2021, and an average user in the top 10 markets spent more than 4 hours and 48 minutes on mobile in 2021, up 30 percent from 2019. Publishers, meanwhile, released 2 million new apps in 2021, 77 percent of which were on Google Play. Consistently, global mobile ad spend reached $295 billion in 2021, a 23 percent increase from 2020.

There is no doubt that social distancing, travel limits, and other pandemic-related policies have contributed to these changes. Even more impressively, these changes happened as consumers' concerns over privacy potentially grew, with many governments having adopted or in the midst of considering the adoption of new privacy and data regulations. Given the role of mobile apps in digital economy, it is important to understand how the demand and supply of mobile apps evolve in this dynamic environment, and how the evolution differs in markets with different privacy and data regulations.

Since the European Union (EU) rolled out its landmark General Data Protection Regulation ("GDPR") in May 2018, policymakers have either adopted or have been considering adopting similar regulations around the globe. That includes the U.S., where although a comprehensive federal law on data and privacy remains elusive, California implemented the California Consumer Privacy Act ("CCPA") in January 2020 and is on the way to roll out the supplemental California Privacy Rights Act ("CPRA") in July 2023. Virginia and Colorado enacted similar laws, effective January 1, 2023 and July 1, 2023, respectively.

Despite these efforts, the regulatory environment is still quite different between the U.S. and the EU. The GDPR defines consent as "freely given, specific, informed and unambiguous" given by a "clear affirmative action." In short, aside from cases of legitimate interest or other contractual clauses, the GDPR requires consent to be opt-in. CCPA, in contrast, allows firms to set data collection and data sharing as the default, as long as consumers can opt out for alternative settings. This opt-out approach entails less consumer awareness and less consumer action than opt-in. Furthermore, GDPR applies to any data collectors that offer goods and services to individuals in the EU, whereas CCPA is only applicable to for-profit data collectors that conduct business in California, have annual gross revenue above 25 million dollars, involve more than 50,000 data subjects, or derive more than 50 percent of their revenue from selling personal information. Such qualified applicability can shield many small and medium-sized mobile app developers from CCPA, and leave room to avoid or mitigate the potential impact of CCPA on app developers. In light of these regulatory differences, we compare app performance in the U.S. and five major European countries (UK, France, Germany, Spain and Italy, referred to as "EU5").

It is worth noting that the U.S.-EU5 comparison may capture many differences between the U.S. and the EU. Aside from the regulatory differences, the U.S. is significantly larger than any individual European member state, and U.S. and EU consumers may differ in smartphone penetration, privacy awareness, user habits, language, demographics, etc. Even if the regulatory difference is the most important dimension to consider, it is unclear how a more comprehensive and more stringent data regulation like GDPR would affect app developers and app users once the pandemic environment drives up the time users spend on smartphones.

For instance, to the extent that privacy and data regulations may raise barriers to entry (in terms of compliance costs and consumer willingness to try new apps), one may expect new apps to face more difficulties entering and growing in a market with stricter regulations. App developers may target a less regulated market first before meeting more stringent regulations in other markets. However, a large expansion in demand may increase the prospects of total revenue, even if it is difficult to attract and monetize each potential consumer.

Consumers may be more willing to accept a reduction in privacy when they anticipate more benefits from mobile apps than alternative uses of time. This would encourage new apps to enter and grow regardless of the regulatory strictness. Conversely, more digital experience may prompt consumer attention to privacy and data concerns, especially if the regulation brings these issues to the surface via opt-in consent windows. Consumers may even feel safer under a stronger privacy and data regulation, and have more comfort downloading and using new apps. Besides these offsetting factors, an expansion in demand may intensify competition between new, young and established apps, and the nature of the competition may depend on the strength of privacy and the regulatory environment.

In fact, the literature has painted a mixed picture regarding the impact of the GDPR before and after 2018 (mostly before the pandemic). On the one hand, studies show that the GDPR has reduced venture investment in technology startups based in the EU,[2] reduced web traffic,

2 Jian Jia et al. *The Short-Run Effects of the General Data Protection Regulation on Technology Venture Investment*, MARK. SCI., 40, no. 4 (2021): 661–84. https://doi.org/10.1287/mksc.2020.1271.

e-commerce revenue and persistent cookies in Europe,[3] increased market concentration among web technology vendors[4] raised the search costs of GDPR-covered users,[5] and reduced consumer surplus from mobile apps because more apps exit and fewer enter post the GDPR.[6] These studies suggest that EU countries may suffer from less entry, less innovation, and less market competition because of the GDPR.

On the other hand, some studies find the GDPR to have zero or offsetting effects. For example, Zhuo et al. find that the GDPR has had no effect on interconnection agreements between EU and out-of-EU network providers.[7] Aridor et al. show that, although the opt-in requirement of the GDPR reduced the number of identifiable consumers, an online travel intermediary is able to better track remaining consumers and increase their average advertising value. Following 900+ news and media websites in the U.S. and EU, Lefrere et al. find that, despite an initial reduction, visitor tracking among EU websites bounced back after a few months, and GDPR has no significant effect on EU websites' traffic rankings, new content provision, or social media engagement with new content.[8] They also find no difference in the monetizing strategy or survival rate of content providers across the EU and the U.S. These findings suggest that the initial, negative effects of the GDPR may not harm the survival and development of online innovations.

As detailed below, the post-pandemic increase in mobile app usage is large and persistent. This demand shock provides an excellent test bed to study the supply of new apps and their competition with established apps. In light of regulatory and other differences between the U.S. and the EU, we compare the U.S. with EU5 before and after the onset of the COVID-19 pandemic.

We also compare six app categories that are arguably more sensitive to user privacy (Games, Health & Fitness, Social, Communication, Shopping, and Finance) with all other categories (Tools, Weather, News & Magazines, etc.); we refer to the two groups as "privacy-sensitive" and "all other" categories, respectively. Strictly speaking, apps tend to involve some type of data transmission in and out of a user's smartphone – apps may utilize location information, a phone's IP address is embedded in signal transmission protocols, and even a user's app use time, session lengths and keystrokes could be correlated with some user attributes, even if such information is not always personally identifiable.

We single out the six privacy-sensitive categories because they are likely to involve the transmittal and potential collection of additional or more sensitive personal information, such an individual's contacts, shopping history, health, finances, and aspects related to cognition. For example, shopping and finance apps have traditionally been associated with price discrimination in the economics of privacy literature and often require a user's address and other personal information;[9] health and fitness may capture biometric information in addition to location and movement changes; and gaming, social and communication apps often involve interactions with other users on the same app. While we believe these six categories may be more privacy-sensitive than all other categories as a whole, we also note that the two groups may differ in other dimensions; for instance, users may derive more benefits from an app if they can interact with each other in real time, or users may care more about timely information from health, fitness and financial apps even if these apps require them to give away location, biometric, and other personal information. Thus, privacy is not the only factor contributing to the observed differences between privacy-sensitive and all other categories.

In short, our descriptive comparison – U.S. vs. EU5, privacy-sensitive vs. all other categories – reflect changes before and after the onset of the pandemic in the data. These changes could be driven by regulatory, privacy, and other fundamental differences across countries and categories. Since the mechanisms behind these changes are manifold, readers should not interpret our summary statistics as causal effects of any particular factor or any particular mechanism. Rather, we hope the data patterns presented in this paper can motivate more and deeper research in this area.

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3 Samuel Goldberg et al. *Regulating Privacy Online: The Early Impact of the GDPR on European Web Traffic & E-Commerce Outcomes*, (2021).
Timothy Libert et al. *Changes in Third-Party Content on European News Websites after GDPR*, Factsheet. REUTERS INSTITUTE (2018). Adrian Dabrowski et al. *Measuring Cookies and Web Privacy in a Post-GDPR World*, INTERNATIONAL CONFERENCE ON PASSIVE AND ACTIVE NETWORK MEASUREMENT. Springer, 258–270 (2019). Raffaele Congiu et al. *The Impact of Privacy Regulation on Web Traffic: Evidence From the GDPR*, (2022). Guy Aridor et al. *The Economic Consequences of Data Privacy Regulation: Empirical Evidence from GDPR*. NBER Working Paper, w26900, (2020).

4 Garrett Johnson & Scott Shriver. *Privacy & Market Concentration: Intended & Unintended Consequences of the GDPR*, (2019). Christian Peukert et al. *Regulatory spillovers and data governance: Evidence from the GDPR*, MARK. SCI., (2022).

5 Yu Zhao et al. *Privacy Regulations and Online Search Friction: Evidence from GDPR*, NBER workshop on the Economics of Privacy, (2022).

6 Rebecca Janßen et al. *GDPR and the Lost Generation of Innovative Apps*, NBER Working Paper, w30028 (2022).

7 Ran Zhuo et al. *The Impact of the General Data Protection Regulation on Internet Interconnection*, TELECOMM POLICY, 45(2), (2021).

8 Vincent Lefrere et al. *Does Privacy Regulation Harm Content Providers? A Longitudinal Analysis of the Impact of the GDPR*, (2022).

9 Vincent Conitzer et al. *Hide and Seek: Costly Consumer Privacy in a Market with Repeat Purchases*, MARK. SCI., 31(2), 277-292 (2012). Jin-Hyuk Kim & Liad Wagman. *Screening Incentives and Privacy Protection in Financial Markets: A Theoretical and Empirical Analysis*, RAND J ECON, 46(1), 1-22, (2015). Alessandro Acquisti et al. *The Economics of Privacy*, JEL, 54(2), 442-492, (2016).

We find that in the categories of Games, Health & Fitness, Social, Communication, Shopping, and Finance, the U.S. is "friendlier" than EU5 to new apps released after January 2020. In particular, relative to EU5, apps in the U.S. have a greater chance to be ranked in a top 200 list in the first two months of app age, a greater chance to stay as a top 200 app in the third, fourth and fifth months since the first time making top 200, and a greater share of daily active usage within top 200 apps. Interestingly, this advantage subsequently dissipates as the U.S. and EU5 converge; and the advantage is negligible in all other app categories.

To explain the temporary U.S. advantage for new apps in the six privacy-sensitive categories, we can think of many potential reasons: for example, a preference among developers to target or first launch in the U.S., more lax and more fragmented data regulations in the U.S., or U.S. users' stronger willingness to try new apps. Further research is needed to distinguish these potential explanations.

We further find that in both the U.S. and EU5, and across all categories, top 200 apps that were released on or after March 2020 are significantly more ad-based than top 200 apps that were released by January 2020, suggesting that the role of ad revenue in app success (in terms of making top 200) has increased post March 2020, possibly because users are more tolerant of ads as they spend more time on mobile apps.

II. DATA AND GLOBAL TRENDS

Our data comes from Apptopia, a third-party data intelligence company that tracks mobile apps on the iOS and Google Play stores, tracking mobile apps through June 1, 2021.

The first part of the data records all mobile apps that have been ever been released, including app id, app name, app creation time, app developer id, app description, and app categories. While this cross-sectional metadata covers the universe of mobile apps up to June 1, 2021, it does not specify whether and how a mobile app targets users in a specific country. In theory, a mobile app released on iOS or Google Play could be available anywhere as long as the user's smartphone can access the app store. In this sense, the metadata can only measure the time of an app's global entry.

The second part of the data tracks high performance apps. Once an app appears on a top-ranking list of iOS or Google Play, Apptopia tracks its downloads, # of monthly active users, # of daily active users, and app star ratings by the user's country and app store, until the app's downloads drop to zero for at least six months. If an app is tracked, Apptopia also estimates the app's download revenue, ad revenue, and in-app purchase revenue by user country and app store. This allows us to define whether an app has any ad revenue at all and whether an app is "ad-based" when at least 50 percent of its revenue comes from ads.

In this article, we focus on Google Play only because the vast majority of new apps released after January 2018 were released on Google Play (81.06 percent according to our calculation from the Apptopia metadata),[10] and Google Play has outgrown iOS since 2014 in terms of the cumulative number of apps released (App Annie, 2022). Another reason to focus on Google Play is that Apple adopted a few new privacy policies in April 2021 and October 2021, which are either near or after the end of our sample period (June 2021). In comparison, Google Play has not changed its privacy policies significantly (although Google announced potential changes in the future in response to Apple's changes). Finally, Google Play used to provide a top 500 ranking list per app category, but shortened it to top 200 in September 2019. To be consistent, we focus on top 200 only throughout our sample period (January 1, 2018 to June 1, 2021). Our top 200 analyses focus on a comparison between the six privacy-sensitive categories and all other categories. Each category has its own top 200 list per country-month. Apps are also separately tracked in top 200 lists by whether they are free-to-install or are pay-to-install.

Based on the metadata, the left graph of Figure 1 plots the number of new apps released on Google Play per month, with the dark grey area for free apps, and the black area for pay-to-install (paid) apps. Throughout the sample period, the vast majority of new apps are free. The vertical light grey bar denotes the onset of the pandemic (January to March 2020). We choose a band of time rather than a specific date, because China locked down Wuhan on January 23, 2020, airlines and countries began to impose travel restrictions in February 2020, the U.S. declared a national emergency on March 13, 2020, and the EU began to restrict all non-essential travel from other countries into the EU on March 17, 2020. Obviously, app entries on Google Play were declining before the onset of the pandemic, but this trend was reverted in early 2020. More specifically, the number of new apps began to increase in January 2020, and peaked in May 2020 before declining again. Unsurprisingly, the entry spike is driven by free apps.

10 Our count of Google Play apps includes those that were released on both iOS and Google Play and those released on Google Play only.

The right graph of Figure 1 plots the total count of monthly active users of top 200 apps on Google Play, for the U.S. and EU5 separately, across all categories. As our data is aggregate without individual user id, a user who is active on two top 200 apps is counted as two users. Consistent with the industry trends reported by App Annie (2022), app usage increased over time and the pattern is remarkably similar between the U.S. and EU5. The huge increase in monthly active users in mid 2019 is largely due to an increase in specific categories like Social and Communication, and the ups and downs between January and May 2020 mainly result from changes in the Game category, which is the single largest category on Google Play. In contrast to the short-lived spike of app entry in May 2020, we observe a rapid increase of monthly active users in June 2020, and this increase is persistent throughout the end of the sample period (June 2021), even after the U.S. and EU5 gradually loosened social distancing policies and travel limits.

In short, Figure 1 suggests that a spike of app entries has coincided with a persistent usage growth for popular mobile apps after the onset of the pandemic.

Table 1 presents a basic comparison between the U.S. and EU5 for top 200 apps in the six privacy-sensitive and all other categories from May 2019 to June 2021. To simplify the comparison, we report EU5 numbers as average per country. Because each category, month and user country has its own top 200 list on Google Play (for free and paid apps separately), the number of unique top 200 apps per month is more than 16000 in the U.S. and more than 13000 per country in EU5. In both columns, new apps released after January 2020 account for a small but non-trivial fraction of top 200 apps. This fraction alone suggests that slightly more new apps made top 200 in EU5 than in the U.S. in the privacy-sensitive categories (14.7 percent vs. 13.6 percent), but fewer new apps made top 200 in EU5 in all other categories (8.7 percent vs. 13 percent). Because this fraction is computed by the count of unique apps, it could be driven by the ease/difficulty of new apps making top 200 or their turnover in and out of top 200. Later on, we explore the likelihood of becoming and remaining a top 200 app.

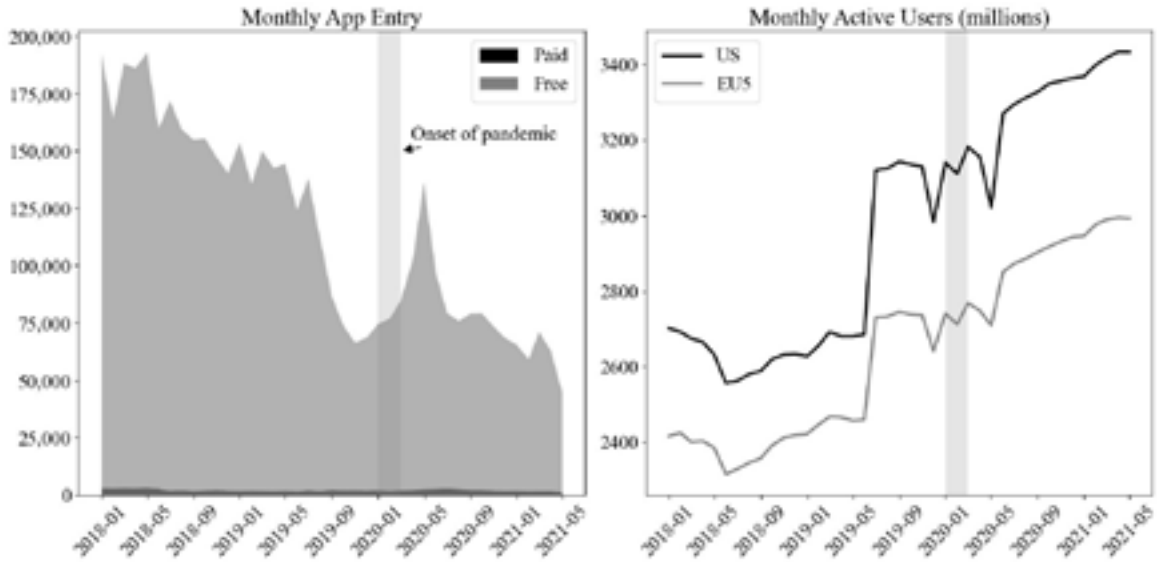


Figure 1: Global App Entry based on metadata and Total Monthly Active Users based on Top 200 apps (Google Play Store)

Within the six privacy-sensitive categories, 57.4 percent of top 200 apps in the U.S. have any ad revenue, which is lower than in EU5 (70.8 percent). Consistently, the fraction of ad-based top 200 apps is lower in the U.S. than in EU5 (33.9 percent vs. 43.1 percent). As for app age, top 200 apps in the U.S. are almost 100 days older than those in EU5. Similarly, for top 200 apps in all other categories, those in the U.S. are less likely to have any ad revenue, less likely to be ad-based, are older, and are of higher star ratings than those in EU5. A comparison between privacy-sensitive and all other categories suggests that top 200 apps in all other categories are less reliant on ad revenue, and are on average younger and have slightly lower ratings than those in privacy-sensitive categories.

Table 1: Summary Statistics of Top 200 apps on Google Play, 2019-05-01 to 2021-06-01

Variable (per month)	U.S.	EU5 (avg. per country)
# of unique apps	15,711	12,781
Privacy-sensitive categories		
# of unique apps in privacy categories	1,804	1,537
# (%) of unique privacy apps released after 1/2020	246 (13.6%)	226 (14.7%)
% of privacy apps with any ad revenue	57.4%	70.8%
% of privacy apps that are ad-based	33.9%	43.1%
avg age of privacy apps (days)	1,297	1,201
avg star rating of privacy apps	4.18	4.13
All other categories		
# of unique apps in all other categories	14,398	11,735
# (%) of unique all other apps released after 1/2020	1,882 (13.0%)	1,104 (8.7%)
% of all other apps with any ad revenue	32.6%	39.5%
% of all other apps that are ad-based	26.9%	32.6%
avg age of all other apps (days)	1,152	1,072
avg star rating of all other apps	4.15	4.11

Notes: Data source: Apptopia data on the performance of top 200 apps in the Google Play Store. Every variable is a monthly average including free and paid apps.

III. GROWTH AND SURVIVAL OF NEW APPS

While the onset of the pandemic provides an opportunity for new apps, it is an open question as to how they perform after entry, and whether this performance depends on the user's country and the privacy sensitivity of the app's primary category.

Generally speaking, mobile apps face intensive competition: every month, 50k to 200k new apps have entered the global Google Play store, but consumers are unlikely to go beyond the first few pages of the top-ranking lists if they conduct a general search for mobile apps. Figure 2 shows the probability of an app first showing up in a top 200 list as a function of the app's age. For privacy-sensitive and all other categories (separately), Figure 2 plots the probability of reaching a top 200 ranking by user geography (U.S. vs. EU5) and app release time (by January 2020 versus on and after March 2020).[11]

Figure 2 suggests that the likelihood of reaching a top 200 ranking is highest in the first month of app's release. Even before the pandemic, it was relatively easier for a brand new app to make top 200 in the U.S. than in EU5, and this difference quickly dissipated after the app's first month of age. This pattern held in both privacy-sensitive and all other categories.

For apps released by January 2020 (as compared to those released since March 2020), the first month difference between the U.S. and EU5 is magnified for both privacy-sensitive and all other categories, and the difference remains positive for the second month of app age.

11 We drop apps that entered Google Play Store in February 2020 given variations of pandemic status and limits in that month.

In privacy-sensitive categories, EU5 catches up with the U.S. for apps in the third, fourth and sixth-months of age, but these differences do not completely offset the U.S.-EU5 differences in the first two months. After the seventh month of age, the chance of an app making top 200 converges to the pattern of apps released before January 2020. The convergence in all other categories is even faster.

Figure 3 plots the extent to which a top 200 app remains on the list once it first appears as top 200. By definition, every top 200 app is on the list in the first month of making the list. However, the chance of staying on the list is slim and drops sharply right after: for the apps that were released by January 2020 and have made top 200 at some point, only 5-6 percent of them remain on the list in the second month, 2-3 percent remain in the third month, and less than 2 percent stay on the list after the fourth month. While this pattern is similar for the U.S. and EU5, the chance of survival is relatively higher in the U.S. For apps that were released since March 2020, the chance of survival improves slightly, especially for apps in the privacy-sensitive categories, that are offered in the U.S., and in their third-, fourth- and fifth-months since the apps first made top 200.

Figure 2: Probability of New Apps Entering Top 200 on Google Play

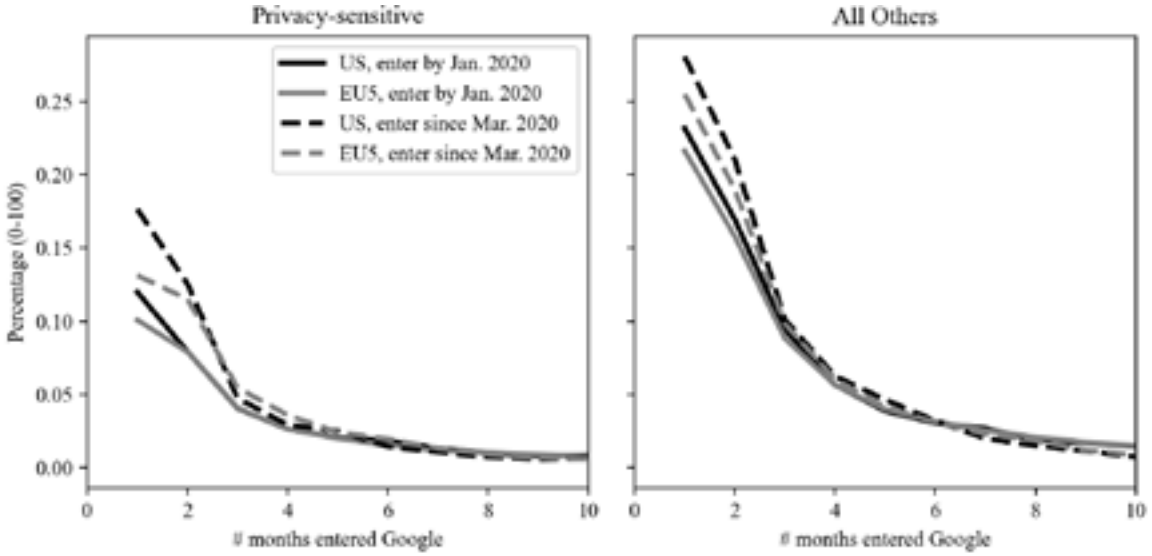
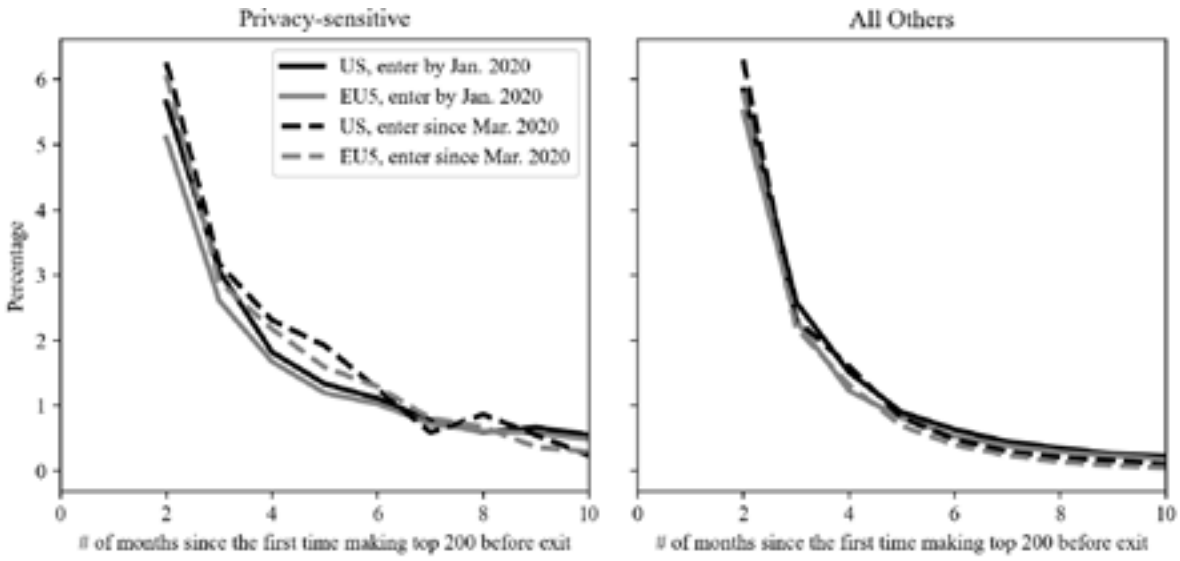


Figure 3: Survival Rate of New Apps Entering Top 200 on Google Play

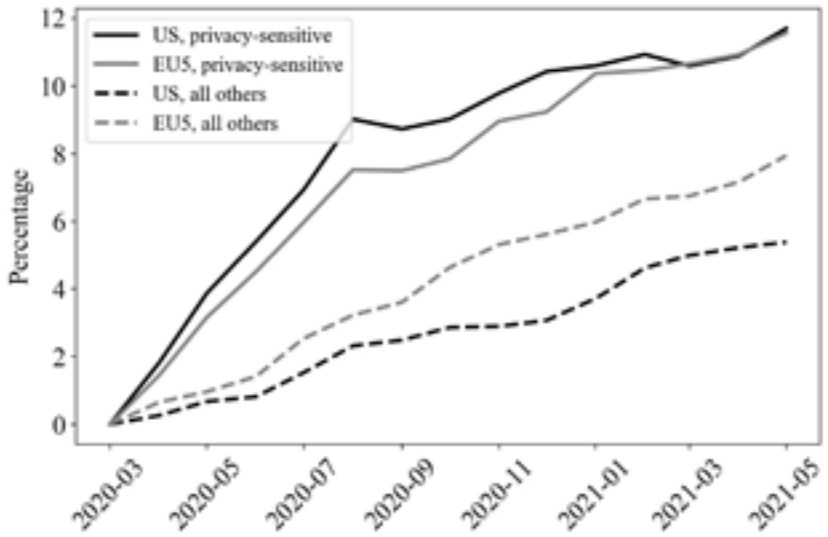


The entry and exit of top 200 apps, while informative, does not provide information regarding how a top 200 app performs relative to other ranked apps. To address this, we compute the percentage of top 200 apps' daily active usage that originates in apps released by January 2020. By definition, this percent increases over time, as more new apps entered Google Play after January 2020 and more of them make top 200 over time. Figure 4 shows that, in privacy-sensitive categories, new apps released post March 2020 have accounted for roughly 9 percent

of top 200 daily active usage in the U.S. since August 2020. This is more than 1 percentage point higher than that of EU5 until the end of 2020. In contrast, in all other categories, only 2-4 percent of top 200 daily active usage in the U.S. are driven by new apps released post March 2020, and these percentages are persistently below that of EU5.

Altogether, Figures 2, 3 and 4 suggest that, in the privacy-sensitive categories, there are more breakthrough new apps in the U.S. than in EU5 after the onset of the pandemic, in terms of a greater chance to make top 200 in the first two months of app age, a greater chance to stay on top 200 in the third, fourth and fifth months since the first time making top 200, and a greater share of daily active usage within top 200 apps. This advantage is less prominent in all other categories, if it exists at all. The U.S. vs. EU5 advantage in the privacy-sensitive categories is also temporary, as the U.S. and EU5 converge on the share of daily active usage by new apps in the last three months of our data (March to May 2021).

Figure 4: % Daily Active Usage of Apps Released Since March 2020 Among Top 200

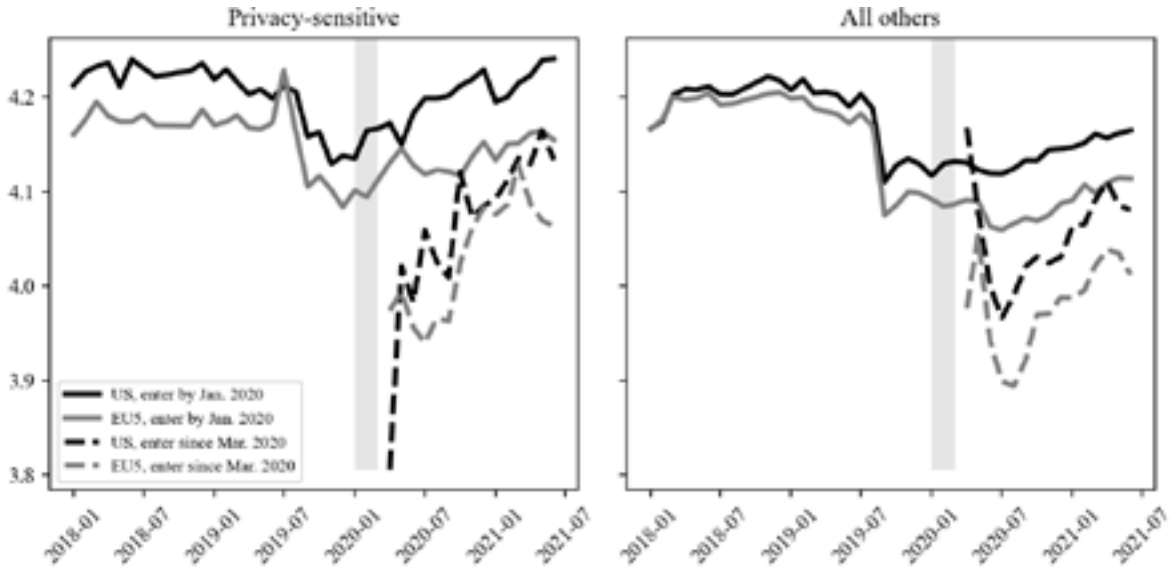


IV. AD RELIANCE AND QUALITY RATINGS OF NEW APPS

While the U.S. appears friendlier than EU5 to new apps in privacy-sensitive categories, one may wonder whether this friendliness may foster more ad-reliant and/or lower quality apps in the U.S. If so, more ad-reliance and lower quality could undermine user benefits from new apps. At the same time, advertising is an important source of revenue for mobile apps, especially free-to-install apps. A market more tolerant of ad-based apps could provide more financial incentives for app developers to innovate and improve app quality, as Shiller, Waldfogel and Ryan (2018) have shown in the context of ad blockers reducing the traffic and quality of websites.

Figure 5 plots the percentage of top 200 apps that are ad-based, conditional on having any positive revenue (from installing, advertising, in-app purchase, etc). As in Figures 2 and 3, Figure 5 plots a graph for privacy-sensitive and all other categories separately. Each graph has a separate line for the U.S. and EU5, as well as by apps released by January 2020 versus apps released since March 2020.

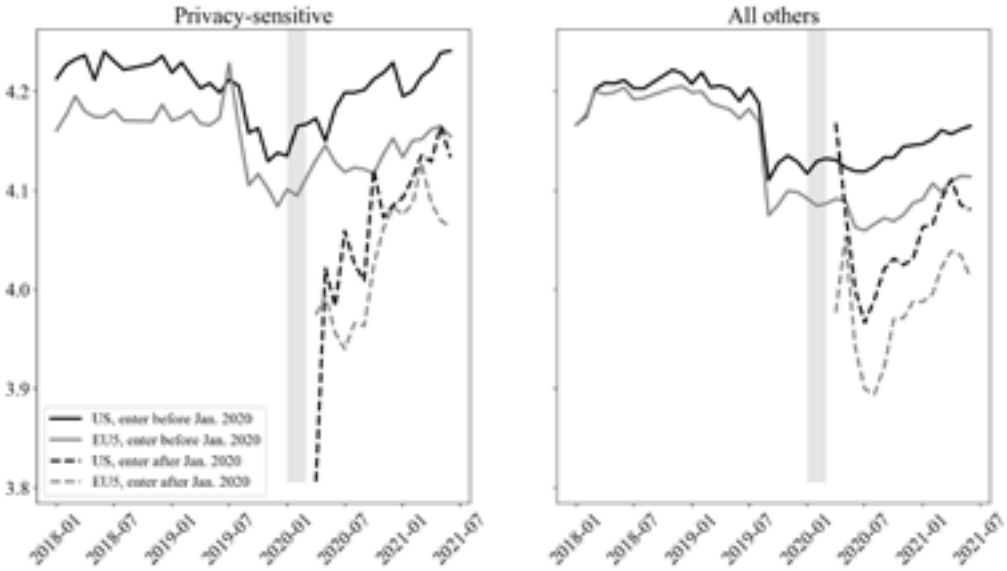
Figure 5: Percentage of Ad-Based Top 200 Apps



Consistent with Table 1, top 200 apps in EU5 are more likely to be ad-based across the sample period and in all categories. For apps released by January 2020, the U.S.-EU5 gap expands after the onset of the pandemic in both privacy-sensitive and all other categories. However, for apps released on or after March 2020, top 200 apps in the U.S. are catching up with their EU5 counterparts in the privacy-sensitive categories, but not in all other categories. These mixed patterns suggest that the U.S. market is friendlier than EU5 for new ad-based apps in privacy-sensitive categories. Interestingly, in both the U.S. and EU5 and across all categories, top 200 apps that were released post March 2020 are significantly more ad-based than top 200 apps that were released before January 2020. This suggests that the role of ad revenue in app success (in terms of making top 200) has increased post March 2020, probably because users are more tolerant of ads as they spend more time on mobile apps.

Figure 6 follows the same structure as Figure 5, but presents the average star ratings of top 200 apps in the U.S. and EU5 — based on whether the apps were released by January 2020 or since March 2020, in privacy-sensitive and all other categories separately. For top 200 apps released by January 2020, there was a big drop in August-September 2019 because Google changed its algorithm for determining an average star rating, which applies to both the U.S. and EU5. Regardless of this technical change, the U.S. top 200 apps demonstrate higher average ratings than those in EU5, and this gap expands soon after the onset of the pandemic, especially post June 2020 for privacy-sensitive categories, and post April 2020 for all other categories. This suggests that the pandemic-driven usage expansion in top 200 apps may help old high-quality apps to stand out more in the U.S., probably because the U.S. market is much larger than each individual member state in EU5.

Figure 6: Average Ratings of Top 200 Apps



For top 200 apps released on or after March 2020, their average ratings are consistently lower than that of older apps. This is understandable, given their relatively younger age and shorter time period for improving upon market feedback. For the new apps in all other categories, we still observe a rating premium between the U.S. and EU5, similar to the gap for the apps released by January 2020. But for the privacy-sensitive categories, the new top 200 apps in EU5 began to catch up with the U.S. in October 2020, which almost closed the U.S.-EU5 gap before the gap expanded again in March 2021. This temporary catch-up is intriguing, and is most likely driven by the fact that, during this time period, young U.S. apps that were released on or after March 2020 and dropped out of top 200 have ratings similar to young apps that entered top 200 each month. This keeps the average ratings of top 200 U.S. apps relatively flat compared to the EU5, where young apps dropping out of top 200 have lower ratings on average than young apps entering the same month.

V. CONCLUSION

We offer a descriptive comparison between the U.S. and EU5, contrasting apps in a group of more privacy-sensitive categories against apps in all other categories, and changes before and after the onset of the COVID-19 pandemic.

Globally, we observe a spike of new app entries in May 2020 while the monthly active users of top 200 apps grow steadily soon after the onset of the pandemic. This suggests that app entry and market expansion go hand in hand. In all categories, we find that apps released on or after March 2020 had a better chance to become top 200 in the first few months of app age than apps released by January 2020, suggesting that market expansion is helpful for the development and growth of new apps.

In the app categories of Games, Health & Fitness, Social, Communication, Shopping, and Finance, we find the U.S. is “friendlier” than EU5 to new apps released on or after March 2020. Apps in the U.S. have a greater chance to be ranked in a top 200 list in the first two months of app age, a greater chance to stay as a top 200 app in months 3 through 5 since their first time making top 200, and a greater share of daily active usage within top 200 apps. This advantage subsequently dissipates and is generally negligible in all other app categories.

We further find that in both the U.S. and EU5, and across all categories, top 200 apps that were released post March 2020 are significantly more ad-based than top 200 apps that were released by January 2020, suggesting that the role of ad revenue in app success (in terms of making top 200) has increased post March 2020, possibly because users are more tolerant of ads as they spend more time on mobile apps.

These changes, especially the temporary advantage of the U.S. for new breakthrough apps in the six privacy-sensitive categories, are subject to multiple explanations. For example, some app developers may prefer to target the U.S. market only or to launch new apps in the U.S. first, which could be related to a more active venture capital market in the U.S., or more lax and more fragmented data regulations in the U.S. It is also possible that U.S. users are less aware or less concerned of privacy and data issues. Alternatively, U.S. users may have a stronger willingness to try new apps, despite holding similar privacy concerns as EU citizens. Different market sizes, different demographics, and different user preferences for social, shopping, health and fitness apps could also contribute to the observed U.S.-EU5 differences. Since the mechanisms behind these differences are manifold, readers should not interpret our findings as causal effects. Identifying the underlying mechanisms merits further research.

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