

POSTER: What you pay depends on where you pay

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ABSTRACT

In this poster, we present an initial investigation of price differentiation between apps, mobile sites and desktop sites. We developed a tool to extract price information from different outlets simultaneously, with self-made scrapers using Appium and actual smartphones to collect data from mobile platforms. We use our tool to gather data from six travel companies over a period of four weeks for a small number of flights. This allows us to contrast each company's offers on desktop, mobile app and mobile browser platforms. We find several differences between various outlets, such as price differences between mobile and website price, or price difference between French and German website. As such, we find that a more thorough, structural investigation is warranted.

CCS CONCEPTS

• **Security and privacy** → **Economics of security and privacy**; • **Information systems** → **Data extraction and integration**.

KEYWORDS

price discrimination, mobile computing, price tracking.

ACM Reference Format:

Benjamin Krumnow, Hugo Jonker, and Godfried Meesters. 2021. POSTER: What you pay depends on where you pay. In *Internet Measurement Conference (IMC '21), November 2–4, 2021, Virtual Event*. ACM, New York, NY, USA, 2 pages.

1 INTRODUCTION

To date, only few studies have investigated price differences between platforms. Hannak et al. [2] used scrapers with different userAgents to emulate either a mobile or a desktop browser. They find both price differences and different items

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IMC '21, November 2–4, 2021, Virtual Event

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displayed for mobile users on two e-commerce sites. A recent study by Azzolina et al. [1] compares prices on three airline websites with prices from a global distribution system. While they found differences, they did not find price differences between different platforms. In addition to scientific studies using automation, pricing has also been investigated by media. The German magazine *Clever Reisen!* [4], for example, manually investigated price differences between mobile apps and desktop websites. Contrary to Azzolina et al.'s results, they found egregious surcharges on airline tickets in mobile apps.

Contributions. We conduct a structural investigation whether price differentiation can be found within travel markets. We design and implement a generic framework that automatically extracts and compares prices from different platforms. We find several cases where one platform was consistently more expensive than another for a specific flight. Moreover, we found that these differences are specific to companies, and cannot be easily attributed to other factors.

2 INITIAL EXPERIMENT

We use a framework based on three components [3]: one central scheduler to synchronise clients, one client per machine to initiate scraper(s), and one scraper per platform. For noise reduction, we used IP addresses from the same country, and set GPS locations on mobile phones. We scrape mobile platforms (apps, mobile sites) from actual phones using Appium.

For an initial experiment, we collected data thrice daily from May, 25th till July, 1st on six platforms offering flights and/or hotel stays. The goal of the experiment is twofold: testing the data collection and analysis process; secondly, to find evidence that this issue warrants deeper investigation. We compared .de vs. .fr desktop sites, app vs. desktop site, and mobile vs. app vs. desktop. Often, companies showed the same price on all platforms. Exceptions we found were Opodo (occasional differences between all platforms) and Air France (.de vs. .fr). Figure 1 to 3 show examples for observed differences.

3 OBSERVATIONS & CONCLUSION

Most of the time, we find that prices on different platforms coincide in the collected data. For data collected from platforms

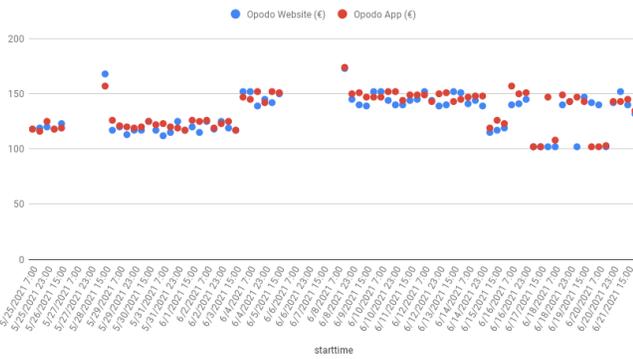


Figure 1: Opodo: desktop site vs. app for flight SN3810.

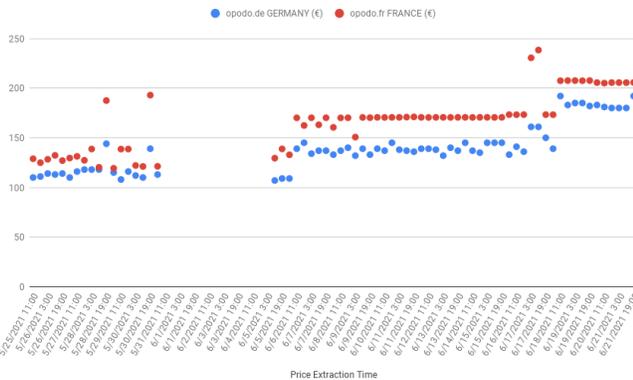


Figure 2: opodo.fr vs. opodo.de for flight LH1052.

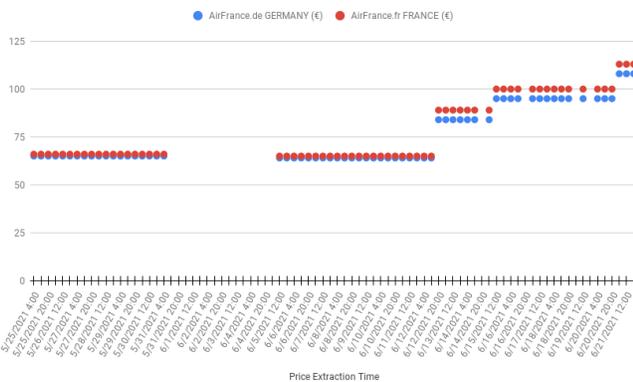


Figure 3: AirFrance’s .de vs. .fr desktop sites for flight AF1619.

of the company Opodo, we typically found varying differences between the app and German desktop site. We used Wilcoxon Matched-Pairs Signed-Rank Test, which shows that prices between both platforms differ significantly (p -value ≤ 0.0001 for all observed flights in this setup). A typical example of this is depicted in Fig. 1.

On average, prices in the app are slightly higher (€2–€5), though, for the occasional data point, the app is cheaper. Overall, this amounts to a price increase of 2.3% on average for flights offered through the mobile app.

Interestingly, comparing Opodo’s French vs German sites typically reveals a much larger and more consistent price difference (e.g., Fig. 2). This difference seems unlikely due to tax differences between France and Germany, as data from AirFrance’s French and German sites paints a very different picture (Fig. 3). More specifically, this figure suggests any price impact due to differing taxes would be between €1 and €5. Taking all data points into account, prices on AirFrance’s outlet for French are, on average, increased by 3.9% (from 2.5% up to 5.3%) per flight. For Opodo, we found an average increase of 14.3%, ranging between 7.0% and 18.6% per flight.

In conclusion, a small part of the data is promising. This suggests that well-targeted, longitudinal, multi-platform data collection on prices is promising. For example, for multiple companies, we found price differences between their French and German websites. This merits further investigation. On the other hand, our initial experiment suggests that prices in the app and on the website are equivalent for most companies.

Nevertheless, occasionally we do find several cases of a slight price difference between desktop site and app. Interestingly, we see the app is always (slightly) more expensive, though the average effect is far smaller than that found by *Clever Reisen!* We do find several outliers that match their findings, however, our observations suggest that such effects occur more often and stronger between country-based sites than between websites and their mobile counterparts.

REFERENCES

- [1] Stefano Azzolina, Manuel Razza, Kevin Sartiano, and Emanuel Weitschek. 2021. Price Discrimination in the Online Airline Market: An Empirical Study. *Journal of Theoretical and Applied Electronic Commerce Research* 16, 6 (2021), 2282–2303.
- [2] Aniko Hannak, Gary Soeller, David Lazer, Alan Mislove, and Christo Wilson. 2014. Measuring Price Discrimination and Steering on E-commerce Web Sites. In *Proceedings of the 2014 Internet Measurement Conference, IMC 2014, Vancouver, BC, Canada, November 5–7, 2014*. ACM, 305–318.
- [3] Godfried Meesters. 2021. Synchronising Distributed Scraping.
- [4] Clever Reisen! 2017. Flugbuchung per Smartphone Achtung! Neue Abzocke! (CR 2017/01).