

Business Model Strategies in Mobile Health: the Role of In-App Purchases

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Abstract: The health sector, despite fundamental, is currently under significant pressure. The ageing of the population, combined with the growing prevalence of chronic diseases, has intensified burden on healthcare budgets. Simultaneously, the struggle with shortages of qualified professionals and limited resources create additional barriers to delivering effective care. Therefore, health systems face a dual challenge: they must improve efficiency to manage rising costs and ensure long-term sustainability; but also, they must maintain high standards of quality and equity to satisfy more informed, more demanding, and increasingly involved patients. To address these global pressures, the concept of e-Health has emerged, driven by the integration of electronic communication and information technologies into healthcare. Advances in digital tools have made health information and services more accessible worldwide, often at significantly lower costs, enabling improved healthcare delivery. Within e-Health, m-Health has gained prominence. By leveraging mobile technologies, m-Health has shifted the healthcare paradigm from a reactive model to a more proactive and preventive approach. The widespread adoption of smartphones and wearable devices allows individuals to monitor and manage their health anytime and anywhere, from using apps that track physical activity to devices that monitor vital signs in real time. The increasing use of healthcare-related mobile apps has led to the growth of its market, making it an attractive business for investors. A health app needs a sustainable business model that can generate revenue. Considering that most health apps are free, one of the most important and growing sources of revenue in the e-health market are in-app purchases (IAP). Despite the growing importance of IAP as a revenue source, few studies exist dedicated to this monetization mechanism. This study contributes to fill in this gap and aims to study the factors that explain the use of IAP as a revenue source. Applying probability models to a sample of health apps from Google Play and Apple App Stores, results show that IAP are positively correlated with the use of personal data for micro-segmentation. Also, the presence of IAP is an alternative to payment for downloading, but complementary to ads.

Keywords: In-app Purchases, App Monetization Models, e-Health, Mobile Apps, Apple App Store, Google Play Store

1. Introduction

The market for mobile health is experiencing a significant growth. Health apps market's expansion is attracting investors to an increasingly competitive industry, highlighting the need for a careful definition of the health app monetization model.

In the two largest app stores – Apple App Store and Google Play Store – most apps, health apps included, are available for free. Since many apps are available for free, how do developers monetize an app? A free app may potentiate the number of users, but the business model must generate revenue from other sources than payment for download.

There are several monetization models that can be enforced, individually or combined, considering the business strategic goals of the app developer, such as the freemium model, the in-app advertising model, the in-app purchases (IAP) model or the data monetization model (Antoja et al, 2019; Appel et al, 2020; Lee et al, 2021; Numminen et al, 2022; Ofulue and Benyoucef, 2022; Roma and Ragaglia, 2016; Tang, 2016).

Choosing from different revenue sources should take into consideration user's experience and how the former will impact the latter (Cao et al, 2023; Ghose and Han, 2014). The balance between revenue goals and user's experience is crucial to provide utility and value, and to ensure the app will remain successful over time (Ji et al, 2019).

The study aims to answer the following research question: what factors explain the use of in-app purchases as a monetization mechanism for health apps? To do so, probability models were applied to a sample of 1,121 health apps marketed in the two major app stores in Portugal - the Apple App Store and the Google Play Store, to explain the use of IAP as source of revenue. The paper analyzes if and how alternative sources of revenue,

the category of the app and the app store where the app is made available impact the probability of using IAP as a monetization mechanism for health apps.

This paper contributes to the existing literature on monetization models for health apps, focusing on the determinants of IAP, an increasingly important revenue source for health apps. Moreover, most studies on the app market in general, and the health app market in particular, use US data, but few studies analyze the European market. Thus, this paper adds to these latter studies by analyzing the case of the Portuguese health app market. This study can also bring new insights for health app developers and their decision on how to monetize an app in a context where health apps are increasingly capturing the interest of investors.

The remainder of the paper is organized as follows: section 2 presents prior research, establishing the state of the art; section 3 sets out the research methodology, namely the data collection, the variables used, and the econometric models employed; section 4 presents the results and their discussion, and section 5 concludes the paper.

2. Literature Review

In this rapidly changing environment driven by digital technologies, new ways of creating value among diverse actors emerge in innovative contexts such as multilateral markets. These innovations in monetization models are not exactly new inventions, but adaptations of existing traditional models for a new area such as the m-Health area (Antoja et al., 2019; Eurich and Mettler, 2017; Tidhar and Eisenhardt, 2020; Vimarlund, 2017).

Health apps have the potential to make the health sector more efficient and to create additional value for both citizens and health professionals. However, the developers of these health apps must configure their business models to capture the value created as a result of the complex relationships between the different stakeholders in healthcare delivery (Antoja et al., 2019; Ehret et al., 2013; Ehret and Wirtz, 2017; L. Guo et al., 2017; Kuziemyk and Vimarlund, 2018; Mettler and Eurich, 2012; Vial, 2019). Monetization is ethical when it aligns with patient welfare, protects privacy, and maintains transparency. It is useful because it enables innovation, reduces healthcare costs, and expands access — but only if implemented with strong ethical safeguards.

Health apps can adopt the following monetization strategies: (1) making the app available for free, (2) providing the paid app, (3) making the free and paid versions of the app available simultaneously, being given the user the opportunity to choose between versions - approach known as freemium. In the first strategy, app developers do not get revenue from downloading the app (since it is free), so revenue must come from other monetization mechanisms such as in-app ads or IAP. In the second strategy, app developers get revenue directly from the first day of sales (for each download of the app), and it is still possible to collect revenue from IAP (as for in-app ads, they are not common in paid apps) (Aydin and Silahtaroglu, 2021; Krishnan and Selvam, 2019; Lee et al., 2021; Liu et al., 2014).

For free apps, in-app ad revenue requires a large installed user base and the return from IAP requires continuous user engagement and conversion from users to in-app shoppers. For paid apps, the revenue from the download payment depends on an unstable influx of new users and the return from IAP is sometimes reduced due to the lower propensity of users to spend within a paid app (since, in their opinion, paying for the download sets up an economic substitute for IAP) (Aydin and Silahtaroglu, 2021; Ghose and Han, 2014; Krishnan and Selvam, 2019; Lee et al., 2021; Liu et al., 2014).

Finally, the freemium approach allows for different sources of revenue from both versions (and ultimately higher total revenues), but requires higher development-related costs, maintenance, and marketing of both versions. Additionally, even if the user base of any version stimulates the future demand of both versions (due to the phenomenon of social influence), there is still the danger of contemporary cannibalization, which will affect the current downloads of both versions (Arora et al., 2017; Aydin and Silahtaroglu, 2021; Hu, 2019; Krishnan and Selvam, 2019; Lee et al., 2021; Tidhar and Eisenhardt, 2020).

Most health and mobile apps are free, as shown by the dominance of free apps in the Apple App Store and Google Play Store. This widespread gratuity requires alternative revenue sources to sustain development. An app's success depends on diversifying monetization methods, and IAP remain one of the most common and effective strategies for generating income (Lee et al., 2021).

Free apps often monetize through indirect mechanisms such as IAP (Salehudin and Alpert, 2021). This shows an exponential growth trend in revenues from IAP, that will cause revenue from free apps, monetized through IAP, to outweigh revenue from paid apps.

Previous studies, such as Ghose and Han (2014), identified that the presence of in-app purchase option can influence ex-ante to potential app users, given that IAP represent additional features beyond the basic features of the app. According to Ghose and Han (2014), the in-app purchase option is very popular for app developers, as they expect to obtain, alternatively or in addition to immediate revenue from the download payment, additional revenue from these future IAP. This option is also popular among app users, given that the presence of IAP is an incentive to reduce the download price of the app, which transpires in the app demand that typically increases with the presence of the in-app purchase option.

IAP are, therefore, perceived as an economic substitute for payment for the app download. Hence, Ghose and Han (2014) alert that app users are less likely to spend on IAP in paid apps. Lee et al. (2021) add that users can, in the extreme, be pushed away by this upselling perspective, since they can consider the presence of in-app shopping options to explore them.

The specific case of IAP requires continuous engagement of users with the app and their conversion to consumers/buyers in the app. Given that the presence of these monetization mechanisms is visible to potential users on each app's web page in the app store, specifically at the time of the download decision, it is vital to achieve a delicate balance in defining these monetization mechanisms (payment for download and payment for IAP). On the one hand, the download price should be reduced, that is, there should be a discount on the price sufficient to trigger the downloads needed to compensate for this lost revenue. On the other hand, the (future) revenue from IAP must be high enough for developers to be able to recover lost revenue by offering (initially) a price discount on the download (Ghose and Han, 2014; Lee et al., 2021).

In this context of the app market, in which the vast majority of apps are moving away from direct monetization mechanisms (such as payment for download), app developers are betting on alternatives for indirect monetization, such as IAP, that enable, upon payment, the deletion of ads, the update to a 'full' version of the app or the acquisition of some additional/ special feature/ functionality for the app (Dinsmore et al., 2017; Salehudin and Alpert, 2021).

Shulman and Geng (2019) also highlight users tend to do their research on app download prices and that most of these potential consumers only discover in-app purchase prices later (after downloading the app). Achieving IAP is the result of ongoing or sporadic offers for updating which arise while using the app, and after prolonged exposure to an app, users are much more involved and likely to make an in-app purchase on impulse (Dinsmore et al., 2017; Shulman and Geng, 2019).

Numminen et al (2022), in their panel data study, for the US Apple App Store, of the effect of revenue model decisions for app revenues, found that, for gaming apps, a model that combines free downloads with the in-app purchase option leads to higher app revenues compared to a model where users only pay for downloading the app or to a model that combines paid downloads with the in-app purchase option.

There are benefits arising from monetizing via IAP since they do not face the drawbacks associated with the use of in-app ads. Users consider ads a source of costs as they are time consuming and distractive, represent extra costs from receiving ad-related traffic, and there are privacy costs linked to the customization of advertisement using personal data (Gao et al., 2022).

3. Methodology

3.1 Data and Variables

To study the determinants of IAP as a monetization source for health apps, a sample of 1,121 health apps was collected complying with the following criteria: mobile apps for Android or iOS systems, available in Portugal on Google Play Store or Apple App Store platforms and listed in the Top Free and Top Paid rankings, for the categories 'Health and Fitness' and 'Medical Care/Medicine'. These criteria followed those of related studies conducted on health apps (Antoja et al., 2019; Lee and Raghu, 2014; Liu et al., 2014). The sample has a cross-sectional nature. Table 1 exhibits the variables collected and available in the dataset and their description.

Table 1: Variables description

Variable	Description
<i>iap</i>	Dummy variable that specifies whether the app has in-app purchases (IAP) = 0, if without IAP = 1, if with IAP
<i>app store</i>	Dummy variable that identifies the store where the app is marketed = 0, if Google Play Store = 1, if Apple App Store
<i>category</i>	Dummy variable that specifies the category of the app = 0, if Health and Fitness = 1, if Medical Care/Medicine
<i>type</i>	Dummy variable that identifies the type of app = 0, if Free = 1, if Paid
<i>ads</i>	Dummy variable that specifies whether the app has ads = 0, if without Ads = 1, if with Ads
<i>advertising</i>	Categorical variable that states if the app uses personal data for micro-segmentation/advertising purposes = 0, if No Use = 1, if Use = 2, if Doesn't Inform on the use
<i>remuneration</i>	Dummy variable that identifies if the app remunerates users = 0, if No = 1, if Yes

Note: the sample was collected on July 21, 2021.

The variable *iap* is the dependent variable in this study and its use is explained controlling for other variables such as the app store, the category of the health app, the existence of other revenue sources (free or paid app, in-app ads, or the use of data for micro-segmentation purposes), and the payment to users. Summary statistics of the variables collected in the sample are presented in Table 2.

Table 2: Descriptive statistics of the variables

Variable	Description	All Sample (N=1,121) Percent (a)	Apps without IAP (N=888) Percent (b)	Apps with IAP (N=233) Percent (c)
<i>iap</i>	= 0, if without IAP	79.21	--	--
	= 1, if with IAP	20.79	--	--
<i>app store</i>	= 0, if Google Play Store	59.05	58.90	59.66
	= 1, if Apple App Store	40.95	41.10	40.34
<i>category</i>	= 0, if Health and Fitness	35.06	33.67	40.34
	= 1, if Medical Care/Medicine	64.94	66.33	59.66
<i>type</i>	= 0, if Free	61.46	55.74	83.26
	= 1, if Paid	38.54	44.26	16.74
<i>ads</i>	= 0, if without Ads	81.71	87.16	60.94
	= 1, if with Ads	18.29	12.84	39.06
<i>advertising</i>	= 0, if No Use	3.30	4.05	0.43
	= 1, if Use	45.41	39.41	68.24
	= 2, if Doesn't Inform on the Use	51.29	56.53	31.33
<i>remuneration</i>	= 0, if No	98.84	98.76	99.14
	= 1, if Yes	1.16	1.24	0.86

In our sample of health apps (column (a)), the free download business model dominates, being the case for 61.46% of the apps. This feature of the sample reproduces the prevalent business model in the app market. Since most apps are available for free, developers must obtain revenue from other sources: 45.41% of these health apps discloses, in their privacy policy, the use of personal data for micro-segmentation purposes (51.29% of these apps do not inform on the use of data in their privacy policy, so one can only speculate on the use of the data and on why the information is missing on the privacy policy), over one fifth uses IAP as a monetization method, and 18.29% have in-app ads.

As for the app store where the apps are available, most health apps in the sample (59.05%) are from the Google Play Store and belong to the 'Medical Care/Medicine' app category (64.94%). Finally, only 1.16% of these health apps remunerate users.

Exploring the sub-samples of health apps (columns (b) and (c) of Table 2), it's clear that among the ones that monetize via IAP (column (c) of Table 2), a significant proportion (83.26%) are free apps. For the apps that do not monetize using IAP (column (b) of Table 2) that proportion falls to 55.74%. This suggests that IAP substitute revenue from payment for download. Other not surprising distinction between the sub-samples is the fact that in-app ads are present in 39.06% of the health apps that have IAP whereas only 12.84% of health apps that do not have IAP exhibit in-app ads. Moreover, while 68.24% of apps with IAP disclose the use of data for micro-segmentation purposes, for apps without IAP that is the case for only 39.41% of the apps. This implies that IAP, in-app ads options, and micro-segmentation complement as revenue sources of free apps.

An analysis by app store (Figure 1) reveals that the proportion of apps with and without IAP is quite similar in both the Google Play Store and the Apple App Store, where over 20% of the apps use IAP as a monetization mechanism.

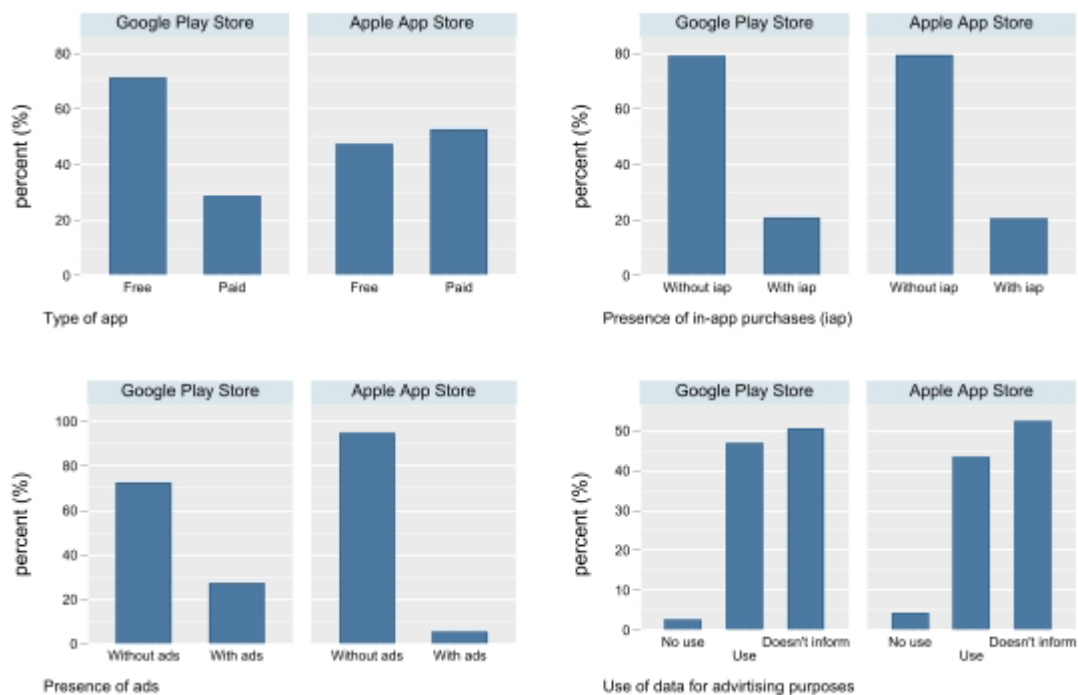


Figure 1: Monetization strategies of health apps, by app store

Source: Author's computations.

The major differences between app stores on the revenue sources occur on the type of app and on the presence of in-app ads. In effect, on the Google Play Store, more than 70% of health apps in the sample are free while in the Apple App Store less than half of the health apps are available for free. As previous studies have shown, Android users are more price sensitive than IOS users (Arora et al., 2017; Ghose and Han, 2014) and it explains why more apps are available for free in the Google Play Store. The presence of ads is significantly higher in the Google Play Store (27.30%) compared to the Apple App Store (5.20%). Also, the use of data for micro-segmentation/advertising purposes is slightly higher in the Google Play Store (46.83%) compared to the Apple App Store (43.36%).

3.2 Econometric Models

Due to the dichotomous nature of the dependent variable *iap*, probability or binary response models were applied in the econometric setup. Probit and logit models were used to model a nonlinear relationship between the dependent variable *iap* and the set of independent variables, making sure that the probability of an event occurring is between 0 and 1 (Gujarati and Porter, 2011). The significant difference between the two models is the cumulative distribution function considered. The probit model considers that the errors are normally distributed (the standard normal cumulative distribution function) while the logit model assumes a logistic distribution (the logistic function) (Cameron and Trivedi, 2008).

The estimation of both models is made by maximum likelihood and comparison of results is straightforward. To select the most appropriate model their log-likelihood were compared: the model that best fits the data is the one with the highest log likelihood.

Therefore, logit and probit regression models are used to establish how the independent variables explain the behaviour of the dependent variable (*iap*). Regression techniques allow us to understand the cause-effect relations, controlling for the other variables to be constant.

4. Results and Discussion

Estimations of both logit and probit models produce similar coefficients. Since probit models report higher log-likelihood values than logit models and, therefore, the goodness of fit is better for the probit models, this section will focus on the probit models' results. Moreover, for the purpose of interpretation, Table 3 exhibits the marginal effects of the independent variables on the dependent variable *iap*.

Table 3: Probit models' marginal effects (dependent variable: *iap*)

	(1)	(2)
<i>category</i>		
Medical Care / Medicine	-0.0151 (0.0238)	-0.0019 (0.0387)
<i>app store</i>		
Apple App Store	0.0801*** (0.0249)	0.137*** (0.0397)
<i>type</i>		
Paid	-0.114*** (0.0253)	-0.113*** (0.0430)
<i>ads</i>		
With ads	0.224*** (0.0380)	0.222*** (0.0524)
<i>advertising</i>		
Use	0.230*** (0.0514)	-- --
Doesn't inform	0.0810 (0.0493)	-- --
<i>remuneration</i>		
Yes	-0.140** (0.0549)	-0.176** (0.0894)
<i>advertising_alt</i>		
Use	-- --	0.259*** (0.0475)
Log-likelihood	-493.5	-301.1
chi2	158.80	58.30
N	1121	546

Notes: (1) Standard errors in parentheses; (2) * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; (3)

Reference groups: Health and Fitness, Google Play Store, Paid, Without Ads, No use of Data for Advertising Purposes, Does not remunerate users.

Table 3 displays the results for two models, (1) and (2), which differ in the number of observations used in the estimation. This difference is due to the variable used in each model to consider if the app uses data for micro-segmentation/advertising purposes: *advertising* or *advertising_alt*. In model (1) the categorical variable *advertising* is included as a predictor: the variable equals 0 if the app does not use data for advertising purposes, equals 1 if the app uses data and equals 2 if the app does not inform on the use of data. When considering this categorical variable, the estimation uses 1121 observations. However, because there are 575 health apps that do not disclose on their privacy policy how they use the data collected for advertising purposes, this missing information was dropped, and a new dummy variable was created *advertising_alt* that equals 0 if the app does not use data for advertising purposes and that equals 1 otherwise. This latter variable is included as an alternative predictor to *advertising* in model (2) and this is the reason why model (2) is estimated using 546 observations. By doing so, the goodness of fit of the model improves.

In both models, the variable *app store* is statistically significant, and it positively influences the probability of a health app having IAP. All else equal, compared to an app marketed in the Google Play Store, being in the Apple App Store increases by 8.01 percentage points (p.p.) the probability of having IAP (model 1). This effect is enhanced if considered the specification adopted in model 2; indeed, *ceteris paribus*, being in the Apple App Store raises by 13.7 p.p. the probability of having IAP, compared to the Google Play Store. Differences in price sensitivity may explain why monetization mechanisms that imply a monetary payment are more common in the Apple App Store than in the Google Play Store (Ghose and Han, 2014; Roma et al., 2016).

Looking at the variables that are alternative sources of revenue, the variable *type* shows a negative and statistically significant impact on the probability of having IAP. The magnitude of the effect is alike in both models. Considering all else equal, being paid decreases by over 11 p.p. the probability of a health app having IAP. This seems to suggest that IAP and payment for download work as substitutes as monetization mechanisms. Since both mechanisms imply a direct spending of money, it is expected that users that pay for download the app are not keen to expend more money on IAP. Also, Garg and Telang (2013) argue that free apps have a higher volume of downloads, and, after download, app developers may extract revenues from IAP.

Contrary to payment for download, the use of ads and/or personal data for micro-segmentation/advertising purposes work as revenue complements to IAP. Compared to an app without ads, having *ads* increases by over 22 p.p. the probability of using IAP to monetize an app, *ceteris paribus*. While IAP are an alternative revenue source, merely offering IAP does not guarantee revenue (to do so, users must purchase the available products/services). In this way, IAP don't have to be an alternative to ads but can be a complement in an in-app monetization model. Another important feature of IAP is that many of them are to remove ads, and this kind of IAP only makes sense in apps with ads.

The same positive and statistically significant effect is obtained for the *advertising* and *advertising_alt* variables: respectively, using data for micro-segmentation/advertising purposes, compared to not using it, raises by 23 p.p. and by 25.9 p.p. the probability of including the IAP option in an app. Kollnig (2021) showed that apps, relying on IAP as a revenue source, harvest personal data. In fact, the use of personal data for micro-segmentation can boost revenue from IAP, because it facilitates customization, and increases the value of services offered.

Finally, compared to an app that does not remunerate users, the *remuneration* of users reduces the probability of using IAP as a revenue source by 14 p.p. (model (1)) or by 17.6 p.p (model (2)). Typically, remuneration is to compensate users for the use of their personal data (for example, selling it to third parties) or the engagement with the app (which may ensure active use of the app, and therefore the audience for ads).

5. Conclusion

This study shows that understanding health-app monetization models is essential for the development of digital health in Portugal. As m-Health tools become more common across both public and private healthcare, the way these apps generate revenue directly affects their accessibility, sustainability, and users' trust.

For Portuguese consumers, transparency about costs—whether direct, indirect, or hidden—is particularly important in a context marked by varying levels of digital-health literacy and strong concerns about personal-data use. For developers and startups, especially within Portugal's small but growing health-tech sector, choosing the right monetization strategy is a key factor for long-term viability.

Findings suggest that IAP are an alternative revenue source to price for download, but a complement to in-app ads. Furthermore, the choice for having IAP cannot be dissociated from the choice of platform where the health app is available for download.

The main limitation of this study is the lack of detailed information on the different types of IAP. Without distinguishing between purchases that remove ads, unlock features, or integrate external services, it is difficult to fully understand their impact on user behaviour and revenue generation. Addressing this gap would be especially valuable for Portugal, where evidence-based guidance on digital-health business models is still limited.

Future research that maps and evaluates specific IAP mechanisms would therefore contribute to more sustainable and user-centered monetization strategies, supporting Portugal's broader goals for digital transformation in health.

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Ethics Declaration

No ethical clearance required

AI Declaration

AI tools were used to perform spell checks

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