The changing face of desktop video game monetisation: An exploration of trends in loot boxes, pay to win, and cosmetic microtransactions in the most-played Steam games of 2010-2019

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Abstract

It is now common practice for video game companies to not just sell copies of games themselves, but to also sell in-game bonuses or items for a small real-world fee. These purchases may be purely aesthetic (cosmetic microtransactions); confer in-game advantages (pay to win microtransactions), or contain randomised contents of uncertain value (loot boxes).

The growth of microtransactions has attracted substantial interest from both gamers, academics, and policymakers. However, it is not clear either how prevalent these features are in desktop games, or when any growth in prevalence occurred.

In order to address this, we analysed the play history of the 463 most-played *Steam* desktop games from 2010 to 2019. Results of exploratory joinpoint analyses suggested that cosmetic microtransactions and loot boxes experienced rapid growth during 2012-2014, leading to high levels of prevalence by April 2019: 71.28% of the sample played games with loot boxes at this point, and 85.89% played games with cosmetic microtransactions.

By contrast, pay to win microtransactions did not appear to experience similar growth in desktop games during the period, rising gradually to a prevalence of 17.38% by November 2015, at which point growth decelerated significantly ($p<0.001$) to the point where it was not significantly different from zero ($p=0.32$).

Introduction

The way that the video game industry makes money has undergone important changes in recent decades. In the 1990s and early 2000s, industry profits were largely based around the sale of copies of games [1]. These copies might take the form of cartridges, discs, or even digital downloads. Under this model individuals were handing over money in return for the either the ownership of a complete product, or the license to play that product for a potentially unlimited period of time[2].

However, at some point in the early 2000s, monetisation in video games underwent a significant shift. As well as selling games as complete products, publishers also began offering gamers the ability to purchase additional items, bonuses or services within the game itself for a real-money fee, known as a 'microtransaction' [3]. Many microtransactions allow players to purchase decorations and alternative costumes that "offer no in-game advantage and are purely aesthetic"[4]. However, as noted in [5], the products available for purchase in games "generally fall into two high-level categories": Cosmetic items that change the appearance of in-game entities, and virtual items and bonuses that affect gameplay and give players an in-game advantage. These microtransactions are sometimes referred to as "pay to win". For example, players of the multiplayer mode in *The Last of Us* can pay real-world money for advantages such as the ability to sneak up on other players silently via an "Agility perk"[6].

These pay to win microtransactions are thought to have originated with online multiplayer games such as *MapleStory* in the early 2000s [7], and have garnered controversy amongst both gamers and academics alike. Criticisms of pay to win microtransactions are wide-ranging. Some suggest that they may encourage the gambling-like entrapment of players [8]; others provide ethical critiques of how they may change "the game from a competition where the best player wins to … who wants to and can pay the most" [9]; still more posit a belief that this model makes games unfair for less affluent players[10]. These controversies have led some game developers to explicitly reject pay to win microtransactions as an element of their design philosophies [11]. Furthermore, despite the popularity of games with pay to win elements, many individuals have publicly voiced their displeasure with their incorporation in the games that they play[12].

Finally, an element of randomisation has been incorporated into both cosmetic and pay to win microtransactions in some games, resulting in loot boxes. Loot boxes are items or bonuses in video games that players can buy with real-world money, but whose contents are randomised and therefore of unclear value at the time of purchase[13]. For example, players of the fighting game *Marvel: Contest of Champions* may pay real-world money to open sealed in-game crystals that contain characters from *Marvel* franchises. Owning powerful and rare characters can help the player win in-game fights. However, when a player hands over their money to open a crystal, they have no way of knowing whether the character that crystal contains is a rare and powerful one, or a weak and common one. Loot boxes are thought to be extraordinarily lucrative for the video games industry, with one source estimating that they may have generated as much as $30 billion in revenue in 2018 alone[14]. However, there are distinct concerns about this monetisation strategy. As noted in [15], loot boxes share distinct similarities with gambling. Both when paying for a loot box and when putting money into a slot machine, individuals are wagering something of value on the chance hope of receiving something of greater value. This has led to concerns that engaging with loot boxes may lead to increases in gambling amongst gamers [16]. Evidence for this causal mechanism is unclear. Spending on loot boxes has been repeatedly linked to problem gambling. However, it is uncertain whether this is because loot boxes cause problem gambling, or whether it is because individuals with pre-existing gambling problems spend more money on loot boxes [17]–[19].

The present research

It is widely acknowledged that both pay to win microtransactions, cosmetic microtransactions, and loot boxes have become more prevalent in recent years. This increase in prevalence has been accompanied by substantial interest.

However, how these features are changing over time is unclear. For example, some news reports have recently suggested that loot boxes are currently experiencing an increase in prevalence [20], whilst others report that loot boxes are currently in decline [21]. Still more imply that the prevalence of specific in-game features may render them relatively unimportant: A recent statement from one industry representative characterises loot boxes as "a particular form of randomised in-game purchase which feature[s] in a minority of games"[22]. However, to the best of our knowledge no piece of academic research has investigated changes in prevalence of either loot boxes, pay to win microtransactions, or cosmetic microtransactions.

This piece of research therefore sets out to explore the changing prevalence of loot boxes, pay to win microtransactions, and cosmetic microtransactions by analysing historical data on how many individuals play games with these features each day.

The *Steam* platform is often considered to be the dominant way for desktop video games to be both sold and delivered [23], [24]. In this piece of research, we create a dataset of the number of players of each of the most-played *Steam* games. This dataset records the peak number of simultaneous players for each game on each day from the 22nd March 2010 to the 22nd April 2019. We then code each of these games for the presence of loot boxes, pay to win microtransactions, and pay to win microtransactions. We then explore how these features change within the sample over time via a joinpoint analysis.

Method

A list was made of the all-time most-played desktop games on the *Steam* platform. This was operationalised as any game that had achieved over 10,000 simultaneous players. This led to the creation of a list of 474 games that fit this criterion on the 22nd April 2019 via reference to the *SteamDB* website[25], which keeps a record of the peak number of simultaneous players for each game on the *Steam* platform.

The complete play history of each of these games was then extracted in turn from *SteamDB*. Inspection of these records revealed that a daily log of peak simultaneous players was kept for each game by the *Steam* platform from 22nd March 2010.

Measures

The following three variables were then measured for each of these games:

(1) **The presence of loot boxes,**
(2) **The presence of pay to win microtransactions**
(3) **The presence of cosmetic-only microtransactions.**

The presence of each of these features were measured by having two researchers separately code each game for their presence or absence. A single illustrative example of *Counter-Strike* was provided as an exemplar at the beginning of the coding process. An initial round of coding resulted in near-perfect agreement between coders when it came to the presence of loot boxes (97%, Cohen's Kappa = 0.90). However, there was only substantial agreement when it came to the

presence of pay to win (85.57%, Cohen's Kappa = 0.66) and cosmetic microtransactions (84.61%, Cohen's Kappa = 0.68).

After this round of coding, it emerged that disagreements in coding may have been due to a lack of clarity about whether downloadable content (DLC) such as expansion packs should be classified as either pay to win or cosmetic microtransactions. In order to resolve this, it was agreed that cosmetic and pay to win microtransactions would be classified as in-game items and rewards that are purchasable with real-world money *but do not add substantial additional game content*. This was undertaken in order to distinguish as best as possible between the addition of small amounts of additional content via microtransaction, and the offer to purchase substantial video game expansion packs such as in *Skyrim*. For example, the Echoes of Auriga Pack in *Endless Legends* may give the player in-game skins such as the Drum of Gios. However, it also comes with a substantial additional content in the form of a new soundtrack, and thus was not coded as a cosmetic microtransaction.

Every game in the dataset was then recoded separately by both coders using this new definition. This round of coding led to near-perfect agreement for both pay to win (96.58%, Cohen's Kappa = 0.91) and cosmetic microtransactions (96.37%, Cohen's Kappa = 0.92). Eleven games remained uncoded at this point. These were either demos, test servers, or other non-game products (e.g. an SDK).

Both coders then met and discussed the remaining games on which their codes conflicted. The resolution of these cases via dialogic intersubjectivity led to perfect agreement, and a final dataset of games annotated with the presence of both loot boxes, pay to win features, and cosmetic microtransactions.

Overall, 463 games were included in the final dataset after removing the eleven that could not be categorised. There were 75 games with loot boxes, 388 games without them, and 11 games that could not be categorised. There were 135 games with pay to win microtransactions, 328 games without them, and 11 games that could not be categorised. There were 203 games with cosmetic microtransactions, 260 games without them, and 11 games that could not be categorised.

The presence of both multiplayer and co-operative features were additionally measured for each of these games. Analysis of these features is not presented here.

The changing prevalence of loot boxes, pay to win, and cosmetic microtransactions was measured by first recording the number of players of each game under test for each of the 3,319 measured days from 22nd March 2010 to 22nd April 2019. This was accomplished by extracting the complete history for each game from the *SteamDB* website. Any missing days were filled in via linear interpolation. The total number of players was summed for each day. The number of players of games with each specific feature on each of these days was then calculated. This figure was then divided by the total number of players overall for that day, and multiplied by 100 to yield a percentage measure of prevalence.

Statistical Analysis

Changing trends in video game features were explored using joinpoint regression. Joinpoint regression is a technique for procedurally fitting a segmented regression model to trend data in order to identify points in a dataset at which a trend changes [26]. It begins by fitting a linear model to the dataset under test, and then iteratively tests whether the segmentation of this model via one or several 'joinpoints' leads to an improvement in overall fit. Joinpoint regression is suitable for the analysis of time series data, and commonly used to analyse change in trends over time. It is most commonly used in the analysis of changes in cancer rates over time. However, it has been used for

analysing changes in trends as diverse as sales of pipe tobacco [27]; suicide rates[28]; fatal car crashes[29]; workforce growth[30]; and the prevalence of coronary heart disease[31].

Joinpoint regressions can be computationally expensive, and data were therefore transformed into weekly means in order to make analysis tractable. The National Cancer Institute's Joinpoint Regression Program Version 4.7.0.0 was used for these analyses. Due to the serial nature of the data, adjustments for autocorrelation were made according to [26]. Model selection was conducted by measuring the fit of each model via the calculation of BIC3, a variant of the Bayesian Information Criterion[32, p. 3]. In order to prevent the development of an overfitted model, we elected for a maximum of three joinpoints to be fit to the data, and for a minimum of 8 weeks to occur between joinpoints.

Results

Changing trends in loot box prevalence

Exploratory joinpoint regression was first carried out on the relationship between time and the percentage of individuals in the sample who played games which featured loot boxes. Prevalence of loot boxes was initially estimated at 4.27% of the sample in 22nd-26th March 2010, rising to 71.28% of the sample by 16th-22nd April 2019. Results indicated that the best-fitting model (BIC3=2.63) contained two joinpoints: 1st-8th January 2012, and 12th-19th March 2014.

Prevalence first increased at an average annual rate of 5.31%, from 4.27% at the beginning of observation to 14.05% in the period of 1st-8th January 2012 ($\beta = 0.10$, $t = 2.82$, $p=0.004$). At this point, the trend increased significantly in steepness (change in $\beta = 0.28$, $t = 6.50$, $p<0.001$) to an average annual increase of 20.38% ($\beta = 0.39$, $t = 15.54$, $p<0.001$). Finally, at the second inflection point during 12th-19th March 2014, prevalence was estimated at 59.42%. At this point, the trend in the data became significantly more shallow (change in $\beta = -0.34$, $t=-12.96$, $p<0.001$). This led to a more gradual rise in prevalence to 71.28% by 16th-22nd April 2019 at an average annual increase of 2.08% ($\beta = 0.04$, $t = 4.78$, $p<0.001$).

Changing trends in pay to win prevalence

Joinpoint regression was then carried out on the relationship between time and the percentage of individuals in the sample who played games with pay to win features. Prevalence of pay to win features was initially estimated at 5.09% of the sample , rising to 15.91% of the sample by 16th-22nd April 2019. Results indicated that the best-fitting model (BIC3=1.51) contained a single joinpoint during 12th-19th November 2015.

Prevalence first increased at an average annual rate of 2.13%, from 5.09% during 22nd-26th March 2010 to 17.38% during 12th-19th November 2015 ($\beta = 0.04$, $t = 10.12$, $p<0.001$). At the inflection point of 12th-19th November 2015, this trend decreased significantly in steepness (change in $\beta = -0.04$, $t = -5.40$, $p<0.001$) to an average annual rate that was not significantly different from zero ($\beta = -0.008$, $t = -0.99$, $p=0.32$).

Changing trends in cosmetic microtransaction prevalence

Joinpoint regression was finally carried out on the relationship between time and the percentage of individuals in the sample who played games which featured cosmetic microtransactions. Prevalence of cosmetic microtransactions was initially estimated at 8.34% of the sample during 22nd-26th March 2010, rising to 85.89% of the sample by 16th-22nd April 2019. Results indicated that the best-fitting model (BIC3=2.34) contained two joinpoints: 12th-19th February 2012, and 20th-27th August 2013.

Prevalence first increased at an average annual rate of 7.76%, from 8.34% at 22nd-26th March 2010 to 23.43% at 12th-19th February 2012 ($\beta = 0.149$, $t = 5.13$, $p<0.001$). At the first inflection point during 12th-19th February 2012, this trend increased significantly in steepness (change in $\beta = 0.40$, $t = 9.02$, $p<0.001$) to an average annual increase of 28.93% ($\beta = 0.555$, $t = 16.18$, $p<0.001$), leading to an estimated prevalence of 67.84% during 20th-27th August 2013. At this point, the trend in the data became significantly more shallow (change in $\beta = -0.49$, $t=-14.15$, $p<0.001$). This led to a more gradual rise in prevalence to 85.89% at 16th–22nd April 2019 at an average annual increase of 3.12% ($\beta = 0.06$, $t = 8.84$, $p<0.001$).

The resulting models from all joinpoint regression analyses are shown below as Figure 1.

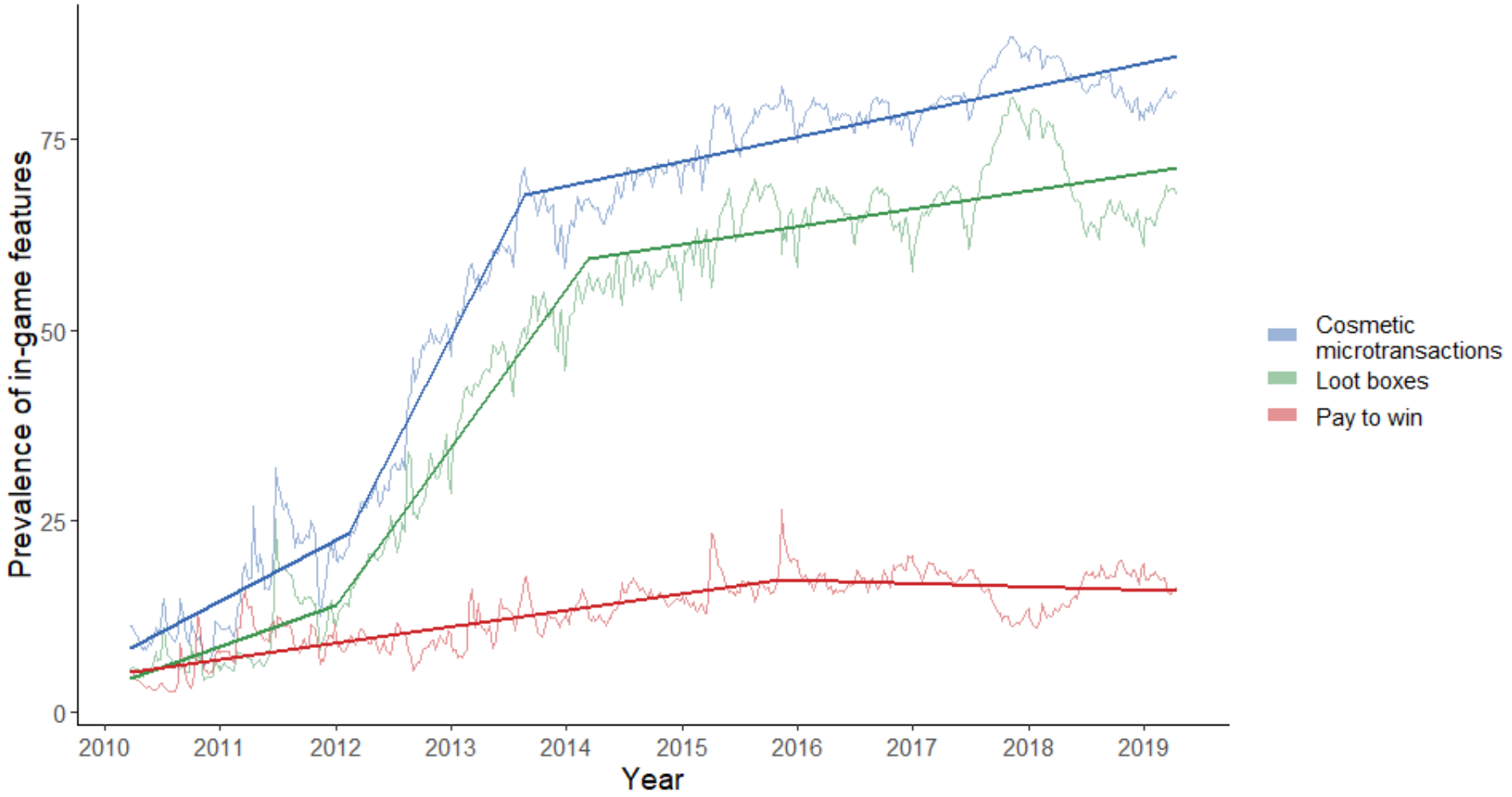

Figure 1: Time series graph showing the percent of the sample playing games with each relevant feature during the period under test. Models produced by three separate joinpoint regression analyses are superimposed on the graph as lines on top of each relevant time series.

Discussion

These results corroborate reports of an overall growth in loot boxes and cosmetic microtransactions in the period 2010-2019. At the beginning of the period, only a small minority of gamers were exposed to these features: 5.31% and 8.34% of the sample respectively. However, by the end of the studied period, the majority of gamers were playing games that featured both loot boxes (71.28%) and cosmetic microtransactions (85.89%). This does not contradict statements by games industry representatives that loot boxes only appear in a minority of games: After all, a mere 75 of the 463 games analysed during this study contained loot boxes. However, they do suggest that the games which do contain loot boxes such as *DOTA 2* and *Player Unknown's Battlegrounds* may be so popular that, whilst the minority of games may have loot boxes, the majority of gamers are exposed to this feature.

It is important to note that the data under test also provides no evidence of a diminishment in the prevalence of either loot boxes or cosmetic microtransactions: None of the regression analyses within any joinpoint model contained a negative coefficient. However, they do suggest that the growth of both cosmetic microtransactions and loot boxes have decelerated in recent years.

The majority of growth in the prevalence of loot boxes was modelled as taking place between January 2012 and March 2014. During this period the prevalence of loot boxes increased at a rate of 20.38% per year to a point where more than half of the sample played games with loot boxes. Similarly, between February 2012 and August 2013, the prevalence of cosmetic microtransactions increased at a rate of 28.93% per year to the point where more than two-thirds of the sample played games with cosmetic microtransactions. However, immediately after these rapid periods of growth, the increase in prevalence of both these features dropped significantly to relatively low rates: 2.08% and 3.12% per year respectively. These low rates remained in place for the subsequent 5-6 years.

The prevalence of pay to win microtransactions appeared to change in a somewhat different manner to the features outlined above. Whilst loot boxes and cosmetic microtransaction growth was characterised by a sharp increase leading to a slow period of gradual growth, pay to win microtransactions did not experience a similar temporary acceleration. Instead, their prevalence was modelled as rising at a gradual rate of only 2.13% per year from the beginning of observation until 12th-19th November 2015, at which point this rate declined ($p<0.001$) to an increase that was not significantly different from zero ($p=0.32$). Consequently, by the end of the sampled period, only 15.91% of the sample were playing games that featured pay to win microtransactions.

Limitations

The analyses presented here are limited in several ways. The dataset used captures the data of a large number of individuals: Indeed, an average of over 4 million players were recorded each day within our dataset by the conclusion of the studied time period. However, it is important to note that this data represents the players of only the 463 most popular games on *Steam*. The data of all less-popular games are is therefore not included in this dataset, and it is likely that these games may have a different distribution of features to the most popular games on the market.

Additionally, each game was coded as containing a specific feature if it contained that feature at the time of coding. Theoretically, a game may have only introduced a feature such as cosmetic microtransactions in 2017 or 2018. Yet, when coding took place, all datapoints for that game would be coded as coming from a game which contained such a feature. If this is the case, the models produced below could underestimate the size of increases in prevalence within the sample. Furthermore, it is also possible that games in the sample had previously contained loot boxes, and

then subsequently removed them. These games would be coded as not containing loot boxes, and their presence in the sample might lead to the overestimation of increases in loot box prevalence.

Finally, and most importantly, this dataset consists only of information about desktop games available via the *Steam* marketplace. It is therefore unable to provide information about the prevalence of cosmetic microtransactions, loot boxes, and pay to win features on other platforms such as mobile devices.

One must also note that this data cannot make any claims about the number of players who actually purchased microtransactions of any kind; rather, it speaks to the frequency with which these features appeared in popular games, and the proportion of gamers who are exposed to these features in the games they play.

Conclusions

The exploratory analysis presented above suggests that pay to win microtransactions continue to be an uncommon feature of desktop video games. Increases in the prevalence of this feature appeared to only gradually rise from 2010 onwards, and to plateau in 2015, leading to relatively low levels of prevalence in 2019.

By contrast, cosmetic microtransactions and loot boxes appear to be present in games played by the majority of desktop gamers within the sample. Over 70% of gamers played a game with loot boxes in by the end of the studied period; over 80% played a game with cosmetic microtransactions. This increase in prevalence does not appear recent: Indeed, the data suggests that these features may have risen to a dominant position in desktop games as early as 2014.

Academics and policymakers have expressed interest and concern in the potential consequences of the incorporation of the features outlined above in modern video games. Recent reports have suggested that loot boxes may recently have experienced either a decline in popularity, or a rise in popularity. This study instead suggests that, at least on desktop platforms, both loot boxes and cosmetic microtransactions experienced a sudden increase in prevalence during approximately 2012-2014, followed by a period of steady and gradual growth.

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