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Gambling spending and its concentration on problem gamblers

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ABSTRACT

While most gamblers spend moderate amounts of money, a few spend much more. This leads to spending being concentrated among a small number of players. Building on a body of literature that shows disproportionate spending by problem gamblers, we hypothesize that problem gambling causes such concentration. We investigate this hypothesis empirically by using GINI coefficients derived from survey datasets of gamblers from three different jurisdictions: France, Québec, and Germany.

We find strong positive relationships between the GINI coefficient and (1) the share of revenue derived from problem gamblers, and (2) excess spending of problem gamblers. We interpret these results as a link between the effect of problem gambling—excessive and disproportionate spending—and concentration of gambling demand. Since the problem gambling status of players is often unknown, policy makers and gambling operators could use the GINI coefficient as an additional indicator to monitor social risk in gambling markets.

1. Introduction

The dose-response-relationship suggests that gambling problems and the amount of money spent are positively correlated (Brosowski et al., 2015; Currie, Miller, Hodgins, & Wang, 2009). Problem gamblers[1] are known to play longer sessions, more frequently, and more intensely than recreational gamblers (O'Mahony & Ohtsuka, 2015; Productivity Commission, 2010). It follows that problem gamblers account for a relatively large proportion of spending.

A sizable body of literature on the share of gambling revenue[2] shows that shares attributable to problem gamblers vary to a great extent depending on the game type and jurisdiction (see the Literature review). The share of revenue derived from problem gamblers can be an important indicator of whether a game is beneficial or harmful to society. Games are deemed less beneficial when the share of revenue derived from problem gamblers is largest. The logic is that spending by non-problem gamblers entails a consumer surplus in the form of enjoyment. By contrast, excess spending from problem gamblers, who have lost control over their gambling behavior, creates social costs in the form of productivity losses, treatment costs, and reductions in quality of life.

The share of revenue from problem gamblers depends on two variables: The prevalence of such persons among all gamblers and their average per-head spending compared to the average spending of all gamblers. Hence, games with a relatively high share of problem gamblers and games in which problem gamblers spend relatively more than recreational gamblers have higher revenue shares derived from problem gamblers. A high revenue share from problem gamblers can either mean that problem gambling is rather prevalent among its players or that problem gamblers spend disproportionately more. While the large body of literature we review in the next section has addressed the former, to our knowledge, no study has addressed the concentration of gambling spending and its relation to problem gambling. We intend to fill the gap and investigate the hypothesis that a relationship exists between problem gambling and concentration of demand for gambling. If such a relationship does exist, policy makers and gambling operators could use the concentration of demand as an additional indicator to measure the social risk of gambling markets. This could be especially helpful since the status of being a problem gambler is usually unknown while data on actual consumption is comparatively easy to obtain, especially in the online market.

We systematically compare information from three surveys

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[1] By 'problem gamblers' we mean either problematic gamblers (scoring 3–7 points on the Problem Gambling Severity Index [PGSI] or 3–4 points on the scale of the 4th Diagnostic Statistical Manual [DSM-IV]) or pathological gamblers (PGSI > 7 or DSM-IV > 4).

[2] We use the term revenue interchangeably with spending and expenses throughout the text (since gambling is a zero sum game, gamblers' net spending equals operators' revenue).

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conducted in France, Germany, and Québec. Comprising interval data on spending, these datasets overcome the limitation of ordinal data, in which the highest amounts of spending are effectively cut off, leading to an underestimation of the amount of revenue derived from problem gamblers. A number of key indicators are derived from each survey and compared across jurisdictions: (1) the concentration of spending as measured by the GINI coefficient, (2) the prevalence of problem gamblers among all players per game form, (3) the money spent by problem versus non-problem gamblers, (4) excess spending of problem gamblers, which we define as the difference between the prevalence of problem gamblers and their share of expenditure.

We first present findings on the concentration of spending in general. The second subsection investigates the concentration of spending from problem gamblers. Next, we break down the concentration of spending per type of game and calculate excess spending. The data show that revenue shares of problem gamblers and excess spending correlate positively with the GINI coefficient of spending of a game form. Considering limitations and reflecting on the implications of our findings, we interpret the evidence as support for the hypothesis that problem gambling is related to concentration of demand and suggest that the GINI coefficient could be used as an additional tool by regulators.

2. Literature review

2.1. Concentration of gambling spending

Spending for gambling is highly concentrated on a small group of high-intensity gamblers. For example, 80% of revenue from fixed-odds sports betting is generated by 5.7% of gamblers, while for online casino games, 80% of losses occur among only 4.9% of subscribers, as shown by Tom, LaPlante, and Shaffer's (2014) study on the betting patterns of internet gambling subscribers of bwin.party. In poker, revenue is yet more concentrated: 1% of the gamblers account for 60% of operators' revenue, 5% account for 83%, and the top 10% of players deliver 91% of the operators' income (Fiedler, 2012, p. 17). In the relatively new game of Daily Fantasy Sports, 1.3% of players account for 40% or all entry fees, and the next 5% of players for another 36%, as shown in a recent McKinsey study (Miller & Singer, 2015).

These revenue shares refer to online gambling forms, where actual and unbiased playing data are recorded automatically and are easily accessible. By contrast, studies on offline gambling must rely on questionnaires, which are prone to biases such as respondents' selective memory and social desirability of answers. Such studies are thus rarer, but show similar results: For example, in the Canadian province Nova Scotia, 96% of all gambling revenue derives from 25% of the players (Hayward, 2004, p. 22). An early study from New South Wales, Australia, shows that 90% of slot machine revenue is derived from the 5.9% of players who gamble more than once a week (Dickerson, Baron, Hong, & Cottrell, 1996).

2.2. Concentration of gambling spending on problem gamblers

A number of studies provide evidence on the diverging spending habits of recreational gamblers and problem gamblers. For instance, Wiebe, Mun, and Kauffman (2006) compare monthly spending means across a range of games and find consistent differences between pathological and non-pathological gamblers. In a typical month, pathological gamblers spend > 20 times as much on online gambling as regular gamblers do, and > 10 times as much on casino slots, racetrack slots, horse races, and Bingo. Smith and Wynne's (2002) study on median monthly gambling expenditures in Alberta (Canada) also reports systematic differences across all types of gambling. Volberg and Bernhard (2006) present data on differences between non-problem, at-risk, and problem gamblers in New Mexico. They show that 47.5% of problem and pathological gamblers spend $100 or more on gambling in an average month, compared to only 8% of non-problem gamblers (n = 1212). Also, 34.5% of problem and pathological gamblers have at some point lost $1000 or more in a single day, while the figure stands at only 3.2% for non-problem gamblers.

Table 1
Studies on the revenue share of problem gamblers.[a]

Study	Country	Revenue share of problem gamblers
Productivity Commission, 2010	Australia	40%[a]
Williams & Wood, 2007	Canada	35%
Williams & Wood, 2004	Canada	23%[b] (32%[c])
Hayward, 2004	Canada	40%
Abbott & Volberg, 2000	New Zealand	19%
Gerstein et al., 1999	USA	15%
Productivity Commission, 1999	Australia	33%
Lesieur, 1998	USA & Canada	30%
Volberg & Vales, 1998	Porto Rico	65%
Volberg, Gerstein, Christiansen, & Baldridge, 2001	USA	14% to 27%
Grinols & Omorov, 1996	USA	52%[d]
Dickerson et al., 1996	Australia	26%

[a] Derived from seven regional studies.
[b] Weighted by provinces.
[c] Weighted by population.
[d] Casinos.

The gambling report by the Australian Productivity Commission explores asymmetries in gambling expenses in even greater depth by breaking down total spending into three factors: number of sessions, average session length, and money spent per hour (Productivity Commission, 2010). The Commission concludes that the reasons why addicted gamblers spend much more on gambling than recreational gamblers are represented in their gambling behavior: they play more often, in longer sessions, and wager more per time unit. Consequently, a large share of gambling revenue is generated from problem gamblers. This relationship was first observed in 1995 by the Australian Institute for Gambling Research (1995) in a report on the socioeconomic consequences of gaming machines in Queensland. The first empirical studies were conducted by Grinols and Omorov (1996) and by Dickerson et al. (1996). Since then the share of revenue coming from problem gamblers has been analyzed more often and across different jurisdictions but still infrequently. As shown in Table 1, the overall revenue share from problem gamblers varies widely across jurisdictions and studies, ranging from 15% in the U.S. (Gerstein et al., 1999) to 65% in Puerto Rico (Volberg & Vales, 1998). In all of these studies, the average spending of problem is much higher than that of non-problem gamblers.

The figures displayed in Table 1 all relate to total spending across all forms of gambling. However, gambling forms differ dramatically with respect to their addictive potential and the prevalence of problem gamblers. Consequently, when deriving the revenue share of problem gamblers, the individual game forms should be considered separately.

2.3. Results for specific game forms

Only few studies report the share of revenue from problem gamblers by game form. In one of the earliest studies, Volberg, Moore, Christiansen, Cummings and Banks (1998) present distinct results for Iowa and Mississippi (U.S.), which differ strongly, especially for Bingo (20.2% vs. 73.8%) and (sports) betting (43% vs. 8%). The authors explain these spreads by differing gambling markets caused by dissimilar legislation in the two states.

A more recent study by Orford, Wardle, and Griffiths (2012) reports rather low figures of revenue shares from problem gamblers for all gambling forms, between 1.5% for the national lottery, up to 22.9% for fixed-odds betting terminals, and 27.2% for dog racing. These results might be underestimations, since expenses were measured in categories, the highest category being “£501 or more” for 10 out of 15

forms of gambling and "£1,001 or more" for the remaining five categories; these categories were interpreted as £501 and £1001, respectively, cutting off all higher spending. As we will show in our analyses and as is also suggested by anecdotal evidence on bankrupted gamblers, it is quite likely that strongly addicted gamblers spend amounts far beyond these thresholds. Not taking the power law distribution of gambling expenses into account but instead using £501 or £1001 for the top expense category will result in a considerable underestimation of the spending share of problem gamblers.

By contrast, Williams and Wood (2007) do account for the importance of the power law distribution in gambling spending. Their results for Ontario (Canada) appear to be representative of most of today's gambling landscape. The revenue share attributable to problem gamblers is lowest for lotteries (17%–19%) and Bingo (17%–28%), and highest for horse racing (38%–52%) and slot machines (61%–62%). However, these figures by themselves do not necessarily mean that concentration of gambling revenue is actually caused by problem gamblers.

2.4. High concentration = addictive properties?

The aforementioned studies clearly indicate that gambling demand is concentrated and that problem gamblers spend more than recreational gamblers. This suggests that the general concentration of gambling demand might be caused at least to some extent by the addictive properties of gambling.

And indeed, another result by Tom et al. (2014) confirms that membership in the small group of top-consumers is significantly related to pathological gambling; in other words, pathological gamblers are overrepresented among the most intense gamblers. Further evidence from Australia shows that money spent on gambling is a good indicator of gambling problems: problem gamblers (SOGS 5+) spend 35% of their net income on gambling and players at risk (SOGS 3–4) spend around 30% (Productivity Commission, 2010). This, in turn, means not only that gambling spending is concentrated in a group of high-intensity players but also that gambling problems are concentrated within the exact same group. This twofold concentration suggests that average gamblers should not be at the focus of gambling studies since they neither generate a considerable amount of revenue nor typically experience gambling problems. However, at this moment, it is not clear to what extent the concentrations of gambling spending and gambling-related problems overlap and how much of the concentration of gambling spending is attributable to problem gamblers.

If addictive properties cause a concentration of demand, concentration of demand for addictive goods should be higher than for general consumer goods. But this is not the always case, as can be shown for alcohol. For example, 20% heaviest drinkers accounted for only 72% of total consumption, as measured by self-report for Canada in 2004 (Stockwell, Zhao, & Thomas, 2009), which is close to the concentration observed by Takayuki, Toriyama, Terano, and Takayasu (2008) for general consumer goods purchased at convenience stores. At the same time, for alcohol the human body provides a natural ceiling of maximum intake per drinking session. By contrast, gambling is recognized as a *behavioral* addiction in the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association. This means that the human body has no reaction that would stop a gambler at any point in his gambling session. Therefore, gambling may exhibit greater concentration of demand.[3] While this is true for problem gamblers and recreational gamblers alike, the literature on spending shares of problem gamblers provides a sufficiently strong indication of a link between demand for gambling and its addictive properties to further investigate this relationship.

Instead of comparing the consumption patterns of gambling with other consumer goods that are necessarily of a different nature, we aim to provide a clearer picture of the connection between gambling demand and problem gambling by triangulating data from France, Canada, and Germany and contrasting these figures with the prevalence of problem gambling.

3. Methodology

3.1. Key indicators and hypotheses

We construct four key indicators: (1) concentration of revenue, (2) the prevalence of problem gamblers, (3) the share of revenue derived from problem gamblers, and (4) excess spending by problem gamblers. While we devote the next subsection to the GINI coefficient as our measure of concentration, the other key indicators are simpler to explain.

The prevalence of problem gamblers is operationalized as the percentage of gamblers who are identified as either problematic gamblers or pathological gamblers by validated screening instruments – in the case of our data, the fourth edition of the Diagnostic Statistical Manual of Mental Disorders (DSM-IV) of the American Psychiatric Association and the Problem Gambling Severity Index (PGSI). The prevalence of gambling problems is widely used as an indicator of the addictiveness of gambling in general and of specific forms of gambling in particular.

The share of revenue derived from problem gamblers is the percentage value of gross gaming revenue (stakes minus winnings) that comes from problem gamblers. By definition, it is 100% minus the share of revenue from recreational players. To measure the share of revenue derived from problem gamblers, we summed the expenses of those players who met the criteria for problem gambling and divided the total by the expenses of all gamblers. We like to note that for this measure it is important that gambling spending was measured using a question with an open answer instead of an ordinal scale with pre-determined answers to avoid underestimating the expenditures by the highest spenders. The share of revenue derived from problem gamblers is an indicator of how important this group is for the gambling market in general and the markets for specific game forms in particular.

We define excess spending of problem gamblers as the difference between the share of revenue derived from the group of problem gamblers and the prevalence of problem gamblers among the gamblers. It can be interpreted as the hypothetical share of revenue of problem gamblers that would not exist if these people were recreational gamblers and did not spend more than their peers. If, for example, 10% of all gamblers are problem gamblers, but they account for 25% of all spending, then excess spending is 15%. We thus follow Atkinson's (1970) logic that in a market unskewed by problem gamblers, we would find that the distribution along the Lorenz curve was mean preserving between, i.e. similar for, the different parts of the population – in our case, between the distribution of different gambling behaviors among all gamblers. This allows us to use excess spending as an indicator of the contribution that problem gamblers make to the concentration of gambling demand.

Our main hypothesis is that there is a significant relation between the concentration of revenues and the addictive properties of gambling. We break this hypothesis down into three sub-hypotheses that we test empirically (see also Fig. 1):

H1. A positive correlation exists between the concentration of revenues and the prevalence of gambling problems.

H2. A positive correlation exists between the concentration of revenues and the share of revenues derived from problem gamblers.

[3] It could be argued that running out of funds functions is a natural ceiling that is analogous to the bodily reaction to substance intake. And yet gambling is different in this regard for two reasons: (1) depletion of funds can also apply to substance intake, so there we have two ceilings compared to only one in gambling; and (2) ATMs in casinos and credit cards for online gambling effectively prevent the depletion of funds.

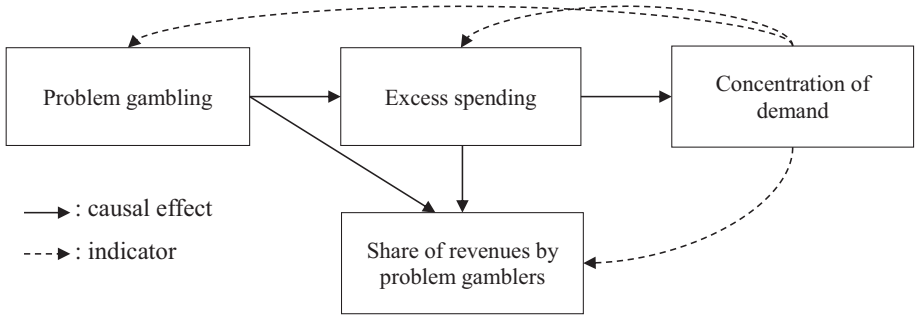

Fig. 1. Hypothesized relationships between problem gambling, excess spending, share of revenues by problem gamblers and concentration of demand.

H3. A positive correlation exists between the concentration of revenues and excess spending by problem gamblers.

3.2. The GINI coefficient as a measure of concentration

To estimate the concentration of revenue, we use the GINI coefficient. First developed by Corrado Gini in 1912, the coefficient is a popular measure of statistical dispersion. It is most commonly used in the context of income or wealth inequality but can easily be applied to the analysis of any form of concentration in general, especially revenue and spending concentration (Ceriani & Verme, 2012).

Gini (1912) himself defines the coefficient as "the mean difference from all observed quantities" (Ceriani & Verme, 2012). In more than one hundred years of continuous research, a rich variety of generalized methods of calculating the GINI coefficient was devised, with Gini's original work already including a number of versions of the coefficient. The variants are suitable for different types of data and different sets of questions addressing either the variability of measures in contrast to absolute values or regarding the variability of objects against their own group (Abounoori & McCloughan, 2003; Ceriani & Verme, 2012; Gini, 1912).

Mathematically, the GINI coefficient G is defined as 1 minus twice the area under the Lorenz curve $l = l(z)$ (Lerman & Yitzhaki, 1984). The Lorenz function is a monotonically increasing, twice-differentiable and convex function where z marks the cumulative proportion of – for instance – gamblers and l the corresponding cumulative proportion of revenue generated from these gamblers (Lorenz, 1905). Since $l(z)$ can be approximated by its frequency polygon the GINI coefficient

$$G = 1 - 2\int_0^1 l(z)dz,$$

can be estimated as

$$G = 1 - \sum_{i=0}^{n-1} (F_{i+1} - F_i)(\Phi_{i+1} - \Phi_i)$$

where $f(x)$ is the proportion of the population with spending of x, $F_{(x)} = \int_{x_0}^{\bar{x}} f(y)dy$ represents the cumulative proportion of the population with spending of x, and $\Phi_i = \frac{1}{\mu}\int_{x_0}^{\bar{x}} yf(y)dy$ is the cumulative share in total spending (Atkinson, 1970; Heshmati, 2004).

The GINI coefficient is normalized between 0% and 100%, where 0% indicates perfect equality and 100% signifies perfect inequality. For instance, when all members of a population have the same income, the GINI coefficient is 0; with a GINI coefficient of 1, all the income would accrue to a single person. For consumption and, consequently, gambling: the higher the GINI coefficient, the stronger is the concentration of demand.

In the context of consumption, a high GINI coefficient can arise from a population with some very heavy consumers or a population with many people consuming very little (or both). Based on Becker and Murphy's (1988) model of rational addiction, a good with addictive properties is expected to have many light users and a few heavy users, causing a higher GINI coefficient compared to a regular good. For comparison, a typical Pareto distribution where 20% of the consumers account for 80% of the demand yields a GINI coefficient of around 60% (depending on the specifics of the distribution). For this study, we calculated the GINI coefficient as indicated above based on the individual answers of gamblers on their spending in each survey.

3.3. Data from France

The French survey was conducted as part of the Health Barometer, a national health survey carried out regularly by the French National Institute for Prevention and Health Education (Costes, Eroukmanoff, Richard, & Tovar, 2015). A representative nationwide telephone survey was conducted, using a computer-assisted telephone interviewing (CATI) system, from December 2013 to May 2014 among 15,635 persons aged 15 to 75 years.

The sample was built from a two-stage random sampling design: a selection of households using random digit dialing covering all French metropolitan regions, and a random selection of one member of the household, using the Kish method. The sample was composed of two sub-samples: landline and cell phone samples. The overall response rate was 64.3% (65.8% for the cell phone sample and 63.6% for the landline sample).

The data were weighted by the number of telephone lines and eligible persons in the household. They were also adjusted to represent the demographic structure of the French population according to age, gender, educational level, region of residence, and level of urbanization.

The participants responded to a set of questions about demographic characteristics, gambling patterns, health status, behaviors, and self-reported gambling-related problems. They reported their spending on each gambling activity either per occasion or on a weekly, monthly, or annual basis by answering to the question (translated from French): "How much money do you usually spend per session when you play these games? We want to know the amount of money you take out of your pockets when you gamble. This does not include money that you won." Total spending was calculated on an annual basis and is available for each game form.

The overall score on the Problem Gambling Severity Index (PGSI), a quantitative sub-section of the Canadian Problem Gambling Index, was used to assess the severity of gambling problems (Ferris & Wynne, 2001). The PGSI consists of 9 items with answers reported on a 4-point Likert scale ('never'; 'sometimes'; 'most of the time'; 'almost always'). Respondents were categorized as non-problem gamblers (PGSI score = 0); low-risk gamblers (score = 1–2); moderate-risk gamblers (score = 3–7); and problem gamblers (score = 8+). The PGSI screening instrument can be found in Appendix A. Note that the instrument is an absolute measure, not a relative one (comparing a gambler to a reference population), which would lead to circular reasoning in the analysis.

3.4. Data from Québec

The Québec data are derived from the ENHJEU-Québec Survey, which was conducted using a random sample of English or French-speaking Québecers over the age of 18 who lived in private residences throughout the province. The sample comprises 12,008 respondents interviewed between June 4 and September 18, 2012, using a CATI system.

A non-proportional stratified two-stage sampling design was employed; private households were selected through random digit dialing and one eligible person per household was picked at random. The sample was stratified according to administrative regions grouped along the urban-rural continuum. The overall response rate was 43.2%. The data were weighted to adjust for the multi-stage cluster sampling design and for non-response, as well as to ensure the sample was representative of the Québec adult population according to the census.

Respondents were asked a series of questions about their past-year gambling habits for 11 different gambling activities including online gambling. Participants reported their participation in each activity, the settings they gambled in, the severity of any gambling-related problems as measured by the PGSI (Ferris & Wynne, 2001), and any concurrent use of alcohol, cannabis or cigarettes. Annual spending was self-reported on an interval scale for each gambling activity, from which total past-year spending was calculated. The exact question was "How much money do you spend on average on a typical occasion when you play [game form]?" The respondents were given a choice of different time frames, from which the spending was then scaled to obtain an annual figure.

3.5. Data from Germany

The empirical results for Germany are based on the Pathological Gambling and Epidemiology (PAGE) research program initiated by the German federal states. The PAGE project provides a rich epidemiological database on the prevalence of pathological gambling among the German population (Meyer et al., 2015). The data were collected by an interdisciplinary research group (EARLINT) at the University Hospital Lübeck and the University of Greifswald.

The random sample was obtained through a dual sampling setup with telephone interviews for the general population. It yielded 15,023 respondents aged 14 to 64, with a response rate of 52.4% for landlines and 56.6% for mobile phones. An additional 594 high-risk participants were recruited through in-depth one-on-one clinical interviews directly at gambling locations and through qualified addiction treatment facilities. EARLINT used large parts of Wittchen and Pfister's standardized Composite International Diagnostic Interview (CIDI-X) codebook (Meyer et al., 2015; Wittchen & Pfister, 2005), which allows for aggregation into parametric rating scale values with high test-retest reliability ($\alpha = 0.49$ to 0.83) and high evidential validity ($\alpha = 0.39$ to 0.82; Wittchen & Pfister, 2005, 105f; Essau, Wittchen, & Pfister, 1999, Stinchfield, 2003).

Individual gambling behavior and gambling problems were classified by the criteria established in the fourth edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (Saß, Wittchen, Zaudig, & Heuben, 2003). The DSM-IV criteria were standardized by translation into explicit questionnaire scale items for pseudonymous self-assessment in order to inhibit self-selection effects. Of the 337 respondents who scored on at least one DSM-IV criterion, 28 fulfilled one or two criteria (gamblers at risk), 36 met three or four criteria (problematic gamblers), and 273 met five to ten criteria (pathological gamblers). The DSM-IV criteria can be found in Appendix B. Importantly, like the PGSI, these criteria constitute an absolute rather than a relative measure.

The dataset contains interval data on spending, gambling participation (lifetime and 12-month prevalence), the number of gambling days per month and gambling hours per day, each differentiated by forms of gambling and channels of access, which permits more accurate analyses than ordinal data. The answer to the question on spending was voluntary and thus yielded only 2923 answers[4] and was not broken down by game form. Translated from German, the question was: "If you add up all your wins and losses over the past 12 months, did you win or lose in total, and by how much?"

Table 2
Concentration of gambling spending as measured by the GINI coefficient.

	France	Québec	Germany
n	8794	7529	2923
GINI	83.9%	80.2%	87.9%

4. Results

4.1. Concentration of spending in general

As Table 2 shows, gambling expenditures are most strongly concentrated in Germany with a GINI coefficient of 87.9%, followed by France (83.92%) and Québec (80.16%).

Fig. 2 shows the distribution of expenditure on all types of gambling for Québec, France, and Germany compared to a hypothetical Pareto distribution where 20% of consumers account for 80% of spending. Based on the evidence from the literature presented in Section 2, the hypothesis is that problem gamblers, who have lost control over their gambling behavior and thus spend much more than non-problem gamblers, are a major source of this additional concentration. This will be investigated in the next two subsections.

4.2. Share of spending from problem gamblers

As shown in the literature section, previous research on gambling behavior clearly indicates that problem gamblers spend much more on gambling than recreational gamblers. Table 3 provides information on the annual average and median spending of non-problem gamblers (PGSI score [France, Québec] or DSM-IV [Germany] score of 0–2), problematic gamblers (PGSI = 3–7 or DSM-IV = 3–4), and pathological gamblers (PGSI > 7 or DSM-IV > 4). Spending increases strongly with the severity of gambling problems: in France, pathological gamblers spend €13,424 (31.2 times more than recreational gamblers), in Québec the ratio is 48.6, and in Germany it is 23.5. The spending gap between pathological gamblers and recreational gamblers is similarly high with respect to the median, with ratios of 75 in France, 45.8 in Québec, and 11.6 in Germany.[5]

[4] The respondents and non-respondents differ significantly regarding their gender (a higher share of males responded), age (younger people responded more often), employment status (respondents were more likely to be employed), and education (respondents were better educated), but not regarding problem gambling. Thus, even though the German data might be somewhat unrepresentative, this does not affect the results regarding spending by problem gamblers.

[5] While the German gambling market per head is a somewhat smaller (175€ per adult per year) than those of France (200€) and Québec (379$), this cannot explain the difference in the reported spending between our samples. Instead, we suspect that the lower values from the German sample are due to the different sampling strategy applied in that country. While both the Québec and the French survey asked about spending on the last gambling occasion and then inferred the annual amounts based on the reported frequency of gambling, Germans were directly asked about their spending over the last 12 months. The German question is much harder to answer precisely; respondents may already have forgotten about some spending, causing an underestimation. However, for our purposes, such absolute differences are immaterial as we analyze data within the countries and compare only relative data across countries.

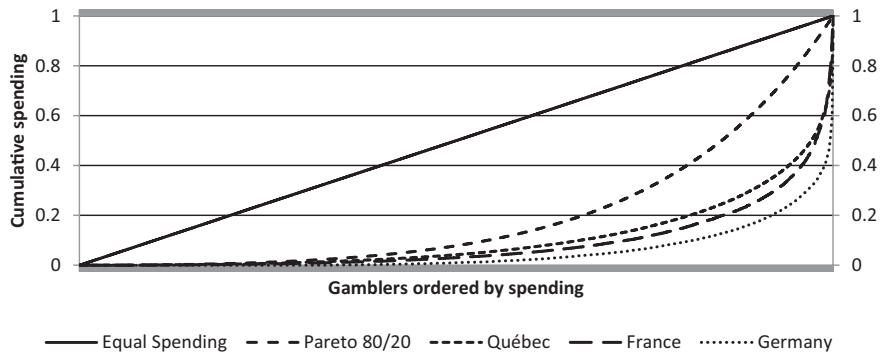

Fig. 2. Distribution of cumulative spending on gambling.

Table 3
Annual average and median spending by problem and non-problem gamblers.

Group	France			Québec			Germany		
	n	Average	Median	*n*	Average	Median	*n*	Average	Median
Non-problem gamblers[a]	8360	€430	€80	7367	$492	$140	2788	€132	€17
Problematic gamblers[b]	339	€4200	€760	124	$3653	$1560	86	€253	€49
Pathological gamblers[c]	75	€13,424	€6000	38	$23,928	$6420	49	€3100	€198

[a] PGSI 0–2 or DSM-IV 0–2.
[b] PGSI 3–7 or DSM-IV 3–4.
[c] PGSI > 7 or DSM-IV > 4.

Table 4
Prevalence of gambling habits and revenue share derived from problem gamblers.

Group	France			Québec			Germany		
	Preva-lence	Spending share	Excess spending	Preva-lence	Spending share	Excess spending	Prevalence	Spending share	Excess spending
Non-problem gamblers[a]	95.3%	59.7%	−35.4%	97.3%	69.4%	−27.9%	95.4%	68.0%	−27.4%
Problematic gamblers[b]	3.9%	23.6%	19.7%	2.1%	10.8%	8.7%	2.9%	4.0%	1.1%
Pathological gamblers[c]	0.9%	16.6%	15.7%	0.6%	19.8%	19.2%	1.7%	28.0%	26.3%

[a] PGSI 0–2 or DSM 0–2.
[b] PGSI 3–7 or DSM 3–4.
[c] PGSI > 7 or DSM > 4.

The much higher spending by problematic and pathological gamblers means that they account for more of the revenue than their headcount would imply. This is evident from a comparison of the prevalence rates of each player group and their spending shares, as depicted in Table 4. Problematic and pathological gamblers jointly account for 40.2% of all gambling expenses in France, 31.6% in Québec, and 32% in Germany.

To understand just how much expenditure is concentrated on gamblers experiencing problems, it is helpful to compare this group's prevalence rates to their share in expenditure. The larger the discrepancy between these variables, the greater the concentration of expenditures. This discrepancy is what we have defined as excess spending: the difference between prevalence and spending share. The table shows that excess spending is highest for pathological gamblers, especially in Québec and Germany. Only in France do problematic gamblers also overspend strongly, whereas the gap is rather small for problematic gamblers in Québec and nearly non-existent in Germany.

These results indicate that the concentration in gambling spending is mainly driven by problem gamblers, a hypothesis we support empirically in the next section. This does not mean, however, that spending is more concentrated *within* the group of problem gamblers. On the contrary: Spending becomes more homogenous with increasing gambling problems, as evidenced by the decreasing gap between the average and median spending of the different player groups. Also, the GINI coefficient falls with increasing gambling problems, as Table 5 shows. The only exception is pathological gamblers in Québec, whose GINI coefficient of 70.8% is higher than for problematic gamblers (64.5%), yet lower than for non-problem gamblers (74.5%).

Table 5
GINI coefficients in relation to gambling problems.

Group	France		Québec		Germany	
	n	GINI	*n*	GINI	*n*	GINI
Non-problem gamblers[a]	8360	80.3%	7367	74.5%	2788	86.4%
Problematic gamblers[b]	339	77.4%	124	64.5%	86	78.7%
Pathological gamblers[c]	75	65.9%	38	70.8%	49	71.7%
Full Sample	8774	83.9%	7529	80.2%	2923	87.9%

[a] PGSI 0–2 or DSM 0–2.
[b] PGSI 3–7 or DSM 3–4.
[c] PGSI > 7 or DSM > 4.

4.3. Concentration of spending by game types

As documented by a large body of literature, significant differences exist between the different gambling forms. This is true not only for their addictive potential but also for the share of revenue derived from problem gamblers, as discussed in Section 2. The game types can be ranked by their addictive potential, as proxied by their prevalence rates

Table 6
Prevalence of problem gamblers, their revenue shares and GINI coefficients, by game form.

Type of game	France					Québec				
	n	Prevalence PGSI ≥ 3	Revenue share PGSI ≥ 3	Excess Spending	GINI all players	*n*	Prevalence PGSI ≥ 3	Revenue share PGSI ≥ 3	Excess Spending	GINI all players
Sports betting	567	19.2%	58.5%	39.3%	82.8%	226	8.0%	16.0%	8.0%	82.1%
Poker	376	18.6%	63.3%	44.7%	85.4%	412	8.0%	43.6%	35.6%	86.4%
Table games (w/o poker)	296	15.9%	76.1%	60.2%	85.0%	245	8.3%	44.1%	35.8%	88.7%
Horseracing[b]	872	12.1%	40.2%	28.1%	84.7%	41	–	–	–	–
Slot machines (EGMs)	897	9.9%	41.0%	31.1%	87.6%	999	8.7%	76.3%	67.6%	92.8%
Scratch cards[a]	4887	5.3%	26.1%	20.8%	79.5%	–	–	–	–	–
Lotteries	6384	4.7%	24.2%	19.5%	78.6%	7360	2.7%	10.5%	7.8%	67.6%
All gambling	8794	4.8%	40.2%	35.4%	83.9%	7529	2.7%	30.6%	27.9%	80.2%

[a] The Québec data set does not include information on scratch cards and horseracing.
[b] We omitted information for horseracing in Québec because $n = 6$ for PGSI ≥ 3.

of problem gamblers. Table 6 shows that lotteries have the lowest rate of problem gamblers among their customers.[6] The revenue shares from problem gamblers per game form indicate how strongly the operators depend on problem gamblers to sustain their business. The revenue shares show that, at 24.2% in France and 10.5% in Québec, lotteries depend the least on revenue from problem gamblers. In France, more than half of the revenue comes from problem gamblers in table games (76.1%), poker (63.3%), and sports betting (58.5%). In Québec, operators of slot machines rely most strongly on problem gamblers (76.3%), followed at a large distance by table games (44.1%) and poker (43.6%); sports betting generates a rather low share of revenue from problem players (16%).

The prevalence rate is one of two factors that drive the share of revenue derived from problem gamblers. The other one is excess spending of problem gamblers, that is, the degree to which problem gamblers overspend compared to non-problem gamblers and thereby cause concentration in spending. This factor is best measured as the difference between the revenue share and the prevalence rate. In all game forms, problem gamblers overspend compared to recreational gamblers. In France, table games exhibit the most excess spending by problem gamblers (60.2%), followed by poker (44.7%) and online gambling (44.4%). In Québec, the ranking is slot machines (67.6%), then (with a large gap) table games (35.8%) and poker (35.6%).

Spending is least concentrated in lotteries. This constitutes some evidence in support of the hypothesis that the concentration of overall gambling spending as measured by the GINI coefficient is driven by problem gamblers. While each survey on its own does not yield a significant correlation between the GINI coefficient and excess spending ($r = 0.568$, $n = 7$, $p = .183$ for France; $r = 0.816$, $n = 5$, $p = .092$ for Québec), we find a strong and significant correlation when combining the results from both surveys ($r = 0.714$, $n = 12$, $p = .006$), which supports hypothesis H3.[7] The combination of both survey results also yields a significant positive correlation between the GINI coefficient and the revenue share from problem gamblers ($r = 0.728$, $n = 12$, $p = .005$), supporting hypothesis H2. Again there are no significant results for the individual surveys, likely because of sample size ($r = 0.597$, $n = 7$, $p = .157$ for France; $r = 0.856$, $n = 5$, $p = .064$ for Québec). There is no significant correlation between the GINI coefficient and the prevalence of problem gambling and thus no evidence in support of hypothesis H1.

[6] This is also true for Germany, though Table 6 only covers France and Québec since the German data does not distinguish by game form.

[7] Note that spending data in the German survey is not broken down by game form thus cannot be included in this analysis.

5. Discussion

5.1. Interpretation

Previous studies have shown that a small group of players account for a large part of the gambling market. Using three datasets from France, Québec, and Germany, we are able to confirm that spending on gambling products is highly concentrated. The GINI coefficients for general gambling spending are between 80.2% in Québec and 87.9% in Germany. In Québec, the GINI coefficients for different game forms vary between 67.6% for lotteries and 92.8% for slot machines. By comparison, the GINI coefficients for income are much lower: 30.7% for Canada, 29.3% for Germany, and 29.1% for France in 2017 (OECD, 2018).

We find evidence that part of the concentration of gambling spending is caused by problem gambling. In all three jurisdictions, pathological gamblers spend much more than non-problem gamblers: between 24 and 49 times more on average, and up to 75 times when comparing median spending in France. This supports Brosowski et al.'s (2015) results that spending is a very good indicator of gambling problems. For electronic game forms where live data on spending is readily available, suitable spending thresholds might thus be used to identify problem gambling behavior.

A potential other explanation of the concentration of gambling spending is inequality in income or wealth, as wealthier individuals may spend more on gambling. While this causality cannot be tested with the current data and must be left for future research, previous research found that gambling has a regressive effect that is likely to limit the effect of income and wealth on the concentration of spending: wealthier households spend more money but a smaller share of their income on gambling (Clotfelter & Cook, 1989; Williams, Belanger, & Arthur, 2011). For example, in Canada, the lowest income quintile have been shown to spend 296 Dollar or 2.2% of their income on average per year on gambling while the highest quintile spend 536 Dollar but only 0.5% of their income (Marshall, 1998, p. 8). Other research has shown that the lowest income group is overrepresented among the group of the most intensive players (MacDonald, McMullan, & Perrier, 2004). This further indicates that the effect of wealth and income on concentration of spending is limited, yet the exact magnitude of this effect remains to be determined – especially in comparison to the effect of problem gambling on spending concentration.

Recreational gambling produces benefits for both consumers and operators. By contrast, problem and pathological gambling is less beneficial or even harmful since it entails social costs (Fiedler, 2016). Hence, the larger the revenue share derived from problem gamblers, the less beneficial (or more harmful) a gambling form is likely to be. Despite problem gamblers only constituting a minority of players and an almost negligible part of any given country's population, they account

for a significant share of gambling revenue: 40.2% in France, 31.6% in Québec, and 32% in Germany. If we distinguish by game form, this share increases up to 76.3% for slot machines in Québec and 76.1% for table games in France. Hence, the operators' financial incentives are unlikely to be well aligned with the responsible gambling efforts that aim to reduce both the number of problem gamblers and their spending. This finding should be kept in mind when discussing the design of responsible gambling programs.

We found evidence in support of our main hypothesis that the concentration of gambling demand is caused by problem gambling. While there was no significant correlation between the GINI coefficient as our measure of concentration and the prevalence of problem gamblers (H1), we believe this is caused by an offset between a lower GINI coefficient due to fewer problem gamblers and a higher GINI coefficient due to more low-intensity gamblers in game forms with low prevalence rates. We did found strong and significant correlations between the GINI coefficient and the share of revenue derived from problem gamblers as an indicator of the importance of problem gamblers for gambling demand (H2), as well as between the GINI coefficient and excess spending as an indicator of the contribution of problem gamblers to the concentration of gambling demand (H3). This can be seen as evidence that the concentration of demand for gambling is attributable not so much to the mere presence of problem gamblers but rather to their extreme spending patterns. In turn, the degree of concentration of gambling spending can be used as a proxy for excess spending and the share of revenues derived from problem gamblers. Therefore, it is also a suitable complement to the use of prevalence rates of problem gamblers that can only be obtained in costly large-scale surveys. Since the GINI coefficient can be monitored more easily (even in real time for electronic gambling forms), it might be a worthwhile additional tool for regulators to monitor and evaluate different game forms and operators, and potentially even to assess the necessity of regulatory intervention.

Our results also suggest that spending in gambling is more strongly concentrated than spending on other behavioral consumer goods that lack an addictive component. If that is indeed so, concentration of demand could be used as an indicator to identify products that are addictive and potentially harmful. We therefore think that this hypothesis warrants additional investigation.

5.2. Limitations

Th study is subject to a number of limitations. First, our analysis relies exclusively on self-reported data which, particularly in the context of gambling expenditure, is inevitably inaccurate (Blaszczynski, Ladouceur, Goulet, & Savard, 2006). For example, comparing gambling expenditure figures from the Australian Household Expenditure Survey with gamblers' actual losses, slot machine gamblers were shown to report only 2.9% of their true losses (Productivity Commission, 2010, p. B.3). At table games, the reported spending is negative, meaning that gamblers report that they win on average, which is not possible. The opposite effect may occur if the question is phrased in such a way that it may be misconstrued to ask about the amount wagered, rather than the amount lost. For example, at a pay-out ratio of 95%, the amount wagered is 20 times the losses. Such overestimation was reported by Williams and Wood (2004) for Canada, where players' extrapolated losses exceeded the actual losses by a factor of 2.1.

Second, it must be acknowledged that the screening instruments we use to determine problem gambling, PGSI and DSM-IV, are not identical. However, the two instruments yield similar results that are highly correlated ($r = 0.83$), and the results for problem gambling rates are comparable (Stinchfield, Govoni, & Frisch, 2007).

Third, the longer a time horizon of a question, the more infrequent players are included in a sample. Since the GINI coefficient is affected when infrequent gamblers with very low spending leave or join the player pool, GINI coefficients cannot be compared across different time horizons. This must be borne in mind, especially if different game forms or jurisdictions are compared. One year may well be the optimal time horizon since it includes a full cycle of seasonable gambling patterns that could have an impact on spending. Furthermore, it ensures comparability to other year-based indicators like for example the 12-month prevalence rate of gambling problems.

Fourth, while we take account of the heterogeneity of gambling by dividing the data by game forms, two limitations to this approach should be mentioned. First, the nature of a game form can vary across jurisdictions, for example because of regulation or cultural differences. Second, the boundaries between game forms are not always clear. This is especially true for the different forms of betting, for example live-betting vs. fixed-odds betting, betting on sports vs. horses, or betting online vs. offline. Aggregating these variants into game forms can lead to a loss of information – a problem that should be kept in mind when comparing different key indicators across game forms.

Fifth, differences in GINI coefficients across game forms can be attributable to game forms being more or less attractive to high spending gamblers as well as low spending gamblers. If, for example, problem gamblers play every game form and distribute their spending equally among them, there can still be differences in the GINI coefficients based on the attractiveness of the game forms to players who spend only small amounts. Hence, differences in GINI coefficients need not be due solely to differences in the addictive potential of the various game forms.

Finally, it must be noted that a reduction in high spenders is not the only cause for a reduction of spending inequality as measured by the GINI coefficient. An increase in recreational gambling also reduces the inequality. A reduction in the GINI coefficient can thus have two causes, and regulators are likely to prefer a reduction in inequality due a reduction in problem gambling rather than an increase in recreational gambling. From the standpoint of consumer welfare, a decrease in spending of high spending problem gamblers is certainly more important, but an increase in recreational gambling could also be positive – given that recreational gamblers enjoy gambling and experience little harm. A reduced inequality in spending can thus be considered beneficial in both cases. This does not mean that regulators should foster recreational gambling to reduce the GINI coefficient, though.

6. Conclusion

Gambling regulators must evaluate their regulatory efforts. When it comes to gambling addiction, the prevalence rate of problem gamblers plays a vital role. Surveys are regularly conducted in all major jurisdictions to determine the rate of problem gamblers among the general population, among the group of gamblers in general, and also among users of a specific gambling form. As prevalence rates only respond to regulatory changes with a time lag, regulators are actively looking for additional indicators to evaluate the success of their efforts.

One important alternative indicator for regulators, which is often discussed in the literature but not always analyzed in epidemiological surveys, is the share of revenue derived from problem gamblers. This indicator is valuable for evaluating gambling in general and different gambling forms in particular. It provides a measure of the part of the market that would not exist with perfect prevention. The greater this share, the higher the social costs relative to the benefits enjoyed by non-problem players. Having reviewed the relevant literature on this indicator, we found that the share of revenue from problem gamblers differs by jurisdiction and even more so by game form. Where allowed outside of casinos, slot machines have the highest share of revenue coming from problem gamblers (> 60%) – a finding that supports the substantial body of evidence on the strongly addictive potential of high-frequency slot machines.

These big spenders are important not only because of their contribution to the operators' profits but also because studies have shown that it is often problem gamblers that spend much more than other gamblers. We call the difference between the problem gamblers' share of revenue and their prevalence rate ‘excess spending’. It can be

interpreted as that part of the problem gamblers' expenditure that is solely attributable to their gambling problems. While the prevalence of problem gamblers refers to the number of people affected, excess spending may be interpreted as denoting the severity of their problems.

Using survey data from France, Québec and Germany, we found that gambling demand is strongly concentrated, with GINI coefficients between 80% and 88%. Strong and significant correlations of GINI coefficients with the share of revenue derived from problem gamblers as well as with excess spending were found, indicating that the effect of problem gambling – spending more than recreational gamblers – is causing a concentrated demand for gambling.

Future studies should assess the concentration of demand by deriving it from the very same surveys that yield the prevalence rate of problem gambling with a simple open question on spending over the last month or year. In addition, this information can easily and automatically be recorded for any kind of electronic games like slot machines, sports betting, online poker, or online casino games. Especially for these game forms we suggest that regulators consider adding the GINI coefficient to their toolbox as an easily available indicator and a complement to prevalence rates to evaluate different game forms, specific operators, and potentially also to guide legislative changes.

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Appendix A. Problem Gambling Severity Index (PGSI)

	Never	Sometimes	Most of the time	Almost always
1. Have you bet more than you could really afford to lose?				
2. Have you needed to gamble with larger amounts of money to get the same feeling of excitement?				
3. When you gambled, did you go back another day to try to win back the money you lost?				
4. Have you borrowed money or sold anything to get money to gamble?				
5. Have you felt that you might have a problem with gambling?				
6. Has your gambling caused you any health problems, including stress or anxiety?				
7. Have people criticized your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?				
8. Has your gambling caused any financial problems for you or your household?				
9. Have you felt guilty about the way you gamble or what happens when you gamble?				

Appendix B. Diagnostic Criteria of Pathological Gambling according to the 4th Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)

A. Persistent and recurrent maladaptive gambling behavior as indicated by five (or more) of the following:

(1) is preoccupied with gambling (e.g., preoccupied with reliving past gambling experiences, handicapping or planning the next venture, or thinking of ways to get money with which to gamble)
(2) needs to gamble with increasing amounts of money in order to achieve the desired excitement.
(3) has repeated unsuccessful efforts to control, cut back, or stop gambling.
(4) is restless or irritable when attempting to cut down or stop gambling.
(5) gambles as a way of escaping from problems or of relieving adysphoric mood (e.g., feelings of helplessness, guilt, anxiety, depression)
(6) after losing money gambling, often returns another day to get even ("chasing" one's losses)
(7) lies to family members, therapist, or others to conceal the extent of involvement with gambling.
(8) has committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling.
(9) has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling.
(10) relies on others to provide money to relieve a desperate financial situation caused by gambling.

B. The gambling behavior is not better accounted for by a Manic Episode.

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