Keeping users addicted: Does gamification affect people's risk profile?

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Abstract

The literature documents a higher demand for skewed returns by several groups, such as younger men, unmarried or divorced, or different ethnic groups. One trading practice that may alter these preferences is gamification, which refers to various marketing strategies and technological elements that attract more retail investors. We use a large dataset from a gambling company with the identified players and a period from 1/2005 to 2/2012, with gamification introduced since 1/2010. This external shock and knowledge of individual characteristics (age, gender, and location) offers us a unique opportunity to identify and analyze the impact of gamification on personal preferences and their demand for lottery-like returns. We find that gamified individuals exhibit more pronounced lottery-seeking than individuals who started before the gamification introduction. These effects amplify over time. Moreover, the individuals attracted by gamification tend to continue gambling much longer. This prolonged gambling reflects the addiction of gamblers facilitated by gamification.

Keywords: Gamification, lottery-like returns, retail investors, risk attitudes, sports betting.

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1. Introduction

How stable are the risk preferences of individuals? Both theoretical and empirical literature support the idea that investors have innate preferences for returns with positive skewness, which are often referred to as lottery-like returns (e.g., Markowitz, 1952; Mitton and Vorkink, 2007; Barberis and Huang, 2008; Kumar, 2009). These preferences can influence stock performance and lead to suboptimal portfolio allocation (e.g., Bali et al., 2011). However, it is unclear whether this demand for lottery-like returns is stable and based on personal characteristics and to what extent outside factors can influence it.

On the one hand, the preference for skewed returns may be inherent to individual characteristics, such as their personalities and the socioeconomic conditions that they live in. In fact, Kumar (2009) provides a literature overview that documents higher demand for skewed returns by several groups, such as younger men, unmarried or divorced, African American or Hispanic minority groups, and Catholics and Jews. On the other hand, the trading practices may alter these preferences. One such trading practice is gamification. Gamification of trading platforms refers to various marketing strategies and technological elements to attract more customers. It is frequently mentioned as one of the driving forces of higher retail investor participation (e.g., Dorn and Sengmueller, 2009). Chapkovski et al. (2023) show that gamification also leads to higher trading activity, and gamified users are also more susceptible to the disposition effects. Our goal is to test the impact of gamification on individual preference for skewed returns.[1]

Brenner and Brenner (1990) show that individual risk preferences may vary over time, especially during economic downturns. This literature primarily refers to the volatility as the second moment of return distribution. While volatility level is crucial for the markets and asset price modeling, the return skewness defines the prevalence of a catastrophic risk – the risk of a significant loss. The higher the preference for lottery-like returns, the higher the risk of such significant loss. Our paper contributes to the literature by showing how individual preferences for lottery-like returns can be affected by gamification.

[1]. Skewed lottery-like returns pertain to assets with high positive skewness in the distribution of returns. While our analysis is focused on sports gambling data, given the large variation in bet odds, a preference for lottery-like returns and high skewness can be observed.

Our empirical analysis relies on an exogenous legislative shock that ratified and legalized online gambling in the Czech Republic at the beginning of 2009. Although gambling was legal in the Czech Republic before 2009, the legislative shock facilitated gamification in the following ways. Before 2009, domestic gambling companies could not offer online gambling. However, Czech citizens could place bets online on international gambling companies, albeit facing potential fines, which made it difficult for Czech companies to compete. This situation was further complicated as it was unclear if and how the winnings from international betting companies should be taxed. To answer these questions, the Czech parliament ratified the laws surrounding gambling and allowed Czech gambling companies to offer online gambling. These firms immediately introduced various promotions and challenges to compete with international betting companies. Our data comes from a large gambling company located in the Czech Republic. The sample period spans seven years (January 2005 to February 2012). This offers us a unique opportunity to analyze the impact of gamification on individual preferences and their demand for lottery-like returns.

We find that individuals attracted by gamification tend to have higher risk tolerance compared to individuals who started gambling before the gamification introduction. This result supports the findings of Chapkovski et al. (2023), who observe high selection bias for gamification. Individuals attracted by gamification challenges exhibit lottery-seeking behavior, i.e., place bets with higher odds and lower stakes and place more bets than their non-gamified counterparts. Notably, these effects amplify over time. Moreover, the individuals attracted by gamification tend to continue gambling much longer. This prolonged gambling reflects the addiction of gamblers facilitated by gamification. Overall, our results suggest that while there appears to be a significant selection effect, gamification tends to increase the demand for lottery-like returns. These results are persistent, not explained by personal characteristics, and robust to various specifications.

Our results contribute to the literature in the following ways. Firstly, we contribute to the literature on the demand for lottery-like returns. A growing literature suggests that some investors have strong preferences for stocks with lottery-like returns (e.g., Kumar et al., 2011; Kumar and Page, 2014; Blau et

al., 2016). However, data limitations make it unclear whether external factors can influence this demand and to what extent. Our results show that gamification is one factor that can affect this demand with persisting effects, and it can impact all individuals regardless of socioeconomic characteristics.

Second, we contribute to gambling literature. This literature frequently outlines the link between financial markets and gambling (e.g., Dorn et al., 2014). Gao and Lin (2015) show that the volume of stocks preferred by retail and with lottery-like returns decreases whenever jackpots of lotteries rise above 500 million Taiwan dollars. Given the large influx of new investors in recent times (McCabe, 2021), it is possible that this influx was partially caused by the disruption to sports gambling caused by Covid 19. Both Grall-Bronnec et al. (2017) and Cox et al. (2020) show that, similarly to gambling addiction, investors can experience addiction to trading. Our results outline that gamification might lead to a higher likelihood of addiction. In particular, we find that gamification increases the likelihood of persistent gambling. These results may explain the persistence of individuals demanding more returns with positive skewness, leading to long-term overpricing and underperformance (Barberis and Huang, 2008). Consistent with this, SEC Chair Gary Gensler pointed out that market gamification could be the reason behind the "meme stock mania" of 2021.[2]

Lastly, we contribute to the literature on gamification in stock markets. While Chapkovski et al. (2023) analyze the effect of gamification through hedonistic elements, we focus on gamification through challenges and bonuses instead.[3] Given the richness of our dataset, which is both broad and long, we can confirm that while gamification likely has a significant selection effect, it can also change individuals' choices.

Our study is organized as follows: Section 2 covers the institutional background and data description. Section 3 outlines the hypotheses and literature review. Section 4 presents the results of our analysis along with the methodology used. Lastly, Section 5 concludes.

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[2] Available at https://www.bloomberg.com/news/articles/2021-03-02/gensler-says-scrutinizing-trading-apps-would-be-focus-at-sec.

[3] Robinhood did offer a similar bonus to new users who created an account and linked it with their bank account (see, e.g., https://money.com/robinhood-free-trades/).

2. Institutional background and data

2.1 Evolution of the betting market: keeping bettors in-game

In January 2009, the Czech Parliament passed a law legalizing online and on-ground gambling in the Czech Republic.[4] This caused a proliferation of gambling and the rise of the top five Czech sports betting platforms (Chance, Fortuna, Tipsport, Sazka, and Synot Tip). One of the companies has shared the betting data with us on the condition of anonymity. While we cannot disclose the name of the betting platform, the information provided by the platform assures us that its gamification practices and client base represent those in the betting industry globally.[5] The proliferation of betting industries led to vigorous competition, and betting platforms developed a mosaic of sophisticated practices to keep clients engaged. One of these practices is the gamification of the clients' betting experience.

The definition of gamification is inconsistent across different sources and, therefore, open to broad interpretation. We specify game design elements as entertaining challenges for platform users. Such challenges serve the purpose of increasing user engagement. In the realm of betting platforms, bettors are attracted and motivated by various monetary bonuses to improve their engagements. However, these bonuses typically have some strings attached. Usually, they require maintaining the minimum odds, number

[4] Before the fall of the Soviet Union, betting was primarily done by illegal bookmakers in the racecourse in Prague-Velká Chuchle. The first brick-and-mortar betting branch (company Fortuna) was opened in Prague in the Lucerna passage, in May 1990, a few days after passing the first law on gambling and lotteries, No. 202/1990. The other companies followed, slowly around 2007 bringing into existence betting over the telephone line. Before the legalization of online betting, the situation was complicated by different treatment for Czech and foreign companies. While the law concerning lotteries and gambling did not explicitly forbid online gambling, and many gambling firms offered to take bets over the phone, online gambling was not allowed by the direction of the Ministry of Finance, which had to approve the "plan of operations" of gambling companies. Nevertheless, gambling online was available through foreign companies, which were even sponsors of some major Czech sports clubs. These firms were not forced to follow the Ministry of Finance and thus existed in the shadow zone legally since the law did not explicitly forbid online gambling. It was also unclear whether online gambling was illegal for Czech individuals. They could technically receive a large fine (around 50,000 CZK), but no one was ever fined. Similarly, it was unclear whether the gains from online gambling (originating in a foreign country) should be taxed locally. All of these concerns were ratified in January of 2009. More info with cited legislation here: https://www.lupa.cz/clanky/internetove-sazky-legalni-forma-v-nedohlednu/

[5] For instance, in late 2009, betting companies started advertising entry bonuses to attract new customers and match with foreign competitors. This and other examples of competition in the global online betting market further confirm that our data is indeed representative of the industry as a whole.

of bets, the target number of days with active bets, time limitations, and the challenge of keeping the aggregate stake of at least 5-7 times the initial deposit before the time limitation is reached. This gamification is the subject of further analysis.

We focus on the users who enter the platform to take advantage of the gamified entry bonuses. In particular, betting platform clients could receive an entry bonus if they complete several challenges. The usual scheme was the following: If the (addressed) customer made a minimum deposit and started to actively perform the challenges within a certain number of days (usually two weeks), they obtained the entry bonus of the matching size of their initial deposit. None of the gamification challenges involved prescribing specific betting decisions to the new users.

In addition to gamified entry bonuses, after 2010, the betting company introduced gamified features to attract inactive customers through returning bonuses. Again, they consist of gamified challenges, where the user must place minimal bets within a specified number of bets while maintaining the required minimum odds. However, the challenges were less intensive than entry bonus challenges, and the corresponding bonus was smaller. The eligible recipients of returning bonuses were existing (already registered) bettors who stopped betting with the company, generally for more than six months. This return bonus aimed to attract lost customers rather than bring new ones to the platform. Bettors would be offered return bonuses via the phone. Regular bettors who did not stop betting for prolonged periods did not qualify for this bonus. Figure 1 schematically describes bettors' timing and eligibility for entry and return bonuses.

[Figure 1]

Figures 2 and 3 show the distribution of the bonuses and the evolution of the mean and maximum bonus among the new individuals attracted by the gamification practices. We can see that the level of available gamification has changed several times and that the demand for various challenges has fluctuated significantly.

[Figure 2] and [Figure 3]

2.2 Data Description

We have individual data covering sports betting activity from one of the largest betting companies in the Czech Republic. We observe all betting activity—over 45 million sports tickets placed by over 100,000 customers across seven years (January 2005 and February 2012). Each bet has a specified stake, (decimal) odds, and a subsequent payout. Decimal odds represent the total return of the bet for every dollar wagered, i.e., including what was risked. In case of a win, a positive payout is associated with the odds (finally lowered by an administrative fee), and 0$ in case of a loss. If the odds are 2.3, in case of the win, it means a payout of $2.3 for each dollar wagered or a profit of $1.3 for every dollar risked. We know a unique identifier for each bettor to track their activity over time. The data also include gender, age, and the bettor's location (region), corresponding to an area roughly the same size as a census tract. For each ticket, we can observe the purchase date and time and the date and time that the bets on the ticket were resolved.

Let us note that there are no incentives for customers to change providers. Loyalty programs exist, and, as a result, a customer is generally unable to receive consistently better odds or lower fees at another betting company. Moreover, we are analyzing one of the largest gambling companies in the country, which has extensive geographical coverage and no legislation barring companies to only specific areas of the country. Consequently, customers should not need to switch companies after moving to a different location.

Critical identification is the existence of the exogenous shock related to introducing the gamification features. Monetary incentives for entry and return bonuses were introduced in early January 2010 after the ratification of online gambling. Since the gamification features were introduced in the middle of our sample, we can observe and analyze the betting behavior of five groups of individuals outlined in Figure 1.[6]

[Table 1]

[6] For completeness, another group of individuals received a bonus for referring a friend (new customer) to the platform who opted for the entry bonus challenge. We omit those individuals, as we only observe 452 users receiving bonuses for a referral (0.6% of the total sample of existing and eligible bettors after 2010), since referral bonuses are outside the scope of the paper.

1) We observe bettors who started gambling before gamification was introduced. These bettors are arguably naturally inclined to gamble and do not need any monetary incentives to play. Our sample contains 107,714 unique users who started betting before gamification.
2) Following the inception of bonuses, we can observe individuals attracted by monetary incentives. The offered challenges vary significantly in difficulty and risk, as outlined in Figures 2 and 3. Our sample contains 5,652 users who enrolled after gamification. We observed 3,280 users who enrolled in the least risky and demanding challenges, corresponding to 58% of entrants. The rest of the users enrolled in challenges with varying difficulty levels based on their preferences and the available level of challenges at the time of their enrollment. [7] The level of challenge users enroll in can indicate both their risk preferences and potentially lower sophistication, as they might not have evaluated the actual monetary benefit of the challenge.
3) Apart from the entry bonus challenge, the betting company also introduced a return bonus to attract lost customers. This option was offered to bettors who were established customers but stopped betting for a more extensive period of at least six months. Similarly to the 2) group, the challenges offered vary significantly in terms of risk and the corresponding reward; however, the rewards and risks are significantly lower than those of entry challenges. We observe 1,407 users who enroll in returning bonuses, with 391 individuals (38.5% of returning bettors) enrolling in more difficult challenges. These bettors might be considered more sophisticated or skilled, given their past betting experience, or they might be more seasonal bettors who bet only on selected sports or events.

We can better understand gamification's effects by observing and comparing these groups. By comparing bettors attracted by gamification with similar bettors who started gambling before the gamification introduction, we can understand the kinds of individuals attracted by gamification and the effects of gamification on inexperienced bettors. We can further investigate the impact of experience on gamification by comparing bettors with entry bonus challenges to those who take advantage of returning bonus

[7] New customers could receive the 100% matching bonus of their first deposit as the entry bonus of up to 3-4,000 CZK (approx. up to 150 USD). While slightly fluctuating with time, it is essential to note that to receive a 150 USD bonus, one must place his bets in an aggregated amount of at least 750 USD with odds higher than 2.0.

challenges. Importantly, our data also allows us to compare any of these groups, or all of them together. This comparison will enable us to analyze how the composition of bettors changed for the company and the total impact on the company's risk.

3. Literature Review and Hypotheses Development.

Demand for lottery-like returns has been extensively studied in finance.[8] Markowitz (1952), for instance, suggests that some investors might prefer stocks with positive skewness. This is further developed by Barberis and Huang (2008), who, using prospect theory, analyze the effect such demand has on prices. This demand is generally measured indirectly. Kumar (2009) uses lottery data to identify socioeconomic characteristics influencing individuals to place lottery bets and shows that similar socioeconomic characteristics influence demand for lottery-like returns. This demand increases during times of economic downturn. Blau et al. (2016) argue that call options have lottery-like returns and analyze how their demand impacts the underlying stock's prices. They observe that it increases volatility, negatively affecting the stability of prices.

The demand for lottery-like returns is also exhibited by investors participating in lotteries or gambling to meet their demand. Gao and Lin (2015) observe that once a state lottery reaches a certain level of the jackpot, stocks favored by retail investors, which have lottery-like returns, decrease in demand, and have significantly lower volume. This suggests that lotteries can function as a substitute for financial markets if they offer skewness demanded by investors. This is further supported by Dorn et al. (2014), who find that the demand for stocks and options decreases whenever lottery payouts are high. The demand for mutual funds or bonds is not affected, nor is the trading associated with long-term saving motive. Overall, the literature supports the findings that retail investors demand lottery-like returns.

[8] In our paper, we consider the demand for lottery-type returns as defined by Kumar (2009). Namely, they are assets with low prices relative to the payoff, low negative expected returns, price distribution has high variance, and a tiny probability of large rewards. In our data, this would correspond to bets with small stakes and huge odds. Such bets naturally have low expected payoffs and high skewness. Higher demand could be measured by persistently placing such bets and increasing the number of bets.

Retail investors have recently risen in prominence, responsible for more than 20% of the volume (McCabe, 2021). While there are many factors at play, with the Covid-19 pandemic and the subsequent rise in inflation arguably driving retail investors to higher rates of investments (Chapkovski et al., 2023), market gamification is frequently mentioned as one of the driving forces (e.g., Dorn and Sengmueller, 2009). Notably, it is even mentioned by Gary Geisler as one explanation of the "meme stock mania" of 2021.[9]

Gamification refers to the application of lessons from the gaming domain to change behaviors in non-game situations (Robson et al., 2015) and has been widely used in marketing (Thorpe and Roper, 2019) and gambling (Owens, 2012). Gamification has also been employed in finance. For example, Chapkovski et al. (2023) define gamification as using celebratory animations and bright colors used by trading platforms. Their results show that individuals using gamified platforms trade more and appear affected by the disposition effect. Moreover, they observe a significant selection effect, with users preferring gamified platforms driving the results. We, therefore, hypothesize that the introduction of gamification will attract users who will demand lottery-like returns. This leads us to our first hypothesis:

Hypothesis H1: *Bettors attracted by gamification have a higher demand for lottery-like returns.*

However, it is not clear how stable the demand for lottery-like returns is. Prior literature (e.g., Markowitz, 1952; Barberis and Huang, 2008; Kumar, 2009) implicitly assumes that this demand is driven by personal characteristics, which are time-invariant. This assumption contradicts the findings of gambling literature, which observes how addiction can change the demand for risk over time (e.g., Grall-Bronnec et al., 2017). Gamification has been shown to increase the likelihood of addiction (Kim and Werbach, 2016), thus suggesting that it can change the demand and preferences of investors in the long term. The increase in gamification and the link between gambling and investing (e.g., Dorn et al., 2014) might explain the higher incidence of addiction to compulsive investing (Cox et al., 2020), which has been rising in both in frequency and severity (e.g., Grall-Bronnec et al., 2017). This leads us to specify our second hypothesis:

[9] Available here https://www.bloomberg.com/news/articles/2021-03-02/gensler-says-scrutinizing-trading-apps-would-be-focus-at-sec.

Hypothesis H2: *The demand for lottery-like returns will increase for gamified bettors more than for non-gamified bettors.*

The literature supports the idea that gamification has a significant selection bias (Chapkovsi et al., 2023) and that there are socioeconomic characteristics that correspond to higher demand for lottery-like returns (Kumar, 2009). For example, age and experience typically decrease demand for lottery-like returns (Kumar, 2009). The question remains whether investors with a lower propensity for lottery-like returns are unaffected by factors that increase the demand for such returns. Gamification challenges in our samples were introduced for new entering players and experienced players who stopped gambling to entice them to return to the platform. We hypothesize that such investors might be less likely to enroll in gamification challenges and less likely to be affected in the long term. We specify the last hypothesis.

Hypothesis H3: *Gamification does not increase the demand for lottery-like returns for individuals with more experience and sophistication.*

4. Results

4.1 Selection and summary statistics

The main focus of this study is to understand the effects of gamification on individuals and the inception of gamification for the company and the entire market segment. To complete the challenge, users need to keep a high-risk profile. However, it is unclear how much self-selection occurs. We report summary statistics for individuals enrolling in any challenge and the summary statistics for individuals entering the sample before the introduction of gamification in Table 2.

[Table 2]

We can observe an increased demand for lottery-like returns by individuals attracted by gamification. They tend to place bets with lower stakes but much higher odds and tend to place more bets overall. This finding supports our hypothesis H1. Naturally, the challenges individuals can enroll in mandate the

minimum risk, stake, and number of bets to complete the challenge, which can increase their overall risk compared to non-gamified users. However, the challenge is not forcing users to demand lottery-like returns or positive skewness. Users could complete the challenges without such a strategy by placing fewer bets with lower odds but higher stakes. Moreover, if the challenge purely drove the results, we should see either a drop in such behavior or a reversal after the challenge ends, which should decrease the mean. Instead, the users going through challenges seem to develop an appetite for sensation-seeking bets, that have lottery-like return. After completing the challenge, they monetary awards can cover, in some capacity, the losses they have suffered. Individuals can then continue placing more and more sensation seeking bets, which lead them to have increasing demand for lottery like returns following the end of the challenge.

However, the challenges available to users vary significantly by risk and by the stake investors need to place to complete them. Given the large stakes individuals need to put up to complete more difficult challenges, they likely suffer more considerable losses than expected. We plot the net stakes and returns for individuals enrolling in challenges in Table 3.

[Table 3]

We can observe that the challenges are, on average, significantly unprofitable for the individuals who enroll in them. Notably, individuals enrolling in more difficult challenges lose more than double the money compared to individuals enrolling in less demanding challenges, even after accounting for the bonus they receive.

4.2 Gamification and demand for lottery-like returns

Next, we explore whether gamification influences demand for lottery-like returns. Gamification challenges prescribe certain behaviors, which can expose individuals to riskier bets, which are, by definition, more sensation-seeking. This can condition individuals to seek more sensation-seeking bets (Grall-Bronnec et al., 2017; Robson et al., 2015), leading to demand for such bets even after the gamification incentive ends. To test the impacts of gamification, we use regression with user-fixed effects. By employing such

specifications, we can control for unobserved personal characteristics and the chosen level of challenge. We report the results in Table 4.

[Table 4]

We can see that the demand for lottery-like returns persists after the end of gamification and increases over time. We analyze the impact on stake and both minimum and average odds of bets.[10] We start our analysis one month after the end of the challenge and provide results up to six months after the end of the gamification challenge.[11] We observe that users attracted by gamification exhibit a strong demand for lottery-like returns, with increasing effect over time. Namely, the stake of bets decreases while both the mean and minimum stake increase. The gamified challenges likely condition users to place and subsequently seek out sensation-seeking bets, leading to addiction and an increase in demand for lottery-like returns. In the next section, we analyze how persistent this effect is and compare the behavior of investors exposed to gamification with similar investors who started before the gamification introduction.

4.3 Long-term effects of gamification

This section explores how persistent this effect is and how the demand for lottery-like returns develops over time. The rich panel data structure allows us to compare individuals entering the sample before gamification and individuals attracted by gamification while controlling for personal characteristics (age, gender, and location).[12]

To estimate the gamification effect, we use propensity score matching to estimate the Average Treatment Effect on the Treated (ATET) to facilitate such analysis and more directly analyze causal effects. Specifically, we use the Rubin Causal Model (Holland, 1986). This model has two possible outcomes: one with treatment and one without.

[10] Results are identical if we employ maximum odds and are omitted for brevity.
[11] We start our analysis of post-gamification one month after the end of the challenge to minimize the effects of house money, which could influence the results. Our results are robust to including the first month after the end of the challenge.
[12] Data spans over seven years and exceeds 45 million sports tickets placed by over 100,000 individuals.

$$y_{0i} = \mu_0 + \epsilon_{0i} \text{ and } y_{1i} = \mu_1 + \epsilon_{1i}. \quad (1)$$

This model can also be formally written as $y_{Ti} = \mu_T + \varepsilon_{Ti}$, where the subscript *T=1* denotes the treatment, and *T=0* represents the control group. In practice, we are only able to observe one outcome (y_T) for each observation *i*. The counterfactual outcome needs to be estimated. We employ propensity matching using the nearest-neighbor approach with an extensive set of control variables to assess the treatment effect (ATET).[13] In our context, the treatment (T) is an indicator if an individual enrolled in the entry challenge (i.e., belongs to group 2), and the control group consists of individuals who started gambling before gamification introduction (i.e., belong to group 1). Assuming that the outcome variable can is, e.g., the stake of the bettor, then the terms μ_1 and μ_0 would represent the incremental effect on the stake of the better when the treatment (gamification) does and does not occur, respectively, while controlling for various characteristics. Details of which factors are controlled for and the matching quality are provided in each corresponding table.

One factor to control is the time when the bettor received the bonus. The challenges may take different amounts of time to complete, and thus, the time when the bonus is received can differ among bettors. Therefore, the impact on bettors' behavior after receiving the bonus must be considered when analyzing the effect. As individuals who started gambling before gamification was introduced (group 1) did not receive any bonus, we cannot control for the time to bonus. To overcome this limitation, when using it as a control group, we randomly assign the time to bonus to group 1, with the mean and variance of time to bonus observed for the treatment group. We bootstrap this process 100 times and report the mean estimates of the treatment effect. This process allows us to analyze the impact of gamification introduction and is consistent with techniques frequently used in finance (Baker et al., 2022; Bernstein et al., 2016; Cai and Adam, 2024; De Araujo et al., 2020; Roberts and Whited, 2013, among others).

[13] We exact match on gender and geographical region, i.e., district, and use age as a coordinate for matching. The treatment effect $E[y_{1i} - y_{0i}]$ is under random assignment equal to $\mu_1 - \mu_0$.

We aggregate individuals' activity monthly to analyze the long-term effects better and minimize the potential noise associated with daily betting activity.[14] We report the numerical results of the treatment effects in the Internet Appendix and use Figure 4 to better visualize the long-term effects.[15]

[Figure 4]

We observe that individuals enrolling in gamified challenges exhibit a stronger demand for lottery-like returns than those not attracted by gamification. Notably, we observe a decreasing trend in daily stakes for the gamified individuals while an increasing trend in the mean odds over the entire period. For example, during the fifth month after the end of the gamification challenge, gamified individuals' daily stake was only higher by less than 50CZK (around 3$) compared to non-gamified individuals, with mean odds higher than 1300. Overall, gamified individuals exhibit a much stronger demand for skewness, increasing over time.

The mechanism for the increasing demand for skewness remains a question. As outlined in previous sections, bets with high skewness are naturally more sensation-seeking. As a result, these bets can lead to a higher likelihood of addiction. While it is not possible to directly test whether our observed gamified individuals suffer from higher addiction, there are observable factors that may infer addiction. Namely, higher and more persistent demand can be measured as the number of bets and the likelihood of continuing gambling. To test whether gamified individuals place more bets and continue gambling for longer, we use the same setup as in Equation (1) and Figure 4, only with different dependent variables. As for Figure 4, we report the effects in Figure 4 to visualize the long-term effects, with the numerical results in the Internet Appendix.

[Figure 5]

We observe that the likelihood to continue gambling is significantly higher for gamified individuals and increases through the six months after the end of the challenge. The number of daily bets has no clear

[14] Similar to Table 4, we omit the first month following the end of the challenge to minimize potential house money effects.
[15] The corresponding tables with match quality indicators are available in the online appendix.

pattern; the first decreases but increases after the third month. The reduction in the sample size can explain this effect, as most individuals tend to quit. However, even during the lowest observation, the effect for gamified individuals is significantly higher than for non-gamified individuals. These results suggest that gamified individuals exhibit stronger evidence of addiction. The monetary bonus after the challenge conditions them to sensation-seeking bets likely has the effect of partially counteracting the losses individuals suffer from those challenges, as outlined in Table 3. Overall, gamification appears to have a significant effect on the demand for skewness, likely through addiction channels, which may not only be harmful to the individual but may also complicate risk management for the company.

4.4 Gamification effects on more sophisticated individuals

Previous sections outline how gamification attracts individuals with a higher propensity for positive skewness and can increase the demand for returns with lottery-like characteristics. However, prior research shows that specific individuals are less likely to demand such returns and less likely to be attracted by gamification (e.g., Kumar, 2009; Chapkovski et al., 2023). Notably, more sophisticated and experienced individuals should be less likely to be influenced by gamification. The only individuals who were offered a return challenge were those who gambled in the past, before the gamification introduction, but have not placed a new bet for at least six months. Given that those individuals gambled in the past, they should have more experience and are likely more sophisticated than individuals who have just started.

Using the methodology outlined in Section 4.3, we compare individuals enrolling in the returning challenge (treatment) to users enrolling in entering the challenge (control). Unlike the methodology in Section 4.3, we do not need to bootstrap our results since we know when the bonus was received for users completing the entry and return challenges. We can also further match the users based on the size of the bonus, in addition to previous variables, namely exact matching on gender and location, and using age as a coordinate for matching. We report the results in Figure 6.

[Figure 6]

We can see that returning bettors seem to be gambling for longer and placing more bets but do not seem to demand lottery-like returns. They typically bet more significant stakes but lower both average and maximum odds. The odds they demand appear to decrease with time, suggesting that exposure to gamification does not impact their long-term behavior. Overall, experienced individuals are less likely to be affected by gamification.

5. Conclusion and discussion

While there is a rich literature on preference for lottery-like returns, prior literature does not clarify whether such preference is constant or can be influenced by outside factors. In our paper, we analyze whether this demand for lottery-like returns, i.e., returns with positive skewness, is influenced by gamification. Gamification refers to the application of game-like elements to non-game situations in attempts to change the behavior of individuals and has been frequently mentioned as a driver of the recent high level of retail participation in the stock market. We take advantage of the exogenous shock that ratified legal gambling in the Czech Republic and led to the introduction of various gamified bonuses for new incoming bettors.

We observe that individuals attracted by gamification exhibit lottery-seeking behavior, i.e., place bets with very high odds and lower stakes and place more bets than the average bettor. However, these effects significantly amplify over time. After the end of the challenge, gamified individuals place bets with higher and higher odds, while reducing the stake of their bets. The likely explanation is that due to gamified individuals being conditioned to place bets with high positive skewness, they have a higher likelihood of getting addicted. We observe that gamified individuals increase the number of bets they place over time, and their likelihood of continuing to gamble is significantly higher than for those not attracted by gamification. While the bonus they earn after the challenge ends is significantly lower than what the average bettor loses, it can still allow the individual to continue their sensation-seeking and loss-chasing behavior. The addicted individuals then continue to place bets that are riskier, i.e., right-skewed, and naturally more sensation-seeking.

We do observe that some mechanisms can limit this effect. Notably, more experienced bettors who have gambled in the past tend not to be as affected. They stay in the game longer but tend to place fewer and larger bets rather than exhibit pure lottery-seeking behavior.

Prior literature typically uses a set of socio-economic indicators when describing likely reasons for the demand for lottery-like returns. While we observe self-selection to the gamified challenges and the lottery-seeking behavior, gamification can strengthen the demand in the long run. Our sample includes individuals across various socio-economic classes, and we control for the effect of age, gender, and the location where the person lives. Our presented results estimate the impact while comparing two individuals with the same characteristics. Thus, gamification can induce individuals to demand lottery-like returns, even if they are not naturally inclined toward them. This result can help explain the surge in retail participation in financial markets and offers further evidence of how gamification is changing both the type of individuals attracted to financial markets and the demands of individuals already on the market.

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Figure 1. Timing and types of gamified bonuses

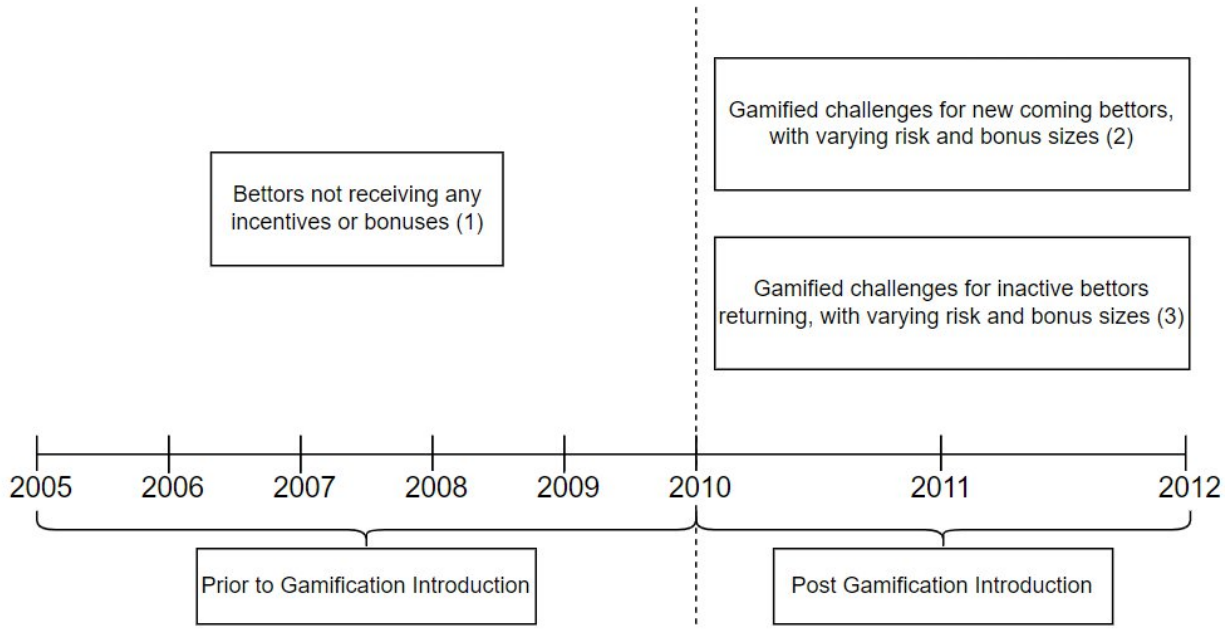


Figure 2: Evolution of maximum and mean bonuses during the gamification period.

The following figures sketch the (realized) maximum and mean bonuses among newcomers during gamification. The 500 CZK bonus (roughly 25$) was the minimum (rounded) and represented the most straightforward bonus challenge. The maximum was 4,000 (~160$). The presented lines used the time when individuals entered the challenges.

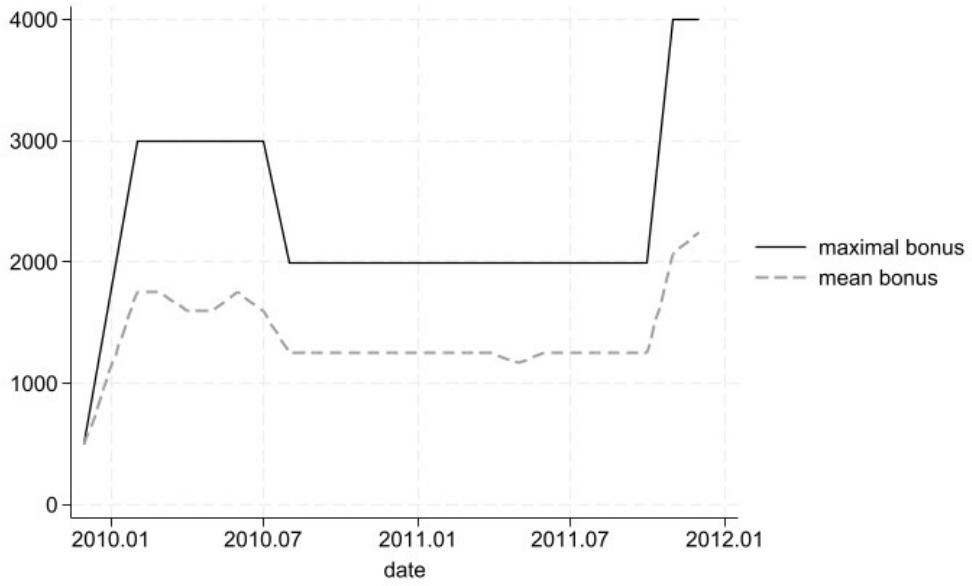


Figure 3: Distribution of bonuses during the gamification period.

The following figures sketch the frequencies of bonuses among newcomers during gamification. The 500 CZK bonus (roughly 25$) was the minimum (rounded) and represented the most straightforward bonus challenge. The maximum was 4,000 (~160$). The presented lines used the time when individuals entered the challenges.

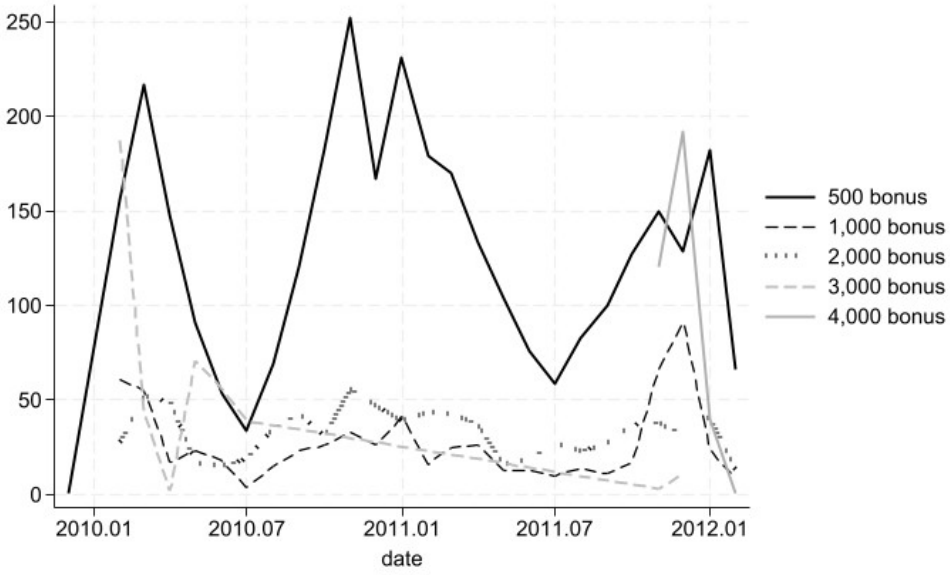


Figure 4: Gamification effect on mean odds and daily stake

The following figure compares the effects of gamification on bettor behavior. We analyze the period after the player receives a bonus, with the control sample being bettors who started gambling before gamification was introduced and who form the control group (base category). This figure analyzes the mean odds and daily stakes demanded by gamified individuals, with non-gamified individuals serving as the control group to estimate the treatment effect. We randomly assigned the time to bonus for these players, using the mean and standard deviation for the gamified group. The simulation was repeated 100 times. Matching is done precisely by gender and region, approximately by age. The presented confidence intervals are based on a distribution of the mean effect and its standard errors. (Critical values are based on an asymptotic normal distribution.)

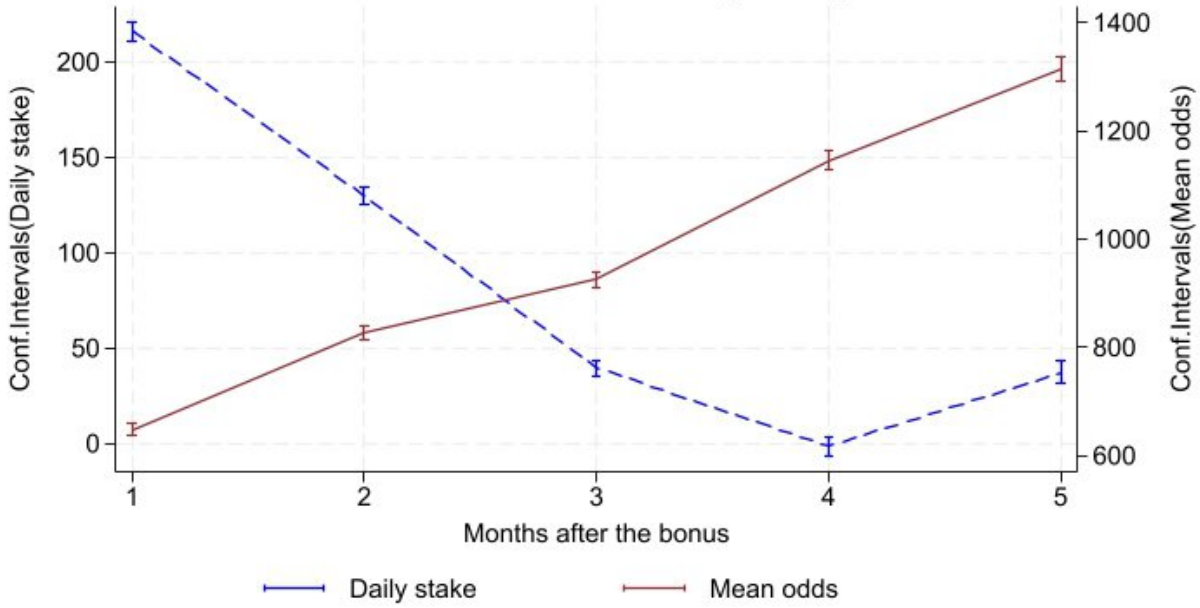


Figure 5: Gamification effect on addiction

The following figure compares the effects of gamification on bettor behavior. We analyze the period after the player receives a bonus, with the control sample being bettors who started gambling before gamification was introduced, who form the control group (base category). This figure analyzes the number of bets placed and likelihood to stay in the game of gamified individuals, with non-gamified individuals serving as the control group to estimate the treatment effect. We randomly assigned the time to bonus for these players, using the mean and standard deviation for the gamified group. The simulation was repeated 100 times. Matching is done precisely by gender and region, approximately by age. The presented confidence intervals are based on a distribution of the mean effect and its standard errors. (Critical values are based on an asymptotic normal distribution.)

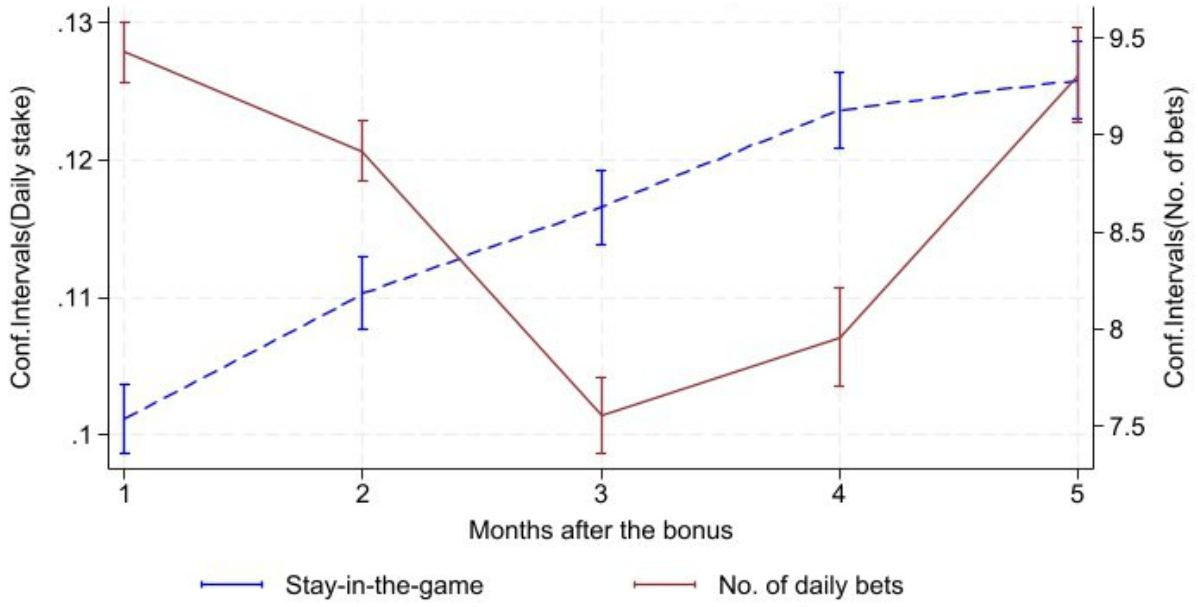
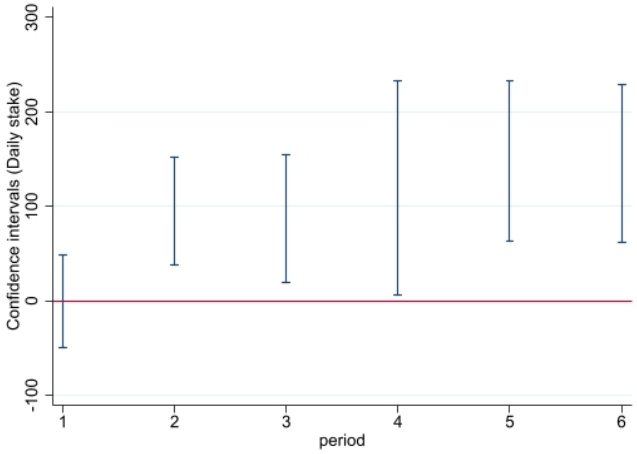


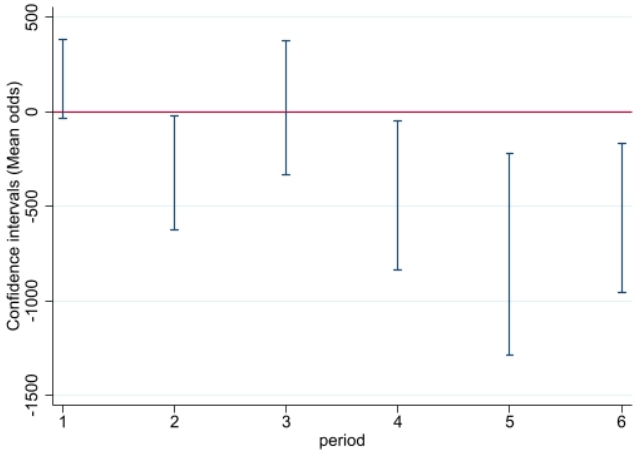
Figure 6: Comparison of bettors with entry challenge/bonus and returning challenge/bonus

The following figures compare the effects of gamification on newcomers and experienced bettors. We analyze the period after the player receives the entry bonus, with the control sample being bettors who receive the returning bonus. Matching is done precisely by gender, region, and bonus size, approximately by age. The presented confidence intervals are based on a distribution of the mean effect and its standard errors. (Critical values are based on an asymptotic normal distribution.) The returning players form the base (control group).

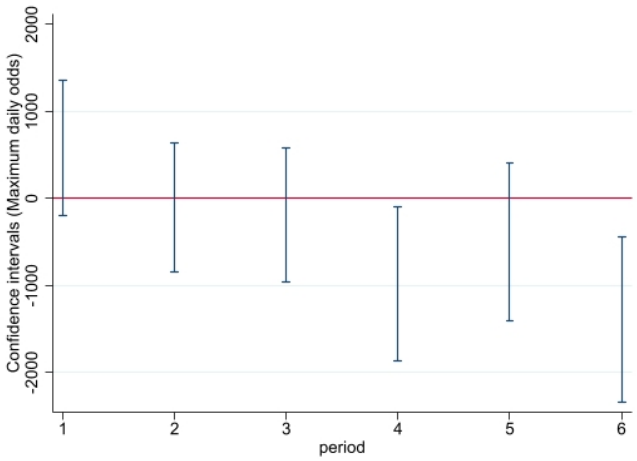
a) Entering vs. Returning players: Daily stake, base: Returning players)



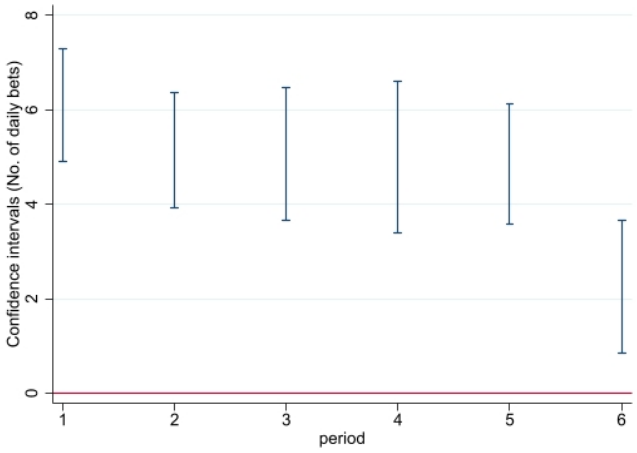
b) Entering vs. Returning players: Mean odds (daily), base: Returning players



c) Entering vs. Returning players: Maximum odds (daily), base: Returning players



d) Entering vs. Returning players: The number of bets (daily), base: Returning players



e) Entering vs. Returning players: Likelihood to stay (continue), base: Returning players

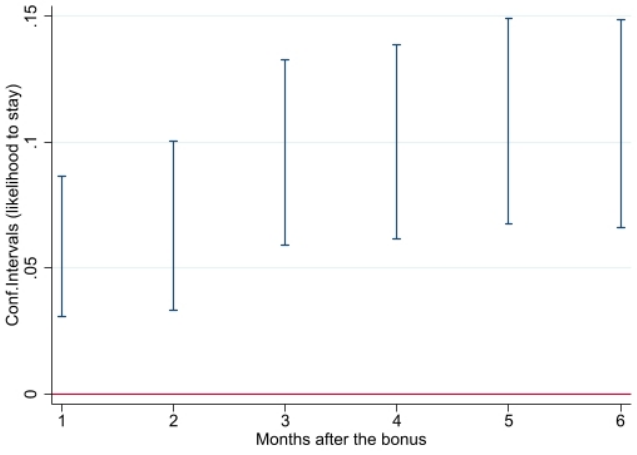


Table 1. Sample statistics for gamification introduction

Table 1 contains the sample statistics for different groups observed in our sample and outlined in Figure 1. No bonus corresponds to individuals starting to gamble prior to gamification introduction (Group 1), entry bonus corresponds to individuals enrolling in entry challenges (Group 2), and return bonus corresponds to individuals enrolling in returning bonuses (Group 3). The referral bonus corresponds to individuals who referred a friend to the platform and is included for completeness.

	Distribution by N (day*player)			**Distribution by players**		
Bonus type	Freq.	Percent	Cum.	Freq.	Percent	Cum.
No bonus	15,654,889	90.69	90.69	107,714	93.8	93.8
Entry bonus	609,006	3.53	94.21	5,652	4.92	98.72
Return bonus	422,020	2.44	96.66	1,016	0.88	99.61
Referral bonus	576,748	3.34	100	452	0.39	100
Total	17,262,663	100		114,834	100	

Table 2. Descriptive statistics for different groups of individuals by gamification period and challenge

Table 2 contains the distributions of the following variables: total daily stake (*D_stake*), *net_win* (0/1 variable =1 if at least one ticket is won during the day). The variables *max_stake* and *min_stake* contain the maximum and mean stakes bet during the day. Similarly, the variables *max_odds* and *mean_odds* refer to the maximum and mean odds on all tickets during the day (and player). Finally, the total number of bets taken during the day is in the variable *D_bet*. Descriptive statistics are in columns; p10-p90 refer to particular percentiles; note that p50 is the median. The different number of observations for odds is due to the so-called combinator bet, a ticket containing several (independent) single bets. Therefore, the total odds for the combinator ticket depend on the rule and are mostly irrelevant for these bets. Detailed splitting by bonus size or age of the players is available in the Internet Appendix or upon request.

Panel A. Statistics for betters during 2009 (before gamification)

Bonus range	N	Mean	Std. dev.	p10	p25	p50	p75	p90
Daily stake	530,687	374.88	2002.34	20.00	40.00	92.00	230.00	644.00
Net win	530,687	0.28	0.45	0.00	0.00	0.00	1.00	1.00
Max stake	530,687	194.83	1259.33	11.00	21.00	50.00	107.00	315.00
Mean stake	530,687	140.33	1122.08	10.67	20.00	40.00	96.00	220.00
Max odds	434,421	1730.55	14165.42	2.73	5.16	15.25	66.75	458.95
Mean odds	434,421	693.34	7538.45	2.45	4.12	10.45	37.94	197.01
Daily bets	530,687	23.17	33.39	4.00	6.00	13.00	27.00	51.00

Panel B. Gamification period: Statistics for all betters with any entry bonus.

Bonus range	N	Mean	Std. dev.	p10	p25	p50	p75	p90
Daily stake	609,006	573.35	2626.73	20.00	50.00	129.00	390.00	1132.00
Net win	609,006	0.38	0.48	0.00	0.00	0.00	1.00	1.00
Max stake	609,006	280.21	1033.65	14.00	30.00	55.00	195.00	515.00
Mean stake	609,006	190.81	697.74	11.50	20.00	47.00	107.00	375.00
Max odds	537,447	2893.88	19985.01	2.50	4.41	13.80	70.00	596.19
Mean odds	537,447	988.94	9689.56	2.25	3.41	8.29	31.62	191.68
Daily bets	609,006	25.48	36.73	3.00	6.00	14.00	31.00	58.00

Table 3. Effect of gamification challenge on the total stake during the entry period

Table 3 contains the distribution of realized net returns by individual and gamification bonus. It is computed as the total net win (winning amount minus fees and provisions) minus the total bet amount (i.e., total stake) plus the received gamification bonus. N denotes the number of participants in each gamification challenge; after their mean and standard deviation, we list the leading percentiles from p10 (10^{th} percentile) to p90 (90^{th} percentile). Median corresponds to p50.

Bonus range	N	Mean	Std. dev.	p10	p25	p50	p75	p90
500-1,000	674	-12,117	11,199	-21,025	-14,543	-10,296	-7,089	-4,700
1,000-2,000	917	-31,152	35,829	-50,786	-33,611	-23,877	17,590	-12,814
2,000-3,000	422	-26,976	27,481	-42,323	-31,304	-24,644	-19,147	-12,558
3,000-4,000	355	-32,776	15,111	-47,054	-37,330	-31,369	25,714	-17,551

Table 4. Time dynamics of the gamification effect: different periods after bonus received.

Table 4 contains the results of daily FE regressions, where all time-invariant bettor characteristics are absorbed (controlled for) using the bettor's FE. Dependent variables are (total) Stake, minimum, and mean odds of daily betting tickets, reported respectively in Panel A, B, and C. The regression is conducted before the bonus is received and x months after. For example, the variable "1 month after" is a dummy indicating all betting one month (and more) after the bonus received — the period between the entry and the received bonus served as an omitted category (benchmark). So, the coefficients following these time dummy variables express the difference compared to the entry period. Robust standard errors are in parentheses. ***, **, and *, denote statistical significance at 1%, 5%, and 10%, respectively.

Panel A)

	Dependent variable – Daily stake					
1 month after	-31.374***					
	(6.921)					
2 months after		-40.633***				
		(6.791)				
3 months after			-41.646***			
			(7.040)			
4 months after				-45.453***		
				(6.916)		
5 months after					-47.791***	
					(6.861)	
6 months after						-45.645***
						(6.992)
Constant	565.683***	558.689***	555.218***	554.057***	549.054***	540.363***
	(5.699)	(5.419)	(5.464)	(5.224)	(5.036)	(4.972)
Adjusted R^2	0.541	0.567	0.565	0.595	0.591	0.574
N (observations)	519,286	471,600	435,624	405,505	378,004	352,347

Panel B)

	Dependent variable – Minimum odds					
1 month after	234.390***					
	(30.453)					
2 months after		258.736***				
		(33.220)				
3 months after			270.801***			
			(35.371)			
4 months after				284.000***		
				(36.999)		
5 months after					295.062***	
					(38.223)	
6 months after						309.833***
						(39.438)
Constant	358.198***	368.958***	380.442***	386.197***	389.622***	383.292***
	(24.909)	(26.304)	(27.217)	(27.687)	(27.773)	(27.750)
Adjusted R^2	0.257	0.263	0.268	0.278	0.293	0.299
N (observations)	456,659	414,569	383,111	356,758	332,914	310,668

Panel C)

	Dependent variable – Mean odds					
1 month after	338.357***					
	(34.382)					
2 months after		373.681***				
		(37.322)				
3 months after			387.885***			
			(39.552)			
4 months after				417.571***		
				(41.258)		
5 months after					433.581***	
					(42.458)	
6 months after						449.053***
						(43.634)
Constant	811.145***	832.754***	851.457***	854.310***	855.763***	845.920***
	(28.123)	(29.552)	(30.434)	(30.874)	(30.851)	(30.703)
Adjusted R^2	0.352	0.362	0.369	0.383	0.400	0.410
N (observations)	456,659	414,569	383,111	356,758	332,914	310,668