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Female-exclusive Support and Gender Gap on Digital Platforms

Short Paper

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Abstract

This study investigates the gender gap issue in the mobile platform context by analyzing performance disparities between male and female-led app companies. First, we identify the existence of the performance gap between the apps from two gender groups, utilizing a representative sample of mobile apps on Apple App Store. By employing the occurrence of Apple Entrepreneur Camp 2019 as an exogenous event, we assess the effectiveness of the platform's female-exclusive support in mitigating the gap. The results demonstrate that following the event, apps from the supported female-led companies exhibit improved performance compared to their male-led counterparts, whereas there is no significant increase in the performance of apps from unsupported female-led companies. We further show that as the age of apps from the unsupported female group increases, the event shows an increasingly positive impact on app performance. This finding suggests the presence of a conditional spillover effect of the platform's support. This study contributes to understanding the gender gap and emphasizes the importance and limitations of platform support initiatives for promoting gender equality within the platform. Managerial implications highlight the need for implementing supporting strategies to foster diversity and inclusion in the platform ecosystem.

Keywords: Gender gap, female-exclusive platform support, mobile platform, mobile app performance, spillover impact

Introduction

Women have been historically underrepresented in the software industry (Bousquette, 2021; Mims, 2017; U.S. Bureau of Labor Statistics, 2020). For example, less than 2% of enterprise software startups in the U.S. feature a female founder (Bousquette, 2021). Such underrepresentation and disadvantages of women in the workforce and leadership can result in the lack of female-specific functionalities and features in some software applications, which may cause insufficiency in serving the needs and demands of female users. A striking example is when Apple released its Health app, it neglected the function of period tracking that roughly half the population needs in a health tracking app (Perez, 2015). With the increased popularity and economic significance of mobile apps, not enough women working and leading in software industries can have short- and long-standing consequences on the economy, culture, and society (Grossman, 2016).

Unlike the traditional software development context, mobile platforms provide equal opportunities and support for the two gender groups regarding mobile app development resources, distribution channels, and large user bases with a decentralized governance structure (Kretschmer et al., 2022). Ideally, female groups can equally take these advantages to create attractive mobile apps with diverse ideas and perspectives and consequently increase the diversity and inclusion of the platform ecosystem. Moreover, with the emergence and prosperity of platform economies, leading platform firms, such as Apple, Google, and GitHub, are committed to helping women assume leadership roles and inspire their unique creativity in the tech sector. At the end of 2018, Apple started the Entrepreneur Camp.

However, female developers may face fierce competition for market demand regarding app adaptation, user engagement, and in-app purchases (IAP) revenues, considering the huge number of male counterparts

within the platform ecosystem (Boudreau, 2012). A crucial question facing platforms and investors in the mobile domain is whether the gender gap exists between female- and male-led app companies. If it does, as the gender imbalance has been a growing concern in the IS field (Masiero & Aaltonen, 2020), it is in the best interest of mobile platforms, developers, users, and relevant regulators to understand the gap in the mobile platform ecosystem and to cultivate the capabilities and competences of female-led app companies.

Motivated as such, this study takes the 2019 Apple Camp as a natural experiment to explore the effect of the Camp in mitigating the gender gap in downloads, daily active users, and in-app purchase revenues. This program is open to app companies with at least one female founder or co-founder and one woman in their development team. Participants receive access to technology resources, mentorship, and guidance from Apple experts for the whole year of 2019. By analyzing a unique dataset consisting of apps from two gender groups on Apple's App Store, this study first shows that, on average, the performance of mobile apps from male-led companies is much higher than that of female-led companies, indicating a gap between the two gender groups. We then leverage the launch of Apple's Entrepreneur Camp 2019, which is exclusive to female-led app companies, as a natural experiment and compare the performance of apps in different groups before and after the Camp launched.

Our regression analyses reveal three key findings. Firstly, the launch of the Camp increases the downloads and daily active users of mobile apps from the Camp-supported female-led companies. However, the downloads and daily active users of mobile apps from the unsupported female-led companies did not change significantly after the launch of the Camp (i.e., no spillover effect). Therefore, the gender gap in app downloads and daily active users is not reduced at the population level. Second, the launch of the Camp increases in-app purchase revenues for female-led companies that joined and did not join the Camp, mitigating the overall gender gap in revenues. We speculate that it is because unsupported female-led companies learn from their role models of female leaders who joined the Camp about adjusting their business models and in-app purchase strategies to generate more revenue. In contrast, they may not have access to the same development expertise and promotion opportunities as supported female-led companies to stand out, limiting their quick learning to improve downloads and engagement. Finally, for apps with a longer age, the launch of the Camp reduced the gender gap in downloads and daily active users between the male and unsupported female group, indicating a spillover impact of the Apple Camp. A plausible explanation is that developers' accumulative experiences on mobile apps facilitate learning from supported apps.

Based on these findings, we conclude that the launch of Apple's Camp benefited a small portion of female-led companies in improving their apps' downloads and daily active user performance and to some extent, it also benefits all female-led companies, whether they joined the camp or not. Therefore, the platform-exclusive support in terms of the Camp had a significant yet limited effect on mitigating the gender gap within the platform ecosystem. Theoretically, our study contributes to the literature by revealing the gender gap in mobile platforms and demonstrating how platforms' female-exclusive support mitigates the gap. Managerially, this study suggests that platform firms launch similar female-exclusive activities and sponsor more female-led companies with the support of technologies and expertise as an effective strategy to mitigate the gender gap.

Literature Review

Our study explores the impact of platform female-exclusive support on performance outcomes and mobile app revenues of female-led app companies. Our study is closely related to the three streams of literature. The first stream of literature explores the existence and causes of gender imbalance in the information system (IS) and related field (Campero, 2021; Kacperczyk et al., 2022; Langer et al., 2020; Masiero & Aaltonen, 2020; Parasurama et al., 2021; Pierce et al., 2021; Rocha & van Praag, 2020; Trauth & Connolly, 2021). In particular, Masiero and Aaltonen (2020) conduct a literature review on gender bias in information system research and conclude various causes and consequences of gender imbalance in the IS domain. The qualitative study by Trauth and Connolly (2021) categorizes the factors that cause gender imbalance into three groups, including societal, organizational, and individual factors. In addition, some studies discover that biased perceptions and behaviors in treating female leaders and employees cause imbalanced outcomes in corporate contexts (Kacperczyk et al., 2022; Pierce et al., 2021; Rocha and van Praag, 2020).

The second stream of literature examines the impact of interventions in addressing gender imbalance in the IS and relevant fields (Bapna & Martin, 2021; Hou et al., 2022; Liang et al., 2018; Masiero & Aaltonen, 2020). These studies examine the effectiveness of certain regulations, social events, or platform policies on mitigating the gender gaps in various aspects, such as wage (Bennedsen et al., 2022), networking (Bapna & Funk, 2021), funding (Bapna & Martin, 2021), performance and productivity (Cui et al., 2021; Wu & Kane, 2021).

The third stream of literature investigates the impact of platforms’ supportive governance strategies on the participants’ innovation and performance outcomes, including the strategies regarding platform resource support (Ye & Kankanhalli, 2018), community activity organized by the platform (Foerderer, 2020), and promotions and rewarding (Claussen et al., 2013; Liang et al., 2019; Rietveld et al., 2019). Specifically, some studies emphasize the role of learning and interfirm exchange in the community activity organized by the platform (Foerderer, 2020). Among these studies, some focus on the platform’s selective support, examining its impact on incentivizing product improvement (Claussen et al., 2013) and the spillover effect of platform supportive strategies (Bhargava et al., 2022; Liang et al., 2019).

This study enriches the gender gap literature by providing empirical evidence of performance gaps between two gender groups within the mobile platform. It shows a direct and spillover impact of the platform’s female-exclusive support on mitigating the gap. It also improves our understanding of the consequences of the platform’s selective support by revealing its heterogeneous impact on the performance of apps with different ages and identifying a boundary condition to its spillover impact on the unsupported group. Moreover, it adds to the literature on how platform owners strategically manage the ecosystem value by selectively promoting certain complementors (Rietveld et al., 2019; Agarwal et al., 2023).

Methodology and Findings

Empirical Setting: Apple’s Entrepreneur Camp

Apple announced the Entrepreneur Camp on November 26, 2018 (Apple, 2018), which aims to support female app company founders and developers (<https://developer.apple.com/entrepreneur-camp/female-founders/>). To be eligible to apply for the female camp, three criteria must be met for an app company: (1) the company has a female founder, cofounder, or CEO; (2) the company has at least one woman in the development team; and (3) the company has an existing app on the App Store or a functional beta. All the app companies whose founders or co-founders are female and at least one woman in the development team are eligible to apply for the Camp, in which Apple offers a technology lab, code-level guidance, mentorship, inspiration, and insights from top Apple leaders and experts. Apple has listed all the 42 app companies participating in the 2019 Camp on its website (<https://nr.apple.com/d2i8Q767x7>). Those app companies had a total of 213 mobile apps available on the Apple App Store before the release of 2019 Camp.

Identification Strategy

Apple’s Camp provides resources and support to a small portion of female-led mobile app companies and their apps, but not all. Leveraging it as an exogenous shock in the difference-in-differences (DID) analysis, this study examines the effects of platform support for the subgroup of females on gender gap mitigation.

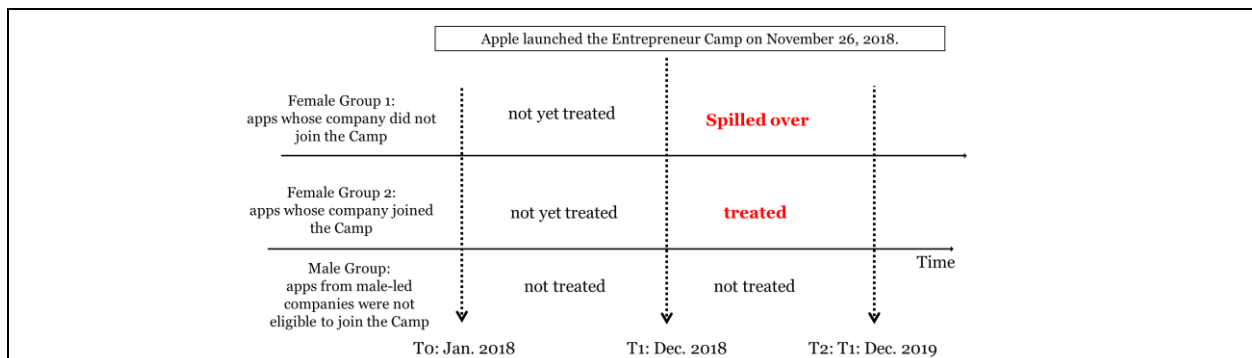


Figure 1. The Launch of the Entrepreneur Camp of Apple

There are three groups. The first group includes 213 mobile apps from the female-led companies that have participated in the 2019 Camp. The second group consists of all the available apps whose companies are female-led yet did not join the Camp in 2019. The third group consists of all the available apps of male-led companies, which are not eligible to join the Camp. The study period was 12 months before and after the launch of Apple Entrepreneur Camp. Figure 1 presents the identification strategy.

Sample and Variables

We purchased the data from mobile analytics firm Apptopia (<https://apptopia.com/>). Apptopia provides data on mobile app characteristics, daily app performance, and revenues. It also marks the genders of the person in charge of app firms (e.g., founder, co-founders, CEO). We extracted the population of all apps available on Apple App Store on or before December 1, 2019. Our sample includes 3,656 apps from female-led companies (213 are from the female-led companies that have joined the 2019 Camp) and 51,034 apps from male-led companies as our sample. Figure 2 presents the parallel trend of average downloads of mobile apps of three groups within 12 months before and after the Camp was launched. It shows that the trend of the performance differences between the three groups of mobile apps is parallel before the event, and the performance of the apps in the treated group tremendously increases after the event.

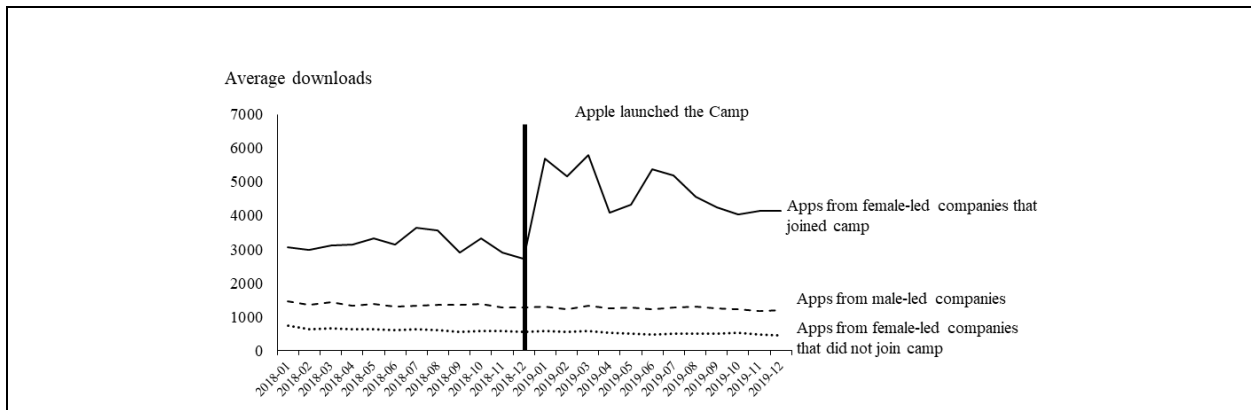


Figure 2. Average Monthly Downloads of Apps in Two Groups

The Impact of the Camp on Mitigating the Gender Gap in App Performance

This study examined whether the Camp diminished such a gender gap. By adopting the difference-in-differences (DID) approach, we quantified the causal effects of the Camp on app performance and revenues. To assess the effect of platform-sponsored female-exclusive support on app performance of the female-led or female-founded app companies, we estimated the following DID model on the matched sample:

$$DV_{it} = FemaleLed_i \times After_t + AppAge_{it} + f_i + f_t + \varepsilon_{it} \tag{1}$$

Following prior literature (Song et al., 2018; Ye & Kankanhalli, 2018), we measured app performance with downloads for app *i* in month *t*. Following previous research, we measured daily active user numbers (DAU) in a monthly unit for robustness check (Kummer & Schulte, 201). Therefore, *DV_{it}* is app performance measured by the number of monthly downloads and daily active users of app *i* in the month *t*. *FemaleLed_i* is a dummy variable indicating whether app *i* belongs to the treatment group or not. *After_t* is a dummy variable indicating whether month *t* is after the event (i.e., after Apple launched the Entrepreneur Camp) or not. *FemaleLed_i* × *After_t* is the main variable of interest. *AppAge_{it}* is control variable of app ages measured by the time length from its initial release on the Apple. The variable *f_i* is to control the app fixed effects, which accounts for time-invariant app characteristics. The variable *f_t* is to control the month fixed effects, which account for seasonality and other time shocks that affect all apps (e.g., changes to the Apple App Store that affect the apps in both groups). *FemaleLed_i* and *After_t* are not listed in the model because they are absorbed into the terms of the fixed effects. Table 2 shows the DID model estimation results.

	Model 1: Female vs. Male	Model 2: Female Camp Participants vs. Male	Model 3: Non-Participant Female vs. Male

Dependent variables	Downloads	DAU	Downloads	DAU	Downloads	DAU
$FemaleLed_i \times After_t$	0.005 (0.005)	0.009 (0.006)	0.121*** (0.007)	0.204*** (0.006)	-0.002 (0.005)	-0.003 (0.007)
$AppAge_{it}$	-0.006 (0.005)	-0.008 (0.006)	-0.007 (0.005)	-0.008 (0.006)	-0.006 (0.005)	-0.009 (0.006)
App fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observation	1,173,800	1,173,800	1,097,12	1,097,12	1,168,899	1,168,899
Adj. R-square	0.8832	0.8885	0.8844	0.8893	0.8829	0.8882
App number	50,575	50,575	47,312	47,312	50,362	50,362
Table 2. The Impact of Apple Camp on Mitigating Gender Gap in App Performance						

Notes: *, **, and *** indicate $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively. Robust t-statistics are in parentheses.

To account for the heterogeneity of app characteristics in different groups and ensure equitable group sizes, we employed propensity score matching to identify a comparable control group that resembles the treated group. Following the previous literature (Caliendo & Kopeinig, 2008; Clarke et al., 2021), we conducted the Probit regression on both the entire and matched samples. We employed a binary variable that indicates whether the app is from a female-led company as the dependent variable. We considered various independent variables: app categories, size, screenshot number, description length, and app age and total downloads in January 2019. The Probit regression results are available upon request. We then conducted the regressions for app performance based on the matched samples (6,436 apps, with 3,218 released by female-led companies). The results are presented in Table 3, consistent with the main findings.

	Model 1: Female vs. Male		Model 2: Female Camp Participants vs. Male		Model 3: Non-Participant Female vs. Male	
Dependent variables	Downloads	DAU	Downloads	DAU	Downloads	DAU
$FemaleLed_i \times After_t$	0.002 (0.007)	-0.000 (0.009)	0.117*** (0.008)	0.195*** (0.009)	-0.006 (0.007)	-0.013 (0.009)
$AppAge_{it}$	0.006 (0.012)	-0.000 (0.016)	0.006 (0.016)	0.003 (0.022)	0.006 (0.012)	-0.001 (0.017)
App fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observation	153,188	153,188	76,986	76,986	148,385	148,385
Adj. R-square	0.8801	0.8402	0.8949	0.9034	0.8772	0.8877
App number	6,436	6,436	3,234	3,234	6,233	6,233
Table 3. The Impact of Apple Camp on Mitigating Gender Gap (After Matching)						

Notes: *, **, and *** indicate $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively. Robust t-statistics are in parentheses.

Heterogeneous Impact of the Camp

We investigated why there is no significant spillover effect of the support on the apps of unsupported female-led companies. The theoretical rationale for the spillover effect is the learning (Agrawal et al., 2016) and role-modeling impact (Rocha & van Praag, 2020; Bosma et al., 2012), which can largely depend on the experiences in or familiarity with the platform and the mobile market. App age can be regarded as an

important conditional factor affecting the extent to which other female developers are incentivized to learn. We included the interaction between $FemaleLed_i \times After_t$ and $AppAge_{it}$ in the regression, which is positively significant (reported in Table 4). It implies that as mobile app age increases, the Camp helps mitigate the performance gap between male-led and unsupported female-led companies, implying a spillover effect of the Camp for older apps.

	Model 1: Female vs. Male		Model 2: Female Camp Participants vs. Male		Model 3: Non-Participant Female vs. Male	
Dependent variables	Downloads	DAU	Downloads	DAU	Downloads	DAU
$FemaleLed_i \times After_t$	-0.038*** (0.015)	-0.063*** (0.015)	-0.009 (0.018)	-0.007*** (0.020)	-0.037** (0.016)	-0.056*** (0.016)
$FemaleLed_i \times After_t \times AppAge_{it}$	0.001** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001** (0.000)	0.001** (0.000)
$AppAge_{it}$	-0.006 (0.005)	-0.006 (0.005)	-0.007 (0.005)	-0.007 (0.006)	-0.006 (0.005)	-0.007 (0.006)
App fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observation	1,173,800	1,173,800	1,097,12	1,097,12	1,168,899	1,168,899
Adj. R-square	0.8832	0.8886	0.8844	0.8894	0.8829	0.8883
App number	50,575	50,575	47,312	47,312	50,362	50,362
Table 4. The Moderating Impact of App Age						

Notes: *, **, and *** indicate $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively. Robust t-statistics are in parentheses.

The Impact of the Camp on Mitigating the Gap in Revenues

We further examined the effect of the Camp on revenues. We replaced the dependent variable with in-app purchase revenues. It measures the app's revenues from the users' in-app payments in a certain month. The regression results are reported in Table 5. The coefficient estimates of $FemaleLed_i \times After_t$ in three models are all positively significant, indicating that the in-app purchase revenues of apps from supported female-led companies increased after joining the 2019 Camp. Moreover, this impact also spills over to the apps from other unsupported female-led companies.

Dependent variables: In-app Purchase revenues	Model 1: Female vs. Male	Model 2: Female Camp Participants vs. Male	Model 3: Non-Participant Female vs. Male
$FemaleLed_i \times After_t$	0.012*** (0.001)	0.028*** (0.004)	0.011*** (0.002)
$AppAge_{it}$	-0.040 (0.045)	0.001 (0.002)	-0.041 (0.005)
App fixed effect	Yes	Yes	Yes
Month fixed effect	Yes	Yes	Yes
Observation	1,173,800	1,097,12	1,168,899
Adj. R-square	0.9259	0.9256	0.9258
App number	50,575	47,312	50,362
Table 5. The Impact of Apple Camp on Mitigating Gender Gap in App Revenues			

Notes: *, **, and *** indicate $p < 0.1$, $p < 0.05$, and $p < 0.01$, respectively. Robust t-statistics are in parentheses.

Robustness Check: Parallel Trend Test

One important condition for the validity of the DID model is that the parallel trend assumption must hold. The dependent variables for the two groups should follow a similar or parallel trend before the event. The effect of the event or the treatment is thus estimated by assessing the change in the trend between the two groups after the event. When validating the parallel trend assumption, we also examined whether there was an anticipatory response before the event. Specifically, we utilize a slightly different model in Equation (2) to examine the monthly treatment effects (e.g., Autor 2003). $FemaleLed \times Month_{it}$ is the interaction term between $FemaleLed_i$ and the monthly dummy variable for month t .

$$DV_{it} = \sum_{t=-m}^{-1} FemaleLed \times Month_{it} + \sum_{t=0}^n FemaleLed \times Month_{it} + Controls_{it} + f_i + f_t + \varepsilon_{it} \quad (2)$$

Figure 3 shows the coefficient estimates of $FemaleLed \times Month_{it}$ ($m = 11$, and $n=11$). Panel A and B show the results of regressions for daily active users and downloads, respectively. Note that t equals zero when the event happens in that month. As we can see in the Panel (a), (b), (c), and (d), most coefficient estimates on the $FemaleLed \times Month_{it}$ are insignificant. It shows that the Camp on average does not mitigate the gender gap in downloads and daily active users, consistent with our main findings. In the Panel (e) and (f), the coefficient estimates on the $FemaleLed \times Month_{it}$ are positively significant when t is 0 or positive. When t is smaller than 0, the coefficient estimates on the $FemaleLed \times Month_{it}$ are all insignificant. These results show that the Camp mitigates the gap in in-app purchase revenues, supporting the robustness of the main findings.

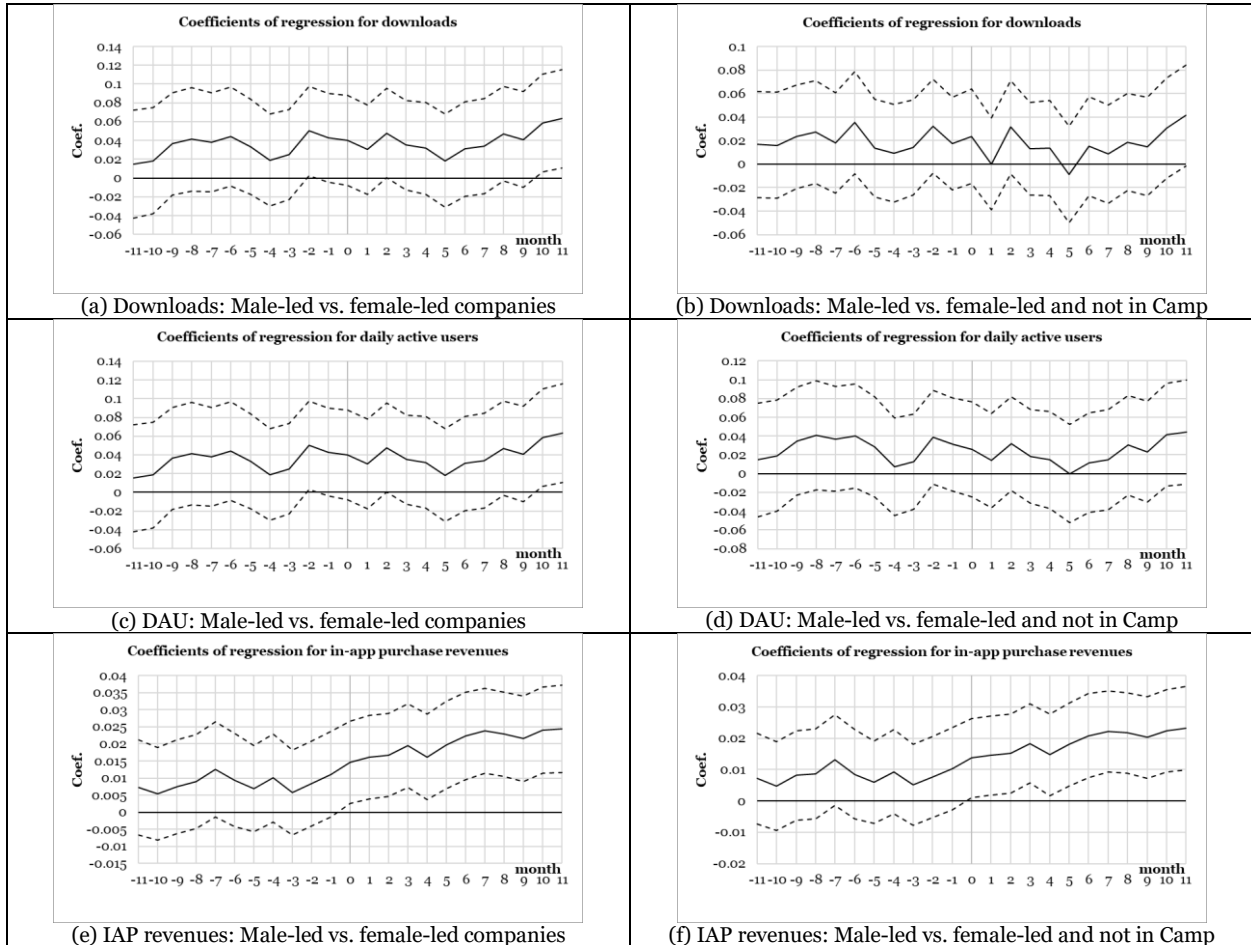


Figure 3. The Coefficients of $FemaleLed_{it}$ in Relative Time Model

Note: The solid line is the coefficient; the dotted lines are the upper and lower 95% confidence interval of coefficients.

Conclusion

This study is among the first to investigate the gender gap in the mobile industry. Our preliminary analysis shows a gap between the two gender groups. Our empirical analysis based on the DID model demonstrates that the platform's female-exclusive support mitigates the gap by improving the app revenue performances of female-led companies. The findings provide important managerial implications for platform managers, investors, and app companies.

This study contributes to the literature by identifying the existence of the gap between two gender groups and examining the impact of platform female-exclusive support on the gender gap. By revealing the direct impact of the platform selective support on mobile app performance and how much impact spillovers to the apps in the unsupported female group, this study further contributes to the literature on the platform supporting strategies.

Future research can identify more patterns of the gender gap in the mobile domain, reveal intrinsic mechanisms accounting for the gaps, and evaluate the impact and mechanisms of platform interventions on mitigating the gender gap. Future studies can also employ machine learning methods to identify more specific differences, such as app function development and feature designs, between the apps from the male and female groups. This study also suggests that further study can investigate how the platform's exclusive supports affect developers' innovation activities, such as new app development.

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