

**T.C.
ANTALYA BILIM UNIVERSITY
INSTITUTE OF POSTGRADE EDUCATION**

**BUSINESS ADMINISTRATION
MASTER'S THESIS**

**MULTI-DYNAMIC COMPETITIVENESS OF MOBILE ADVERTISING
SYSTEMS: BEYOND A MINIMALIST APPROACH**

Hira QAYYUM

APRIL 2023

ANTALYA

T.C.
ANTALYA BILIM UNIVERSITY
INSTITUTE OF POSTGRADE EDUCATION

BUSINESS ADMINISTRATION

MASTER'S THESIS

**MULTI-DYNAMIC COMPETITIVENESS OF MOBILE ADVERTISING
SYSTEMS: BEYOND A MINIMALIST APPROACH**

Hira QAYYUM

APRIL 2023

ANTALYA

T.C.
ANTALYA BILIM UNIVERSITY
INSTITUTE OF POSTGRADE EDUCATION

**MULTI-DYNAMIC COMPETITIVENESS OF MOBILE ADVERTISING
SYSTEMS: BEYOND A MINIMALIST APPROACH**

Hira QAYYUM

This thesis was accepted by the jury (with unanimous vote / majority vote) on the date 26/04/2023 In Masters in Business Administration of Department of Business Administration

Prof. Dr. Ibrahim Sani MERT (Supervisor) (signature)

Prof. Dr. A. Mohammed ABUBAKAR (signature)

Prof. Dr. Kemal KÖKSAL (signature)

Director of The Institute

Prof. Dr. Ibrahim Sani MERT (signature)

Thesis Submission Date: /202.....

DECLARATION

MBA Thesis of this named “Multi-Dynamics Competitiveness of Mobile Advertising Systems: Beyond Minimalist Approach”, which I presented, I declare that scientific moral principles were followed in the preparation of this study, in case of benefiting from the works of others, reference is made in accordance with scientific norms, no falsification has been made in the data used, and that any part of this study is not presented as another academic study.

.... /..../20....

(Signature)

Hira QAYYUM

CONTENTS

ABSTRACT	i
ÖZET	iii
LIST OF ABBREVIATIONS	v
LIST OF TABLES.....	vi
1.1. Background of Research.....	1
1.2. Advertisers and Publishers Revenue Optimization.....	3
1.3. Research Problem.....	4
1.4. Research Gap.....	5
1.5. Research Purpose.....	5
1.6. Contribution of Research.....	5
1.7. Research Objectives.....	5
1.8. Research Questions.....	6
1.9. Scope of Study.....	6
1.10. Significance of Research.....	6
2. LITERATURE REVIEW.....	7
2.1. Advertisers and Publishers Revenues and Cost Optimization.....	9
2.2. Advertising Pricing Models and Advertisers & Publishers Revenues Maximization.....	10
2.3. Literature Framework.....	20
2.4. Conceptual Framework and Hypothesis.....	21
3. METHOD.....	22
3.1. Research Design.....	22
3.2. Research Data and Sources.....	23
3.3. Data Collection Methods.....	23
3.4. Statistical Techniques for Data Analysis.....	24
3.5. Model Specification.....	24
4. FINDINGS	25
4.1. Unit Root Test (Stationary Analysis in Data).....	25
4.2. Regression Analysis.....	26
4.3. Regression Hypothesis.....	27
4.4. Co-integration Analysis.....	28
5. CONCLUSIONS AND SUGGESTIONS.....	29

5.1. Conclusion.....	29
5.2. Discussion.....	29
5.3. Implementation of Theory.....	31
5.4. Implications of Research.....	31
5.5.Limitations of Research.....	32
REFERENCES	33
APPENDICES	38
Appendice1. Data Sheet.....	38
Appendices 2. E-views Outputs.....	40

ABSTRACT

MULTI-DYNAMIC COMPETITIVENESS OF MOBILE ADVERTISING SYSTEMS: BEYOND A MINIMALIST APPROACH

Hira QAYYUM

Master in Business Administration

Supervisor: Prof. Dr. Ibrahim SANI MERT

April 2023; 64 pages

The research conducted to analyze mobile advertising through Android mobile applications platforms and its impact on publisher's cost and revenue maximization. There are various pricing models used in advertising includes CPM, CPC, CPA, and CPI. Mobile advertising is the fastest-growing industry as of the dramatic rise in the usage of smart phones making this platform increasingly attractive for businesses to advertise. Advertising is an essential component and publishers gain revenues through these applications. The research conducted is based on Positivism research paradigm and research is secondary data analysis of mobile applications pricing models. This research study is focused on highlighting the economic incentives and tradeoffs for advertisers and publishers by evaluating some of the commonly used pricing models in this industry and measuring their effectiveness. The secondary was collected from Appodeal, Thomson Reuters and android application mobile rates websites for analysis of pricing models of Android in US and values are considered in dollars. The time series and data of CPM, CPC, CPA, and CPI with dependent variables publishers' revenues of last 5 years month wise figures from January 2018 to December 2018 has been collected for secondary data analysis. The analysis was performed through E-views 9.5 software and econometric models applied. The research analysis applied Unit root test performed for analyzing the Stationarity of data, regression analysis performed to evaluate the significance of models, co-integration applied to analyze the long-term relationship of these pricing model with revenues optimization. The results analysis shows that the data is nonstationary and first difference applied to convert data into stationary data and then regression analysis performed. The regression analysis shows the models CPM and CPA are effective models and the values are significant and having impact of revenues maximization of publishers and effective models for advertising, while the CPI and CPA are not significant in this case based on collected time series data. The research implication shows that marketers and mobile application companies must focus on CPM and CPC as pricing models for advertising while using android mobile applications.

KEYWORDS: Mobile advertisement, pricing models, Android, CPM, CPC, CPI, CPA, and Publishers Revenues.

COMMITTEE: Prof. Dr. Ibrahim Sani MERT

Prof. Dr. A. Mohammed ABUBAKAR

Prof. Dr. Kemal KÖKSAL

ÖZET

MOBİL REKLAM SİSTEMLERİNİN ÇOK DİNAMİK REKABET GÜCÜ: MİNİMALİST BİR YAKLAŞIMIN ÖTESİNDE DEĞERLENDİRMESİ

Hira KAYYUM

İşletme Yüksek Lisans Tezi

Danışman: Prof. Dr. İbrahim SANI MERT

Nisan 2023; 64 sayfa

Araştırma, Adriod mobil uygulama platformları aracılığıyla mobil reklamcılığı ve bunun yayıncının maliyet ve gelir maksimizasyonu üzerindeki etkisini analiz etmek için yapılmıştır. Reklamcılıkta kullanılan çeşitli fiyatlandırma modelleri vardır; CPM, CPC, CPA ve CPI içerir. Mobil reklamcılık, bu platformu işletmeler için reklam yapmak için giderek daha çekici hale getiren akıllı telefonların kullanımındaki çarpıcı artış nedeniyle en hızlı büyüyen endüstridir. Reklam önemli bir bileşendir ve yayıncılar bu uygulamalardan gelir elde eder. Pozitivizm araştırma paradigmasına dayalı olarak yürütülen araştırma ve araştırma, mobil uygulama fiyatlandırma modellerinin ikincil veri analizidir. Bu araştırma çalışması, bu sektörde yaygın olarak kullanılan bazı fiyatlandırma modellerini değerlendirerek ve bunların etkinliğini ölçerek, reklamverenler ve yayıncılar için ekonomik teşvikleri ve takasları vurgulamaya odaklanmıştır. İkincil veri, ABD'de Android fiyatlandırma modellerinin analizi için Appodeal, Thomson Reuters ve android uygulaması mobil ücretler web sitelerinden toplanmıştır ve değerler dolar olarak kabul edilmiştir. İkincil veri analizi için Ocak 2018'den Aralık 2018'e kadar son 5 yıllık aylık bazda BGBM, TBM, YBM ve TÜFE bağımlı değişkenleri ile yayıncı gelirlerinin zaman serisi ve verileri toplanmıştır. Analiz, E-views 9.5 yazılımı ve uygulanan ekonometrik modeller aracılığıyla gerçekleştirildi. Araştırma analizi, verilerin Durağanlığını analiz etmek için gerçekleştirilen Birim kök testi, modellerin önemini değerlendirmek için yapılan regresyon analizi, bu fiyatlandırma modelinin gelir optimizasyonu ile uzun vadeli ilişkisini analiz etmek için eş bütünleşme uygulandı. Sonuç analizi, verilerin durağan olmadığını ve verileri durağan hale dönüştürmek için birinci farkın uygulandığını ve ardından regresyon analizinin yapıldığını göstermektedir. Regresyon analizi, CPM ve CPA modellerinin etkili modeller olduğunu ve değerlerin önemli olduğunu ve yayıncıların gelirlerini maksimize etmede etkili olduğunu ve reklamcılık için etkili modeller olduğunu gösterirken, toplanan zaman serisi verilerine dayalı olarak bu durumda CPI ve CPA anlamlı değildir. Araştırma sonucu, pazarlamacıların ve mobil uygulama şirketlerinin android mobil uygulamaları kullanırken reklamcılık için fiyatlandırma modelleri olarak CPM ve CPC'ye odaklanmaları gerektiğini göstermektedir.

ANAHTAR KELİMELER: Mobil reklam, fiyatlandırma modelleri, Android, CPM, CPC, CPI, CPA ve Yayıncı Gelirleri

JÜRİ: Doç. Dr. Ibrahim Sani MERT

Doç. Dr. A. Mohammed ABUBAKAR

Doç. Dr. Kemal KÖKSAL

LIST OF ABBREVIATIONS

CPM	: Cost per Impression/million
CPI	: Cost per Install
CPC	: Cost per Click
CPE	: Cost per Engagement
CPL	: Cost per Lead
CPA	: Cost per Action
CPS	: Cost per Sale
CPV	: Cost per view
CTR	: Cost through Rate

LIST OF TABLES

Table 1. Data and Source	31
Table 2. Unit Root Test.....	33
Table 3. Regression Analysis.....	34
Table 4. Hypothesis Testing.....	35
Table 5. Co-integration Analysis.....	35

1.INTRODUCTION

1.1. Background of Research

In the world of data and analytics the organizations are focused on mobile devices and social media marketing creating the huge buzz of marketing and drive sales and growth for companies. Many new brands established through online marketing and increase the market focus and create new dynamics of business. The emergence of e-commerce increases the focus of business and change the future of business. Due to change in mobile communication marketing dynamics also been changed and consumers are focusing on mobile marketing and aware of social media marketing. Thus this creates facility for marketers to show availability on online mediums and increase customers focus and sales.

Mobile advertising become an indispensable part of business models by 2025 (MAGNA, 2016). Elementary knowledge of the economics of mobile advertising will be a significant factor in the success of companies. The study aimed to highlight the economic incentives and tradeoffs for advertisers and publishers by evaluating some of the commonly used pricing models in this industry. The models include cost per thousand impressions (CPM), cost per click (CPC), and cost per thousand installs (CPI).

The CPM model was introduced in 1957 (Shah, 2021) and can be described as advertisers' pays and publishers' realized payments for impressions (whenever visitors get an opportunity to see the ad). This method is similar to conventional newspaper advertising, where newspaper publishers are paid based on the circulation of their newspapers. For example, CPM is the cost of 1,000 advertisement impressions on one web page. If a website publisher charges \$2.00 CPM, an advertiser must pay \$2.00 for every 1,000 ad impressions. The letter "M" in CPM stands for "mille," which is Latin for "thousands." (Shah, 2021).

The CPC model can be explained as that advertisers pay only for the clicks on their ads (when the visitor after seeing an ad clicks on it. Mobile advertising is the fastest-growing market today. It has evolved through time to become a tool that allows advertisers to efficiently and successfully market products or services to targeted people. This is because mobile devices are omnipresent and may deliver contextual information as well as allow users to indicate preferences (Li et al., 2012). Mobile advertising currently accounts for the majority of overall digital ad spending. Mobile advertising's appeal originates from an ad type unique to the mobile environment: in-app advertisements or adverts displayed within apps. These advertisements offer strong user-tracking features and enable ad networks to connect user data from different sessions, apps, and advertisers. As a result, one of the primary benefits of in-app advertising is its capacity to support behavioral targeting (Rafieian&Yoganarasimhan, 2021).

A report by Smart Insights discovered that mobile marketing is one of the well-liked digital marketing practices in 2017. Mobile ads can range from SMS text advertisements to smartphone banner adverts. Smartphones vary from traditional forms of advertising in that they may allow location-specific applications. This feature of smartphones, together with their communication design, allows marketers to target their clients with personalized adverts (for example, location-based advertising). Thus, smart mobile phones enable businesses to target their clients with customized advertising and messaging, demonstrating that mobile advertising media is a significant platform for businesses to create relationships with their customers. As a result, organizations use a variety of mobile advertisements, including mobile advertisements via social networks, SMS, search engines, and in-app mobile advertising.

By 2002, Google and Yahoo! had both embraced the CPC model, making it the most extensively used pricing model in paid search advertising (Hu et al., 2016). However, clicking' transition on actual sales is difficult to calculate. Online advertising is different from traditional media advertising because of its measurability and accountability. These attributes give mobile advertising a competitive advantage over other mediums of advertising (Asdemir et al., 2012). In the context of CPI, most of the time advertisers have some sort of digital product (application or game), which can be installed. Herein, advertisers do not pay for impressions or clicks but only when some user installs their application or game, consequently publishers get paid.

The advantage of charging by CPC is its high conversion rate: in general, users will click on the material they are interested in, and marketers may investigate and evaluate possible consumer demands through user click data, and then push similar items to target people. Internal competition among diverse sectors on TikTok should not be disregarded. Advertisers charged by CPC cannot prevent fraudulent clicks by competitors in the same business, which may increase their advertising costs. In general, CPC pricing is appropriate for marketers with limited budgets but strong performance criteria. Second, CPM refers to billing based on the number of exposures. Exposure implies that the video appears on the user's mobile phone screen whether or not the user views it. TikTok's CPM for Feed advertisements is 4 yuan, which means that TikTok costs advertisers a 4-yuan advertising price for every thousand exposures of an advertisement. CPM billing has the benefit of being inexpensive: If the ad click rate is 2% and the CPM price is 4 yuan, the cost of a single click is merely 0.2 yuan. Advertisers have different objectives that include but are not limited to generating awareness, leads, views, likes, subscriptions, and installs. There are a lot of mobile advertising companies operating in this market including big names like AdMob, Unity, and Amazon, but the pricing models they employ are not producing satisfactory results for advertisers or publishers. The three most renowned pricing models are CPM, CPC, and CPI – each model has its pros and cons. Most companies use a “one for all” approach when it comes to the pricing model.

Following a single approach to pricing creates problems for both parties (advertisers and publishers). Amazon uses the CPM model, which offers secured but fewer revenues to publishers. Moreover, advertisers also strongly argue to be charged

solely based on impressions not considering the fulfillment of their objectives. Michael Sands quoted in Business Week that he is exhausted hearing how much internet advertising is similar to television advertising. On the other hand, the marketing head of online travel company Orbits... says... "There's a notion that accountability is not the direction to go in," scoff Sands, who adds: "That's frightening. Worse, it's a capitulation" (Asdemir et al., 2012).

CTR (Click through rate) is considered to be a measure of an ad's effectiveness based on a view that the target audience of the ad will click upon. Sadly, that's not true. If the application/game is more engaging and the ad pops up in the middle or even if the user willingly watches an ad to earn some consumables, i.e., game currency, so he might not click on the ad although being a part of the targeted segment. Publishers bear a significant decrease in revenues because organic CTR tends to remain below 5%, hence, 95% of the secured impressions are good for nothing. The large multinational organizations like P&G and Unilever tend not to offer online products and most of the time their objective is just to raise awareness, consequently, they have to pay (higher amounts) for the clicks.

1.2. Advertisers and Publishers Revenue Optimization

Mobile applications and game developers' one of the major sources of earning are ads. The criteria for being paid differ in each of the pricing models that subsequently determine their revenue and profitability. Publishers can select different ad formats which best suit their applications or games considering response rate and expected revenue. This thesis analyses all these factors comparing CPM, CPC, CPI, which will help them in the determination and selection of ad formats and networks pursuing revenue optimization based on the alternatives available in market.

There are several types of interactive internet advertising. According to an Internet Advertising Bureau survey, banner adverts accounted for 55% of total online spending, while sponsorships accounted for 30%, interstitials accounted for 5%, email accounted for 1%, and others accounted for 8%. The majority of online interactive advertising is comprised of banner adverts, which are employed by practically all advertising companies participating in interactive advertising.

In the world of records and analytics the organizations are focused on cellular devices and social media advertising growing the big buzz of advertising and drive income and growth for organizations. Many new manufacturers mounted through on line advertising and marketing and growth the market awareness and create new dynamics of business. The emergence of e-commerce will increase the focal point of enterprise and trade the destiny of enterprise. Due to alternate in mobile communicate advertising and marketing dynamics additionally been modified and clients are that specialize in mobile advertising and aware of social media advertising and marketing. Thus this creates facility for marketers to reveal availability on online mediums and increase clients attention and sales. From the commercial enterprise management viewpoint, in addition analysis could

assist style corporations to better apprehend the factors that increase the perceived value of branded mobile apps; this, in turn, would assist them adapt their cellular communications to ensure that their clients reap higher fee and, consequently, purchase and make hints thru social media. Perceived price is vital to continuance goal for a carrier, and has become a completely essential supply of aggressive advantage, being one of the foremost determinants of buy goal. Mobile advertising come to be an necessary a part of business fashions by 2025 (MAGNA, 2016). Elementary knowledge of the economics of cellular advertising might be a sizeable aspect inside the fulfillment of organizations. Thetake a look at aimed to focus on the financial incentives and tradeoffs for advertisers and publishers by means of comparing some of the normally used pricing models on this industry. The fashions consist of value consistent with thousand impressions (CPM), value according to click (CPC), and fee in keeping with thousand installs (CPI).

1.3. Research Problem

The Advertisers and publishers' cost is challenging issue for marketers to launch the digital and mobile marketing campaigns and enhance its effectiveness. The research conducted to analyze the impact of cost of advertising models on publishers cost optimization. The research conducted to analyze the effectiveness of pricing models (CPM, CPC and CPI) and ad formats (interstitial and banner) for advertisers and publishers.

This research study will significantly contribute to the optimization of advertisers' costs. Undoubtedly, all three models are being exercised in the market but the offer varies not only on their terms but also on the prices charged. Assuming an advertiser that advertises on a network that offers CPI and it suits him as he intends to increase downloads of his application available on the app store. Undoubtedly, now he will be charged on the number of installs secured, but there is a rate of installs per showing the ad a thousand times. He might save his cost if he somehow knows the rate of installation per impression basis, as he will be able to choose from all of the available models based on his objectives. In the same manner, the knowledge and comparison of ad formats in terms of their response rate and the price will help advertisers optimize their marketing budgets.

This research can be extended for the evaluation of world's data. In the context of mobile advertising industry each of the mobile operating system dealt separately, consequently Window and Amazon segments can also be evaluated. Moreover, mobile advertising companies are continuously trying to launch novel ad formats i.e., icon ads, carousals etc. Consequently, new ad formats can be evaluated to check their economic and overall effectiveness.

1.4. Research Gap

The substantial research gap in this area is that analysis on real data in order to check the effectiveness of pricing models for this industry has not been performed yet. Moreover, the CPI model has not been measured in the context of economic effectiveness. Moreover, ad formats have not been explored in the evaluation of pricing models. The major research gap has been the availability of the data for comparing the performance of different pricing models. The research paper found that neither data had been collected for comparing the effectiveness of different pricing models nor enough research was conducted to find the relationship between mobile marketing and ad formats being used.

The previous research paper did not carry out detailed research on tracing the relationship between ad formats and the effectiveness of mobile marketing. Limited Research work has been done on finding the best pricing model but primarily, research has not been conducted to examine the potential relationship between ad formats and the effectiveness of mobile marketing. This might be because of the fact that banner ad formats were widely used before the advent of social media. Consequently, a need was not felt to see whether changing the ad format would bring more encouraging results for mobile marketing.

1.5. Research Purpose

The Purpose of this research is to analyze which Pricing Model and ad format is economically effective for Advertisers and Publishers on Android platforms. The research analyzes the various pricing models and which model is effective for advertisers to promote brands through mobile marketing and how mobile marketing and advertising affects the revenues of publishers and advertisers.

1.6. Contribution of Research

The study has measured the effectiveness of pricing models by evaluating the real term data published by Appodeal.com. CPI model have also been included in this study, while measuring the effectiveness of other pricing models that are widely used in today's in-app advertising. The role of Ad formats in fluctuating the CTR and choosing the pricing model will also be examined in this research.

1.7. Research Objectives

1. To analyze the impact of CPM (Cost per Mile/Million) Pricing model on Advertisers & Publishers Revenues in Android Platforms.
2. To analyze the impact of CPI(Cost per Click) Pricing model on Advertisers & Publishers Revenues in AndroidPlatforms.

3. To analyze the impact of CPA (Cost per Action) Pricing model on Advertisers & Publishers Revenues in AndroidPlatforms.
4. To analyze the impact of CPI(Cost per Click) Pricing model on Advertisers & Publishers Revenues in AndroidPlatforms.

1.8. Research Questions

1. What is the impact of CPM (Cost per Mile/Million) Pricing model on Advertisers & Publishers Revenues in AndroidPlatforms?
2. What is the impact of CPI(Cost per Click) Pricing model on Advertisers & Publishers Revenues in AndroidPlatforms?
3. What is the impact of CPA (Cost per Action) Pricing model on Advertisers & Publishers Revenues in Android Platforms?
4. What is the impact of CPI(Cost per Click) Pricing model on Advertisers & Publishers Revenues in Android Platforms?

1.9. Scope of Study

This research will cover both mobile operating systems Android and android and two ad formats that include interstitial and banner on which basis effectiveness of pricing models (CPM, CPC and CPI) will be evaluates.

1.10. Significance of Research

This research doesn't only contribute academically, but also facilitates the practitioners to address this debate in an appropriate manner MAGNA (2016) reported that the global expenditure on mobile advertising in 2016 was \$493 billion. Moreover, mobile advertising increased by 48% reaching \$80 billion which is 45% of the total expenditure of mobile advertising (\$178). In 2017, it is expected that the growth of mobile advertising will remain increasing (+31%), consequently in digital advertising most of the expenditure will occur in mobile advertising. Dentsu Aegis Network's forecasts reaffirm the aforementioned surveys forecasting that in 2017, mobile advertising expenditure will surpass desktop advertising by reaching up to 56% of global digital advertising expenditure. It will increase beyond 2018 and reach a total of US\$116.1 billion. It will continue to grow to \$215 billion in 2021.

2. LITERATURE REVIEW

Mobile advertising is getting fame and consideration not only because smart phones have been used widely, but also because its excellent implication in mobile commerce as well as one of the appropriate monetization business models for mobile applications and games (Kim et al., 2012).

Mobile advertising is one of the interactive media of advertising as it does not communicate the message of advertisers, but also allows the audience to respond in a certain manner that usually starts with clicking upon the ad, which further allows them to visit advertisers' websites, filling out a survey, installing some application or game, buying some sort of online products, etc. (Rzemieniak, 2015). Entrepreneurs can take big advantage of this because of the easy access to information on the consumer's end. A plethora of research has been conducted in this research area (Rafieian&Yoganarasimhan, 2021).

The CPC model can be explained as that advertisers pay only for the clicks on their ads (when the visitor after seeing an ad clicks on it. Mobile advertising is the fastest-growing market today. It has evolved through time to become a tool that allows advertisers to efficiently and successfully market products or services to targeted people. This is because mobile devices are omnipresent and may deliver contextual information as well as allow users to indicate preferences (Li et al., 2012).

On the academic front the literature on mobile advertising covers three aspects: creating measurement benchmarks, interpreting mobile advertising response, and creating responsive advertising models, i.e. targeting, scheduling, or defining advertising extent (KursadAsdemir, Nanda Kumar, 2012). Initially, the mobile industry lacked standardization; consequently, early research focuses on developing and analyzing standards and benchmarks. Hoffman and Novak (2000) and Novak and Hoffman (1997) put forward measurement benchmarks and highlighted some major issues in exercised pricing models of this industry. Companies do not truly consider the market while adopting pricing models and dictate their terms in this regard. We are primarily trying to investigate the economic benefits and tradeoffs associated with pricing models. This will help advertisers and publishers choose an appropriate pricing model (KursadAsdemir, Nanda Kumar, 2012).

The Advertisers and publishers' fee is hard trouble for entrepreneurs to launch the digital and mobile advertising campaigns and beautify its effectiveness. The research conducted to analyze the impact of fee of advertising fashions on publishers cost optimization. The research conducted to investigate the effectiveness of pricing fashions (CPM, CPC and CPI) and advert formats (interstitial and banner) for advertisers and publishers.

This research take a look at will drastically make a contribution to the optimization of advertisers' charges. Undoubtedly, all three fashions are being exercised inside the marketplace however the provide varies now not handiest on their terms but additionally

at the prices charged. Assuming an advertiser that advertises on a network that gives CPI and it suits him as he intends to increase downloads of his software available on the app shop. Undoubtedly, now he could be charged on the number of installs secured, however there is a rate of installs in step with showing the ad a thousand times. He would possibly keep his cost if he somehow is aware of the rate of set up consistent with impression basis, as he will be capable of choose from all the available fashions based on his goals. In the equal way, the expertise and evaluation of ad formats in terms in their reaction charge and the rate will help advertisers optimize their advertising and marketing budgets.

This research can be prolonged for the assessment of worldwide's facts. In the context of cellular advertising and marketing industry every of the cellular operating device dealt separately, consequently Window and Amazon segments can also be evaluated. Moreover, cellular advertising companies are continuously trying to release novel ad formats i.E., icon advertisements, carousals etc. Consequently, new ad formats may be evaluated to test their financial and normal effectiveness.

The great research gap on this place is that evaluation on actual records so as to test the effectiveness of pricing models for this enterprise has not been achieved yet. Moreover, the CPI version has no longer been measured within the context of monetary effectiveness. Moreover, advert codecs have no longer been explored inside the evaluation of pricing fashions. The essential research gap has been the supply of the records for evaluating the overall performance of various pricing models. The studies paper determined that neither statistics have been collected for evaluating the effectiveness of various pricing models nor sufficient studies became conducted to find the relationship among cell advertising and ad formats getting used.

The preceding studies paper did now not perform unique research on tracing the relationship between advert formats and the effectiveness of cellular advertising. Limited Research work has been performed on locating the fine pricing model however broadly speaking, research has not been carried out to have a look at the capacity courting between advert codecs and the effectiveness of cell advertising. This is probably due to the reality that banner advert formats were extensively used before the appearance of social media. Consequently, a want changed into no longer felt to peer whether converting the advert layout would carry extra encouraging consequences for cell advertising

Mobile advertising is one of the interactive media of advertising and marketing as it does no longer communicate the message of advertisers, but also permits the target market to reply in a positive way that usually begins with clicking upon the advert, which further allows them to visit advertisers' websites, filling out a survey, putting in a few application or recreation, shopping for a few kind of on-line merchandise, etc. (Rzemieniak, 2015). Entrepreneurs can take massive advantage of this because of the clean get admission to to information on the customer's end. A plethora of studies has been performed on this studies location (Rafieian&Yoganasimhan, 2021).

The CPC version can be explained as that advertisers pay handiest for the clicks on their ads (while the traveller after seeing an advert clicks on it. Mobile advertising is the fastest-growing marketplace these days. It has evolved via time to grow to be a tool that

lets in advertisers to successfully and successfully market services or products to targeted human beings. This is due to the fact cell gadgets are omnipresent and may supply contextual statistics in addition to permit customers to suggest preferences (Li et al., 2012).

On the instructional front the literature on cellular advertising covers 3 factors: developing measurement benchmarks, decoding cell marketing reaction, and creating responsive advertising and marketing models, i.E. Concentrated on, scheduling, or defining advertising extent (KursadAsdemir, Nanda Kumar, 2012). Initially, the cell industry lacked standardization; consequently, early research focuses on growing and studying requirements and benchmarks. Hoffman and Novak (2000) and Novak and Hoffman (1997) recommend measurement benchmarks and highlighted a few most important issues in exercised pricing fashions of this industry. Companies do not clearly take into account the market at the same time as adopting pricing fashions and dictate their phrases in this regard. We are generally trying to research the financial benefits and tradeoffs related to pricing models. This will assist advertisers and publishers pick the proper pricing version (KursadAsdemir, Nanda Kumar, 2012).

2.1. Advertisers and Publishers Revenues and Cost Optimization

Advertising is still one of the few revenue sources for online companies, with others still in the testing stage (E-commerce, pay-per-click, transaction-based, etc.). Internet advertising grew significantly in the United States, reaching \$8.2 billion in 2000 (a 78 percent increase over 1999). Sales for the fourth quarter increased to \$2.2 billion (Internet Ad Revenue Report 2000), but are presently slowing (Q4 2000 sales in the United States are only 9% higher than Q3 2000) due to the failure of numerous dot.com ventures. In the year 2000, one-third of American homes have already purchased things on the internet (24 percent in 1999). The most often purchased items and services were books, aircraft tickets, and trip services (Aramendia-Muneta et al., 2019).

Advertisers have different objectives that include but are not limited to generating awareness, leads, views, likes, subscriptions, and installations. There are a lot of mobile advertising companies operating in this market including big names like AdMob, Unity, and Amazon, but the pricing models they employ are not producing satisfactory results for advertisers or publishers. The three most renowned pricing models are CPM, CPC, and CPI – each model has its pros and cons. Most companies use a “one for all” approach when it comes to the pricing model.

Following a single approach to pricing creates problems for both parties (advertisers and publishers). Amazon uses the CPM model, which offers secured but fewer revenues to publishers. Moreover, advertisers also strongly argue to be charged solely based on impressions not considering the fulfillment of their objectives. Michael Sands quoted in Business Week that he is exhausted hearing how much internet advertising is similar to television advertising. On the other hand, the marketing head of online travel company Orbits... says... “There’s a notion that accountability is not the

direction to go in,” scoff Sands, who adds: “That’s frightening. Worse, it’s a capitulation” (Asdemir et al., 2012).

The large multinational organizations like P&G and Unilever tend not to offer online products and most of the time their objective is just to raise awareness, consequently, they have to pay (higher amounts) for the clicks. CTR (Click through rate) is considered to be a measure of an ad’s effectiveness based on a view that the target audience of the ad will click upon. Sadly, that’s not true. If the application/game is more engaging and the ad pops up in the middle or even if the user willingly watches an ad to earn some consumables, i.e., game currency, he might not click on the ad although being a part of the targeted segment. Publishers bear a significant decrease in revenues because organic CTR tends to remain below 5%, hence, 95% of the secured impressions are good for nothing.

Unity uses a CPI model that refrains potential advertisers who do not have published apps or games; since they cannot offer something to install. Further, as the model is CPI, so publishers get paid only when some user after watching an ad installs that app or game. For instance, 1000 game ads are shown through which only 30 are clicked and only 10 users install that game; publishers will be paid only for installs not for impressions or even not for clicks. Publishers reluctantly accept such policies because they realize the potential loss for the obtained impressions and clicks. To put it in a nutshell – a single prescription cannot heal a variety of patients having different diseases.

2.2. Advertising Pricing Models and Advertisers & Publishers Revenues Maximization

In digital landscape there was one and only model of pricing exercised initially, which was CPM (cost per impression). However, with the passage of time and considering demands of advertisers and publishers’ different new models come into existence. These models include CPC, CPI (cost per install), CPA (cost per acquisition), CPS (cost per sale), CPL (cost per lead), CPV (cost per view) and CPE (cost per engagement) (Mario Torija, 2016). On the other hand, as far as ad formats are concerned primarily banner and video ads were introduced and subsequently interstitials, MREC, native ads, icon ads and other formats introduced as per demand of advertisers and publishers.

Currently only three pricing models are being exercised in this industry that are CPM, CPC and CPI. Facebook Audience Network, Chitika, Infolinks, Media.net, Amazon Display Ad Network, Adversal, VigLinks, SkilmLink and so forth are exercising Cost per Impression Model (“Chitika | Online Advertising Network,” 2017, “Display Advertising - Amazon Advertising,” 2017, “Facebook Audience Network,” 2017, “Infolinks - Innovative Ads Powered by Intent,” 2017, “Media.net | Yahoo! Bing Network Contextual Ads,” 2017, “SKIMLINKS,” 2017, “The Adversal Publisher Network,” 2017, “VigLink — Powering Content-Driven Commerce,” 2017).

CPC network is used by Admob, which is subsidiary of Google, Leadbolt, Gowide, Black6adv, Billy Mobile, Epom Market, Smarty Ad, Bidsopt, StartApp. Above all, CPI

network is employed by Mopub, Unity Ad Network, Tapjoy, InMobi, Vungle, CHartboost, and Adcolony (APPODEAL, 2017).

In earlier research, authors proposed some optional contracts to bring advertisers and publishers an agreement and they evaluated the properties of their proposed optional contract (Moon & Kwon, 2011). Mobile advertising effectiveness relies on the appropriate selection of the ad format, position of impression, and exercised pricing model (Rzemieniak, 2015). Consequently, previously done research successfully showed how to market apps and generate revenue. Similarly, another researcher Baiba Limpuce (2021), contributed to previous literature with his thesis work on yielding a marketing strategy for a startup company known as Freshbox Games, which focuses on maintaining the feminine genre in mobile games. Finding the most efficient marketing strategies with the fewest financial resources needed to increase brand and app presence online was the goal of the research. Additionally, the author provided the marketing strategy to build the mobile game along with its trendy stylist.

The CPC version may be defined as that advertisers pay handiest for the clicks on their ads (whilst the traveler after seeing an advert clicks on it. Mobile marketing is the quickest-growing marketplace nowadays. It has advanced thru time to grow to be a device that permits advertisers to efficiently and correctly marketplace services or products to targeted humans. This is because cellular gadgets are omnipresent and might supply contextual information in addition to permit customers to indicate possibilities (Li et al., 2012). Mobile marketing presently debts for almost all of usual virtual advert spending. Mobile advertising's enchantment originates from an ad type particular to the cellular environment: in-app advertisements or adverts displayed within apps. These advertisements offer sturdy consumer-monitoring functions and allow advert networks to connect user facts from specific sessions, apps, and advertisers. As a result, one of the primary advantages of in-app advertising is its ability to assist behavioral focused on (Rafieian & Yoganarasimhan, 2021).

A document through Smart Insights observed that mobile advertising is one of the preferred virtual advertising practices in 2017. Mobile ads can variety from SMS textual content classified ads to phone banner ads. Smartphones vary from conventional forms of marketing in that they may permit region-specific packages.

Organizations view cell devices as a key advertising medium and dedicate substantial assets to cell advertising. For instance, mobile advertising and marketing spending in 2007 changed into \$2,773 million, has accelerated to \$189 billion in 2019, and is expected to exceed \$240 billion by using 2022. These numbers display that groups are investing heavily in cell marketing, which is motivating teachers and researchers to assess the efficiency of those cellular advertising efforts (Jebarajakirthy et al., 2021).

By 2002, Google and Yahoo! Had both embraced the CPC model, making it the most significantly used pricing version in paid seek marketing (Hu et al., 2016). However, clicking' transition on real income is difficult to calculate. Online advertising is different from traditional media advertising and marketing due to its measurability and

accountability. These attributes deliver cell advertising a competitive advantage over different mediums of marketing (Asdemir et al., 2012). In the context of CPI, maximum of the time advertisers has some type of digital product (software or recreation), which may be mounted. Herein, advertisers no longer pay for impressions or clicks however simplest when a few people install their software or game, therefore publishers receives a commission.

Fresh box games use the known pricing model and advertising format Admob offers (i.e., reward videos, banner ads, and interstitial ads) on iOS and Android mobile systems. Moreover, these strategies are proven beneficial to grab the user's attention and make them download the game for free. Moreover, Moon and Kwon (2011) suggested hybrid pricing models according to which advertisers optimize their costs by buying an option to choose the minimum CPM and CPC fees. The price of this exclusive option is determined considering the Nash bargain game.

In another study, authors presented a proper pricing model of mobile advertising using principal-agent settings to analyze two of the most employed: input-based cost CPM and CPC (Asdemir et al., 2012). In the context of the CPC model, the performance is based on CTR (click-through rate), which established the cost per click on an advertisement unit (Rzemieniak, 2015). They outlined four elements using game theory – that impact the selection of pricing models: Uncertainty effect, exposure value effect, miss-targeting effect, and alignment effect (Asdemir et al., 2012).

It was also noted from the earlier literature that the audience and age, and gender have a significant role in the impact of advertisements. Data from 120 ads were collected by Pengyuan Wang et al. (2019) to examine the efficacy of serial ad positions. Along with comparing the different ad formats, the role of CPI was also examined. Additionally, the results revealed no long-term effect of the serial positions of adverts, where the effectiveness is more influenced by the nature of the advertisement and the metric results. Additionally, the study indicated that banner advertising is intrusive; therefore, using native ads can mitigate this aspect of banner ads. Additionally, the CPI affects the conversion per click rate (CVR), but it has a minimal probability of affecting the click-through rate (CTR).

In addition, it was found in the research by Chiong et al. (2017) that banner advertising is particularly invasive because mobile screens are smaller than those on PCs, making it challenging to advertise on Android mobile phones. Their study sought to determine if incentive-based advertisements, which reward users for watching ads, are beneficial when used in conjunction with gaming applications. The author uses CPI (cost-per-install) pricing for all of its adverts to only be paid when an advertisement results in a conversion event, which is defined as the user downloading the provided app. Results showed that when users are given prizes, incentive-based advertisements have a favorable impact.

Sayapina (2018), in the context of Russian gaming marketing confirmed that banner advertisements are no longer a practical format to catch the eye of the users as they seem to get easily annoyed by the exposure of banners hence and are likely to ignore the hem.

The CPI/ CPA method was used, and both respondents felt that such campaigns are more appealing to marketers because the advertiser pays only when the predetermined target is achieved. Whereas the finding indicated that to enhance the ROI, marketers should ensure that ARPU is high, and CPI is low as the number of monthly active users significantly impacts ARPU. In conclusion, they demonstrated that mobile gaming firms should modify their product to meet better market orders to boost the likelihood that consumers will accept them.

Sorvari&Tommi (2018), conducted a case study where to find the subjectivity of experience by the users. The goal was to comprehend how elements like monetization, acquisition, and retention function in mobile gaming on iOS and Android to predict the introduction of free games. When using adverts is the only means of making money, the gamer may become irritated and interrupted by them. The study concentrated on enticing the right audience using interstitial ad styles and CPI marketing. Although interstitials are highly successful, they also have the drawback of being obtrusive. Therefore, it is evident from a simple observation that poorly designed monetization elements may lead to negative judgments.

Mobile advertising is used by around 65% of active apps currently available, making it the primary revenue stream for developers. Users' main complaints are network usage, battery use, and privacy concerns. As a significant contribution to this field, B TOPCU and MU EREN (2018) investigate how mobile advertising affects these intangible costs associated with mobile apps. The authors used an Interstitial video ad format where the finding indicated the 44 total supports of such ad networks. Along with the explanation that the mobile ad platform considers CPI a crucial component for determining publishers' income since CPI provides users the option to download the promoted software after a few hours or even days, user behavior becomes crucial. Finally, the analysis found that iOS commercials are 1.3 times more successful than Android ads.

As we know, mobile advertisers are the primary source of income for advertisers and serve as their vendors. The developers get paid according to the number of impressions, also known as CPM marketing. Geumhwan Cho et al. (2016) gave a study to explain the potential risk these mobile-based advertising is causing. The study demonstrated that CPM is widely used for advertising in android along with the use of banner ad formats. However, the results evaluated that these advertisements are causing a potential risk for 75% of networks. (Mark, Corner &Levin,2018) studied Micro Mobile, a method for mobile advertising allocation of brief information trials to a vast population of clients.

The study results demonstrate that the engagement rate was noticeably higher. Although, the focused advertising campaign may have cost a little more because most other advertisements ran at a CPM of \$2.50. Additionally, we found interactive advertisements had the highest engagement than native ads and two times higher than the experiments conducted in browsers. The results also demonstrated that because traffic is expensive, consumers of iOS experience more expensive experimental outcomes than

those of Android. Additionally, it was determined that CPM rates would need to be raised to boost impression rates.

Gong Chen et al. (2016) used the CPM and CPC models as their studies' most commonly used models. Without regard to CPC or CPM, a landing page analysis demonstrates that the advertiser's cost per click (CPC) or cost per thousand impressions (CPM) is directly associated with the ad traffic quality, as noted from the previous literature by Gong Chen et al. 2016. They used CPM and CPC models as they are the most commonly used models in other related studies in the digital marketing platform. Moreover, Mathews Nkhoma and WanniwatPansuwong (2019)) predicted from their research that various sources of revenue, particularly in-app display revenue, will continue to increase in the future. The study was put forward to further increase the efficacy of mobile in-app advertising for not just one, but all interested parties; this research constructs the role of publishers and suggests an integrated effectiveness paradigm. Further, it was concluded that performance-based ad revenues recently eclipsed CPM revenues and are continuing to gain ground when applied in Android and iOS advertisement platforms.

Shetty (2014) highlighted all the entities involved in the mobile application industry, including Developers and their revenue streams, App Stores, and app distributors available in the market, app development tools cost and processes, In-app advertising networks, and Pricing models followed by ad networks. The author also provided statistics on time spent per app category, downloads and revenues per category, app user behaviors, etc. As from the latest research, the effectiveness of these app advertisements and pricing models is highlighted. According to the research cited in the Quarterly Report, CPM earned the highest and most desirable revenue for both advertisers and publishers out of the four pricing models (CPM, CPC, CPI, and CPE) used to create revenue in Android or iOS.

N Pham (2016), stated in his report that CPC and CPE generated 25% and 15% of revenue, CPM generated 32% of revenue, and CPI generated 28% of revenue. As a result, CPM and CPI are the most popular pricing models used in both Android and iOS. The research under discussion included further significant facts, including that intended revenue is not only the result of pricing models but also the application of strategies such as optimization and spending money on the right kinds of ads and management personnel. Moreover, changing the strategies to gain revenue is also important while using the CPM model.

Sakib (2019), highlighted in his study that bit spearhead uses the CPI model more to build revenue, especially on android applications. The objective of his study was to study the digital marketing process applied to the Bitspearhead. Notably, on the applications like Szimek, Amazon, and Verizon, the company uses the CPI advertising pricing model feasibly. Whereas wildly successful apps like ESPN and Crickbuzz only sell the inventory space for both iOS and android by using banner advertising and a CPM pricing model. Banner advertising is used by nearly all app producers who rely on ad revenue. The study also indicates that bit spearhead has a fixed rate for CPM as the

changes might not benefit them. Banner advertising is used by nearly all app producers who rely on ad revenue. However, the study also explained the use of CPC for apps like Yahoo and IMO (Sakib, 2019).

Arshanapally&et al. (2022), article provided that CPC gives out information related to the investment and its effectiveness rate. However, CPC failed to calculate Google search and networking; hence, the CPCs rate should be lowered to protect the industry standard. Moreover, the prior literature has enough material to show the effectiveness of these pricing models.

Khai&Chen (2016), developed a new strategy for an online mobile app for app ads marketing, and for that, they used the model CPI (cost per impression) to acquire users. The result indicated the effectiveness of the CPI campaign for Android and iOS to score the highest CPI bid.

Despite pricing models, ad formats play a crucial role in monetization. As discussed in the study by Mohammad Tahaei (2022), the framing of an advertisement significantly impacts revenue. He conducted a survey consisting of participants with gained experience in mobile and digital marketing. Further, the participants were provided with multiple-choice questions about ad formats (banner and interstitials advertisement), mobile platforms, android or iOS, and ad types. The aim was to find the user's concerns regarding their privacy and ad framing. Lastly, the findings demonstrated that ad formats like banner ads and interstitial advertisement framing significantly affect the privacy of more than a million users using iOS and Android mobile platforms.

Chatterjee (2008) examined the impact of ad sizes and formats on the advertised brand's instant and deferred recall, recognition, and attitude. In this research, authors performed a lab experiment of 3 stages measuring respondents' involvement with several product categories, measuring the Ad stimuli and its impact on brand recall over a delayed period.

Additionally, Goncharova and Elizaveta's (2017) article briefly explained the effectiveness of banner interstitial ads. The aim was to explain the strategies used to monetize using free games and how these free apps affect other mobile apps. The study was articulated by primary and secondary data, where secondary data was gathered from magazines, prior research, and reliable internet sources. However, primary data was collected by conducting an online survey. The findings supported the study's hypothesis that the advertising format of free-play game apps conflicts with the other apps' monetization. The study consists of advertising formats which include (interstitials, banner ads, offer walls, and rewarded ads). From the games like Top stars football, it was found that integration of other ads will be beneficial instead of using the same banner ad form. The results reveal that the users show a negative attitude towards banner ads in both mobile systems. Similarly, interstitial ads also seemed to affect the users negatively. Thus, the offer walls and rewarded videos are the most acceptable advertisement formats for revenue generation. Regarding the mobile operating platforms, the revenue split is 38% for Android and 62% for iOS.

Although banner ads are used widely in digital platforms and are supposed to be a communication tool. Eren-Erdoğan & Daştan (2018), stated that the effectiveness of the banner ad is affected by its intrusiveness and blindness. However, the finding illustrated that those banner ads are pop-up ads that come at the top and bottom of the screen. As in the free mobile game platform, these advertisers popped up in landscape mode; hence it should make the users remember the context. But the results revealed that instead of recalling the banner better, the user got irritated as they were more involved and focused on the game. Further, the suggestion was put forward to do more investigation results. Likewise, the Gui & et al. (2017), study showed that more participants from 400 samples reacted and showed negative impacts towards the interstitial advertisement in the android and iOS operating systems. Thus, it is observed from the previous literature that the framing and strategies for choosing the ad formats and pricing model impact highly on revenue production. For instance, the free game strategy proved helpful as it showed the intended statics in regions like Russia, the US, and Japan. Similarly, targeting the right audience influences the intended results through digital advertisement.

The CPC model can be explained as that advertisers pay only for the clicks on their ads (when the visitor after seeing an ad clicks on it). Mobile advertising is the fastest-growing market today. It has evolved through time to become a tool that allows advertisers to efficiently and successfully market products or services to targeted people. This is because mobile devices are omnipresent and may deliver contextual information as well as allow users to indicate preferences (Li et al., 2012). Mobile advertising currently accounts for the majority of overall digital ad spending. Mobile advertising's appeal originates from an ad type unique to the mobile environment: in-app advertisements or adverts displayed within apps. These advertisements offer strong user-tracking features and enable ad networks to connect user data from different sessions, apps, and advertisers. As a result, one of the primary benefits of in-app advertising is its capacity to support behavioral targeting (Rafieian & Yoganarasimhan, 2021).

Mobile advertising is utilized by around 65% of lively apps presently to be had, making it the primary sales movement for developers. Users' principal complaints are community usage, battery use, and privateness concerns. As a substantial contribution to this subject, Topcu & EREN, (2018). The study reflects how mobile advertising influences these intangible charges associated with cellular apps. The authors used an Interstitial video advert format where the finding indicated the forty-four general helps of such ad networks. Along with the explanation that the mobile ad platform considers CPI an essential issue for determining publishers' income on the grounds that CPI affords users the option to download the promoted software program after a few hours or even days, person conduct will become crucial. Finally, the analysis located that iOS classified ads are 1.3 times greater a hit than Android ads.

As we recognize, cell advertisers are the primary source of income for advertisers and function their providers. The developers receive a commission according to the quantity of impressions, also known as CPM advertising. Geumhwan Cho et al. (2016) gave a look at to provide an explanation for the ability risk those cell-based totally

advertising and marketing is inflicting. The study established that CPM is broadly used for marketing in android alongside the use of banner advert codecs. However, the consequences evaluated that those advertisements are causing a ability hazard for 75% of networks. Mark D. Corner and Brian N. Levin (2018) studied MicroMobile, a technique for mobile advertising allocation of brief facts trials to a giant populace of customers.

In advance studies, authors proposed some optionally available contracts to convey advertisers and publishers an settlement and they evaluated the houses in their proposed non-compulsory contract (Moon & Kwon, 2011). Mobile advertising and marketing effectiveness relies on the suitable selection of the advert layout, position of impact, and exercised pricing model (Rzemieniak, 2015). Consequently, formerly performed studies effectively confirmed how to marketplace apps and generate sales. Similarly, some other researcher BaibaLimpuce (2021), contributed to preceding literature together with his thesis paintings on yielding a advertising method for a startup company referred to as Freshbox Games, which specializes in keeping the feminine genre in mobile video games. Finding the maximum green marketing strategies with the fewest financial assets needed to growth emblem and app presence on line changed into the goal of the research. Additionally, the writer furnished the advertising and marketing method to construct the mobile game in conjunction with its today's stylist. The CPC model can be described as that advertisers pay handiest for the clicks on their advertisements (even as the traveller after seeing an advert clicks on it. Mobile advertising is the fastest-growing marketplace these days. It has advanced through time to emerge as a device that lets in advertisers to successfully and efficiently marketplace services or products to centered human beings. This is because cell devices are omnipresent and may deliver contextual facts in addition to permit clients to suggest possibilities (Li et al., 2012). Mobile advertising currently money owed for almost all of typical digital ad spending. Mobile advertising's enchantment originates from an advert type particular to the mobile surroundings: in-app commercials or ads displayed inside apps. These advertisements provide sturdy patron-tracking functions and allow ad networks to connect person statistics from precise sessions, apps, and advertisers. As a end result, one of the primary benefits of in-app advertising is its capacity to assist behavioral targeted on (Rafieian&Yoganarasimhan, 2021).

Organizations view cellular gadgets as a key marketing medium and commit good sized assets to mobile marketing. For instance, cellular advertising and advertising spending in 2007 modified into \$2,773 million, has multiplied to \$189 billion in 2019, and is expected to exceed \$240 billion by the usage of 2022. These numbers show that agencies are making an investment closely in cell advertising, that's motivating teachers and researchers to evaluate the efficiency of those mobile advertising and marketing efforts (Jebarajakirthy et al., 2021).

By 2002, Google and Yahoo! Had both embraced the CPC version, making it the most importantly used pricing version in paid are looking for marketing (Hu et al., 2016). However, clicking' transition on real profits is difficult to calculate. Online marketing is different from traditional media advertising and marketing due to its measurability and

accountability. These attributes supply mobile advertising a aggressive advantage over unique mediums of advertising (Asdemir et al., 2012). In the context of CPI, most of the time advertisers has some type of digital product (software program or recreation), which may be established. Herein, advertisers now not pay for impressions or clicks but best when some people install their software or game, therefore publishers receives a fee.

In addition, it was located inside the research through Chiong et al. (2017) that banner advertising is particularly invasive due to the fact cell screens are smaller than those on PCs, making it challenging to put it on the market on Android cell telephones. Their observe sought to decide if incentive-based totally commercials, which reward users for watching commercials, are useful while used along side gaming applications. The author uses CPI (cost-in keeping with-deploy) pricing for all of its ads to simplest be paid while an commercial consequences in a conversion occasion, which is defined as the consumer downloading the supplied app. Results confirmed that after users are given prizes, incentive-based totally classified ads have a positive effect.

Sayapina (2018), within the context of Russian gaming marketing showed that banner classified ads aren't any anger a sensible layout to trap the attention of the customers as they appear to get without problems annoyed via the exposure of banners subsequently and are in all likelihood to ignore the hem. The CPI/ CPA technique turned into used, and both respondents felt that such campaigns are greater appealing to entrepreneurs because the advertiser will pay simplest when the predetermined target is done. Whereas the locating indicated that to beautify the ROI, entrepreneurs have to make certain that ARPU is excessive, and CPI is low as the range of monthly lively customers extensively impacts ARPU. In conclusion, they verified that cellular gaming companies have to adjust their product to meet higher marketplace orders to enhance the probability that consumers will be given them.

Sorvari & Tommi (2018), performed a case observe wherein to locate the subjectivity of experience by means of the customers. The goal became to comprehend how factors like monetization, acquisition, and retention function in mobile gaming on iOS and Android to predict the introduction of free games. When the use of ads is the simplest means of making money, the gamer might also end up indignant and interrupted via them. The examine targeting attractive the proper target audience the usage of interstitial advert styles and CPI advertising. Although interstitials are distinctly successful, additionally they have the disadvantage of being obtrusive. Therefore, it is evident from a simple remark that poorly designed monetization factors may lead to negative judgments.

Khai& Chen (2016), evolved a new strategy for an online cellular app for app ads advertising, and for that, they used the model CPI (cost according to impact) to acquire customers. The result indicated the effectiveness of the CPI marketing campaign for Android and iOS to attain the highest CPI bid.

Despite pricing fashions, advert formats play a critical function in monetization. As discussed in the examine by Mohammad Tahaei (2022), the framing of an advertisement considerably impacts revenue. He conducted a survey which includes contributors with received enjoy in cellular and digital advertising and marketing. Further, the contributors have been supplied with more than one-preference questions on ad codecs (banner and interstitials advertisement), mobile structures, android or iOS, and ad sorts. The goal become to locate the consumer's issues concerning their privacy and advert framing. Lastly, the findings tested that ad codecs like banner advertisements and interstitial advertisement framing extensively affect the privacy of greater than a million users using iOS and Android mobile systems.

Chatterjee (2008) tested the effect of ad sizes and codecs at the advertised emblem's immediate and deferred bear in mind, recognition, and mindset. In this studies, authors completed a lab experiment of 3 tiers measuring respondents' involvement with several product classes, measuring the Ad stimuli and its effect on logo bear in mind over a behind schedule length.

The examine outcomes show that the engagement fee become incredibly higher. Although, the targeted advertising and marketing campaign may have value a bit more because maximum other commercials ran at a CPM of \$2.50. Additionally, we observed interactive advertisements had the very best engagement than local commercials and times better than the experiments carried out in browsers. The effects additionally confirmed that due to the fact visitors are high-priced, customers of iOS revel in more pricey experimental outcomes than the ones of Android. Additionally, it was determined that CPM charges could want to be raised to reinforce impact charges.

Gong Chen et al. (2016) used the CPM and CPC models as their studies most normally used fashions. Without regard to CPC or CPM, a touchdown web page evaluation demonstrates that the advertiser's value in line with click (CPC) or price per thousand impressions (CPM) is without delay associated with the advert visitors first-rate, as referred to from the preceding literature by way of Gong Chen et al. 2016. They used CPM and CPC fashions as they are the most normally used models in different related research within the digital advertising platform. Moreover, Nkhoma&Pansuwong (2019),expected from their studies that diverse sources of sales, particularly in-app display revenue, will retain to growth within the future. The observe changed into put forward to further growth the efficacy of mobile in-app advertising for no longer simply one however all fascinated parties; this study constructs the function of publishers and shows an included effectiveness paradigm. Further, it became concluded that overall performance-primarily based advert revenues currently eclipsed CPM sales and are continuing to benefit ground whilst carried out in Android and iOS commercial systems.

However, clicking' transition on actual sales is difficult to calculate. Online advertising is different from traditional media advertising because of its measurability and accountability. Measurability refersto that in real-time the campaign's performance can be traced using metrics such as clicks. Accountability refers to that the websites can be

rewarded based on similar metrics. These attributes give mobile advertising a competitive advantage over other mediums of advertising (Asdemir et al., 2012). In the context of CPI, most of the time advertisers have some sort of digital product (application or game), which can be installed. Herein, advertisers do not pay for impressions or clicks but only when some user installs their application or game, consequently publishers get paid.

2.3. Literature Framework

Name of the Author	Summary of the research paper
Rzemieniak (2015)	Effectiveness of mobile advertisement is based on the appropriate selection of ad format; position of impression, and pricing model being used.
Moon & Kwon (2011)	Proposed hybrid pricing models, which is based on optimization of costs through minimum CPM and CPC fees.
BaibaLimpuce (2021)	Recommending a pricing strategy based on the rewards and different financial offers.
Pengyuan Wang (2019)	Concluded that age and gender have a significant influence on the effectiveness of mobile marketing.
Khai X. Chiong (2017)	Banner advertisements are not effective for mobile phones because of the small screens of mobile phones.
Diana Sayapina (2018)	Concluded that banner advertisements lead to the irritation of viewers hence are ignored by most of the target audience.
Gong Chen (2016)	Found that CPM and CPC are most widely used pricing models.
Sakib Ahmed (2019)	Concluded that CPI is the most effective pricing model for mobile marketing.
SurajArshanapally (2022)	Found that CPC was more effective pricing model as compared to other pricing models.

2.4. Conceptual Framework and Hypothesis

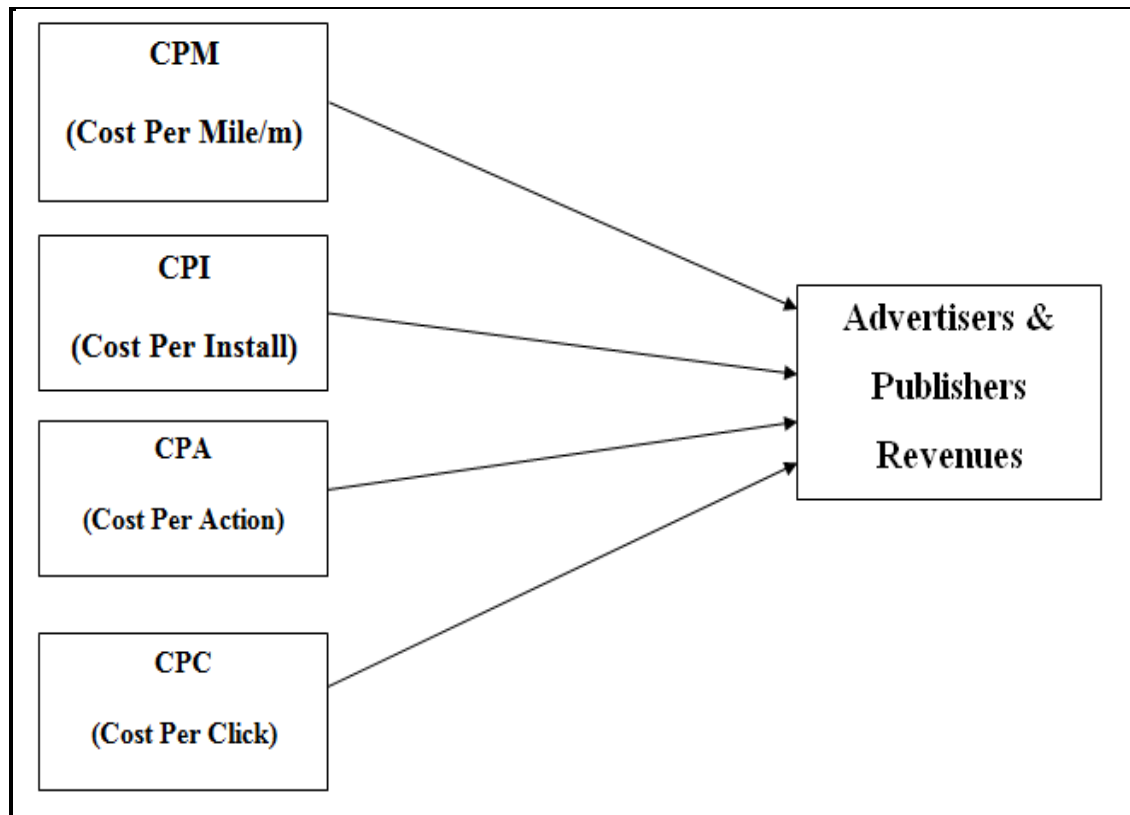


Figure 1. Framework

H1: There is significant impact of CPM (Cost per Mile/Million) Pricing models on Advertisers & Publishers Revenues in Android operating system.

H2: There is significant impact of CPC(Cost per Click) Pricing models on Advertisers & Publishers Revenues in Android operating system.

H3: There is significant impact of CPA (Cost per Action) Pricing models on Advertisers & Publishers Revenues in Android operating system.

H4: There is significant impact of CPI(Cost per Install) Pricing models on Advertisers & Publishers Revenues in Android operating system.

3. METHOD

The Research Methodology is the process of selection of various choices of research methods based on philosophy of research. The researcher can choose Quantitative or Qualitative research approach based on those approaches all choices are different in data collection and data analysis. This portion explains the choices researchers select to conduct the research.

The current research utilizes a quantitative approach by using secondary data published by Appodealand Thomson Reuters that contains records of several variables like ad formats, impression, e-CPM and so forth. The secondary data for such kind of study will not be used for the first time. Appodeal and its published data have been used for similar research in the past (Kim et al., 2012). The research is based on time series data analysis of pricing models of and advertising cost and how advertisers and publishers of Android operating system platforms utilize various models and how it will affect the cost. The time data analysis performed by collecting the US Android operating system mobile advertisers and publisher's data on models includes CPI, CPM, CPC, and CPA.

3.1. Research Design

The research methodology of a research paper is stated to be the study's foundation, upon which the pillars of the research are constructed in terms of the data, audience, geography, and sample collection. This research will be conducted based on secondary data analysis and time series data analysis will be performed.

The current study is focused on determining the economical effectiveness of different ad formats and pricing models. There are various pricing models that are being used including CPI, CPM, CPC and CPA and data of various publishers will be taken for analysis. This study is positive in nature since it employed the data collected from Appodealand Thomson Reuters to evaluate and deduct the findings. A deductive approach is employed in this study, which is also aligned with Crowther and Lancaster (2008) who informed that as a general rule, positivist studies usually adopt deductive approach.

Secondary data is used in current study and data is gathered from reports published by Appodeal. The time series data of Pakistani companies and publishers using Android operating system advertisers collected to analyze the impacts of pricing models on advertising revenues and cost optimization. Current study used quantitative data (secondary data) in order to analyze the effectiveness of CPM, CPC, CPA and CPI; while taking into account commonly used ad formats for evaluation purposes to make the research more comprehensive. Time horizon of this research is limited and depends upon the collection of archival data, its analyses and interpretation. The current study covered the data between 2018 to 2022.

3.2. Research Data and Sources

The research is explanatory in nature and research time series data analysis performed based on last year's 5 years data of various Models includes CPM, CPI, CPA and CPC and revenues of advertisers and publishers. The year's data taken from 2018 to 2022 to selected publishers and advertisers and time series data collected to analyze the impact and significance of these pricing models. The current study is focused on determining the economical effectiveness of different ad formats and pricing models. There are various pricing models that are being used including CPI, CPM, CPC and CPA and data of various publishers will be taken for analysis. This study is positive in nature since it employed the data collected from Appodeal and Thomson Reuters to evaluate and deduct the findings.

Table 1. Data and Sources

Variables	Data	Source
CPM	Cost per minute/million	Appodeal and Thomson Reuters
CPC	Cost per Click	Appodeal and Thomson Reuters
CPI	Cost per Install	Appodeal and Thomson Reuters
CPA	Cost per Action	Appodeal and Thomson Reuters
Revenues of Publishers and Advertisers	Revenues of publishers and advertisers	Appodeal and Thomson Reuters

3.3. Data Collection Methods

The research is quantitative and will be conducted based on secondary data of selected advertisers. This study is positive in nature since it employed the data collected from Appodeal and Thomson Reuters to evaluate and deduct the findings. The time series collected of at least five years from 2018 to 2022 on Pakistani companies advertising Android operating system companies, the time series data on selected variables will be collected to finalize the impact of variables on advertisers cost.

Data Links and Sources of Data:

www.appodeal.com

www.thomsonreuters.com

<https://www.businessofapps.com/ads/research/mobile-app-advertising-cpm-rates/>

<https://appodeal.com/monetization/>

3.4. Statistical Techniques for Data Analysis

Analysis of the data is regarded as one of the most vital pillars of overall research methodologies because it comprises the evaluation of the information gathered from primary and secondary resources. Further, authentic analyses of collected data lead the researcher to highlight the aim of the case study, which further permits them to estimate the research findings, as well as the pros and cons of the subject under study (Heeringa *et al.*, 2017). With that being said, this case study analyzed its data through the details gathered from the conducted online survey.

Secondary data is used in current study and data is gathered from reports published by Appodeal. The time series data of Pakistani company's Android operating system advertisers collected to analyze the impacts of pricing models on advertising revenues and cost optimization. Current study used quantitative data (secondary data) in order to analyze the effectiveness of CPM, CPC and CPI; while taking into account commonly used ad formats for evaluation purposes to make the research more comprehensive. The research results analyzed through E-views 9.5 Software and time series data analysis will be performed. The time series data analysis performed includes Unit root test, regression analysis and co-integration model to evaluate the results.

3.5. Model Specification

$$\text{Revenues} = \alpha + \beta_1 \text{ CPM} + \beta_2 \text{ CPC} + \beta_3 \text{ CPI} + \beta_4 \text{ CPA} + \varepsilon$$

DV: Rcp= Revenues of Advertisers using Android operating system platforms

IV-1: CPM: Cost Per minute/millions of advertisings

IV-2: CPC: Cost per click

IV-3: CPA= Cost Per Action

4. FINDINGS

The research conducted to analyze the impact of cost pricing model of mobile advertisers and publishers in Pakistani companies based on Android operating system operators. The data collected from Appodeal and Thomson Reuter's data analytics software's and time series data collected of last 5 years based on average values. The Unit Root Tests, Regression Analysis and Co-integration analysis applied based on time series data and model are analyzed as they are impacting on increase in revenues of publishers or only increase cost of advertisers.

4.1. Unit Root Test (Stationary Analysis in Data)

Unit Root test performed to evaluate the stationary of data, if data is Stationarity, then further test can be applied. The data for the unit root test was nonstationary and were taken from appropriate and reliable sources. The variables are tested based on ADF test conducted in E-views. The results are below.

H₀ = series have no unit root (time series is stationary)

Table 2.Unit root test ADF

Variable	At Level	Critical value	Decision of H ₀	At 1st Difference	Critical value	Decision of H ₀
CPM	-1.02	0.33	Rejected	-7.33	0.00	Do not Reject
CPC	-2.08	0.25	Rejected	-22.25	0.001	Do not Reject
CPI	-0.26	0.90	Rejected	-14.21	0.00	Do not Reject
CPA	-0.65	0.98	Rejected	-8.3	0.00	Do not Reject
Advertisers Revenues	-0.21	0.92	Rejected	-10.8	0.00	Do not Reject

The Unit root test applied to analyze the Stationarity of data; the data should be normally distributed and if the data is non-stationary the researcher applied first difference, to convert data is to normally distributed data. All the models and factors are non-stationary at level means there is unit root in the data and being an analyst, we have to conduct analysis with normally distributed data, so we applied first difference based on ADF tests to convert data in stationary data and we can apply model and analysis. The criteria for unit root are 95% confidence interval approach and based on 95% confidence

interval approach the value must be greater than 2.88 of statistics and probability value must be less than 0.00. in case of all model the unit root exists and then applied first difference to convert data at normal distribution.

4.2. Regression Analysis

The Regression Analysis is the model applied to predict the changes in dependent variables. The models CPM, CPC, CPI and CPA are taken as independent variables and revenues maximization is dependent variable for analysis.

Table 3. Mobile Advertising Pricing Models

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.573446	0.466815	1.228421	0.2245
CPM	0.269883	0.098903	2.728761	0.0085
CPC	1.596910	0.378192	4.222486	0.0001
CPA	-0.039461	0.021449	-1.839777	0.0712
CPI	0.445688	0.230761	1.931382	0.0586
Model Summary				
R-squared	0.755526	Mean dependent var	6.084000	
Adjusted R-squared	0.737747	S.D. dependent var	2.750412	
S.E. of regression	1.408505	Akaike info criterion	3.602590	
Sum squared residual	109.1137	Schwarz criterion	3.777119	
Log likelihood	-103.0777	Hannan-Quinn criter.	3.670858	
F-statistic	42.49331	Durbin-Watson stat	1.695334	
Prob(F-statistic)	0.000000			

The regression analysis applied based on 95% confidence interval approach and required values are t statistics must be greater than 2 and probability value must be less than 0.00 to show the significant of model and variables. The pricing model is significant when criteria matched, and we can emphasis on those models which are significant. The Model CPA and CPI are insignificant as the value is less than 2 and probability is less than 0.05. The models CPM and CPA values of t-statistics are greater than 1.96 and probability values are less than 0.00 this shows the models are significant. These models

are significant models to analyze the revenues publishers and these models are better models in analyzing the cost and revenues of advertisers and publishers in the case of Android operating system.

The Model R Square elaborates the predictability power of model this shows 0.75 which is 75% predictability, based on analytics this model is having sufficient predictability power in secondary data 0.6 is required (Hair & et al, 2009). The models CPM and CPA are better models and significant to analyze the revenues of publishers in Android case. The mode F Statistics is also significant as the value is greater than 2 and probability is less than 0.05. The regression results elaborates the significance of models the models CPM and CPC are significant models and these models are effective for publishers to use while considering cost and revenues optimization, and considering the CPA and CPI are less impacted and these models has less impact on advertising and these models are insignificant. The Android publishers may use the CPM and CPC while considering the cost and approach to customers and may consider the others models in Android publishing and advertising.

4.3. Regression Hypothesis

Table 4.Hypothesis Testing

Hypothesis	T Values	Probability Values	Decision
H1: There is significant impact of CPM (Cost per Mile/Million) Pricing models on Advertisers & Publishers Revenues in Android operating system.	2.728761	0.0085	Accepted
H2: There is significant impact of CPC (Cost per Click) Pricing models on Advertisers & Publishers Revenues in Android operating system.	4.222486	0.0001	Accepted
H3: There is significant impact of CPA (Cost per Action) Pricing models on Advertisers & Publishers Revenues in Android operating system.	-1.839777	0.0712	Rejected
H4: There is significant impact of CPI (Cost per Install) Pricing models on Advertisers & Publishers Revenues in Android operating system.	1.931382	0.0586	Rejected

There are four hypotheses based on regression analysis. Regression analysis is performed to evaluate the impact of these pricing models on revenues and cost optimization of android publishers. The hypotheses testing is decided based on 95%

confidence interval and 5% margin of error, the values of t statistics must be greater than 1.96 and probability values must be less than 0.05 for significance of variable (Hair & et al, 2009). Based on regression results the model CPM and CPC are significant, and CPA and CPI are insignificant. The hypothesis of CPA and CPI are rejected, and this elaborates these models are not significant and has no impact or less impact of publishers cost of advertising in Android operating systems.

4.4. Co-integration Analysis

Table 5.Co-integration Test results

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**	Hypothesis Decision
None *	0.799735	239.1574	69.81889	0.0000	None
At most 1 *	0.735079	145.8867	47.85613	0.0000	Co-integrated
At most 2 *	0.582571	68.84386	29.79707	0.0000	Co-integrated
At most 3 *	0.263216	18.17276	15.49471	0.0193	Co-integrated
At most 4	0.007833	0.456084	3.841466	0.4995	Co-integrated
None *	0.799735	239.1574	69.81889	0.0000	Co-integrated

The Co integration table results evaluates that there is no long-term relationship of variables based on stationary data. The data analyzed is based on an economic model, hence the co-integration model is significant. The Models CPM and CPA are significant models and thus predict the changes in revenues of publishers and these are effective models to use and implement while advertising through Android operating system. The results evaluate the long-term relationship of variables and CPM and CPA having significant value and significant models for analysis.

5. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

The purpose of this research is to analyze the advertising through mobile application and various pricing models are analyzed to evaluate the cost minimization and increasing revenues of publishers and advertisers. The researcher develop analysis based on exiting usage of models by various advertisers and analyze four models includes CPM, CPI, CPC and CPA in android operating systems. Various researches has been explains the models based on need and specific requirements. BaibaLimpuce (2021) Recommending a pricing strategy based on the rewards and different financial offers, the offers they provide the best utilization of revenues models and analysis can be used. Pengyuan Wang (2019) Concluded that age and gender have a significant influence on the effectiveness of mobile marketing, these factors are not separately used of compare with the pricing model in this particular research. Gong Chen (2016) Found that CPM and CPC are most widely used pricing models, this research also explain the same thing these models are effective based on statistical analysis and researcher recommend to use these models for effective advertising and increase revenues maximization. SurajArshanapally (2022) Found that CPC was more effective pricing model as compared to other pricing models, this research also explain the same thing that research elaborates the same pricing models CPC and CPM which are very effective. Based on these researches in various economies this research also investigates based on empirical data and analyzed in e-views software. Based on empirical results the model CPM and CPC are effective for advertisers to use and increase their revenues and while the othersmodels are insignificant and do not have any impact of advertisers revenues. The research also explains the significance of models in android mobile systems and various models has been adopted by various publishers as literature also quotes the studies in literature and discussion.

5.2. Discussion

The secondary was collected from Appodeal, Thomson Reuters and android application mobile rates websites for analysis of pricing models of Android in US and values are considered in dollars. The time series and data of CPM, CPC, CPA, and CPI with dependent variables publishers' revenues of last 5 years month wise figures from January 2018 to December 2022 has been collected for secondary data analysis. The analysis was performed through E-views 9.5 software and econometric models applied. The research analysis applied Unit root test performed for analyzing the Stationarity of data, regression analysis performed to evaluate the significance of models, co-integration applied to analyze the long term relationship of these pricing model with revenues optimization. The importance of mobile advertising for marketers makes it a key task to gain insight into the drivers of mobile advertising effectiveness. Mobile advertising allows consumers to access advertising messages at their convenience. When consumers receive mobile advertising messages they can read them, delete them, or keep them until they decide what to do with them. Thus, factors underlying mobile advertising acceptance

can play a key role in the success of mobile advertising. Prior studies have emphasized that attitudes to mobile advertising is an important construct for mobile marketing research due to its effects on perceived value which, in turn, impacts on consumer loyalty. Whereas previous research on attitudes towards mobile advertising has focused on innovation-based drivers and consumer beliefs such as trust.

The CPC model can be explained as that advertisers pay only for the clicks on their ads (when the visitor after seeing an ad clicks on it). Mobile advertising is the fastest-growing market today. It has evolved through time to become a tool that allows advertisers to efficiently and successfully market products or services to targeted people. This is because mobile devices are omnipresent and may deliver contextual information as well as allow users to indicate preferences (Li et al., 2012). Mobile advertising currently accounts for the majority of overall digital ad spending. Mobile advertising's appeal originates from an ad type unique to the mobile environment: in-app advertisements or adverts displayed within apps. These advertisements offer strong user-tracking features and enable ad networks to connect user data from different sessions, apps, and advertisers. As a result, one of the primary benefits of in-app advertising is its capacity to support behavioral targeting (Rafieian&Yoganarasimhan, 2021).

The results of this research analysis show that the data is nonstationary, and first difference applied to convert data into stationary data and then regression analysis performed. The regression analysis shows the models CPM and CPA are effective models and the values are significant and having impact of revenues maximization of publishers and effective models for advertising, while the CPI and CPA are not significant in this case based on collected time series data. The advantage of charging by CPC is its high conversion rate: generally, users will click on the information they are interested in, and advertisers can explore and analyze the potential needs of users through user clicks data, and then push related products for target users. On TikTok, the internal competition among various industries should not be underestimated. Advertisers who are charged according to CPC cannot avoid malicious clicks by competitors in the same industry, which may increase their cost of advertising. In general, the CPC pricing method is suitable for advertisers with small budgets and high-performance requirements (Cai et al., 2022).

Rzemieniak (2015) elaborates that Effectiveness of mobile advertisement is based on the appropriate selection of ad format; position of impression, and pricing model being used. This study also reflects the sales the mobile advertising impact the revenues maximization and the models need to be selected carefully so that models should be effective for advertising and promotion. Moon & Kwon (2011) explains that proposed hybrid pricing models, which is based on optimization of costs through minimum CPM and CPC fees. The results of this study also similar to this research findings. These two CPM and CPC models are effective and best can be utilized pricing models and at few stages these are used as hybrid models as well.

5.3. Implementation of Theory

The theoretical contribution of this research is that this research elaborates the four pricing models on Android application platforms and from two was justified to use by advertising in Pakistan. Various other researchers in different economies also contribute the knowledge of these android models, Mobile advertising is one of the interactive media of advertising as it does not communicate the message of advertisers, but also allows the audience to respond in a certain manner that usually starts with clicking upon the ad, which further allows them to visit advertisers' websites, filling out a survey, installing some application or game, buying some sort of online products, etc. (Rzemieniak, 2015). Entrepreneurs can take big advantage of this because of the easy access to information on the consumer's end. A plethora of research has been conducted in this research area. Mobile advertising is the fastest-growing market today. It has evolved through time to become a tool that allows advertisers to efficiently and successfully market products or services to targeted people.

This is because mobile devices are omnipresent and may deliver contextual information as well as allow users to indicate preferences (Li et al., 2012). Mobile advertising currently accounts for the majority of overall digital ad spending. Mobile advertising's appeal originates from an ad type unique to the mobile environment: in-app advertisements or adverts displayed within apps. These advertisements offer strong user-tracking features and enable ad networks to connect user data from different sessions, apps, and advertisers. As a result, one of the primary benefits of in-app advertising is its capacity to support behavioral targeting (Rafieian&Yoganarasimhan, 2021). Based on regression analysis the hypothesis of CPM and CPC are accepted, hence based on this research we can recommend to marketers and advertisers to use CPM and CPC models for revenue maximization for android operating platforms. .

5.4. Implications of Research

The research is useful for analysis of Android mobile applications by using various pricing models includes CPM, CPI, CPC, and CPA. The pricing models are analyzed based on time series data and revenues optimization is analyzed. The researcher predicts based on statistical results that's the CPM and CPC are effective models for analysis and publishers can increase their revenues by using these mobile pricing models with Android platforms. There are various pricing models used in advertising including CPM, CPC, CPA, and CPI. Mobile advertising is the fastest-growing industry as of the dramatic rise in the usage of smart phones making this platform increasingly attractive for businesses to advertise. The research implication shows that marketers and mobile application companies must focus on CPM and CPC as pricing models for advertising while using android mobile applications. The Android applications companies in Pakistan and advertisers and marketers must consider the pricing models while advertising and they should use the CPM and CPC which are better models and analysis can be performed by using these models.

5.5. Limitations of Research

The study is limited to Pakistan – for convenient collection, better evaluation, and interpretation of data. Moreover, we have limited our research to just one operating system, Android and pricing models are used as CPM, CPC, CPA, and CPI. The time series data of Pakistani company's Android operating system advertisers collected to analyze the impacts of pricing models on advertising revenues and cost optimization. Current study used quantitative data (secondary data) in order to analyze the effectiveness of CPM, CPC and CPI; while taking into account commonly used ad formats for evaluation purposes to make the research more comprehensive. The research is based on time series data and data generalization can be possible for Pakistani Android mobile companies to select which pricing models. The other researchers focus on studying in future on other pricing models and other mobile applications systems like iOS and e-CPM models etc. to have more contribution towards research knowledge.

REFERENCES**Research Journal Articles**

- Adler, M., Gibbons, P. B., & Matias, Y. (2002). Scheduling space-sharing for internet advertising. *Journal of Scheduling*, 5(2), 103-119.
- Aramendia-Muneta, M. E., & Olarte-Pascual, C. (2019). Consumer attitudes towards mobile advertising: an updated vision. *International Journal of Internet Marketing and Advertising*, 13(3), 235-252.
- Arshanapally, S., Green, K., Slaughter, K., Muller, R., & Wheaton, D. (2022). Use of a Paid Digital Marketing Campaign to Promote a Mobile Health App to Encourage Parent-Engaged Developmental Monitoring: Implementation Study. *JMIR Pediatrics and Parenting*, 5(2), 34425.
- Asdemir, K., Kumar, N., & Jacob, V. S. (2012). Pricing Models for Online Advertising: CPM vs. CPC Pricing Models for Online Advertising
- Asdemir, K., Kumar, N., & Jacob, V. S. (2012). Pricing models for online advertising: CPM vs. CPC. *Information Systems Research*, 23(3-part-1), 804-822.
- Chandon, J. L., Chtourou, M. S., & Fortin, D. R. (2003). Effects of configuration and exposure levels on responses to web advertisements. *Journal of Advertising Research*, 43(2), 217-229.
- Chatterjee, P. (2008). Are Unclicked Ads Wasted? Enduring Effects of Banner and Pop-Up Ad Exposures on Brand Memory and Attitudes. *Journal of electronic commerce Research*, 9(1).
- Chen, G., Cox, J. H., Uluagac, A. S., & Copeland, J. A. (2016). In-depth survey of digital advertising technologies. *IEEE Communications Surveys & Tutorials*, 18(3), 2124-2148.
- Chiong, K., Chen, R., & Yang, S. (2017). Incentivized advertising: Treatment effect and adverse selection. arXiv preprint arXiv:1709.00197.
- Cho, G., Cho, J., Song, Y., Choi, D., & Kim, H. (2016). Combating online fraud attacks in mobile-based advertising. *EURASIP Journal on Information Security*, 2016(1), 1-9.
- Choi, S. M., Kim, E., Kim, S., & Yeh, Y. H. (2013). Factors Affecting Advertising Avoidance on Online Video Sites. *Journal of Advertising and Promotion Research*, 2(1), 87-121.
- Çiçek, M., Eren-Erdoğan, İ., & Daştan, İ. (2018). How to increase the awareness of in-app mobile banner ads: exploring the roles of banner location, application type and orientation. *International Journal of Mobile Communications*, 16(2), 153-166.
- Corner, M. D., & Levine, B. N. (2018, June). MicroMobile: Leveraging mobile advertising for large-scale experimentation. In *Proceedings of the 16th Annual*

- International Conference on Mobile Systems, Applications, and Services (pp. 310-322)
- Eze, U. C., & Lee, C. H. (2012). Consumers' attitude towards advertising. *International journal of business and management*, 7(13), 94-108.
- Fatima, S., & Lodhi, S. (2015). Impact of Advertisement on Buying Behaviours of the Consumers: Study of Cosmetic Industry in Karachi City. *International journal of management sciences and business research*.
- Fjell, K. (2009). Online advertising: Pay-per-view versus pay-per-click—A comment. *Journal of revenue and pricing management*, 8(2-3), 200-206.
- Fjell, K. (2010). Online advertising: Pay-per-view versus pay-per-click with market power. *Journal of revenue and pricing management*, 9(3), 198-203.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 39-50.
- Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of marketing research*, 382-388.
- Friman, J. (2010). Consumer attitudes toward mobile advertising.
- Gallego, G., & Phillips, R. (2004). Revenue management of flexible products. *Manufacturing & Service Operations Management*, 6(4), 321-337.
- Gallego, G., Kou, S. G., & Phillips, R. (2008). Revenue management of callable products. *Management Science*, 54(3), 550-564.
- Gao, C., Zeng, J., Sarro, F., Lyu, M. R., & King, I. (2018, September). Exploring the effects of ad schemes on the performance cost of mobile phones. In *Proceedings of the 1st international workshop on advances in mobile app analysis* (13-18).
- Ghose, A., & Han, S. P. (2014). Estimating demand for mobile applications in the new economy. *Management Science*, 60(6), 1470-1488.
- Goncharova, E. (2017). *Monetization Strategies in Free-To-Play Mobile Games: Case: From the Bench*.
- Grewal, D., Bart, Y., Spann, M., & Zubcsek, P. P. (2016). Mobile advertising: a framework and research agenda. *Journal of Interactive Marketing*, 34, 3-14.
- Gui, J., Nagappan, M., & Halfond, W. G. (2017). What aspects of mobile ads do users care about? an empirical study of mobile in-app ad reviews. arXiv preprint arXiv:1702.07681.
- Hirsimäki, M., Alavesä, P., & Arhippainen, L. (2021). Between Beats: Linking Player Engagement to Advertisement Frequency and Intrusiveness. In *2021 30th Conference of Open Innovations Association FRUCT* (71-78). IEEE.

- Hoffman, D. L., & Novak, T. P. (2000). How to acquire customers on the web. *Harvard business review*, 78(3), 179-188.
- Hu, Y., Shin, J., & Tang, Z. (2016). Incentive problems in performance-based online advertising pricing: Cost per click vs. cost per action. *Management Science*, 62(7), 2022-2038.
- Izquierdo-Yusta, A., Olarte-Pascual, C., &Reinares-Lara, E. (2015). Attitudes toward mobile advertising among users versus non-users of the mobile Internet. *Telematics and Informatics*, 32(2), 355-366.
- Jebarajakirthy, C., Maseeh, H. I., Morshed, Z., Shankar, A., Arli, D., & Pentecost, R. (2021). Mobile advertising: A systematic literature review and future research agenda. *International Journal of Consumer Studies*, 45(6), 1258-1291.
- Kim, B., Ha, J., Lee, S., Kang, S., Lee, Y., Rhee, Y., ... Song, J. (2012). AdNext: A Visit-Pattern-Aware Mobile Advertising System for Urban Commercial Complexes, 7–12.
- Kim, S. C., Yoon, D., & Han, E. K. (2016).Antecedents of mobile app usage among smartphone users.*Journal of marketing communications*, 22(6), 653-670.
- Kumar, S., &Sethi, S. P. (2009). Dynamic pricing and advertising for web content providers. *European Journal of Operational Research*, 197(3), 924-944.
- Kwon, C. (2011). Single-period balancing of pay-per-click and pay-per-view online Li, M., Dong, Z. Y., & Chen, X. (2012). Factors influencing consumption experience of mobile commerce: A study from experiential view. *Internet Research*, 22(2), 120-141.
- Levin, Y., McGill, J., &Nediak, M. (2007). Price guarantees in dynamic pricing and revenue management. *Operations Research*, 55(1), 75-97.
- Li, K., & Du, T. C. (2012).Building a targeted mobile advertising system for location-based services. *Decision Support Systems*, 54(1), 1-8.
- Limpuce, B. (2021). Marketing plan for promoting a mobile game: Case: Freshbox Games.
- Ling, K. C., Piew, T. H., & Chai, L. T. (2010).The determinants of consumers' attitude towards advertising.*Canadian social science*, 6(4), 114-126.
- Mangani, A. (2004). Online advertising: Pay-per-view versus pay-per-click. *Journal of Revenue and Pricing Management*, 2(4), 295-302.
- Meng, W., Ding, R., Chung, S. P., Han, S., & Lee, W. (2016, February). The Price of Free: Privacy Leakage in Personalized Mobile In-Apps Ads. In *NDSS* (pp. 1-15).
- Moon, Y., & Kwon, C. (2011).Online advertisement service pricing and an option contract. *Electronic Commerce Research and Applications*, 10(1), 38–48.

- Nash Jr, J. F. (1950).The bargaining problem.Econometrica: Journal of the Econometric Society, 155-162
- Pham, N. (2016). Behind the App: How Developers are Operating, Scaling and Measuring Success. Application Developers Alliance, Quarterly Report.
- Rafieian, O., &Yoganarasimhan, H. (2021).Targeting and privacy in mobile advertising.Marketing Science, 40(2), 193-218.
- Raluca, C., &Ioan, P. (2010).The impact of consumer's attitude toward advertising on product attitude. Interdisciplinary Management Research, 6, 727-738.
- Rzemieniak, M. (2015).Measuring the effectiveness of online advertising campaigns inthe aspect of e-entrepreneurship.Procedia - Procedia Computer Science, 65(Iccmit), 980-987.
- Salem, M. (2016). Factors affecting consumer attitudes, intentions and behaviors toward SMS advertising in Palestine, Journal of Digital Marketing
- Sayapina, D. (2018). Attracting mobile game users in foreign markets: Case study: The Russian Mobile Game Market.
- Shetty, D. (2014). Mobile app ecosystem: an app developer's path to success.
- Sorvari, T. (2018). How the Different Retention and Monetization Features Affect the User Experience in Free-to-play Mobile Games.
- Tahaei, M., Frik, A., &Vania, K. (2021). Deciding on Personalized Ads: Nudging Developers About User Privacy. In Seventeenth Symposium on Usable Privacy and Security (SOUPS 2021) (573-596).
- Truong, V. N. X., Nkhoma, M., &Pansuwong, W. (2019).An integrated effectiveness framework of mobile in-app advertising.Australasian Journal of Information Systems, 23.
- Wang, P., Xiong, G., & Yang, J. (2019). Serial position effects on native advertising effectiveness: Differential results across publisher and advertiser metrics. Journal of Marketing, 83(2), 82-97.
- Wilmott, P., Dewynne, J., &Howison, S. (1993). Option pricing: mathematical models and computation. Oxford financial press.
- Zabadi, A. M. A., Shura, M., &Elsayed, E. A. (2012).Consumer attitudes toward SMS advertising among Jordanian users. International journal of marketing studies, 4(1), 77
- Zubcsek, P. P., Katona, Z., &Sarvary, M. (2017).Predicting mobile advertising response using consumer colocation networks. Journal of Marketing, 81(4), 109-126.

Books

Ahmed, S. (2019). Digital marketing services of Bitspearhead Limited.

Black, W., & Babin, B. J. (2019). Multivariate data analysis: Its approach, evolution, and impact. In *The Great Facilitator: Reflections on the Contributions of Joseph F. Hair, Jr. to Marketing and Business Research* (121-130). Cham: Springer International Publishing.

Hair, J. F. (2009). *Multivariate data analysis*.

TOPCU, B., & EREN, M. U. (2018). A methodology for the classification of mobile advertising platforms.

Web Sources

APPODEAL. (2017). Retrieved November 20, 2017, from <https://www.appodeal.com/reports/2017-11-13/android/pk>

Chitika | Online Advertising Network. (2017). Retrieved November 20, 2017, from <https://chitika.com/>

Display Advertising - Amazon Advertising. (2017). Retrieved November 20, 2017, from <https://advertising.amazon.com/amazon-display-advertising>

Facebook Audience Network. (2017). Retrieved November 20, 2017, from <https://developers.facebook.com/products/audience-network/overview/>

Infolinks - Innovative Ads Powered by Intent. (2017). Retrieved November 20, 2017, from <https://www.infolinks.com/>

Mario Torija. (2016). Performance Marketing for dummies - mobusi mobile advertising. Retrieved November 17, 2017, from <http://blog.mobusi.com/performance-marketing-for-dummies/>

Media.net | Yahoo! Bing Network Contextual Ads. (2017). Retrieved November 20, 2017, from <https://www.media.net/>

SKIMLINKS. (2017). Retrieved November 20, 2017, from <https://skimlinks.com/>

The Adversal Publisher Network. (2017). Retrieved November 20, 2017, from <https://www.adversal.com/>

VigLink — Powering Content-Driven Commerce. (2017). Retrieved November 20, 2017, from <https://www.viglink.com/>

APPENDICES

Appendice1. Data Sheet

Year	CPM \$	CPC \$	CPI \$	CPA \$	Publishers Revenues bn \$
2018-Jan	3.285	1.01	0.05	7.20	2.34
2018-Feb	2.19	1.05	0.28	7.88	2.496
2018-March	2.11	0.75	0.52	6.53	1.8
2018-April	2.11	0.78	0.52	4.05	2.52
2018-May	1.42	0.83	0.72	1.80	2.88
2018-June	2.63	0.80	0.72	4.05	2.52
2018-July	2.72	0.99	0.79	4.73	2.28
2018-Aug	2.17	1.06	0.97	5.40	1.8
2018-Sep	2.21	0.99	0.95	6.98	2.88
2018-Oct	1.24	1.02	0.97	9.68	2.28
2018-Nov	2.19	1.35	0.92	12.38	2.364
2018-Dec	2.96	1.05	0.88	12.15	1.92
2019-Jan	6.57	2.01	0.10	14.40	4.68
2019-Feb	4.38	2.10	0.56	15.75	4.992
2019-March	4.22	1.50	1.04	13.05	3.6
2019-April	4.22	1.56	1.04	8.10	5.04
2019-May	2.85	1.65	1.44	3.60	5.76
2019-June	5.26	1.59	1.44	8.10	5.04
2019-July	5.43	1.98	1.58	9.45	4.56
2019-Aug	4.34	2.12	1.94	10.80	3.6
2019-Sep	4.42	1.98	1.89	13.95	5.76
2019-Oct	2.47	2.04	1.94	19.35	4.56
2019-Nov	4.38	2.70	1.85	24.75	4.728
2019-Dec	5.91	2.10	1.76	24.30	3.84
2020-Jan	9.00	2.16	0.13	19.20	5.85
2020-Feb	6.00	1.44	0.75	21.00	6.24
2020-March	5.78	1.98	1.38	17.40	4.5
2020-April	5.78	2.10	1.38	10.80	6.3
2020-May	3.90	2.22	1.92	4.80	7.2
2020-June	7.20	2.46	1.92	10.80	6.3
2020-July	7.44	2.58	2.10	12.60	5.7
2029-Aug	5.94	1.74	2.58	14.40	4.5

2020-Sep	6.06	1.86	2.52	18.60	7.2
2020-Oct	3.38	2.16	2.58	25.80	5.7
2020-Nov	6.00	2.22	2.46	33.00	5.91
2020-Dec	8.10	2.16	2.34	32.40	4.8
2021-Jan	10.95	3.35	0.17	24.00	7.80
2021-Feb	7.30	3.50	0.94	26.25	8.32
2021-March	7.04	2.50	1.73	21.75	6.00
2021-April	7.04	2.60	1.73	13.50	8.40
2021-May	4.75	2.75	2.40	6.00	9.60
2021-June	8.76	2.65	2.40	13.50	8.40
2021-July	9.05	3.30	2.63	15.75	7.60
2021-Aug	7.23	3.53	3.23	18.00	6.00
2021-Sep	7.37	3.30	3.15	23.25	9.60
2021-Oct	4.12	3.40	3.23	32.25	7.60
2021-Nov	7.30	4.50	3.08	41.25	7.88
2022-Dec	9.86	3.50	2.93	40.50	6.40
2022-Jan	15.00	3.60	0.22	32.00	9.75
2022-Feb	10.00	2.40	1.25	35.00	10.40
2022-March	9.64	3.30	2.30	29.00	7.50
2022-April	9.64	3.50	2.30	18.00	10.50
2022-May	6.50	3.70	3.20	8.00	12.00
2022-June	12.00	4.10	3.20	18.00	10.50
2022-July	12.40	4.30	3.50	21.00	9.50
2022-Aug	9.90	2.90	4.30	24.00	7.50
2022-Sep	10.10	3.10	4.20	31.00	12.00
2022-Oct	5.64	3.60	4.30	43.00	9.50
2022-Nov	10.00	3.70	4.10	55.00	9.85
2022-Dec	13.50	3.60	3.90	54.00	8.00

Data Links and Sources of Data:

www.appodeal.com

www.thomsonreuters.com

<https://www.businessofapps.com/ads/research/mobile-app-advertising-cpm-rates/>

<https://appodeal.com/monetization/>

Appendices 2. E-views Outputs

Eviews Outputs

Null Hypothesis: CPA_\$ has a unit root

Exogenous: Constant

Lag Length: 8 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	0.652753	0.9899
Test critical values: 1% level	-3.565430	
5% level	-2.919952	
10% level	-2.597905	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CPA_\$)

Method: Least Squares

Date: 03/06/23 Time: 10:57

Sample (adjusted): 10 60

Included observations: 51 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPA_\$(-1)	0.034333	0.052597	0.652753	0.5176
D(CPA_\$(-1))	-0.593591	0.160910	-3.688956	0.0007
D(CPA_\$(-2))	-0.446956	0.138788	-3.220434	0.0025
D(CPA_\$(-3))	-0.080580	0.105861	-0.761183	0.4509
D(CPA_\$(-4))	0.150193	0.086675	1.732824	0.0906
D(CPA_\$(-5))	-0.364120	0.085017	-4.282897	0.0001
D(CPA_\$(-6))	-0.745960	0.100805	-7.400036	0.0000
D(CPA_\$(-7))	-0.959495	0.151962	-6.314044	0.0000
D(CPA_\$(-8))	-0.399061	0.183383	-2.176104	0.0354
C	1.502684	1.019118	1.474495	0.1480
R-squared	0.850101	Mean dependent var	0.922059	
Adjusted R-squared	0.817197	S.D. dependent var	5.795521	
S.E. of regression	2.477904	Akaike info criterion	4.826607	
Sum squared resid	251.7404	Schwarz criterion	5.205396	
Log likelihood	-113.0785	Hannan-Quinn criter.	4.971353	
F-statistic	25.83533	Durbin-Watson stat	1.998661	
Prob(F-statistic)	0.000000			

Null Hypothesis: D(CPA_ \$) has a unit root
 Exogenous: Constant
 Lag Length: 10 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-8.370128	0.0000
Test critical values: 1% level	-3.574446	
5% level	-2.923780	
10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(CPA_ \$,2)
 Method: Least Squares
 Date: 03/06/23 Time: 10:59
 Sample (adjusted): 13 60
 Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CPA_ \$(-1))	-9.317008	1.113126	-8.370128	0.0000
D(CPA_ \$(-1),2)	7.572935	1.042465	7.264448	0.0000
D(CPA_ \$(-2),2)	6.899686	0.939134	7.346863	0.0000
D(CPA_ \$(-3),2)	6.381049	0.810877	7.869314	0.0000
D(CPA_ \$(-4),2)	5.811138	0.681836	8.522776	0.0000
D(CPA_ \$(-5),2)	4.943443	0.618738	7.989558	0.0000
D(CPA_ \$(-6),2)	3.931844	0.580343	6.775033	0.0000
D(CPA_ \$(-7),2)	2.890072	0.519564	5.562492	0.0000
D(CPA_ \$(-8),2)	2.169497	0.408688	5.308446	0.0000
D(CPA_ \$(-9),2)	1.559130	0.275198	5.665484	0.0000
D(CPA_ \$(-10),2)	0.883540	0.150709	5.862569	0.0000
C	4.536718	0.589836	7.691495	0.0000
R-squared	0.940632	Mean dependent var	-0.016146	
Adjusted R-squared	0.922491	S.D. dependent var	6.637227	
S.E. of regression	1.847831	Akaike info criterion	4.278220	
Sum squared resid	122.9212	Schwarz criterion	4.746020	
Log likelihood	-90.67727	Hannan-Quinn criter.	4.455002	
F-statistic	51.85298	Durbin-Watson stat	1.007014	
Prob(F-statistic)	0.000000			

Null Hypothesis: D(CPC_\$\$) has a unit root
 Exogenous: Constant
 Lag Length: 4 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-7.316681	0.0000
Test critical values: 1% level	-3.557472	
5% level	-2.916566	
10% level	-2.596116	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(CPC_\$\$,2)
 Method: Least Squares
 Date: 03/06/23 Time: 11:01
 Sample (adjusted): 7 60
 Included observations: 54 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CPC_\$\$(-1))	-3.322513	0.454101	-7.316681	0.0000
D(CPC_\$\$(-1),2)	1.832625	0.391320	4.683187	0.0000
D(CPC_\$\$(-2),2)	1.340504	0.310821	4.312785	0.0001
D(CPC_\$\$(-3),2)	0.894291	0.225206	3.970984	0.0002
D(CPC_\$\$(-4),2)	0.543069	0.135012	4.022382	0.0002
C	0.168314	0.061705	2.727722	0.0089
R-squared	0.760488	Mean dependent var	-0.001296	
Adjusted R-squared	0.735539	S.D. dependent var	0.823890	
S.E. of regression	0.423692	Akaike info criterion	1.224819	
Sum squared resid	8.616718	Schwarz criterion	1.445818	
Log likelihood	-27.07013	Hannan-Quinn criter.	1.310050	
F-statistic	30.48150	Durbin-Watson stat	2.112539	
Prob(F-statistic)	0.000000			

Null Hypothesis: CPI_\$ has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.083880	0.2518
Test critical values: 1% level	-3.546099	
5% level	-2.911730	
10% level	-2.593551	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CPI_\$)

Method: Least Squares

Date: 03/06/23 Time: 11:02

Sample (adjusted): 2 60

Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPI_\$(-1)	-0.147579	0.070820	-2.083880	0.0417
C	0.333730	0.151784	2.198721	0.0320
R-squared	0.070792	Mean dependent var		0.065263
Adjusted R-squared	0.054490	S.D. dependent var		0.633971
S.E. of regression	0.616457	Akaike info criterion		1.903653
Sum squared resid	21.66107	Schwarz criterion		1.974078
Log likelihood	-54.15776	Hannan-Quinn criter.		1.931144
F-statistic	4.342554	Durbin-Watson stat		2.052211
Prob(F-statistic)	0.041665			

Null Hypothesis: CPM_\$ has a unit root
 Exogenous: Constant
 Lag Length: 9 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.265450	0.9224
Test critical values: 1% level	-3.568308	
5% level	-2.921175	
10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(CPM_\$)
 Method: Least Squares
 Date: 03/06/23 Time: 11:04
 Sample (adjusted): 11 60
 Included observations: 50 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPM_\$(-1)	-0.025964	0.097811	-0.265450	0.7921
D(CPM_\$(-1))	-0.687426	0.163961	-4.192611	0.0002
D(CPM_\$(-2))	-0.322122	0.178882	-1.800752	0.0795
D(CPM_\$(-3))	-0.369226	0.186908	-1.975440	0.0553
D(CPM_\$(-4))	-0.959202	0.197968	-4.845241	0.0000
D(CPM_\$(-5))	-0.567240	0.228648	-2.480838	0.0175
D(CPM_\$(-6))	-0.051411	0.196562	-0.261551	0.7950
D(CPM_\$(-7))	-0.029788	0.189141	-0.157493	0.8757
D(CPM_\$(-8))	-0.570182	0.192530	-2.961524	0.0052
D(CPM_\$(-9))	-0.487065	0.167591	-2.906271	0.0060
C	1.027945	0.655244	1.568796	0.1248
R-squared	0.709974	Mean dependent var	0.245297	
Adjusted R-squared	0.635609	S.D. dependent var	2.522398	
S.E. of regression	1.522641	Akaike info criterion	3.870309	
Sum squared resid	90.41904	Schwarz criterion	4.290954	
Log likelihood	-85.75772	Hannan-Quinn criter.	4.030493	
F-statistic	9.547077	Durbin-Watson stat	2.162488	
Prob(F-statistic)	0.000000			

Null Hypothesis: D(CPM_ \$) has a unit root
 Exogenous: Constant
 Lag Length: 10 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-14.21385	0.0000
Test critical values: 1% level	-3.574446	
5% level	-2.923780	
10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(CPM_ \$,2)
 Method: Least Squares
 Date: 03/06/23 Time: 11:04
 Sample (adjusted): 13 60
 Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CPM_ \$(-1))	-12.32419	0.867055	-14.21385	0.0000
D(CPM_ \$(-1),2)	10.33419	0.823226	12.55329	0.0000
D(CPM_ \$(-2),2)	9.343317	0.753220	12.40450	0.0000
D(CPM_ \$(-3),2)	8.347628	0.686265	12.16385	0.0000
D(CPM_ \$(-4),2)	7.258002	0.634732	11.43474	0.0000
D(CPM_ \$(-5),2)	6.246751	0.546734	11.42557	0.0000
D(CPM_ \$(-6),2)	5.283738	0.435666	12.12795	0.0000
D(CPM_ \$(-7),2)	4.297104	0.335043	12.82552	0.0000
D(CPM_ \$(-8),2)	3.240522	0.269635	12.01819	0.0000
D(CPM_ \$(-9),2)	2.165527	0.195054	11.10218	0.0000
D(CPM_ \$(-10),2)	1.093481	0.100943	10.83263	0.0000
C	2.082864	0.177817	11.71351	0.0000
R-squared	0.973701	Mean dependent var	0.056948	
Adjusted R-squared	0.965665	S.D. dependent var	3.996854	
S.E. of regression	0.740603	Akaike info criterion	2.449615	
Sum squared resid	19.74576	Schwarz criterion	2.917415	
Log likelihood	-46.79076	Hannan-Quinn criter.	2.626397	
F-statistic	121.1703	Durbin-Watson stat	0.597007	
Prob(F-statistic)	0.000000			

Null Hypothesis: PUBSLIHERS_REVENUES_BN_\$ has a unit root

Exogenous: Constant

Lag Length: 9 (Automatic - based on SIC, maxlag=10)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.211733	0.9299
Test critical values:		
1% level	-3.568308	
5% level	-2.921175	
10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(PUBSLIHERS_REVENUES_BN_\$)

Method: Least Squares

Date: 03/06/23 Time: 11:05

Sample (adjusted): 11 60

Included observations: 50 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PUBSLIHERS_REVENUES_BN_\$(-1)	-0.013787	0.065113	-0.211733	0.8334
D(PUBSLIHERS_REVENUES_BN_\$(-1))	-1.113817	0.172326	-6.463424	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-2))	-0.793099	0.231223	-3.430014	0.0014
D(PUBSLIHERS_REVENUES_BN_\$(-3))	-0.512404	0.205239	-2.496617	0.0169
D(PUBSLIHERS_REVENUES_BN_\$(-4))	-0.057359	0.163961	-0.349836	0.7283
D(PUBSLIHERS_REVENUES_BN_\$(-5))	-0.059150	0.170253	-0.347421	0.7301
D(PUBSLIHERS_REVENUES_BN_\$(-6))	-0.838889	0.179291	-4.678922	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-7))	-1.042591	0.226690	-4.599192	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-8))	-0.669415	0.251053	-2.666431	0.0111
D(PUBSLIHERS_REVENUES_BN_\$(-9))	-0.336474	0.189742	-1.773323	0.0840
C	1.085934	0.432749	2.509385	0.0164
R-squared	0.777910	Mean dependent var	0.114400	

Adjusted R-squared	0.720963	S.D. dependent var	1.803652
S.E. of regression	0.952759	Akaike info criterion	2.932630
Sum squared resid	35.40227	Schwarz criterion	3.353275
Log likelihood	-62.31575	Hannan-Quinn criter.	3.092814
F-statistic	13.66042	Durbin-Watson stat	1.862470
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PUBSLIHERS_REVENUES_BN_\$) has a unit root

Exogenous: Constant

Lag Length: 10 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.80317	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(PUBSLIHERS_REVENUES_BN_\$,2)

Method: Least Squares

Date: 03/06/23 Time: 11:05

Sample (adjusted): 13 60

Included observations: 48 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PUBSLIHERS_REVENUES_BN_\$(-1))	-9.697287	0.897634	-10.80317	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-1),2)	7.824042	0.864003	9.055575	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-2),2)	7.093860	0.786081	9.024333	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-3),2)	6.427806	0.681608	9.430358	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-4),2)	5.733078	0.573732	9.992608	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-5),2)	4.914183	0.505224	9.726750	0.0000
D(PUBSLIHERS_REVENUES_BN_\$(-6),2)	3.989163	0.473428	8.426130	0.0000

D(PUBSLIHERS_REVENUES_BN_				
\$(-7),2)	3.199733	0.425619	7.517832	0.0000
D(PUBSLIHERS_REVENUES_BN_				
\$(-8),2)	2.550436	0.340356	7.493431	0.0000
D(PUBSLIHERS_REVENUES_BN_				
\$(-9),2)	1.871354	0.224951	8.318930	0.0000
D(PUBSLIHERS_REVENUES_BN_				
\$(-10),2)	1.068622	0.101590	10.51901	0.0000
C	1.494427	0.154603	9.666205	0.0000
<hr/>				
R-squared	0.982022	Mean dependent var	-0.029292	
Adjusted R-squared	0.976529	S.D. dependent var	3.083814	
S.E. of regression	0.472448	Akaike info criterion	1.550539	
Sum squared resid	8.035450	Schwarz criterion	2.018339	
Log likelihood	-25.21294	Hannan-Quinn criter.	1.727322	
F-statistic	178.7702	Durbin-Watson stat	0.624447	
Prob(F-statistic)	0.000000			

Dependent Variable: PUBSLIHERS_REVENUES_BN_\$

Method: Least Squares

Date: 03/06/23 Time: 11:07

Sample: 1 60

Included observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.573446	0.466815	1.228421	0.2245
CPA_\$	-0.039461	0.021449	-1.839777	0.0712
CPC_\$	1.596910	0.378192	4.222486	0.0001
CPI_\$	0.445688	0.230761	1.931382	0.0586
CPM_\$	0.269883	0.098903	2.728761	0.0085
<hr/>				
R-squared	0.755526	Mean dependent var	6.084000	
Adjusted R-squared	0.737747	S.D. dependent var	2.750412	
S.E. of regression	1.408505	Akaike info criterion	3.602590	
Sum squared resid	109.1137	Schwarz criterion	3.777119	
Log likelihood	-103.0777	Hannan-Quinn criter.	3.670858	
F-statistic	42.49331	Durbin-Watson stat	1.695334	
Prob(F-statistic)	0.000000			

Date: 03/06/23 Time: 11:12

Sample (adjusted): 3 60

Included observations: 58 after adjustments

Trend assumption: Linear deterministic trend

Series:

CPA_\$ CPC_\$ CPI_\$ CPM_\$ PUBLIHERS_REVENUES_BN_\$

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.799735	239.1574	69.81889	0.0000
At most 1 *	0.735079	145.8867	47.85613	0.0000
At most 2 *	0.582571	68.84386	29.79707	0.0000
At most 3 *	0.263216	18.17276	15.49471	0.0193
At most 4	0.007833	0.456084	3.841466	0.4995

Trace test indicates 4 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized	Max-Eigen	0.05		
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.799735	93.27068	33.87687	0.0000
At most 1 *	0.735079	77.04284	27.58434	0.0000
At most 2 *	0.582571	50.67110	21.13162	0.0000
At most 3 *	0.263216	17.71668	14.26460	0.0137
At most 4	0.007833	0.456084	3.841466	0.4995

Max-eigenvalue test indicates 4 cointegratingeqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

				PUBLIHER
				S_REVENUE
CPA_\$	CPC_\$	CPI_\$	CPM_\$	S_BN_\$
0.124198	0.630862	-0.580422	-0.245663	-0.186453

0.010223	-0.760166	-1.272334	-0.287970	0.948108
0.016432	0.121200	0.555461	-0.685450	0.481929
-0.068114	2.911988	-0.826368	-0.269124	-0.225957
-0.033155	0.452540	-0.290613	-0.176426	-0.183665

Unrestricted Adjustment Coefficients (alpha):

D(CPA_ \$)	-2.999805	-0.685605	1.762203	0.416201	0.021833
D(CPC_ \$)	-0.047343	0.082475	0.118264	-0.219070	-0.004522
D(CPI_ \$)	-0.201621	0.231736	-0.248102	0.091057	-0.017975
D(CPM_ \$)	0.638318	0.213940	1.330696	0.071627	0.017490
D(PUBSLIH ERS_REVEN UES_BN_ \$)	0.135317	-0.741145	0.093937	-0.213463	-0.055064

1 Cointegrating Equation(s): Log likelihood-385.3342

Normalized cointegrating coefficients (standard error in parentheses)				
				PUBSLIHER
				S_REVENUE
CPA_ \$	CPC_ \$	CPI_ \$	CPM_ \$	S_BN_ \$
1.000000	5.079472	-4.673349	-1.977990	-1.501250
	(1.66937)	(0.98159)	(0.47106)	(0.62799)

Adjustment coefficients (standard error in parentheses)

D(CPA_ \$)	-0.372571
	(0.05201)
D(CPC_ \$)	-0.005880
	(0.00813)
D(CPI_ \$)	-0.025041
	(0.00890)
D(CPM_ \$)	0.079278
	(0.03141)
D(PUBSLIH ERS_REVEN UES_BN_ \$)	0.016806
	(0.02004)

2 Cointegrating Equation(s): Log likelihood-346.8128

Normalized cointegrating coefficients (standard error in parentheses)

				PUBSLIHER S_REVENUE S_BN_\$
CPA_\$	CPC_\$	CPI_\$	CPM_\$	
1.000000	0.000000	-12.33272 (1.20146)	-3.652707 (0.56705)	4.524968 (0.74881)
0.000000	1.000000	1.507907 (0.16728)	0.329703 (0.07895)	-1.186387 (0.10426)
Adjustment coefficients (standard error in parentheses)				
D(CPA_\$)	-0.379580 (0.05079)	-1.371289 (0.40263)		
D(CPC_\$)	-0.005037 (0.00803)	-0.092562 (0.06368)		
D(CPI_\$)	-0.022672 (0.00796)	-0.303353 (0.06308)		
D(CPM_\$)	0.081465 (0.03130)	0.240061 (0.24809)		
D(PUBSLIHERS_REVENUES_BN_\$)	0.009230 (0.01539)	0.648759 (0.12200)		

3 Cointegrating Equation(s): Log likelihood-321.4772

				PUBSLIHER S_REVENUE S_BN_\$
CPA_\$	CPC_\$	CPI_\$	CPM_\$	
1.000000	0.000000	0.000000	-17.91514 (1.98449)	16.34332 (2.20383)
0.000000	1.000000	0.000000	2.073554 (0.25053)	-2.631403 (0.27822)
0.000000	0.000000	1.000000	-1.156471 (0.15587)	0.958293 (0.17310)
Adjustment coefficients (standard error in parentheses)				
D(CPA_\$)	-0.350622 (0.04078)	-1.157711 (0.32286)	3.592309 (0.48813)	
D(CPC_\$)	-0.003093 (0.00783)	-0.078229 (0.06201)	-0.011766 (0.09375)	
D(CPI_\$)	-0.026749 (0.00673)	-0.333422 (0.05332)	-0.315631 (0.08062)	
D(CPM_\$)	0.103332 (0.02116)	0.401340 (0.16758)	0.096453 (0.25336)	

D(PUBSLIH ERS_REVEN UES_BN_\$)	0.010773 (0.01544)	0.660145 (0.12222)	0.916621 (0.18479)
--------------------------------------	-----------------------	-----------------------	-----------------------

4 Cointegrating Equation(s): Log likelihood-312.6189

Normalized cointegrating coefficients (standard error in parentheses)

CPA_\$	CPC_\$	CPI_\$	CPM_\$	PUBSLIHER S_REVENUE S_BN_\$
1.000000	0.000000	0.000000	0.000000	-3.384904 (0.29171)
0.000000	1.000000	0.000000	0.000000	-0.347997 (0.02469)
0.000000	0.000000	1.000000	0.000000	-0.315218 (0.02607)
0.000000	0.000000	0.000000	1.000000	-1.101204 (0.06195)

Adjustment coefficients (standard error in parentheses)

D(CPA_\$)	-0.378971 (0.04562)	0.054261 (0.98204)	3.248374 (0.54784)	-0.385536 (0.26422)
D(CPC_\$)	0.011828 (0.00775)	-0.716158 (0.16688)	0.169266 (0.09310)	-0.034227 (0.04490)
D(CPI_\$)	-0.032951 (0.00744)	-0.068267 (0.16014)	-0.390877 (0.08933)	0.128354 (0.04309)
D(CPM_\$)	0.098453 (0.02403)	0.609917 (0.51723)	0.037263 (0.28854)	-1.149821 (0.13916)
D(PUBSLIH ERS_REVEN UES_BN_\$)	0.025313 (0.01703)	0.038542 (0.36654)	1.093020 (0.20448)	0.173244 (0.09862)
