The Economic Impact of the DMA: Evidence from Big Tech Acquisitions in the App Industry

Pauline Affeldt (E.CA Economics)

W@CompetitionDE Talk: DMA - Let's Go!

Based on joint work with Reinhold Kesler

11 March 2024

Big Tech Acquisitions

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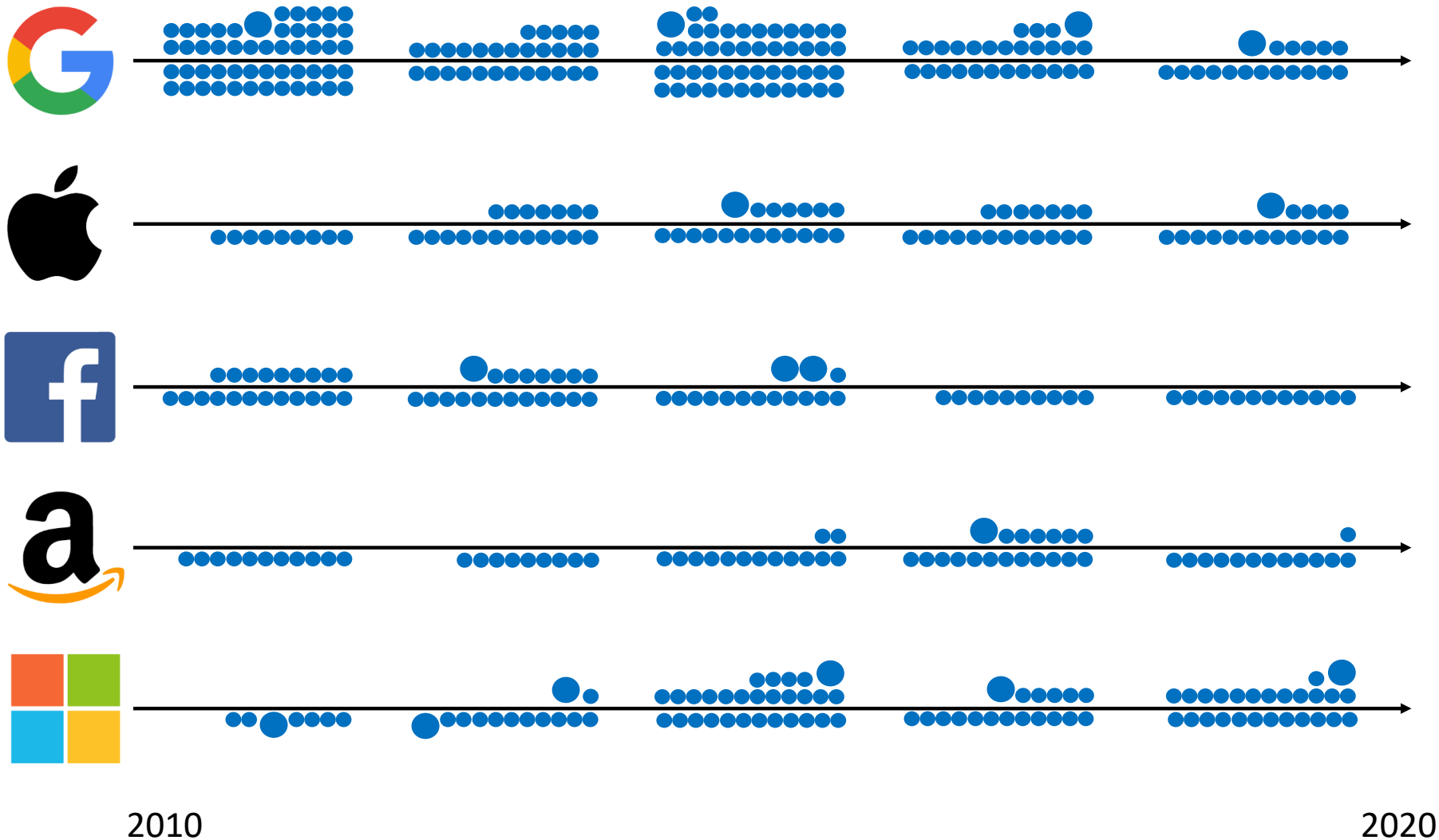

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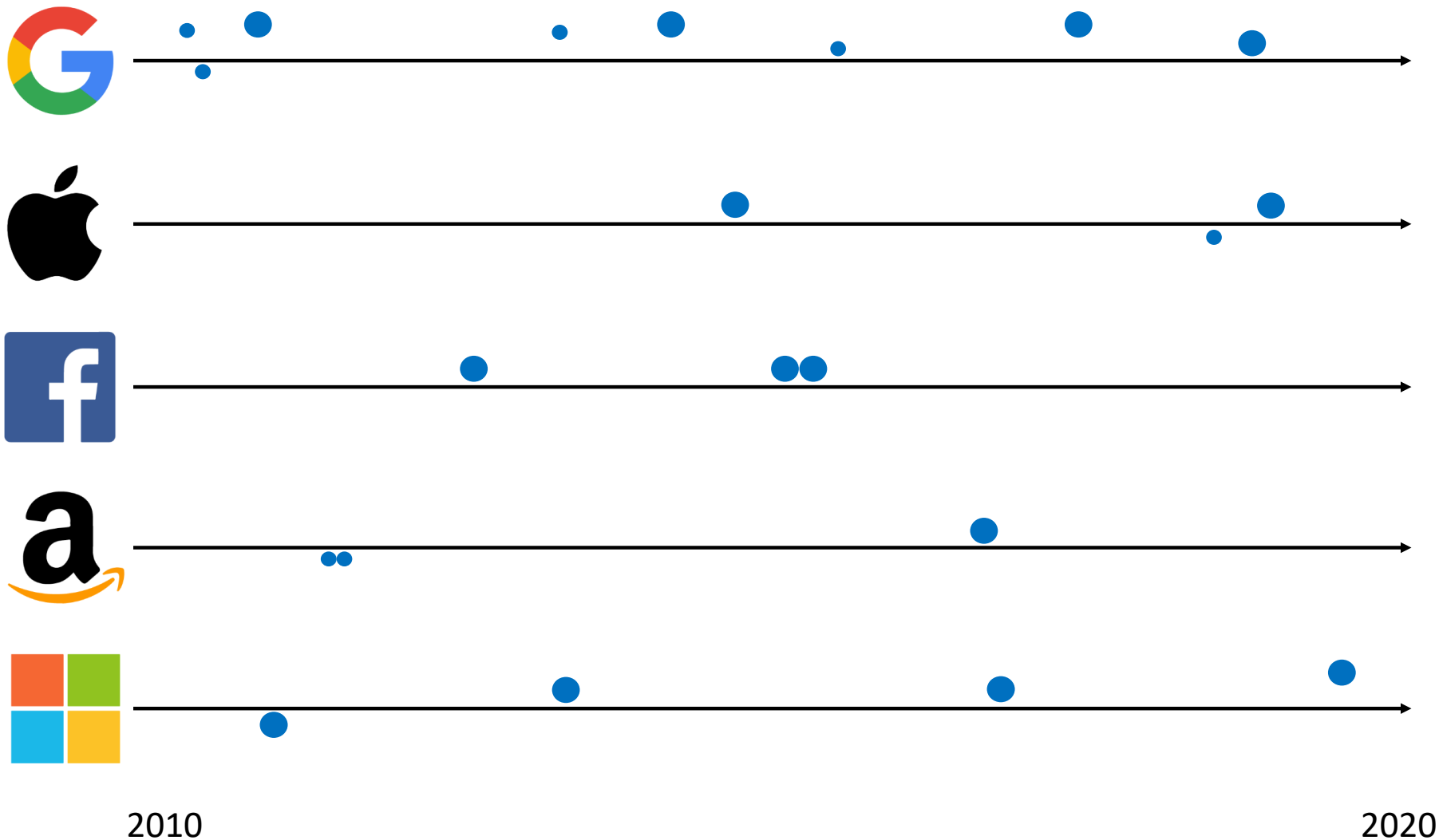

Big Tech Acquisitions

Growing Concerns leading to Regulation

- Increasing concerns by policy makers about the competitive effects of such big tech acquisitions:
  - US House Judiciary Subcommittee, 2020; OECD, 2020; ACCC, 2019; Cremer et al., 2019; Furman et al., 2019; Scott Morton et al., 2019.

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- (Current) merger control enforcement might not cope with challenges posed by digital markets (e.g. Argentesi et al., 2019).

- **Under DMA gatekeepers must notify every acquisition**, where the merging parties or the target of concentration provide digital sector services or enable the collection of data.

Mobile Apps as a Case in Point

Facebook to buy WhatsApp for $19 billion

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Google is on a shopping spree – what does it mean for Android?

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- Our research question: What are the competitive effects of big tech acquisitions *on competitors* in the Google Play Store?

Related Literature on Big Tech Acquisitions

Two opposing **theoretical effects**:

- Big tech acquisitions decrease innovation and entry incentives by increasing market concentration.
- Big tech acquisitions provide entry-for-buyout incentives.

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Empirical literature:

- Acquisition strategies of GAFAM: Gautier and Lamesch (2020), Parker et al. (2021), Jin et al. (2023).

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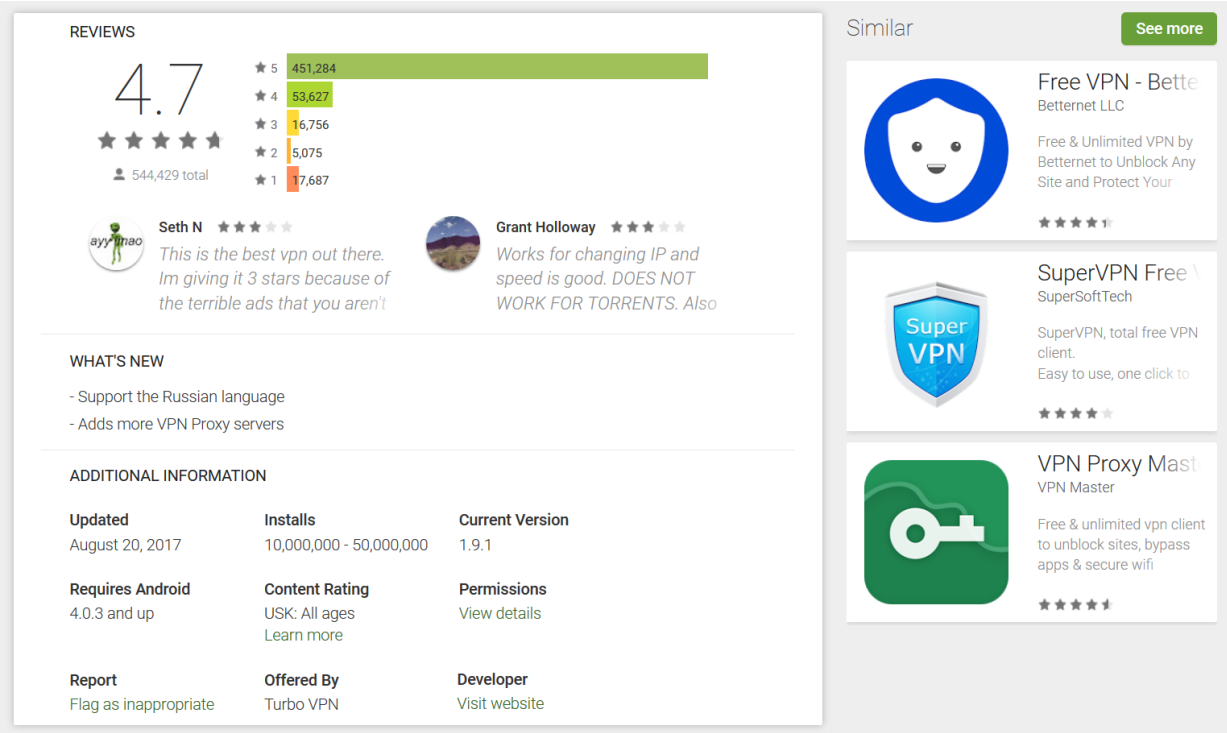
Empirical literature:

- Acquisition strategies of GAFAM: Gautier and Lamesch (2020), Parker et al. (2021), Jin et al. (2023).
- Effects of big tech acquisitions on
  - Venture capital funding: Koski et al. (2020), Prado and Bauer (2022), Gugler et al. (2023).
  - Entry: Koski et al. (2020), Jin et al. (2023), Eisfeld (2023).
  - Patenting: De Barsy and Gautier (2023), Gugler et al. (2023).

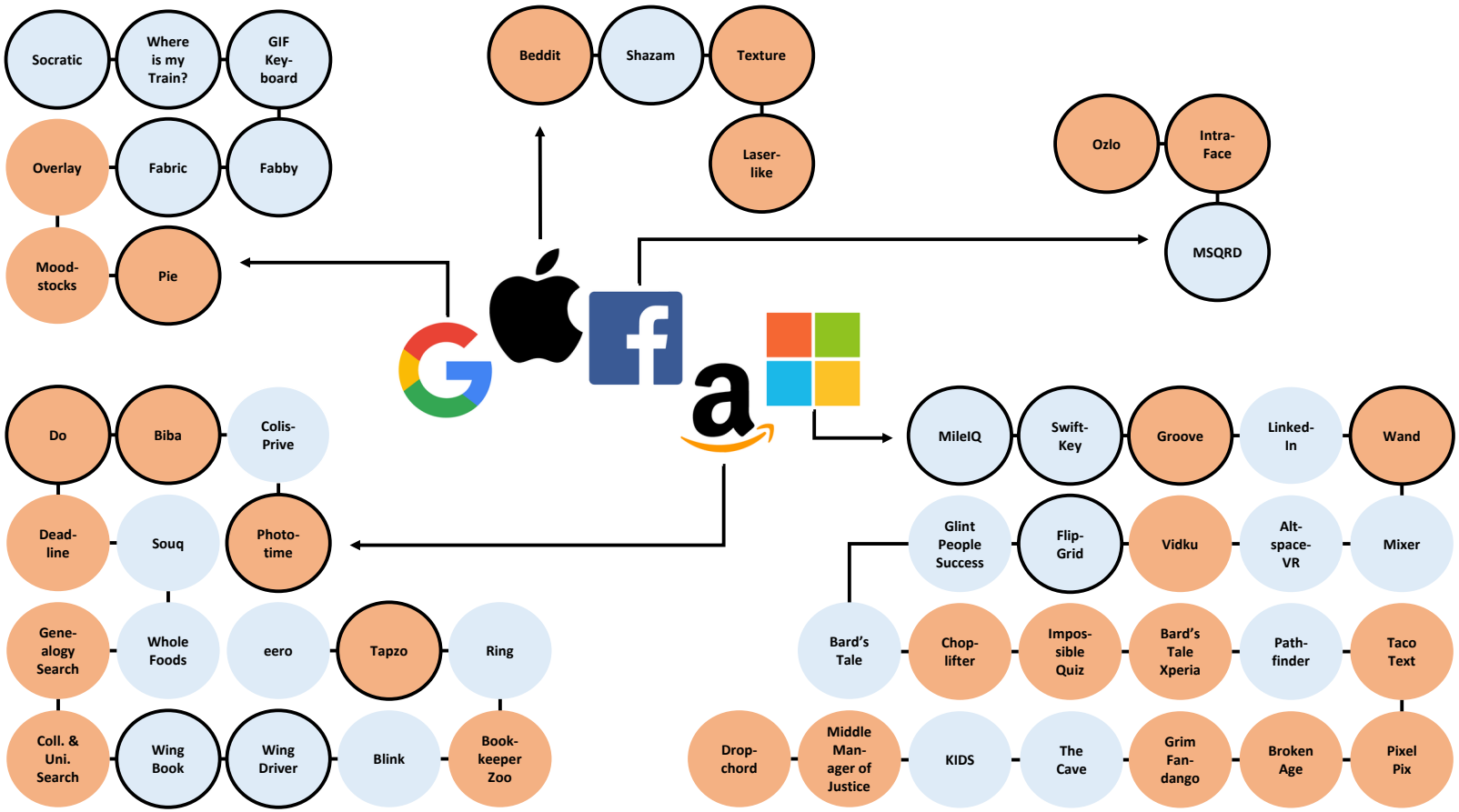
Crawling the Google Play Store from 2015 to 2019



- We observe everything users can see about an app and its developer.
  - 1 to 2.5 million apps observed each of the 17 quarters, resulting in more than 30 million observations.
  - A rich set of characteristics enables us to measure, for example, the monetization strategy, functionality, and quality.
- We use this data to identify acquired apps and their competitors.

▸ Web-Scraping

GAFAM Acquisitions Involving Apps

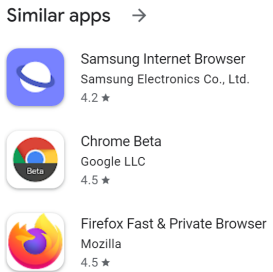


- Acquisitions can be characterized into, whether the acquired app:
  - is discontinued (highlighted in orange), and
  - constitutes the main part of the target company (outline in bold).

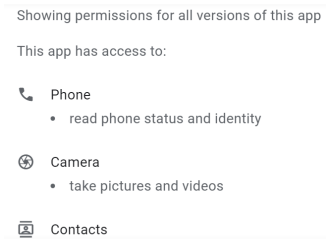
▶ Identifying ▶ Main Part

Identifying Competitors and Non-Price Outcomes

- Identify competitors of acquired apps based on:
  - similar apps recommended by platform, or
  - textual similarity of app descriptions.



- Consider **non-price outcomes** relevant in digital sphere:
  - innovation proxied by updates and entry and
  - data measured by (privacy-sensitive) permissions.



▶ Competitors ▶ Empirical Strategy

Stylized Facts about Acquired Apps

- About 50 percent of all acquired apps are discontinued. ▸ Discontinued
- Discontinued apps tend to be smaller and less privacy-intrusive than apps that are continued. ▸ Comparison
- Acquired apps become free of charge but request more privacy-sensitive permissions post-acquisition. ▸ Monetization

Effects on Competing Apps

- **Effects in affected market:**
  - Competing apps react to GAFAM app acquisitions by updating less: **propensity to update decreases by 2.4pp (about 3.5%)**.
  - Distinguishing the nature of updates, feature updates seem to decrease.
  - Competing apps request fewer privacy-sensitive permissions with no statistically significant change post-acquisition.

▸ Baseline ▸ Dynamic ▸ Robustness ▸ Entry ▸ Developers

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- **Effects beyond the acquired market:**
  - Entry in markets of apps acquired by GAFAM decreases: **number of apps in the market decreases by about 17** (average pre-acquisition market size of 50 apps).
  - Developers shift their (innovative) effort towards unaffected apps and markets: **propensity that developer updates unaffected app increases by about 2.4pp**.

▸ Baseline ▸ Dynamic ▸ Robustness ▸ Entry ▸ Developers

Recent Cases: Google/Fitbit and Facebook/Giphy

- Two recent cases under regulatory scrutiny:
  - **Google/Fitbit:** announced on 1 Nov 2019; clearance (with remedies) by EC on 17 Dec 2020.
  - **Facebook/Giphy:** announced on 15 May 2020; decision of UK CMA that Giphy had to be divested on 18 Oct 2022.

▸ Update ▸ Entry

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  - **Facebook/Giphy:** announced on 15 May 2020; decision of UK CMA that Giphy had to be divested on 18 Oct 2022.

- **Reaction of competitors:**
  - Likelihood of updates and number of competitors drops with acquisition announcement.
  - Competitors increase (decrease) innovative effort with unwinding (clearance) by regulators.
  - Number of competitors increases (decreases) with unwinding (clearance) by regulators.

▸ Update ▸ Entry

Conclusion

- Empirical evidence on competitive effects *on competitors* of big tech acquisitions in app industry.

- Results:
  - Competing apps react to GAFAM app acquisitions by **innovating less**.
  - Post-acquisition, app developers with multiple apps **shift their innovative effort towards unaffected apps** and shy away from launching new apps in affected markets.
  - Competitors react not only to acquisition announcement but also regulatory decision.

Conclusion

- **Implications of DMA:**
  - Gatekeepers must notify every acquisition and list will be published on yearly basis.
  - Hopefully this will trigger more ex-post evaluations of the competitive effects of these acquisitions.
  - Might lead to more merger investigations but unclear how this should change outcome of merger review.

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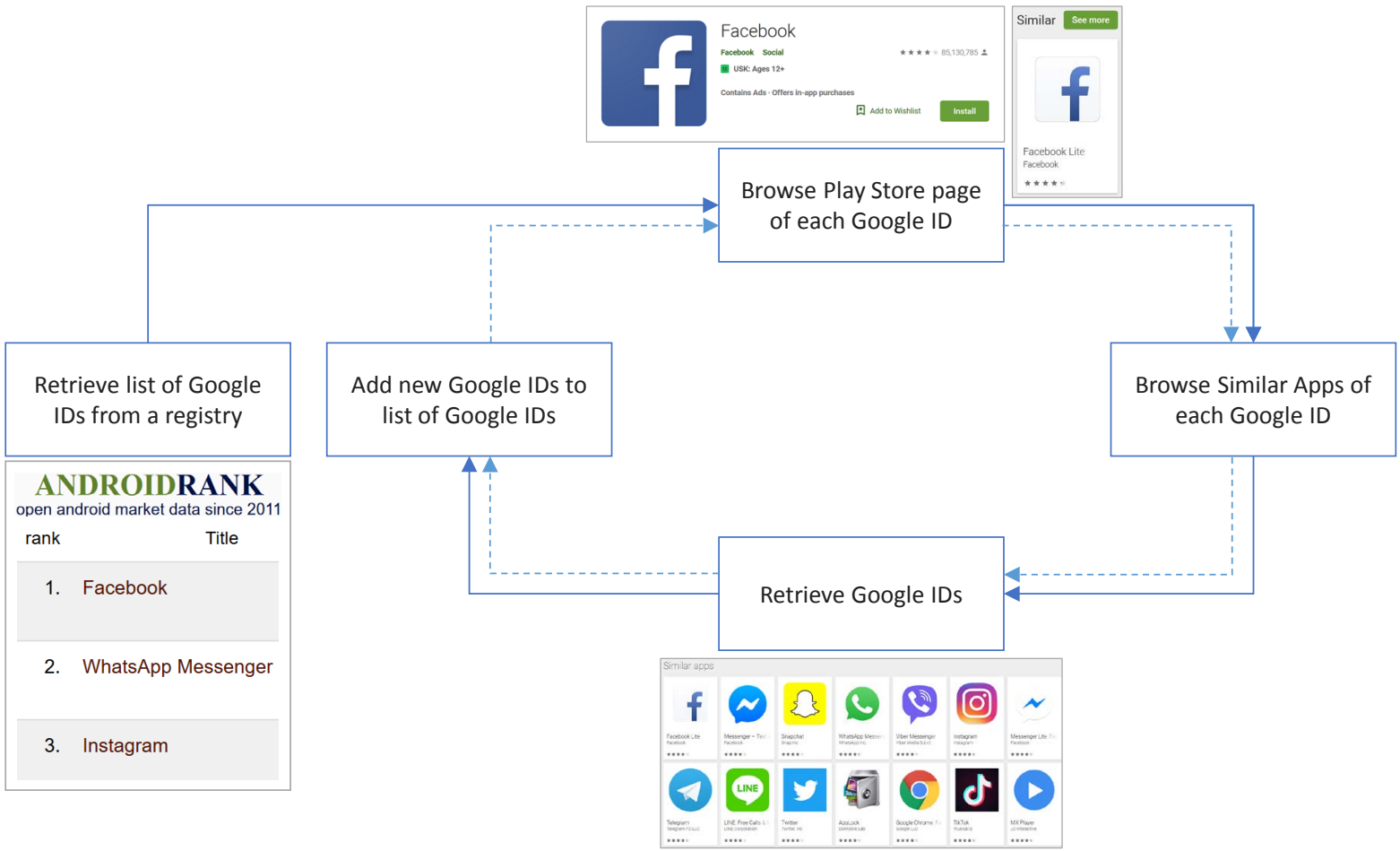
Web-Scraping of the Google Play Store



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Identifying Acquired Apps on the Google Play Store

- Desk research of more than 200 acquisitions between 2015 and 2019 by GAFAM inferred from different sources:
  - Gautier and Lamesch (2020), Argentesi et al. (2019), Wikipedia.
  - This is complemented by Google search requests, e.g., 'company name + acquires app'.
- Standardized procedure to look, whether target company has an app on the Google Play Store and retrieve its Google ID.
- Results in 54 apps acquired by GAFAM and successfully identified in the dataset.

Identifying Acquired Apps on the Google Play Store

- Study, whether news articles about the acquisition mention any apps.
- Look at the target company's (archived) website and articles about the firm for the presence of an app.

- If an app is mentioned, try searching it on the Google Play Store.
  - If app still available, take Google ID from the Play Store URL.
  - If app is not available, retrieve links containing Google ID following these steps:
    - Look for news articles linking to the former Play Store page.
    - Consider information on the firm's website (or archived versions through the WebArchive).
    - Search for early entries on Google mentioning the app and linking to it.

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Acquired Apps by Main Part of Business

Table: Acquired Apps Main Part of Business by Acquirer

Acquirer	App Main Part of Business	App Not Main Part of Business	Total
Google	6	2	8
Apple	4	0	4
Facebook	3	0	3
Amazon	6	10	16
Microsoft	5	18	23
Total	24	30	54

- Acquisitions by Facebook, Apple, and Google comprise app-based companies, while majority acquired by Amazon and Microsoft do not revolve around apps.

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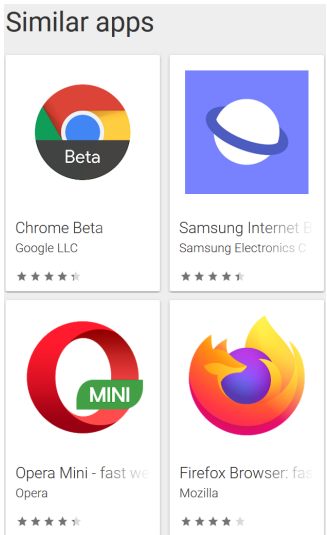
Identifying Competitors of Acquired Apps



- Similar apps provided on Google Play Store:
  - Up to 50 similar apps considered as 'close' competitors (Wen and Zhu, 2019; Kesler et al., 2020).
  - Provided in descending order of closeness.
  - Constant set of competitors at time of acquisition.
- Alternatively, we define markets based on textual similarity of app descriptions:
  - Define up to 10 keywords best describing each acquired app.
  - Competitors defined as apps in same category and app description contains at least 5 keywords.
  - Set of competitors can change over time.

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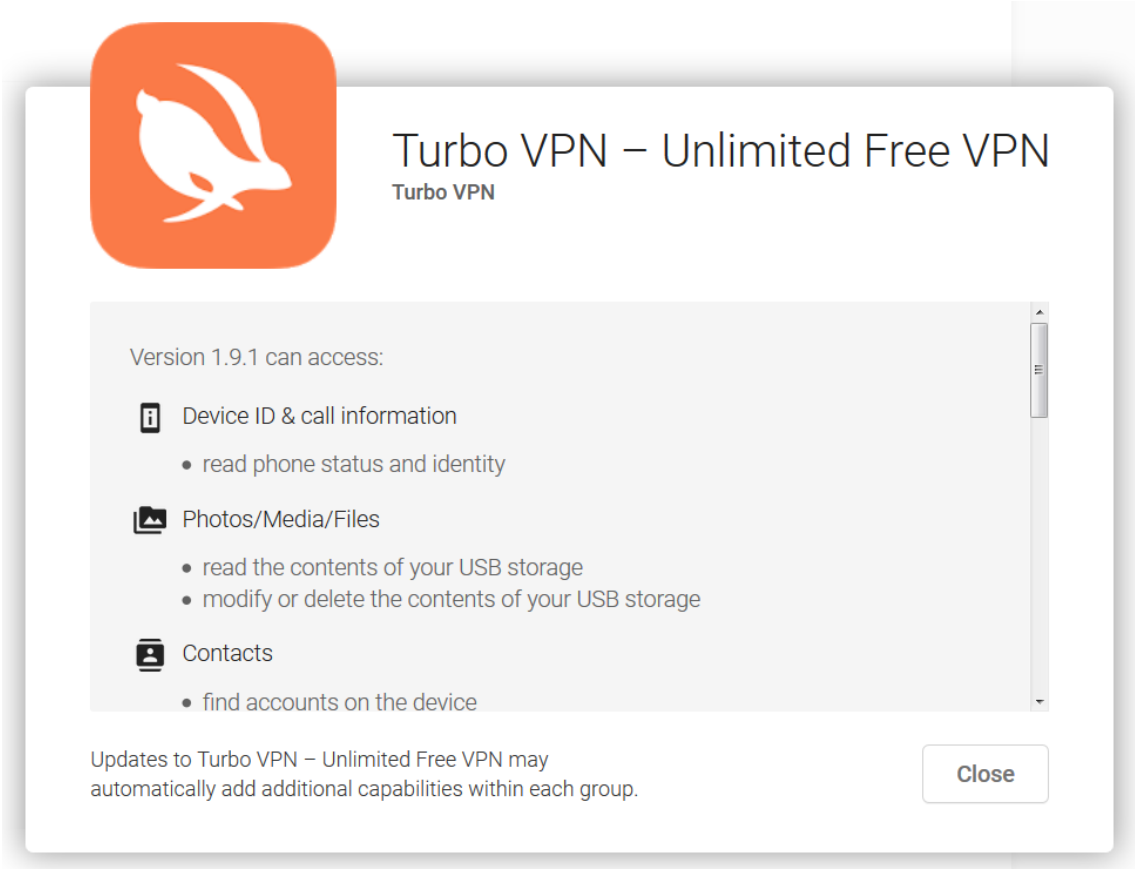
Measuring Privacy



- Permissions can be divided into clean and privacy-sensitive ones.
- If the majority of paid apps in a category does not use a certain privacy-sensitive permission, it is considered non-functional.

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Comparing Acquired Apps with Competing Apps I

	Acquired Mean	Similar Mean	Difference
App Price (1=Yes)	0.29	0.10	0.19***
In-App Product (1=Yes)	0.17	0.35	-0.18***
Days Since Last Update	358.37	128.28	230.09***
Update in Last Quarter (1=Yes)	0.59	0.69	-0.10***
Feature Update in Last Quarter (1=Yes)	0.11	0.12	-0.01
Other Update in Last Quarter (1=Yes)	0.36	0.41	-0.05*
P-S Permissions (Number)	2.47	2.03	0.44***
P-S Permissions (1=Yes)	0.61	0.67	-0.06**
Non-Functional P-S Permissions (Number)	2.34	1.95	0.40***
Non-Functional P-S Permissions (1=Yes)	0.61	0.67	-0.06**
Ratings (k)	148.98	285.27	-136.29
Average Rating	4.12	4.24	-0.12***
Clean Permissions (Number)	8.62	8.40	0.22
Observations	301	8,981	
Number of Apps	45	1,370	

- Competing apps request fewer privacy-sensitive permissions than acquired apps.

Event Study Approach: Baseline

- Two-way fixed effects (TWFE) model on competitors:
  - Compare similar apps of acquired app pre- and post-acquisition.
  - Control for app FE and time FE.
  - Control for time-varying app characteristics (demand, functionality, and quality).

- We run the following regression for competing app i, in market m, at time t:

$$Y_{imt} = \beta_0 + \beta_1 Acq_{mt} + X_{it} + \eta_i + \eta_t + \varepsilon_{it}$$

- Varying fixed effects and clustering assumptions (app and market).
- Robustness checks:
  - Look at dynamic effects of acquisitions on competitors.
  - Consider different sample restrictions.
  - Account for staggered treatment (Callaway and Sant'Anna, 2021).

Event Study Approach: Further Analyses

- Consider different market definitions:
  - Consider only similar apps with a rank below 25.
  - Define a market based on textual similarity of app description.
- Consider all apps of an 'affected' developer to measure possible spillovers.
- Consider effects of acquisitions on entry in the affected market.

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Acquired Apps by Acquirer and Shutdown

Table: Continued, Inactive, and Discontinued Apps by Acquirer

Acquirer	Continued Active	Continued Inactive	Discontinued	Total
Google	5	0	3	8
Apple	1	0	3	4
Facebook	0	1	2	3
Amazon	9	0	7	16
Microsoft	7	4	12	23
Total	22	5	27	54

- Microsoft is the most active acquirer and 50 percent of all acquired apps are discontinued.

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Contrasting Continued with Discontinued Acquired Apps

	Continued Mean	Discontinued Mean	Difference
App Price (1=Yes)	0.14	0.39	-0.24***
In-App Product (1=Yes)	0.14	0.20	-0.06
Days Since Last Update	209.66	615.14	-405.48***
Update in Last Quarter (1=Yes)	0.78	0.29	0.49***
Feature Update in Last Quarter (1=Yes)	0.14	0.05	0.09***
Other Update in Last Quarter (1=Yes)	0.45	0.19	0.25***
P-S Permissions (Number)	2.99	2.50	0.49
P-S Permissions (1=Yes)	0.70	0.57	0.13***
Non-Functional P-S Permissions (Number)	2.86	2.42	0.45
Non-Functional P-S Permissions (1=Yes)	0.70	0.57	0.13***
Installations (k)/Age in Quarters	1,089.40	34.08	1,055.32***
Ratings (k)	257.90	10.07	247.84***
Average Rating	4.14	3.81	0.32***
Observations	167	180	
Number of Apps	25	26	

Notes: * p<0.10, ** p<0.05, *** p<0.01.

- Discontinued apps face lower demand and tend to be less privacy-intrusive.

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Acquired Apps Pre- and Post-Acquisition

	Pre Mean	Post Mean	Difference
App Price (1=Yes)	0.16	0.04	0.12***
In-App Product (1=Yes)	0.16	0.15	0.01
Days Since Last Update	323.35	205.13	118.22**
Update in Last Quarter (1=Yes)	0.68	0.72	-0.04
Feature Update in Last Quarter (1=Yes)	0.12	0.09	0.04
Other Update in Last Quarter (1=Yes)	0.41	0.45	-0.04
P-S Permissions (Number)	2.68	3.40	-0.71***
P-S Permissions (1=Yes)	0.63	0.81	-0.18***
Non-Functional P-S Permissions (Number)	2.53	3.31	-0.79***
Non-Functional P-S Permissions (1=Yes)	0.63	0.81	-0.18***
Installations (k)/Age in Quarters	788.88	1,378.43	-589.55**
Ratings (k)	188.19	397.95	-209.77***
Average Rating	3.94	3.85	0.09
Observations	238	197	
Number of Apps	34	34	

Notes: * p<0.10, ** p<0.05, *** p<0.01.

- Acquired apps change from being for pay to requesting privacy-sensitive permissions.

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Stylized Facts about GAFAM Apps

- 422 apps by GAFAM, the majority developed by Google (197) and Microsoft (148), while Apple has 4.
  - They account for about 20 % of the total installations in the Play Store.
- Only 5 of all acquired apps are rebranded as a GAFAM developer post-acquisition.

▶ GAFAM Apps ▶ Core

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  - They account for about 20 % of the total installations in the Play Store.
- Only 5 of all acquired apps are rebranded as a GAFAM developer post-acquisition.
- Google also acquires in its 'core' market, while the others predominantly enter 'non-core' markets.
- Acquiring in the core market does not often lead to a shutdown.

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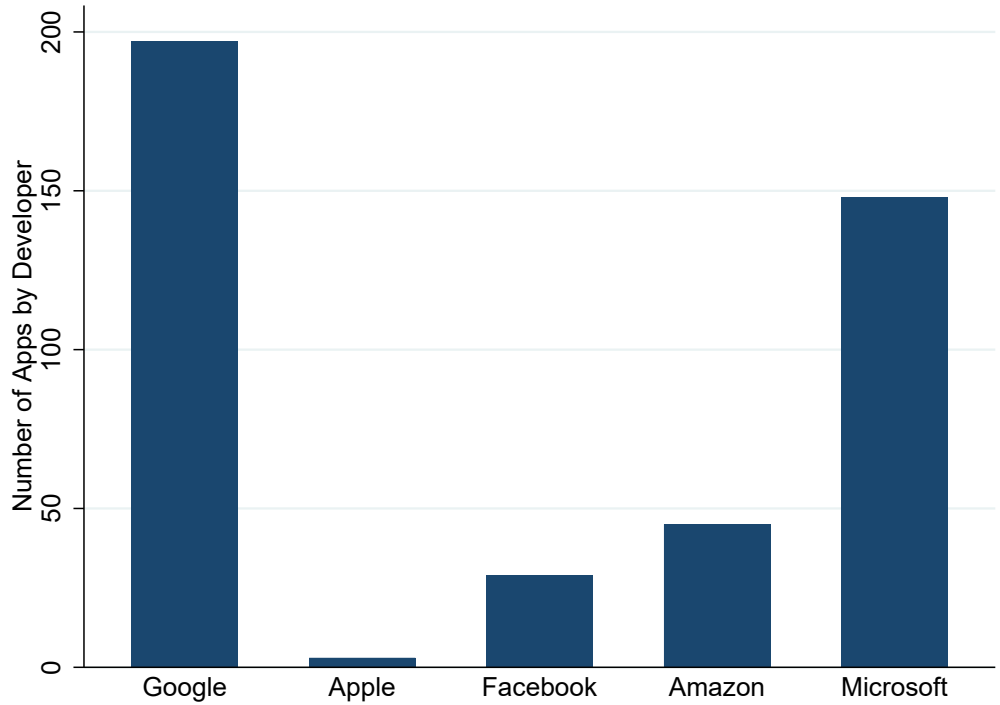
Apps by GAFAM in the Play Store



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Acquisitions and Shutdowns by GAFAM Presence

Table: Acquisition Type by Acquirer

	Google	Apple	Facebook	Amazon	Microsoft	Total
Not Core	4	4	2	13	17	40
Core	3	0	1	1	2	7
Total	7	4	3	14	19	47

- Google also acquires in its 'core' market, while the others predominantly enter 'non-core' markets.

Table: Acquisition Type and Shutdowns

	Continued	Discontinued	Total
Not Core	22	18	40
Core	5	2	7
Total	27	20	47

- Acquiring in the core segment does not often lead to a shutdown.

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Baseline Results

	Update	Feature Update	Other Update	P-S Perms.	Non-F. P-S Perms.
Acquisition (1=post-acquisition)	-0.028**	-0.019**	-0.020	-0.000	-0.000
	(0.011)	(0.009)	(0.013)	(0.007)	(0.007)
Number of Ratings (log)	-0.029***	0.011***	-0.071***	-0.001	-0.002
	(0.006)	(0.004)	(0.007)	(0.005)	(0.005)
Average Rating	0.114***	-0.024*	0.131***	0.009	0.011
	(0.022)	(0.015)	(0.025)	(0.015)	(0.016)
Number of Clean Permissions	0.016***	0.041***	-0.010***	0.024***	0.026***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Constant	0.331***	-0.284***	0.767***	0.514***	0.495***
	(0.107)	(0.075)	(0.114)	(0.078)	(0.080)
Further Controls	Yes	Yes	Yes	Yes	Yes
Quarter & App FE	Yes	Yes	Yes	Yes	Yes
Mean Dep. Var.	0.652	0.111	0.389	0.694	0.691
Observations	16535	16535	16535	16535	16535
Num. of Groups	1477	1477	1477	1477	1477
Adjusted R^2	0.46	0.09	0.17	0.84	0.83

- Negative relationship between GAFAM acquisition and updates. No statistically significant relationship found for (non-functional) privacy-sensitive permissions.

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Dynamic Effects

	Update	Feature Update	Other Update	P-S Perms.	Non-F. P-S Perms.
2 Quarters Pre-Acquisition	-0.006	-0.008	0.033*	0.008	0.007
	(0.014)	(0.012)	(0.018)	(0.007)	(0.007)
1 Quarter Pre-Acquisition	-0.009	-0.015	0.027	-0.007	-0.007
	(0.015)	(0.012)	(0.018)	(0.009)	(0.009)
Quarter of Acquisition	-0.015	-0.028**	0.012	-0.004	-0.006
	(0.016)	(0.012)	(0.019)	(0.010)	(0.010)
1 Quarter Post-Acquisition	-0.049***	-0.012	-0.041**	0.002	0.002
	(0.018)	(0.014)	(0.021)	(0.011)	(0.011)
2 Quarters Post-Acquisition	-0.044**	-0.048***	0.037	-0.002	-0.002
	(0.020)	(0.015)	(0.023)	(0.013)	(0.013)
more than 2 Quarters Post-Acquisition	-0.044*	-0.031*	0.000	0.023	0.023
	(0.023)	(0.016)	(0.026)	(0.016)	(0.016)
Number of Ratings (log)	-0.028***	0.012***	-0.072***	-0.001	-0.001
	(0.006)	(0.004)	(0.007)	(0.005)	(0.005)
Average Rating	0.113***	-0.024*	0.131***	0.011	0.013
	(0.022)	(0.015)	(0.025)	(0.015)	(0.016)
Number of Clean Permissions	0.016***	0.041***	-0.010***	0.024***	0.026***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Constant	0.334***	-0.287***	0.775***	0.505***	0.485***
	(0.107)	(0.075)	(0.114)	(0.077)	(0.079)
Further Controls	Yes	Yes	Yes	Yes	Yes
Quarter & App FE	Yes	Yes	Yes	Yes	Yes
Mean Dep. Var.	0.652	0.111	0.389	0.694	0.691
Observations	16535	16535	16535	16535	16535
Num. of Groups	1477	1477	1477	1477	1477
Adjusted R^2	0.46	0.09	0.17	0.84	0.83

- (Almost) no anticipation effects for the relationship between acquisition and updates.

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Robustness Checks

- Employing Group-Time Average Treatment Effect (Callaway & Sant'Anna, 2021):

	Update	Feature Update	Other Update
Overall Average Treatment Effect	-0.0526*	-0.031	0.0072
Standard error	0.0256	0.0202	0.0314
95% Confidence Interval	[-0.1027; -0.0025]	[-0.0707, 0.0087]	[-0.0544, 0.0687]
Further Controls	No	No	No

  - Negative relationship between acquisitions and updates robust to accounting for staggered treatment.

- Varying market definition:
  - Negative relationship between acquisitions and updates robust, both to restricting to more relevant similar apps and defining markets based on text analysis.

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Affected Developers' Updating Behavior

	Update	Feature Update	Other Update
Acquisition (1=post-acquisition)	-0.009***	0.024***	-0.040***
	(0.003)	(0.002)	(0.003)
Acquisition x Similar App	0.027***	-0.053***	0.110***
	(0.010)	(0.006)	(0.010)
Number of Ratings (log)	-0.075***	0.015***	-0.116***
	(0.003)	(0.002)	(0.003)
Average Rating	0.030***	-0.004*	0.032***
	(0.005)	(0.002)	(0.005)
Number of Clean Permissions	0.016***	0.052***	-0.025***
	(0.001)	(0.003)	(0.002)
Constant	0.497***	-0.382***	0.950***
	(0.034)	(0.026)	(0.036)
Further Controls	Yes	Yes	Yes
Quarter & App FE	Yes	Yes	Yes
Mean Dep. Var.	0.331	0.052	0.226
Observations	209966	209966	209966
Num. of Groups	29358	29358	29358
Adjusted R^2	0.46	0.12	0.26

- Developers shift feature updates from apps affected by GAFAM acquisition to unaffected apps.

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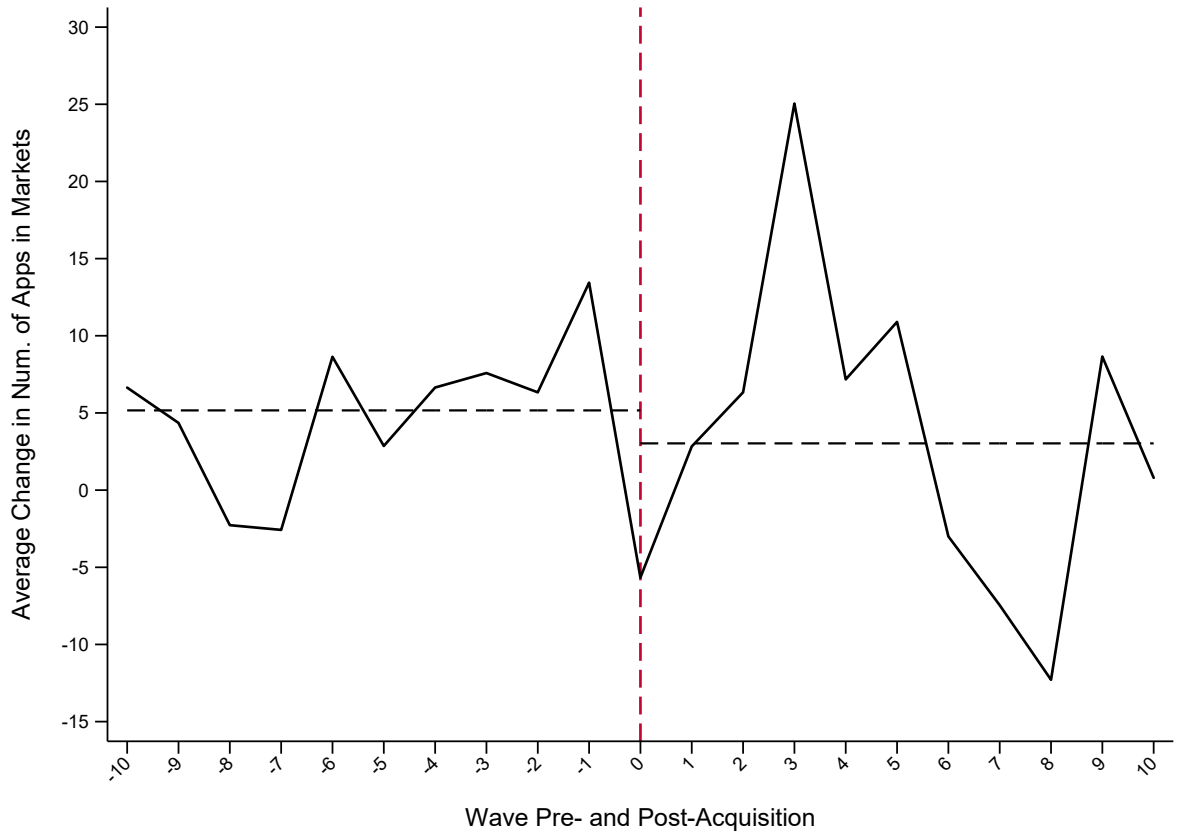
Entry in Markets of Acquired Apps I



- On average, there is a decrease in the number of active apps in a market at the time of the acquisition.

Entry in Markets of Acquired Apps II

	All	-10 $\leq$ t $\leq$ 10	-5 $\leq$ t $\leq$ 5	-3 $\leq$ t $\leq$ 3
Acquisition (1=post-acquisition)	2.132	-3.130	-17.684*	-16.926*
	(8.989)	(5.476)	(9.823)	(9.055)
Constant	18.125	11.531	-26.914	-22.854
	(14.873)	(19.404)	(41.682)	(34.336)
Quarter FE	Yes	Yes	Yes	Yes
Mean Num. of Apps	79	78	80	76
Observations	676	606	392	202
Num. of Groups	43	43	43	43
Adjusted R^2	0.80	0.79	0.79	0.94

- Negative relationship between GAFAM acquisition and number of apps active in the market.

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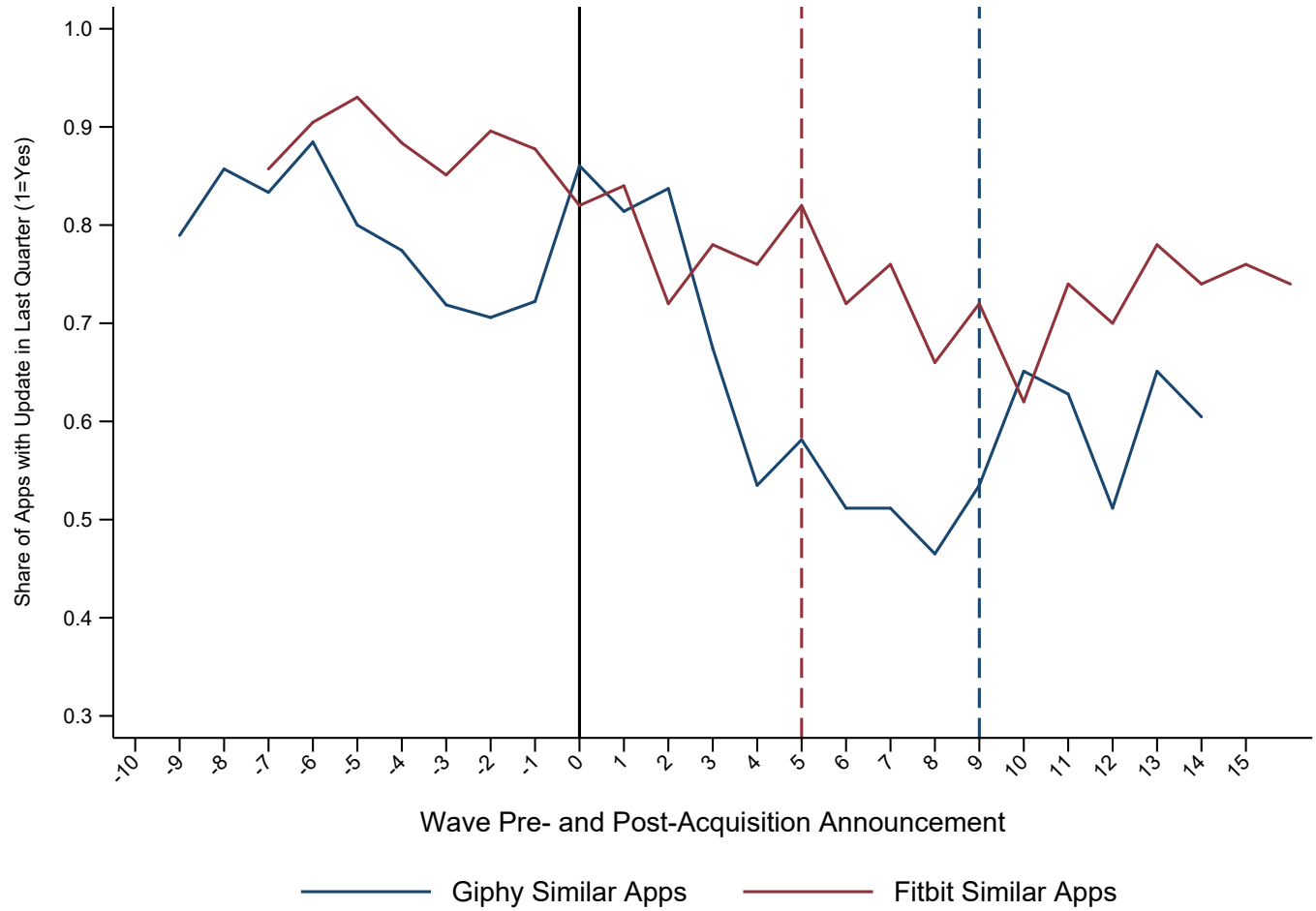
Recent Cases: Google/Fitbit and Facebook/Giphy



- While the likelihood of an update drops with the acquisition announcement, there is a distinct increase (decrease) with the unwinding (clearance) by regulators.

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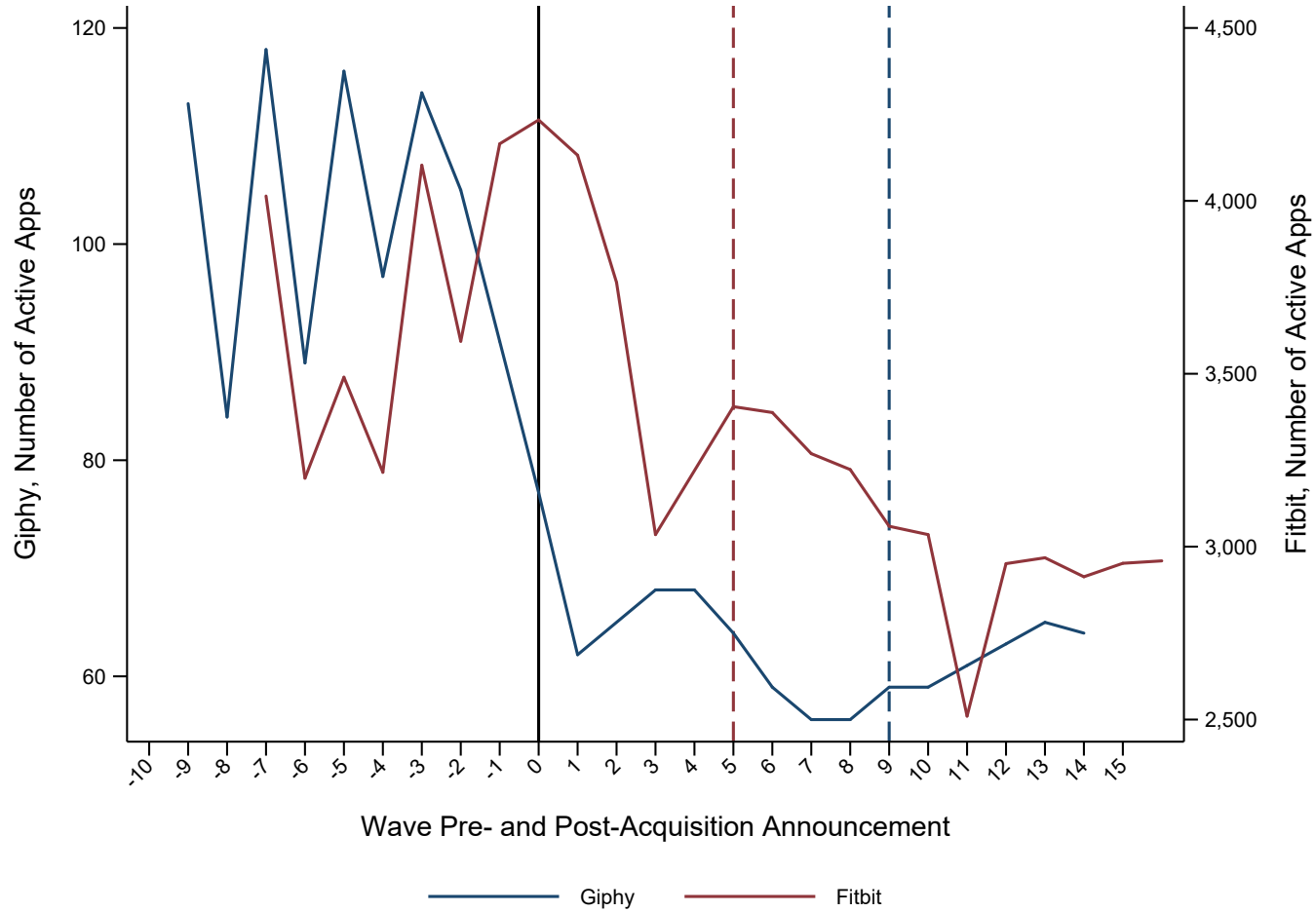

- While the number of competitors drops with the acquisition announcement, there is a distinct increase (decrease) with the unwinding (clearance) by regulators.

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