

## THE ECO-FOOTPRINT OF E-BOOKS: A USER-CENTERED EMPIRICAL INVESTIGATION

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### Article Info

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### Abstract

For over two millennia, paper has been a cornerstone of human communication, evolving from early forms crafted with linen and straw to today's ubiquitous wood-based sheets. However, this progress comes at a significant environmental cost. The modern paper industry, heavily reliant on timber, has emerged as a driving force behind deforestation. Astonishingly, 40% of the world's commercially harvested timber finds its destiny in paper production, leading to the annual loss of over 30 million acres of forests. This grim reality not only threatens countless species reliant on these habitats but also underscores the extensive environmental footprint of paper.

The life cycle of paper is a chronicle of environmental harm, commencing with the felling of trees and culminating in their incineration, releasing carbon dioxide into the atmosphere. Furthermore, the manufacturing process exerts immense pressure on water resources, with an A4 sheet demanding a staggering 10 liters of water (The World Counts Report, 2019). Notably, the United States, home to a mere 5% of the global populace, consumes a disproportionate 30% of all paper. The forest and paper products industry, with an annual revenue of \$200 billion, constitutes a formidable 7% of the nation's manufacturing output. A startling 28% of all timber harvested in the U.S. is channeled into paper production (Alvarez, 2018).

This rampant deforestation driven by the insatiable needs of paper and other industries poses a severe threat to our environment and its delicate ecological balance (Matthews, 2016).

### Introduction

Ever since the first invented paper with linen and straw about 2,000 years ago, it quickly outdated books made of bamboo splits, silk, skin, and papyrus. Today's paper industry relies heavily on trees for its products. According to The World Count, 40% of the world's commercially cut timber is used for the paper production, and over 30 million acres of forest are destroyed annually. The pulp and paper industry is a big contributor to the problem of deforestation and is partly to blame for the endangerment of some species that live in the forests. The life cycle of paper is damaging to the environment from beginning to end. It starts off with a tree being cut down and ends its life by being burned – emitting carbon dioxide in the atmosphere. In addition,

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paper production uses up lots of water, another scarce resource, i.e. an A4 paper requires 10 liters of water per sheet (The World Counts Report, 2019). The U.S., which contains only 5 percent of the world's population, uses 30 percent of all paper, and the forest and paper products industry generates \$200 billion dollars in sales every year, accounting for 7 percent of the total manufacturing output of the United States. About 28 percent of all wood cut in the U.S. is used for papermaking (Alvarez, 2018). Deforestation due to paper and other industries' needs has alarmingly endangered our environment and the nature (Matthews, 2016).

E-books and audiobooks have been growing in popularity for years, despite calls from traditional print book lovers that they are an abomination. Americans are spreading their book consumption across several formats, and the use of audiobooks is on the rise. Roughly seven-in-ten U.S. adults (72%) say they have read a book in the past 12 months in any format, a figure that has remained largely unchanged since 2012, according to a Pew Research Center survey conducted Jan. 8-Feb. 7, 2019. Print books remain the most popular format for reading, with 65% of adults saying they had read a print book in the year before the survey (McCue, T. J. (2019)).

This study, in an empirical setting, examines the users' preferences, in order to provide some managerial insights on the publishing market: what consumers prefer and how they make their book purchasing decisions. The focus is mainly on the issues of the digital publishing and printed publishing. In addition, this study attempts to investigate if there were any differences resulted from the consumers' viewpoints between e-books and printed books, centering on product offerings and their qualities, price (including promotions), deliveries and usability. This study aims to explore the impact of the emerging e-books on the publishing industry, on book readers and their reading behavior, on our society and on general global environment.

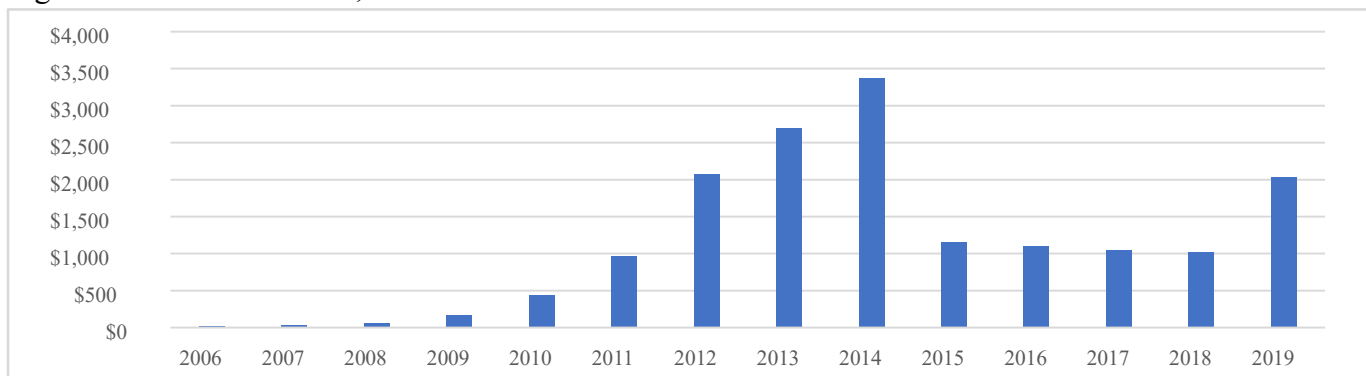
## 2. Review of Literature

E-books that do not use paper are emerging from an almost zero fifteen years ago, and the sales reached \$2,040million in 2019 and have grasped 14.3% of the total sales of publishing industry(AAP, Report 2014-2019).

The e-books and all other digital forms of publishing, i.e. newspaper, magazines, etc.,are challenging the traditional way of publishing and reading. *Newsweek*, with its 80 year history, announced a complete seizure of its printed form, while retaining only its digital form in 2012 (Hagey& Fitzgerald, 2012). Plenty of other printed publications, i.e. PC Magazine, Gourmet, and SmartMoney, etc. have embraced digital-only strategies, encouraged by the proliferation of digital tablets and the growth in digital advertising over the past two years (Gillette, 2012).

In the recent years, the traditional printed publishing industry is facing an emerging challenge from digital publishing, quite resembling the competition between filmed cameras and digital cameras, even though the digital publishing represents only a small fraction of the total publishing industry's sales at the moment. However, some of the printed publishing, i.e. newspapers, have experienced a sharp decline recently. Figure 1 documents the emerging sales of e-books in the U.S. from combined sources between 2006 and 2019.

Figure 1. U.S. e-book sales, in millions of US\$.



While the revenues in digital publishing are growing rapidly, and reached a new high in 2014, and started to fall rapidly from 2015 through 2018, picking up slightly in 2019. The total sales still lagged far below that of printed publishing. Some of the printed publishing, i.e. newspapers and magazines have experienced a sharp decline in the recent years. Contrary to traditional printed publishing, the digital publishing market needs both reading gadgets and contents. As far as the selection of digital gadgets, consumers have quite a number to choose from. Ranging from tiny gadgets, such as smartphones to specially manufactured e-book readers, i.e. Amazon's Kindles and Barnes and Noble's Nooks, etc, to generic tablets like Apple's iPad, netbooks and laptops, and desktop computers, choices are abundant. There are no universal standards for the e-books, just like with printed books which have a variety of type settings. For many people, the problem with e-books is that they come with limitations. E-books bought today from Amazon.com, for example, can be read on Amazon's Kindle and/or other electronic gadgets.

The popularity of these specialized gadgets for reading e-books has diminished. Figure 2 presents the ebook user population growth over years. Contradictory to the decline of e-book sales in the recent years, the ebook users have kept up along an upward trend.

Figure 2: Trend of e-book users in the US, in millions.

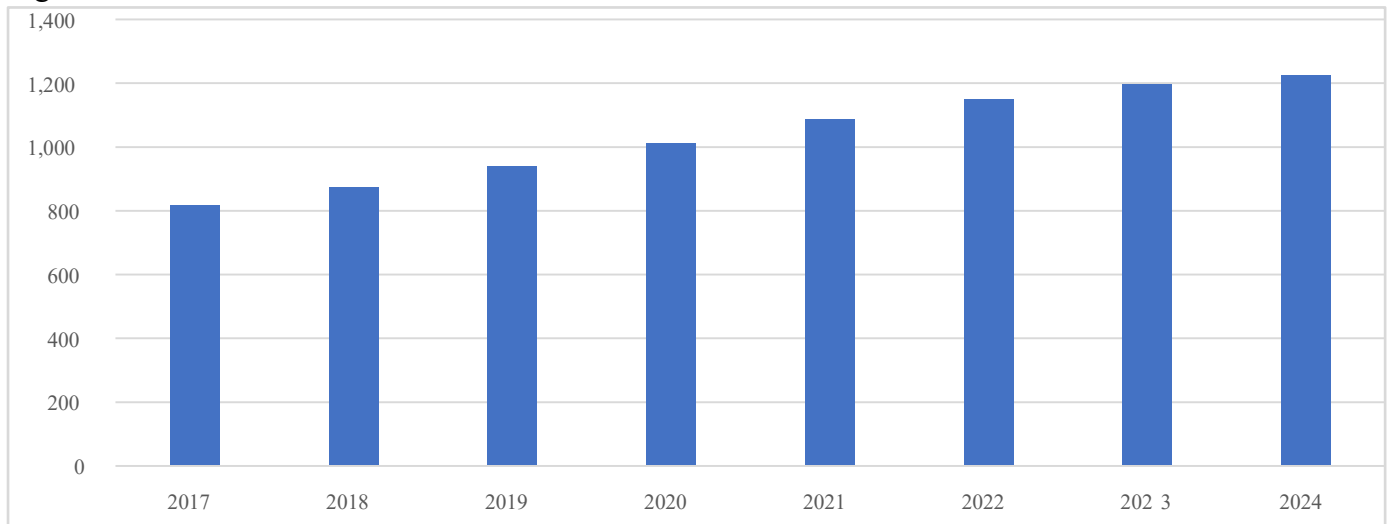
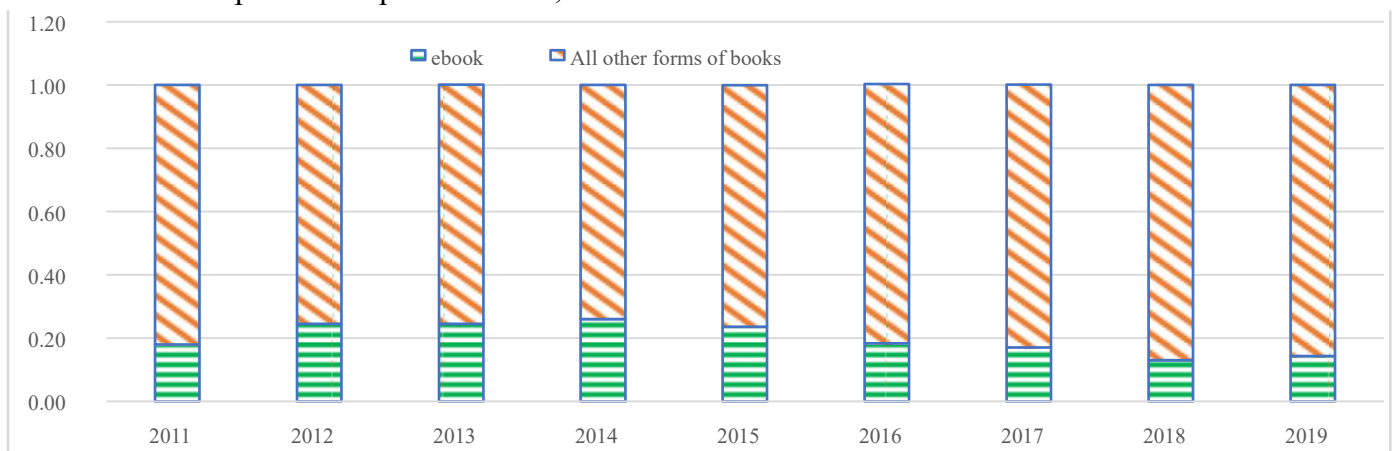


Figure 3 presents the percentage of the global market share of e-book and printed books. E-book also faced the challenges of audio books which favored by older generation and it is much easy for them to listen to books on their smartphones, rather than holding a printed book or an gadget for an e-book. Figure 3. E-book market share compared with printed books, %.<sup>6</sup>



For years, college students had to buy the textbooks from the bookstores and spent several hundred dollars for their textbook purchases each semester (Foderaro, 2010). Although printed books and magazines are in the low technology spectrum compared with digital publications, the screens won't go blank, nor would they be

transacted a virus, and they have been around for thousands of years. However, they are heavy and expensive. Now both resellers and publishers want to provide their customers with an alternative of e-books (Kane & Fowler, 2010).

Chao and Lu conduct an empirical study on e-books, and it is an early academic work done in this area. They cover eleven variables related to consumer book purchase decision making. Their study finds that e-books are more appealing for college students than the printed books. However, their study has very limited sample size, and is not generalizable (Chao & Lu, 2011).

Motivated by the fastgrowing trend of e-book adoptions, and the availability of the limited research work, this paper thus attempts to duplicate Chao and Lu's study, and dig into this challenges in digital printing industry. This study is designed to compare consumer use of digital and printed books. The variables incorporated in this study include, along with others, those related to the consumer books purchase decision, with a few core decision variables with the regards to price and promotion, quality, and deliveries. A side objective is to promote a global greenness therefore, helps protect our environment.

### 3. Method

With the focal questions in mind, this research studies the consumers' views about e-books as compared to the traditional printed books. The books include all books, magazines, newspapers, and other related publications. A survey is designed to investigate the consumer preferences on products and their quality, price and promotion, as well as deliveries. The following variables were based on literature reviews.

#### 3.1 Variable Selection and Survey Questionnaire

Stemmed from literature review, the following variables affect consumers' preferences in how and where they make their purchasing decisions:

1. easy to obtain
2. low cost of possession of the reading materials
3. easy to read
4. attractive prices for possessing contents
5. easy to carry around
6. easy to share with others
7. free delivery or delivery incentives
8. compatibility in the formats
9. concern with copyright

These variables were served as cores in a survey questionnaire designed to collect the consumers' opinions, paired both in digital books and printed books. The questionnaire also included the background information of the respondents.

#### 3.2 Sample, Data Collection, Measurements, and Hypotheses

Due to the exploratory nature of this empirical study, the questionnaires were distributed to college students and some professors in a large university campus in the Northeast for a convenient sampling. Since these respondents tended to browse websites and download digital books regularly, they would provide some meaningful insights to the publishing industry and book readers. The respondents were asked to evaluate the selected variables on a five point Likert scale, with 5=strongly prefer, 4=prefer, 3=neutral, 2 not prefer, and 1=strongly not prefer.

The hypotheses for this research were to find if there were significant differences from the consumers' viewpoints between e-books and printed books. The hypotheses for this study state:

*Hypothesis 1. There is no significant difference in "easy to obtain" between e-books and printed books.*

*Hypothesis 2. There is no significant difference in "low cost of possession" of the reading materials between e-books and printed books.*

*Hypothesis 3. There is no significant difference in “easy to read” between e-books and printed books.*

*Hypothesis 4. There is no significant difference in “attractive prices for possessing contents” between e-books and printed books.*

*Hypothesis 5. There is no significant difference in “easy to carry around” between e-books and printed books.*

*Hypothesis 6. There is no significant difference in “easy to share with others” between e-books and printed books.*

*Hypothesis 7. There is no significant difference in “free delivery or delivery incentives” between e-books and printed books.*

*Hypothesis 8. There is no significant difference in “compatibility in the formats” between e-books and printed books. Hypothesis 9. There is no significant difference in “concern with copyright” between e-books and printed books.*

Alternatively, there are significantly different preferences in these variables between e-books and printed books from the consumers’ viewpoints. **3.3 Test of Hypotheses— Kruskal-Wallis test**

Due to the nature of this empirical study, the questionnaires were distributed in college students in a large university campus in the northeast for a convenient sampling since students tend to browse on the websites and download movies. The respondents were asked to evaluate the selected variables in a five point Likert scale, with 5=strong agree, 4=agree, 3=neutral, 2-disagree, and 1=strongly disagree. Since the data collected are of ordinal scaling, the Kruskal-Wallis nonparametric statistic test was used to test the hypothesis.

The Kruskal-Wallis test is based upon a test statistic calculated from ranks established by pooling the observations from k independent simple random samples, where k is at least equal to two. The experimental situation is one where k random samples have been obtained, one from each of k possibly different populations, to test the null hypothesis that all populations are identical against the alternative that some populations tend to furnish greater observed values than other populations. The null hypothesis is that the populations are identically distributed, or alternatively, that the samples were drawn from k identical populations.

The Kruskal-Wallis test is believed usually to be more powerful than the several other nonparametric statistics. Because the Kruskal-Wallis test is designed to be sensitive against differences among means in the k populations, the alternative hypothesis is sometimes stated as the k populations do not all have identical means. In this study, a 5% significance level for the Kruskal Wallis test was selected to determine whether to accept or reject the null hypothesis. The null should be rejected if the significance level is less than or equal to 5% in any one criterion (Hamburg, 1977; Conover, 1980; Davis and Cosenza, 1985; SPSSX, 2002).

#### **4. Results**

Over 700 respondents were surveyed at a college campus in the Northeastern U.S., with 275 completed responses for analyses, representing about 39 percent of the total surveyed. Table 1 presents the general background information of the respondents. All the respondents had experience in downloading digital articles and/or books from websites. Table 2 presents reading behavior between two categories: e-book vs printed book.

**Table 1. Demographic Backgrounds of the Respondents**

Demographic issues	Groups	Valid %
1. Age	<18	1.1
	18-35	96.7
	36-55	2.2
2. gender	Male	57.8
	Female	42.2

3. Family annual income	<\$30k	19.4
	\$30-50k	16.8
	\$50-75k	22.7
	>\$75k	41.1
4. Education	high school	12.4
	College	81.0
	Graduate	6.6
5. Marital status	Married	28.2
	Single	71.8

Source: original

**Table 2. Respondents spent slightly more time on printed books**

Each week, hours spent on printed books	<5	48.7
	5-10	34.5
	11-15	11.3
	16-20	2.2
	>20	3.3
Each week, hours spent on e-books	<5	55.3
	5-10	24.9
	11-15	11.7
	16-20	4.8
	>20	3.3

Source: original

Table 3 presents the Kruskal-Wallis test results. Significant differences are found in ten of the eleven variables.

**Table 3. Kruskal-Wallis test results for all variables**

Variables	Chi-S	Mean Dif.	Sig.
<b>1. easy to obtain</b>	<b>16.02</b>	<b>0.320</b>	<b>0.000</b>
<b>2. low cost of possession of the reading materials</b>	<b>16.40</b>	<b>0.338</b>	<b>0.000</b>
<b>3. easy to read</b>	<b>7.67</b>	<b>-0.243</b>	<b>0.006</b>
<b>4. attractive prices for possessing books or articles.</b>	<b>33.33</b>	<b>0.464</b>	<b>0.000</b>
<b>5. easiness to carry with</b>	<b>35.01</b>	<b>0.524</b>	<b>0.000</b>
<b>6. easy to share with others</b>	<b>5.90</b>	<b>0.216</b>	<b>0.015</b>
7. free delivery or delivery incentives	1.41	0.099	0.235
<b>8. compatibility in the formats</b>	<b>7.81</b>	<b>0.192</b>	<b>0.005</b>
<b>9. concern with copyright</b>	<b>31.51</b>	<b>0.474</b>	<b>0.000</b>

Significance level is 2-tailed. Source: original.

## 5. Discussions

### 5.1 Managerial Implications and Recommendations

The Kruskal-Wallis results reject eight of the null hypotheses; therefore, the study concludes that there are statistically significant differences from the consumers' viewpoints between e-books and printed books, when the significance levels are less than 5% in eight out of the total nine variables. These variables are: **1. easy to obtain; 2. low cost of possession of the reading materials; 3. easy to read; 4. attractive prices for possessing books or articles; 5. easiness to carry with; 6. easy to share with others; 8. compatibility in**



**the formats; 9. concern with copyright.** No statistically significant difference is found in only one variable, **free delivery or delivery incentives.**

The test results also indicate that in seven out of eight variables with significant differences in the respondents' preference, e-books are favored over printed books. These variables include: **1. easy to obtain; 2. low cost of possession of the reading materials; 3. easy to read; 4. attractive prices for possessing books or articles; 5. easiness to carry with; 8. compatibility in the formats; 9. concern with copyright.** This finding may suggest to the publishing industry, book authors and readers, i.e. students and professors alike, the need to continuously focus on promoting and improving e-books in these areas.

The adoption of e-books has emerged as a great challenge to the printed book, not only because of its advantages, but also because it helps make our environment greener. Publishers, book retailers, professors, students, and all readers should move to adaptation of e-books in the future to protect our environment.

Additionally, the test results confirm that in one area: **easy to read**, the sample respondents prefer printed books over e-books. This illustrates that even with numerous convenience features; e-books may never completely outweigh some key advantages of printed books. Consequently, e-books may never replace printed books. According to a report from the Association of American Publishers, publishers of books in all formats made almost \$26 billion in revenue in 2019 in the U.S., with print making up \$22.6 billion and e-books taking \$2.04 billion (Handley, L. (2019). However, it is undeniably clear that publishers will need to continue to improve readability of e-books in the future, as this important trend will not likely disappear in the future.

The results are mostly in line with the research done by Chao and Lu (2011), but show some minor differences, i.e. as their respondents did not concern with the copyright, while this study shows that the users do concern with copyright. Their study showed that the users concern with the free delivery or delivery incentives, while this study shows differently.

## 5.2 Limitations and Future Research

The academic research that focuses on e-books is still limited, and it is not an issue of which formats are favored by the users, but an important environmental impact, and it may take years for more users to adopt digital books, and digital newspapers and magazines have already replaced the printed opponents.

As a preliminary and exploratory research, this study offers some initial glimpses of the fundamental aspects of the differences between the e-books and the printed books, while the consumers' reading behavior can only evolve slowly in the years to come. Since this study focused on surveying only college students, staff and professors, caution must be exercised in trying to generalize the outcomes of the research. Larger, general population may have more significant variations in computer skills and use than college students/professors have, which may skew the results of a similar survey.

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