A framework for the games of chance index calculation in the HICP

Pavel BELCHEV ([1])

European Commission, Eurostat

Paper prepared for the 18th Meeting of the Ottawa Group on Price Indices, 13-15 May 2024, Ottawa, Canada

Introduction

The issue of including games of chance into the HICP was regularly discussed until 2015 in a series of different meetings organized by Eurostat. European experts agreed that games of chance should be included in the HICP and that, methodologically, the inclusion should be in line with the consensus that the item is adequately classified in the ECOICOP as a recreational (entertainment) service. A number of more general and conceptual aspects of the games of chance treatment (i.e. on weights, coverage etc.) were also agreed but there were different opinions on the proper method to apply for the price index compilation. As a result, and with the argument that the degree of methodological harmonisation was not yet sufficient, the item was temporarily excluded from the HICP. With the adoption of the Commission Framework Regulation (EU) 2016/792, it was decided that Eurostat would retain the option to reopen the issue, should the circumstances become more favourable in the future ([2]).

In 2013, Eurostat organized a survey in the member states to overview the status quo of games of chance treatment. The results confirm the findings of an earlier survey that took place in 2009, the results of which can be found on the last pages of this Ottawa Group document ([3]). It was found that 12 out of the 29 surveyed countries covered games of chance in their CPI. Expressed in country weights, that corresponded to 52% of the euro area (EA) and 45% of the EU at the time ([4]). However, some significant developments happened by 2020 as several countries included games of chance in their national CPI in the meantime. As a result, expressed in 2020 pre-COVID weights, these numbers have almost doubled, with some 80-85% of EU member states weight including the games of chance item. It was also observed that the games of chance expenditure increased by almost 40% at the European level, while the total monetary consumption expenditure increased by only 19% for the same period.

([1]) Eurostat, Unit C4 (Price statistics. Purchasing Power Parities. Housing statistics). This article and the endorsed framework for games of chance index calculation has benefited from the contributions of all delegates of the TFQI (Task Force HICP Quality adjustment) and especially of Claude Lamboray who provided useful theoretical insights and discussions on the topic as my colleague in Eurostat until 2022.

([2]) Article 5 of the Regulation states: *'The Commission shall be empowered to adopt delegated acts […] in order to include games of chance in the HICP and the HICP-CT.'*

([3]) Games of chance and HICP, paper by INE, ISTAT and Statistics Finland for the Ottawa Group meeting, 2011.

([4]) These are 2009 (when the first Eurostat survey was organized) country weights, but the results of the 2013 survey are almost identical.

This disproportional increase was mostly caused by the ever-increasing share of online gambling ([5]). More recent data of the European gambling markets, such as the annual reports of the EGBA (European Gaming and Betting Association), confirm that by 2020 the relative share of lotteries has decreased in comparison to other games of chance (especially online casinos and sports betting). Consequently, even though the surveys of 2009 and 2013 reveal that most of the countries only included lotteries in their samples, this game type is nowadays much less representative for the sector. Moreover, lotteries are not really a representative game of chance from a methodological point of view either, so below it will be described how these considerations had an essential impact on the appropriateness of the adopted index aggregation method. All of the above-mentioned developments explain Eurostat's motivation to reopen the methodological discussion in 2021.

This document is divided into seven sections. Section 1 reviews the methods that were considered for index aggregation and explains the rationale behind the method selection in the context of the framework presented in Annex I. Section 2 examines the issue of service charge measurement which is described in greater detail and illustrated with examples in Annex II. Section 3 discusses the option of using administrative and other data sources which were utilised for the analysis on the impact of inclusion conducted in section 4. Section 5 introduces an elementary aggregate stratification structure reflecting the differences between the main game types. Section 6 addresses the issue of product definition for each of the stratified game categories. It also provides numerous examples and different practical considerations and recommendations. Section 7 concludes with a summarised outline on the recommended treatment for each of the elementary aggregates.

1. The methods

There were practically 2 main contenders, the so-called New Zealand ([6]) method and the Minimum Bet method, as most countries that had games of chance in their CPI were using one of the two or their variations. But before discussing the two methods in detail, it is worth mentioning a couple of the alternatives and why they are ruled out:

Using prices directly [*price = bet*] is not a real option as:

a) only some lottery tickets have fixed prices that can be followed, while in other games it is the player who decides how much to bet, and
b) even in lotteries the cost of ticket is not the price that the player pays, as this price does not account for the expected winnings.

In short, the real price of a bet is its expected loss which is the difference between the bet amount and the bet's expected winnings. That is the proportion of the bet that does not come

([5]) See Excel file (spreadsheet 'EU gambling market').
([6]) Named after Woodhouse and Hanson who first described it in a section on games of chance in Appendix 5 to *Consumer Price Indices* by *Ralph Turvey et al.,* ILO (1989). Even though gambling services were considered for inclusion in the New Zealand CPI in 1988, the method was first applied in production in Sweden in 1993.

back to the players. We can call it *the service charge*. Games of chance are organized in such a way that in the long run this service charge is practically a constant percentage of the bet. For example, for a fixed bet of 10 EUR placed on a roulette table, the expected winnings can be calculated with precision. If bets in gambling were fixed, using only the service charge would be perfect and a price index would be constructed using the following formula:

$$I^{0,t} = \frac{(1 - c^t)}{(1 - c^0)}$$

where c^t and c^0 are the share of the bet in periods t and 0 that goes back to the players as winnings ([7]).

Using only the service charge [*price = bet - expected winning (bet)*] is, however, not a good method because bets are usually not fixed. Moreover, if the bets would be kept fixed, the HICP basket would not be fixed. A bet of 1 EUR, which may have been representative for the service several decades ago – for example in 1995 (period t^0), is not the same as a 1 EUR bet today (period t^1) from the point of view of the consumer's entertainment.

Therefore, the service charge component in the formula should include a factor of monetary inflation, which is what the New Zealand and Minimum Bet methods offer. In the New Zealand method, this factor (see $P^{0,t}$ in the formula below) is the general change in the value of money measured as the price index for all other products. The additional component in the New Zealand method introduces the cost of maintaining the amount of the representative bet. In the Minimum Bet method, the added factor is the change in the minimum bet, see b^t_{min} and b^0_{min} in the formula below, which are the minimum bets in periods t and 0.

New Zealand method [*price = (bet – expected winning (bet)) * inflation factor*]

$$I^{0,t} = \frac{(1 - c^t)}{(1 - c^0)} \cdot P^{0,t}$$

Minimum bet method [*price = minimum bet – expected winning (minimum bet)*]

$$I^{0,t} = \frac{(1 - c^t)}{(1 - c^0)} \cdot \frac{b^t_{min}}{b^0_{min}}$$

Comparing the formulas above, it is visible that if the minimum bet never changes, then the Minimum Bet method would be equivalent to using only the service charges. If the minimum bet changes exactly as the CPI index does, then the Minimum Bet and New Zealand methods are identical.

([7]) In gambling market terminology, the *c* variable is often known as **RTP** (Return to player) and therefore the *1-c* component as the **margin** (or the '**house edge**' which is practically the service charge proportion collected by the organizer).

The Minimum Bet method is intuitively applicable to lotteries, often the only game type that statistical offices are covering. In a lottery, the minimum bet could be viewed as the ticket one needs to pay in order to use the service. However, this is a misconception as the minimum bet, unlike cinema or museum ticket, can always be shared and is therefore not an obstacle that in practice prevents someone from using the gambling service for any desired amount below it.

In addition, the Minimum Bet has if not more then at least the following practical and conceptual shortcomings:

- In certain games the minimum bet is hard to determine (poker) or is not subject to change (instant lottery scratch cards).
- The minimum bet in online gambling (in contrast to land-based betting facilities where it may indeed be still used as a de facto entrance fee) is often 0.01 unit of currency. Organisers are even likely to increase their profit the lower the minimum bet, so there are no reasons to expect that the minimum bet development in online gambling must depend on inflationary factors.
- The minimum bet is not representative in casino games or sports betting where almost no player bets with the minimum amount.
- Playing only the minimum would result in lower service quality levels in terms of entertainment and excitement from a consumer point of view.
- The minimum bet is usually a round number, and it is not frequently changed in time. Thus, when a change happens, for example when the price of a lottery ticket increased from 1.00 EUR to 1.50 or 2.00 EUR, it is likely to introduce very sharp index movements.
- There is the need to follow minimum bet developments over time. In contrast, for the New Zealand method statistical offices would instead simply use the overall inflation measure that they anyway produce.

The above explains why the New Zealand method clearly outperforms the alternatives. Moreover, its inflation adjustment factor is in practice a quality adjustment in CPI terms. If the quality in playing games of chance is the level of entertainment for the consumers, then, keeping everything else constant, it is precisely the price level of the bet that determines the quality of using a gambling service. Thus, in order to reflect the reality that gambling is an entertainment service and because of the necessity to keep the HICP basket fixed, the service charges factor should be continuously adjusted with inflation. This keeps the amount of the bet equally representative over time.

In addition, in the case of the HICP we also have some legislative constraints. Article 7 of the Commission Implementing Regulation (EU) 2020/1148 clarifies that in services like games of chance, where the price is determined as a proportion of the transaction price, the observed price that shall be used is namely the multiplication of this proportion by the price of a representative unit transaction. Article 7(3) also stipulates that 'If a change in the price of a representative unit transaction cannot be measured, it shall be estimated using an appropriate price index'. The New Zealand method strictly satisfies these requirements. As a

result, a methodological framework ([8]) for the games of chance index calculation structured around this method was endorsed.

This section will not be full without a couple of concluding remarks. First, it must be noted that the HICP is designed as a COGI (cost of goods) and not COLI (cost of living) index. That is why in the case of HICP the appropriate auxiliary price index applied on the representative bet in the New Zealand method is the price index itself as a measure for the general change in the value of money. It could however be argued that in a COLI-designed index different adjustment factors may rather be justified and applied. ([9])

And secondly, although the New Zealand method outperforms the Minimum Bet method in all aspects, the Minimum Bet method is still methodologically valid for the case of pool betting ([10]) games like lotteries. This is because winnings in a lottery, unlike other game types, depend on the number of tickets sold, and it is therefore reasonable to expect that their price will follow inflationary patterns in the long run. In other words, the lottery clients would view a ticket price increase as an improvement of the quality of the game because this will result in more attractive prizes.

2. Service charge measurement

The inflation factor component of the New Zealand method formula is already measured by statistical offices, so the real effort needed concerns the measurement of the service charges proportion. However, the different game types could vary significantly in terms of their mechanics or service charge pricing mechanism. For this reason, all games of chance could be classified in four main categories, which cover the total gambling market: Lotteries, Betting, Gaming (slot machines and other casino games), and Games of skill.

In Annex II there is a detailed description with references to an Excel file containing numerous practical examples illustrating the service charge measurement for each category. In general, all game types operate so that the service providers have fixed their charges in a way that enables in advance the calculation of the precise expected winning of a given bet. Usually, the exact service charge proportions are either directly available or could easily be derived.

Betting and scratch card games are the easiest case as their pricing mechanism is practically public. For most other types, there are no practical challenges too, as standard lotteries, casino table games and games of skills feature low variance of games, the service charge proportions of which are easy to find or calculate.

When this is not the case, an almost precise empirical measurement using real gameplay data is also possible as a last resort. This is because the expected outcomes are inevitably reached in the long run. The only data needed for this is the turnover (the total amount of bets made)

([8]) See Annex I.

([9]) For example, an index measuring the changing levels of consumers income.

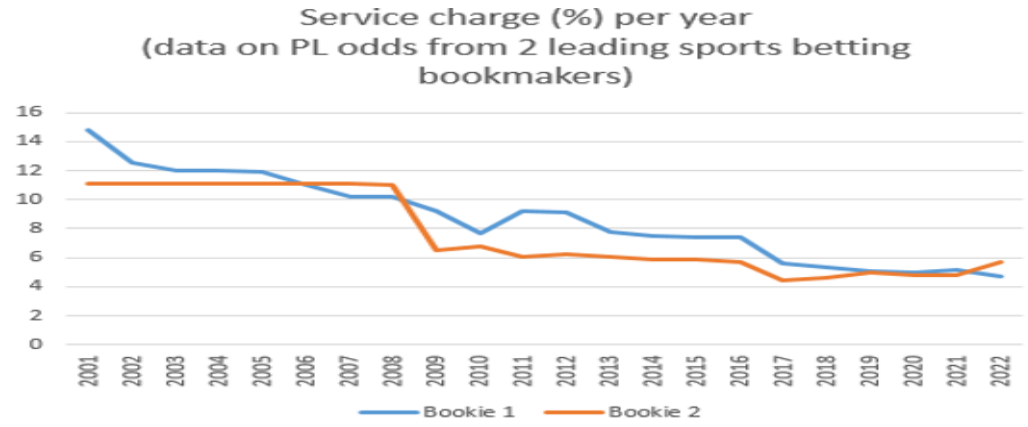
([10]) A betting pool is a form of gambling where participants pay a fixed price into a pool to make a prediction on an outcome. The pool is then distributed between those that made correct predictions.

from which the corresponding service charge (organisers net profit = bets – winnings) was taken. It is the slot machine games that are most likely to benefit from such a strategy if no alternative indicator of their service charge proportion is available. For this, the statistical office would need to sample casinos that have agreed to provide data on the service charges of the actual long-term gameplay for each of their games. The targeted price collection in this case would then be analogous to transaction data which is anyway preferable as the information on the weights would allow better measurement.

3. Data sources

Having illustrated that the service charge proportions are measurable for all types of games of chance, means that the New Zealand method is in practice applicable. However, the method is defined so that only its service charges component could lead to price index changes ([11]) while for most games the service charges are rarely changed. As it is explained in Annex II, the mechanics of some game types does not even allow to have their service charge proportion fluctuate at the game level. This may raise doubts if it is worth including games of chance into a price index, as it could have no impact on it.

Similar assumptions are best checked against actual data which is anyway needed to determine the relative weights of the main game types and their representative games. There are plenty of freely available online sources which allow a quick test for the case of sports betting. Here is an example on the evolution of the margins that two of the leading sports betting bookmakers had for their historical odds on the English PL (Premier League) football matches ([12]):



The graph demonstrates that prices in this representative sport betting market have dropped by some 50% during the last two decades. Even though this is a quite indicative trend, wider evidence of actual collected service charges data is needed for more definite conclusions

([11]) The other component is neutral to inflation as it is the price index for all other products itself.

([12]) Based on data from https://www.football-data.co.uk/ for the odds of all (around 8000) Premier League football matches for the 2001-2022 period.

about the games of chance impact on the overall inflation. The necessary data sources would also allow the aggregation of an experimental index based on the proposed methodology.

An extensive search for data sources revealed that national authorities regulating the gambling sector ([13]) usually have centralized administrative data on the nominal service charge expenditures broken down by game type. Moreover, the actual turnovers from which the respective service charges were collected would also often be included, which allows to directly observe the evolution of the service charge proportions per game type.

Such administrative data are likely to have minor shortcomings and be of varying quality in the different countries – for example, they may not cover offshore gambling ([14]), they may come without the turnovers for certain game types, or they may not always have sufficiently detailed breakdowns. Even if the administrative data are found to be of a lower quality (time lag, problems with disaggregation at the lower levels, gaps in the coverage, etc.), they would be a great starting point for stratification and sampling choices. It will help statistical offices determine the weights breakdown for the different game types and indicate where the resources for direct collection are best directed. It can also serve as a benchmark against the results of the alternative price collection method.

The main problem with similar well-summarized and aggregated datasets is that they are typically coming with a significant time lag which makes it impossible to meet the expected timeliness and frequency requirements for a monthly games of chance sub-index computation. It is not necessarily problematic that administrative data sources could come with time lags. The framework for index calculation is defined in terms of the winning chances and not on actual gameplay, so statistical offices should anyway target the collection of the theoretical service charge.

4. Impact of inclusion

H2 Gambling Capital, the leading provider of gambling data, has for several decades been collecting statistical data covering the entire gambling market and mostly based on primary administrative national sources. Eurostat contacted the company, which granted access to a very detailed dataset with all the necessary breakdowns, so all data needed to compile historical indices for games of chance were available.

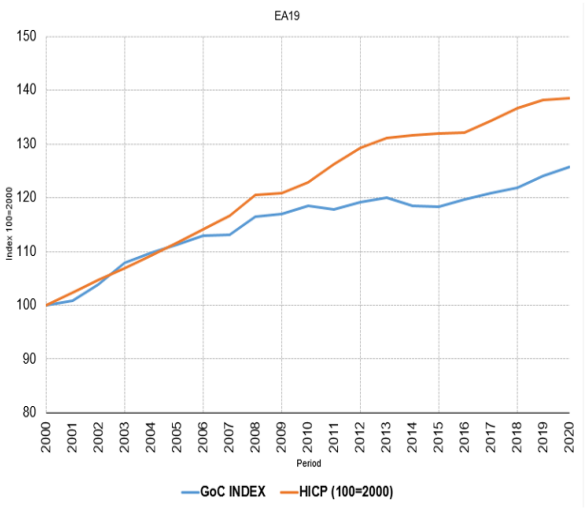
For the purposes of this experimental index, the data were stratified along the three main categories of sub-games – Lotteries, Betting and Gaming ([15]). To generate the indices using the New Zealand method, first the margins for each game type were calculated based on the data of the collected service charge as a proportion of the respective game type's gambling

([13]) See for example the UK Gambling Commission database: www.gamblingcommission.gov.uk/statistics-and-research/publication/industry-statistics-november-2023

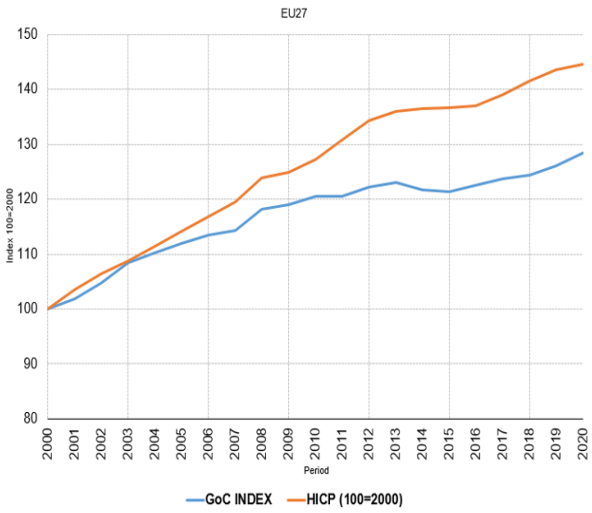
([14]) Offshore gambling covers the gambling that takes place at online operators that are located outside of the national territory. These offshore providers have no licences for the national market and are practically not regulated. Therefore, there is no official data for their turnovers.

([15]) Essentially including Games of skill (e.g., poker) into the Gaming category, as the share of poker in most European gambling markets is too low to merit a split.

turnout. Then, using the relevant weights per game type and the HICP all-items index, the resulting indices were aggregated and set to 100 in the year 2000 ([16]). The provided dataset enabled the computation of the games of chance indices for all EU Member States for the 2000-2020 period. In these two graphs the obtained indices for the fixed composition of the euro area (EA19) and the EU (EU27) can be seen:



Note: Games of chance index based on data provided by H2 Gambling Capital.



Note: Games of chance index based on data provided by H2 Gambling Capital.

If it were included in the HICP index, the weight of the games of chance item would have been approximately 1.35% on average annually during the 2000-2020 period. Though this is a relatively minor weight, the observed movements are still likely to impact the price index even at the highest all-items level. As a result, the inclusion of the item could no longer be considered only as a matter of principle but rather as a necessity to improve inflation measurement.

The graphs illustrate that if games of chance were included in a price index using the proposed methodology this would have a downward effect on inflation. Analysing the results, it looks like the transition to online gambling and the increased competition caused by the liberalization of the markets has led to the general trend of decreasing the service charges.

It must be underlined that we have taken a conservative approach assessing the impact of inclusion. This is because the data allowed for a split between online and land-based gambling for all main different game types, while service charge proportions in online gambling are naturally much lower. In contrast, if the three main categories of games were accounted as single units without separating the steadily growing online share, this would result in much bigger drops than those indicated in the graphs ([17]). The resulting price indices would clearly depend a lot on the decision whether playing the same game of chance online or in a land-

([16]) See Excel file (spreadsheet 'Indices') for an example on how the data for each national market country were aggregated. The example used is an illustration of the index aggregation for the Betting category presented in Section 6.2 but the structure is practically identical.

([17]) An illustration of the unit value bias in Games of chance index measurement organised around the New Zealand method can also be found in Annex I of this document, where a framework for the Games of chance index calculation is proposed.

based casino ([18]) should be considered as homogenous service consumption. Stratification of the main game types should therefore be accompanied with methodologically justified sampling choices and clear product definition within the stratified elementary aggregates.

5. Stratification

Selecting the practical definition for product and elementary aggregate is of course also a matter of data availability. In principle, finding the most detailed data possible is necessary for optimal stratification opportunities. National administrative data sources suggest that weighting information would usually be available for the three main game categories – Lotteries, Gaming, and Betting. The games within each category are similar and, from a consumption point of view, they can be viewed as broadly comparable products. At the same time, they feature quite disparate mechanics when compared to those of the other categories. These differences were assessed ([19]) and, as a result, the following structure was found to be the ideal partition of the games of chance universe for price collection purposes, where a fixed expenditure weight is assigned to at least ([20]) each of the three main game categories as elementary aggregates:

1. Games of chance
   1.1 Lotteries
      1.1.1. Classic lotteries
      1.1.2. Instant lotteries
   1.2. Betting
   1.3. Gaming
      1.3.1. Slot machines
      1.3.2. Other casino games

In the case of the HICP, comparability and harmonisation would be at risk in the absence of a stratification approach commonly applied by the EU member states, so it was essential that this structure is adopted by convention. However, the proposed stratification is in any case reasonable, as there are obvious quality differences between the services provided for each of the categories by default. Moreover, for some categories it is only the addition or removal of other games that creates dynamics. Defining the product in very tight terms should therefore be avoided, and the elementary aggregates should not be set at a very detailed level.

The weights at the level of the different games could be quite volatile depending on the players' luck in the short run ([21]). At the same time, the games within the stratified elementary

([18]) Or likewise, if it is for example two different slot machine games but offered by the same service provider.
([19]) See for example the table in Annex II.
([20]) Some countries may have a significant market of instant lotteries (the so-called scratch cards) or other casino games. In this case it is justified to include them by splitting the main category into two separate elementary aggregates.
([21]) But also in the long run, as the weights naturally shift towards the games where the profit margins for the organizers are lower. This may be caused by changing customer preferences or by having the organizers remove older more 'expensive' games or introduce 'cheaper' new games.

aggregates could also be viewed as broadly comparable and even homogenous, especially when offered by the same provider. That is why the average price may be best calculated by means of the unit value approach – using overall revenue and quantity data supplied by the service provider. Otherwise, if standard index methods are applied, there is the risk of bias as explained in Silver (2016) ([22]):

> *"The bias in superlative index numbers for homogeneous goods (or services) is a neglected and important index number issue. Say, for example, the price of good A was 10 in both the reference and current period and the price of good B was 12 in both periods, but there was a shift in quantities from say 6, for both A and B in the reference period, to 8 for A and 4 for B in the current period. A superlative, or any other index number formula for heterogeneous goods, would give an answer of unity, no overall price change. However, the correct answer for homogeneous goods would be a unit value fall of 3 per cent appropriately reflecting the shift in the quantity basket in the current period from the higher price level of 12 for A to the lower price level of 10 for B."*

If this is the case with games of chance, the optimal strategy is to define the product directly at the level of the service provider. It would be best that statistical offices negotiate an agreement with major casinos or online betting sites to periodically provide actual gameplay data, preferably broken down to the most detailed game level to capture the weighting shifts. It can be anyhow concluded that it is important to address the issue of product definition for each of the main game types.

6. Product definition and elementary aggregate index compilation

In the presented framework for games of chance index calculation, the element used for price measurement is the game. In practice, this is more complicated, and it may in some cases be a bundle of game offers or even a building block of all the games offered by a certain provider that should be used for the elementary aggregate calculation. This is because:

- For some of the elementary aggregate categories, it can be claimed that there are no significant quality differences between the available games, at least when offered by the same provider.
- As the price of gambling is a percentage (the service charge proportion), the price-determining factors are not usually related to the quality of the different games or of the service.
- In the Betting category there are no actual games.

([22]) https://www.imf.org/en/Publications/WP/Issues/2016/12/31/An-Index-Number-Formula-Problem-The-Aggregation-of-Broadly-Comparable-items-22557.

It has already been mentioned that in some categories, like in Gaming or instant lotteries, the different games feature a constant service charge proportion for their lifetime. This makes the mentioned product definition clarification even more important to consider. This is because, for these game types, the only way that providers have for adjusting the price of their service is to change the available games composition. In other words, changes occurring in the assortment must be reflected as price changes. Therefore, defining the product for each of the three main categories is probably the most important issue as it may have a large impact on the eventually compiled indices, especially for the categories where price changes do not practically occur at the level of the game.

6.1. Lotteries

Classic lotteries

The classic lotteries are the easiest to handle. In most countries, the classic draw number lotteries of the 6/49 or Euromillions type are unique games offered as a single product of a separate provider. The provider can also change the service charge proportion for its lottery game, even though this is rather rare. Therefore, the approach of treating each different lottery as a separate product is recommended.

The service charge proportions for this game type are generally publicly available ([23]). It is most important to obtain information for the relative weights of the particular lotteries. The administrative data should be detailed enough at least to this level, so this game type should not present price collection or sampling problems. In the unlikely case that the weights are not broken down to the specific lottery game level, the elementary aggregates could be compiled as in the example for the instant lotteries presented below.

Instant lotteries

Instant lotteries, also known as scratch cards, are usually of smaller service charge weight in comparison to the classic number draw lotteries. However, they come in a much wider variety of offers, as there can well be dozens of different games by the same provider. It can be demonstrated that service charges for scratch cards are easy to collect directly ([24]). Once a new game is sampled, there is no need to follow its service charge proportion in time, as price change at the level of the particular game is not possible ([25]). Consequently, index variation occurs only when a game is removed or added in a sample of scratch card games.

([23]) Further explanations and examples are available in section A of Annex II.

([24]) See section A of Annex II.

([25]) Nevertheless, it is good practice to check annually the service charge of the sampled scratch cards, as it might not be forbidden for a supplier to introduce a new game that is named and looks exactly like the originally sampled one, though with a different service charge.

In principle, there are no significant quality differences between the scratch card games of the same provider. So, they could be treated as homogenous offers, unless there is an essential characteristic to serve as a reason for splitting them into different product groups.

There are two main strategies to sample the games. The first is exhaustive – the organizers are likely to have a full list of their instant lottery games. This usually comes with a description of the prize fund distribution for each game, which enables the service charge measurement for the particular game. The same information can be found on the back of each physical scratch card ticket.

Here is an example of the Luxembourg sample, where the local national lottery is the only supplier of scratch card games:

- https://www.loterie.lu/content/portal/fr/reglements-documents.html (in the 'Rubbel' section, there is a link to the description of each physical scratch card game offered), and
- https://www.loterie.lu/content/portal/fr/instants.html (where also the variety of the online scratch card games can be viewed, and registering an account allows access to the mentioned description for each of them)

Eurostat has extracted all necessary data from these descriptions on two different occasions – on 1 March 2022 and on 1 March 2023 to demonstrate the calculation of an unweighted index for these two periods ([26]). It is unlikely that countries will obtain monthly scratch card consumption expenditures for the compilation of high-quality unit value indices. However, with the assumption that the total potential service charge expenditure may be used as a very good proxy, the relative weights for each particular game could be calculated ([27]), so weighted price indices are also applicable ([28]).

When the exhaustive sampling strategy cannot be applied, the second strategy by sampling a few kiosks where scratch card games are offered could be used. There would be a representative subset of different scratch card tickets for sale ([29]). In Period 1, it will be enough to only collect the service charges for the games available at this kiosk. In each subsequent period, the collector should simply update the sampled games; games no longer offered at the kiosk would be removed, and new games should be added with their relevant service charge data. Otherwise, the calculation of the average price and the consequent index would be the same as in the Excel example for the first sampling strategy.

([26]) See column K in Excel file spreadsheets 'Period 1' and 'Period 2'.
([27]) See column H in Excel file spreadsheets 'Period 1' and 'Period 2'.
([28]) The recommendation is that the weights should be kept fixed throughout the year. An example illustrating such a weighted aggregation is not provided, as it is practically identical to the case when we have the data on the weights for the games in the Gaming category.
([29]) If the scratch games of several providers are offered at the sampled sales location point, these would usually have identical characteristics from a service consumption point of view. Still, if their conditions differ significantly, it is possible to use the market shares of each provider as weights in an additional aggregation step.

6.2. Betting

The mechanics of the betting games category is explained in detail in section B of Annex II. In contrast to the other categories, there are no actual separate games in Betting. Moreover, the product cannot be defined at the lowest possible level – that of the betting offers – for price statistics purposes. This is because individual offers are unlikely to reoccur on monthly basis. On the other hand, different providers would certainly have quality differences for their general betting service (i.e., customer support, wider assortment of events covered, live streaming of sport events, the conditions under which money are deposited or withdrawn etc.). Therefore, betting offers with otherwise identical characteristics could hardly be viewed as homogenous when offered by different providers. Consequently, the highest level at which the product could be acceptably defined is that of the service provider itself.

In principle, it is relatively easy to treat all betting offers by a certain provider as homogenous items, as they are not even real products but simply means to enable the service consumption. Neither can they be found to have significant (if any) quality differences in relation to each other from point of view of the service quality. It is useful to provide the following arguments that the product for the Betting elementary aggregate should be defined at the level of the service provider and not at that of the different betting market groups it offers:

1. The price differences between the offers are determined by factors which are not related to the quality of the betting service.

Montone (2021) ([30]) presented an extensive analysis of the price-determining factors that betting companies use to establish the service charges for their different market options, as well as of the broad literature on the subject. The findings are intuitive and in line with expectations:

- Service charges are generally a decreasing function of the elasticity of demand.
- Service charges are also dependent on risk-aversion factors:
    - They are higher for bets with a higher number of potential outcomes, as more outcomes imply more volatile profits.
    - They are lower for lower profile sport events, as there is higher risk of match fixing or asymmetric information.

Even though service charge levels would vary for the different types of bets or events, the service conditions of the provider are otherwise identical. Whether the event is the number of goals in the football World Cup final, or the winner of a low-level tennis match between two non-popular players, this is clearly irrelevant to the quality of the service at least in the

([30]) Montone (2021), Optimal pricing in the online betting market (Journal of Economic Behaviour and Organization); https://www.sciencedirect.com/science/article/pii/S0167268121001487

COGI (cost of good index) ([31]) sense. The price levels of the different markets practically depend on the providers efforts to minimise revenue volatility.

2. Discounts or promotions are usually given in the form of bonuses applied horizontally for the service.

When the provider offers a discount/promotion to attract consumption, the accounts of the benefiting players are usually topped up with a certain bonus that can be used by customers to make free bets on offers of their own choice. Thus, practically the pricing for concrete events or bet types is unaffected and the offers remain homogenous in the context of the discount.

3. At a more detailed level, the short-run performance of the betting markets is not consistent with the economic theory assumption that price differences between competing products at a given point in time correspond to quality differences.

Betting markets are characterised with sharper weight movements and increased volatility as the level of detail goes lower. For example, the weight for a certain minor betting market in a particular month may be several times bigger than usual if the provider received an outlier bet of a relatively big amount. It could also easily happen that a low-level market is of a negative weight ([32]), depending on how lucky the users were during the period, and this would not make sense in CPI terms. In general, if statistical offices get access to detailed real gameplay transaction data, they will find that applying the product definition at a deeper level of granularity would lead to contradictory results. This is because the weights breakdown at this level is not really a function of the general consumption preferences.

4. Players usually combine offers of different event and bet types into a single betting transaction.

Users can consume simultaneously the service of several offers that may be of different service charge levels, events or bet types. Players often use the so-called combos in which the odds of their betting offer selections are multiplied ([33]). Even if some players do not use combo bets, it is unlikely that they would be betting only on single offers of the same type/event sharing uniform service charge levels.

([31]) As opposed to COLI (cost of living index).

([32]) This could potentially be avoided if the total turnover for the market or only the losing bets are used to determine the market weights. However, it would then not align with the idea that the service charge weight should be the overall net profit from the supplier point of view.

([33]) Also note that the combo option enables users to control the size of their potential winning. If players prefer to increase the eventual potential winning sum for their bet, they can include an additional event while keeping the amount of their intended bet unchanged. In this sense, if there are limits for the maximum winning allowed, these are also usually applied by the provider horizontally for the whole service.

5. There is no continuity in the service if bet type groups of identical service charge are defined as the product.

There are not many events for which a bet could be placed weeks or months before the outcome of the event is known. Players generally bet on live or shortly upcoming events. The service is practically consumed within the duration of the event itself. Bookmakers offer betting events on a non-stop 24/7 basis as there are always sport matches taking place somewhere around the globe. Offers could be grouped into markets that share a common service charge line depending on the different event type, but there is no single sport tournament or league that would be constantly available for live betting.

6. Betting is a service of entertainment because a given bet amount can be multiplied to result in a certain winning sum, so offers of different service charges can be perfect substitutes.

In betting, it is not the level of the service charge but the level of the odds that determine the factor by which the bets are multiplied to generate the winnings. If two separate 1 EUR bets are placed at odds of 3.00 on two events with different service charge levels (for example 5% and 10%), the earning would nevertheless be the same (3 EUR) if the bet wins.

A tariff-like structure

All of the above arguments indicate that it is methodologically justified to define the product at the level of the service provider. However, the following reasons imply that it is still reasonable to organise the betting offers of a certain provider into homogenous groups with similar characteristics.

A. Betting providers have their offers split exactly into market groups, which:

- Often have different service charge levels in relation to each other.
- Are defined by certain characteristics around which they are categorised.
- Are essentially the only real pricing mechanism used, as all offers within the same group share the service charge proportion that the provider has set and may update.

Providers divide their betting offers into markets that are defined first by event type and then by the type of bet. A breakdown of all offered sports and then individual competitions would be present. For example, each national league or international competition in the football section would be a separate category. All match events within a certain competition will usually have the same bet market types (i.e., full time result, total number of goals, correct score, etc.). An example of a market would be 'Total number of points scored in a basketball NBA match' or 'Full time result in a football match of the English Premier League' ([34]). The provider would generally set service charges for all offers within a particular market to a

([34]) See the Excel file (sheet 'Betting markets') for examples of betting market offers.

relatively constant level ([35]). Changing this level is how in practice price change occurs in Betting.

B. The classic unit value index approach ([36]) could not be otherwise reasonably applied.

In principle, it should be possible to calculate an aggregated average monthly service charge for the provider by presenting its total turnover as a percentage of the total amount of bets made, without the need of homogenous offers groupings. However, the resulting index would be dependent on the random factor of luck that consumers had during their gameplay, even if all underlying weights and service charge proportions remain unchanged.

C. The introduction of a new market type is an improvement of the quality of the service.

A wider assortment of betting offers is an obvious service quality difference. In the optimal case, when detailed transaction data are available, differences coming from newly introduced markets should be captured and lead to price changes.

D. Customer expenditure would experience significant changes in time between the different betting markets.

Many betting markets are not regularly available because some of the most popular competitions in the sport events calendar do not happen with a monthly frequency. One cannot simply sample these events out as they attract significant shares of the expenditures, so it is important to cover them.

Considering the above, it is evident that the different markets offered, categorised by sport competition and bet type, are the key element in the pricing structure of a betting service provider. Though it was shown that it would not be methodologically sound to define them as targeted products, it is inevitable to view them essentially as different tariffs for the same service product. The presented framework also assumes that it is necessary to have a level at which the different offer components are priced before combining them into an index.

In fact, quite different results may be obtained, even if the offers of the same provider are grouped by sport and bet type (for example predicting the winner or the number of goals/points scored in a match). Providers normally apply uniform service charge proportions for events of the same tournament or sports league. However, within the same sport there are usually different tournaments with varying service charge levels. Moreover, some of the most popular events do not happen with a monthly frequency (e.g., a tennis Grand Slam tournament or the football World Cup), while at the same time they are likely to attract

([35]) Minor fluctuations are always present as bookmakers prefer to offer more user-friendly rounded odds.
([36]) Using total revenue and quantity data for the bookmaker.

disproportionally higher consumption expenditures. The practical and methodological aspects that need to be considered in this context are best seen in an example.

Illustrative examples

The Excel file accompanying the document presents an example from tennis. The data for tennis matches for two consecutive years were extracted from tennis-data.co.uk, which has a database of historical tennis betting odds. This example shows how a monthly period of significant price change may be treated, and it demonstrates some important sampling considerations too.

The margins for each of the tennis matches based on the odds that a provider has set in 2020 are calculated ([37]). The average annual service charge proportion was around 6.40%, with the clear exception of the Grand Slam tennis tournaments, where the margin is significantly smaller (a bit less than 5%) ([38]). This meets the expectation that the Grand Slam tournaments were priced as a different category. Indeed, examining the odds of the consequent year, a big price drop in March 2021 can be observed ([39]). It is demonstrated that this price decrease would be measured quite differently depending on whether Grand Slam tennis offers would be treated as a separate tariff group or together with those of the regular ATP tour tennis matches ([40]).

While there are regular ATP tournaments throughout the year, Grand Slam tournaments take place in a limited number of months. It may seem reasonable to sample only the event category which will feature continuous price offers during the whole year. This would be convenient as there are almost no temporal gaps, neither is there a mix with other category of events within the same sport. However, in most sports there are rare but quite popular major events which also usually attract a greater share of the expenditure weight. In the end, all sports betting offers of a certain provider are defined as homogenous elements of the same service. Therefore, these less frequent major events should be included in the calculation of the unit value for the sport even though this may have a seasonal effect in the resulting indices.

Price offers availability in a particular period does not depend on the service provider but on the sports calendar (e.g., a World Cup football match cannot be offered for betting in a month when there is no World Cup tournament). These major international tournaments usually occur only in selected months or years and are scheduled so that they do not coincide with the regular events in the sport's calendar. This is why it is best to classify the targeted unit blocks directly at the higher level, that of the sport. Although the quality characteristics of the

([37]) See spreadsheet 'Tennis 2020' in the Excel file.

([38]) The value targeted by the bookmakers in this case was probably exactly 5%. However, as it is explained in section B of Annex II, on an event-by-event basis the service charge proportion in betting has minor fluctuations, as it is a function of the odds and the standard is to use rounded and user-friendly odds.

([39]) See spreadsheet 'Tennis 2021' in the Excel file. Examining closely the dataset it can be even seen that the organizers decreased the service charges exactly on 26 February 2021.

([40]) The same is applicable to any other sport – for example the World Cup or Champions League football tournaments in contrast to regular national league championship matches.

obtained data sources may allow having these blocks defined in more detailed ways, a higher-layer definition would anyway be preferable also because the weights are more stable at the level of the sport.

Some remarks on sampling

Clearly, the key characteristic around which the aggregates should be defined in the Betting category is the sport. Usually, customers bet mostly on the sports they follow and information about the respective sports' weights will be essential for more precise measurement. The number of different markets in a popular online provider may well be around 1000, but a select few would be much more important than the rest in terms of weight. Most betting sites are likely to constantly provide live betting options for events in football, racing and tennis, while other sports would have much less stable availability of offers during the year.

New sport competitions or bet types are often added as additional markets to the provider's assortment, but it should not be necessary to follow the price development for hundreds of betting markets, although their price offers are easily available. The most representative market groups may be chosen, and they could serve as the basis for calculating the average price change. A bookie may stop offering bets on whether there will be a tie-break in a volleyball match, or it may even decide to get rid of its whole handball betting section. However, it is nearly impossible that the winner ([41]) markets for the most representative sports would ever be discontinued.

For reasons of continuity and comparability, it is recommendable that not only the sports, but also their sampled market types are aligned. Analysing the average service charge levels for the winner markets of the most popular sports, Montone confirmed the expectation that sports with a bigger number of possible full-time score outcomes (like football and ice hockey, where matches can also end in a draw) are characterised by higher service charges. It is therefore recommendable to avoid markets with a high number of outcome options, as they could be quite volatile. For example, the number of horses or greyhounds in different races may vary significantly or in some races the outlier odds for the least likely winners could significantly distort the betting line margins.

It is essential that the sampled components of the tariff-like structure are stable and likely to remain representative in the very long-run as a facilitating factor to avoid replacements. In this sense, the sports of football and tennis represented by their main market – the above-mentioned winner market – are a perfect sampling choice. The combination of these two markets can in most cases be viewed as the minimum target coverage, but countries could

([41]) The winner markets are the most popular ones, where the users must predict the full-time outcome of a match. For example, in tennis, that would be predicting the winning player; in football, where matches can finish in a draw, there are three possible outcomes. In practice, the odds of all other bet types related to the sport match are generated as a function of its winner market odds.

cover a wider set of representative sports or markets, especially if they find their respective weights.

Summarising the index aggregation

Our tennis example can be extended to summarise the aggregation. In line with the choice of having the sport as the level for sampling the betting offers, Eurostat collected the winner market odds of two leading bookmakers in the post-COVID period (international tennis resumed in August 2020) until July 2023 ([42]). The graph of Bookmaker 1 illustrates the price change that occurred in the end of February 2021, when the provider decided to decrease the price level for all tennis matches to the service charge level of the Grand Slam tournaments. The drops in September-October 2020, and in February 2021 were due to the Grand Slam tournaments organized in these months. Once the major price change happened, the service charges for tennis stabilised until another smaller price change in January 2023. The service charges of Bookmaker 2 were more stable in the long run though they seem to feature slightly more sensitive monthly fluctuations ([43]).

The index aggregation for the entire Betting category is also illustrated in an example ([44]) in which the sport of tennis is covered using the data for the tennis matches winner markets of Bookmaker 1. For the purposes of the example, fictitious data for the service charges of two other sports – football and basketball – are included, as well as some made-up weights. The aggregation is done according to the proposed framework for index calculation. Note that the weights for the different sports are intentionally kept fixed during the year which is recommended even if transaction data of higher frequency are available. This is because the weights in betting are otherwise extremely volatile and could be even negative in the shorter term depending on random factors such as the size of some lucky outlier winning bets.

Finding the data

In most countries, betting takes place predominantly or entirely online, and in some cases all online betting transactions must go via the servers of different national financial or fiscal agencies. As a result, administrative transaction data could even be available with the required timeliness and frequency. In any case, the betting odds are practically public prices that could be directly collected online. The collected betting odds coefficients are enough for the measurement of the theoretical service charge proportion, set by the organisers. Therefore, actual gameplay data at the most detailed level of the bets is not really needed

([42]) See spreadsheets '2020', '2021', '2022', '2023' in the Excel file, and spreadsheet 'Service charges' for the resulting price indices.

([43]) Please note that Eurostat did not find real historical odds time series for the lower tier tennis tournaments, like those of the ITF Tour, even though a bigger provider would cover such tournaments. This is especially relevant for the month of December, when there are no high-level tennis events during the ATP tour break. The November data were simply carried over to December.

([44]) See spreadsheet 'Indices' in the Excel file.

and should even be avoided, as users can make betting choices which distort the pure theoretical service charge against their favour.

The presented aggregation examples are applicable even without data on the weights. However, approaching the betting markets as tariffs for the otherwise homogenous betting service of a given provider works best when information for the weights of each tariff component ([45]) is available. For optimal index measurement, data on the relative weights of the collected service charge for the provider's sampled representative sports and betting markets should be targeted ([46]).

For the purposes of the presented tariff-like structure, it would be enough if a bookmaker agrees to supply its weights data only annually and only at a higher level of detail (e.g., that of the sport). However, providers are likely to have statistics for their markets profit, based on quite detailed breakdowns. If bookmakers agree to supply monthly data on their market weights, it is very probable that it will also contain information about their relevant service charge levels. In this case it may not even be necessary for the statistical offices to collect separately data for this provider's betting odds.

The www.top100bookmakers.com website is a good starting point for sampling providers as it offers data on the daily visits from each country for most bookmakers that operate on its local markets. The site also provides data on the average service charge levels ([47]) for the top six major sports for each of the listed providers. It is recommended to sample bookmakers that also have an online casino section ([48]), as obtaining transaction data would also be particularly desirable in the case of Gaming.

6.3. Gaming

Game mechanics

The mechanics of the different game types in the Gaming elementary aggregate is described in detail in section C of Annex II but it is still interesting to make a comparison to the other two main categories. There are several important differences between Betting and Gaming. Unlike in Betting, in Gaming generally:

- there are clearly defined games.
- each game is constantly available for play and has a fixed price level (service charge proportion), which usually cannot be changed.
- consumers are often unaware of the price differences between the offers.
- even the most representative slot machine games are sooner or later subject to replacement as there is a tendency of regular assortment changes.

([45]) See for example Table 7.4.19. in the HICP methodological manual (p. 237).
([46]) If several providers are sampled, then data on their relative market shares would also improve the aggregation measurement.
([47]) Defined as 'betting margins' on the website.
([48]) If a provider agrees to share their gameplay data, they will probably not mind doing this not only for their sports betting but also for their online casino games.

In this sense, the games within the Gaming category are very similar to the scratch cards from the Lotteries category. However, there are also essential differences. Importantly, for scratch cards, the act of consumption – the actual gameplay scratching – does not usually happen at the time and place of the betting transaction. Moreover, usually there are only a few providers of scratch card games at the national level and normally those have also developed their own games. Thus, each scratch card game is practically supplied only by a certain provider, and the set of games offered by this provider is likely to be the same regardless of location ([49]).

In contrast to scratch cards, the service providers in the Gaming category enable consumption only within their sale point location (land-based or online casino) and are typically using third-party produced games hardware/software. This means that a very different set of games may be offered even when comparing two locations of the same provider. At the same time, many identical games may be offered by two different providers. In other words, quality differences between two different locations are likely, and it would be methodologically justified to keep open the option to define the product at the level of the provider's site.

Product definition

Just as it is for the games in the other categories, the price-determining factors for casino games are not a function of any of their detailed specifications that may otherwise make them more expensive to produce. Two similar slot machine games could differ a lot when certain technical specifications of their hardware ([50]) or software ([51]) are compared. However, these characteristics would not be correlated with the actual service charge proportion level for the respective game.

The presented framework for games of chance measurement is organized around calculating the price offers at the level of the game and then combining them into an index. Nevertheless, it is important to note that, in CPI terms, the game is not the actual product in gambling. An individual game of chance is just a mean for consuming the service of a gambling provider. If customers were paying a price to buy and obtain different casino games like slot machines or roulette to play them for fun at home, then these games could be defined as products with quality differences. However, games of chance is a service the price of which is by default a proportion applied on a consumer's bet. Therefore, in the consumption basket, it is necessary to find representative bets for a gambling service, while the different games offered by the same provider are essentially different tariffs at which this provider's service can be consumed.

([49]) That is why it would not constitute a serious problem to cover the whole scratch cards national market with the exhaustive approach recommended in section 6.1, although there may be dozens of locations in each city, like street kiosks, where the distribution of the tickets has been outsourced.

([50]) For example, touch screen, options for automatic dealing or direct money deposit into the automate.

([51]) For example, the maximum amount a bet could win, the expected gameplay length, bonuses, the easiness to understand the game prize determining rules, etc.

For simplicity, all game offers provided by the same casino are included in a single homogenous group in the aggregation examples. This should not prevent statistical offices from drawing further homogenous groups distinctions if there are good reasons for this. Assessing the differences of the games available for play at the sampled providers ([52]) should help finding the key characteristics to potentially divide the games into more homogenous groups. It can hardly be argued that a slot machine and a roulette are homogenous from the point of view of the consumer, even if offered by the same provider. In principle, the Gaming category can even be split in two separate aggregates – 'slot machines' and 'other casino games'. This is to distinguish the classic casino table games, such as roulette or some other dice or card games, from the ever-growing variety of slot machine offers. However, the weight of slot machines is several times that of all other casino games combined in most countries.

Pricing mechanism

In the Gaming category, the different games – slot machines or other casino table games – feature a constant service charge proportion for their lifetime which makes the mentioned product definition clarification even more important to consider. This is because the only way that Gaming providers ([53]) have for adjusting the price of their service is to change the available games composition. The fact that prices at the level of the individual games are constant indicates that applying a very tight product definition should be avoided. If the product is defined at the lowest level, any method will result in no index variation ([54]).

A certain game is most often removed when it becomes outdated, and it is usually replaced by a newer more popular game. Data also suggests that gameplay is likely to slowly move towards the cheaper or newer games. In other words, changes occurring in the assortment must be reflected as price changes. For these reasons, it would not be so favourable to apply the sampling strategy proposed for Betting, in which only the most representative consumption options are followed.

At the same time, the outlined tariff-like structure will produce optimal measurement results if information on the corresponding weights is available. It is therefore recommended to contact the sampled providers asking for information about the relative weights of their games. Finding gameplay statistics provided by the casinos is in any case preferrable as they can also serve as a shortcut for the measurement of the theoretical service charge proportions set for the different slot machine games ([55]), which may otherwise not always be easily measured.

([52]) For example, using the MARS (Match-adjusted R-Squared) method if transaction data are available.

([53]) Online or land-based casinos.

([54]) Even if transaction data from service providers on their shifting weights per month and per game is available, which would otherwise allow the application of multilateral methods.

([55]) As explained in section C of Annex II, this would not be a problem for other casino games, which are usually of the table games type (i.e., roulette, black jack, certain dice games etc.) as their service charge levels are popularly known and easy to obtain.

The special case of Games of chance

With any ordinary COICOP item product for which transaction data is available, applying the traditional tariff prices treatment ([56]) would satisfy the constraints explained above. However, games of chance involve a random element: consumers can also have winning bets which may lead to non-representative weight deviations. For a period as short as the calendar month, such occasions could even result in negative weights depending on the amount of luck that players had ([57]). Therefore, at this most detailed game level, the short-run performance of the Gaming markets is not consistent with the economic theory assumption that the corresponding weights would be a function of price differences and the law of supply and demand. This is inevitable because, in gambling, the expected loss ([58]) is a constant only in the long run.

It is therefore clear that it is preferable to use more stable weights, and the examples in the annexed Excel file are based on the recommendation that the relative weights for the different games should be kept fixed during the year and only updated annually. This approach solves an essential practical problem too. Price collectors would not need to obtain transaction data to cover the weights of the most detailed level for several providers every month. It would also be much more likely that Gaming providers agree to supply data on the relative weight shares of their games annually. Then, the only thing that statistical offices would need to follow on a monthly basis are the assortment changes.

Illustrative aggregation examples

The approach described in this section can be explained in the following way:

For each month, a representative bet of 1 EUR is split into smaller bet amounts corresponding to the different games' relative weights. As these weights shall be kept fixed annually, a price change in Gaming will only happen in two cases:

a) When the annual weights update takes place, or

b) When there is a change in the game assortment.

The annexed Excel file contains examples for the proposed treatment of all possible cases presenting assortment change – when an old game is removed; when a new game is added; and when an old game is replaced with a new game ([59]). For completeness, the cases when there are no weights data are first listed – a standard arithmetic mean index is applied.

The more interesting cases arise when the weights are available (spreadsheets 'Gaming4' to 'Gaming6'). It is assumed that each January, after a calendar year is over, the provider would supply the Y-1 data for the relative weights of its current games' assortment, so column B

([56]) See for example tables 3.4.3 (p.50) and 7.4.21 (p.243) in the HICP methodological manual.
([57]) Especially when very big wins like jackpots occur.
([58]) The expected loss is predetermined by the theoretically set service charge proportion which is in practice the price itself for each bet made.
([59]) See the last 6 spreadsheets in the Excel file.

contains the weights that were used in the previous year. Column C contains the new weights which will be used from January onwards. Like this, the annual weights update at the games level takes place in January when a price change is inevitable ([60]). The resulting weighted average price index is calculated on row 28, and it remains stable until the month of August, when the assortment change happens.

The case when a game is removed is treated so that the weights of the remaining games are normalised. It is as if the weight of the removed game is redistributed to that of the rest of the games proportionally to their relevant shares.

The last two cases, when a new game is added and when it replaces an old one, are respectively illustrated on the last two spreadsheets. The challenge is to decide what weight should be used for the newly introduced game until the next January, when the more stable transaction-based data for the weights will be supplied by the provider. In the example this is done in the most neutral way, by simply assigning to the new game a weight proportional to its numerical share out of the total number of games ([61]), while the rest of the games are essentially rescaled as in the previous case.

This solution is always available but other techniques may even be better for keeping the weights stability during the year. For example, in the replacement case, the weight of the replaced game can simply be assigned to the new one. Another option would be to keep a constant lower number of games that are actively used in the sample, so that several of the provider's less representative remaining games are followed only in reserve. Like this, when a game is removed or replaced, there is always a game in hand to use for the replacement ([62]) until the annual weights update take place.

To obtain a better estimate for the new game's weight, statistical offices could also use past data to analyse how consumption changed in previous occasions when games were introduced to the provider's assortment. For example, it may be found that the relative weights of the games are correlated to their price. If this is the case, then statistical offices could estimate the weight of the new game based on its service charge proportion ([63]) until they get the more precise data in the January annual weight update. Historical data may also

([60]) The idea is to have it coincide with the annual weight update of the games of chance COICOP item, as well as that of the three main stratification elementary aggregates which will most likely be based on annual administrative data. Depending on the regular weight updating or chain-linking practices in the relevant national CPI, another month may be more appropriate than January.

([61]) See cell D52 on sheets 'Gaming5' and 'Gaming6'.

([62]) As explained in Annex II, if there is no other way to calculate the service charge proportion of a slot machine game but to use its gameplay statistics, this should be done only after several months of consumption. So the benefit of this option is that not only the weight but also the service charge proportion of the game that enters the sample will already be known, which is not always the case for a newly introduced game in the casino's assortment.

([63]) Please note again that, to use this option, one should already know the service charge proportion for the new game. It would not make sense to apply it if the price is yet to be empirically measured based on gameplay. This is because, in the initial period of a game's exploitation, luck is still a factor as there are not enough observations for reliable price measurement. It would usually take several months of play to have the game's profit statistics converge to the set theoretically expected service charge proportion.

reveal how quickly an assortment change impacts the customers, as it may be found that the 'new game effect' usually leads to a certain consumption reaction ([64]).

Some final considerations

Naturally, the average prices calculated as unit values for the tariffs of the provider service should simply be further aggregated to the level of the Gaming elementary aggregate. Having several homogenous groups does not lead to methodological challenges as any traditional price index formula (Jevons or a weighted one) can be used for the aggregation.

Similarly to what was recommended for the Betting category, it will also be necessary to sample providers in the case of Gaming. It should be noted that there would be significant differences between land-based and online casino games service charge levels ([65]). Having several providers is also business as usual – the average prices by provider can be combined into a price index for the elementary aggregate using the market share of each provider as weights. According to the methodology endorsed in the Framework for the Games of chance index calculation, the inflation adjustment factor ([66]) must also be applied as a step before the finalized aggregation.

The optimal measurement will depend to a large extent on the quality of the data that statistical offices manage to obtain. If it is agreed that providers would supply their transaction data annually, it is essential that it comes in a format with all needed breakdowns. This format should enable the calculation of the relative weights per game for each of the assortment variations experienced in the casino during the year ([67]).

7. Summary of recommended treatment per game type

Eurostat is still in the process of preparing the finalized aggregation examples, decision trees and formal guidelines to summarise the recommendations on the treatment of the games of chance item. In any case, the endorsed stratification structure and the treatment proposed for each of the main elementary aggregates can generally be outlined at this stage:

([64]) For example, customers may be slow to switch to playing a game they are not familiar with, or, on the contrary, they may be willing to try games they have never played before.

([65]) Data suggest a trend of gradual increase in online Gaming market share. It would then be optimal to have at least one representative casino from both types – online and land-based – to capture that shift. For the Betting category this is not so important, as nearly all Betting consumption already takes place online.

([66]) The general change in the value of money, measured as the price index for all other products, is an obligatory component in the so-called New Zealand method as it introduces the cost of maintaining the value of the representative bet.

([67]) This is because, as the assortment changes, some games would have been offered for less than the full 12 months and these differences should obviously be accounted for the weight calculation for these games.

Lotteries

- National administrative data should be detailed enough to decide whether to cover only classic lotteries, or if instant lotteries (scratch cards) are also of a significant enough weight to be included as a separate elementary aggregate.
- For classical lotteries, the product is defined at the individual game level. The sampled games and their weights could be updated only annually, but it is necessary to confirm monthly that the service charge proportion of the respective game has not changed.
- For scratch cards, the product is defined at the level of the provider/sales location point. If possible, all games of the major national providers could be sampled exhaustively so that their service charge proportion is measured; if not possible, this may be done only for a sample of different representative locations where scratch cards are sold. In both cases the samples are monitored monthly to capture potential addition/removal of individual games.
- The total potential service charge expenditure ([68]) can be used as a proxy for the relative weight for each of the games to enable weighted price index aggregation.

Betting

- The product is defined at the level of the service provider whose betting markets are viewed as different tariffs for the same service product.
- Some major national providers ([69]) are sampled and, ideally, transaction data to determine the weights of their betting markets are obtained ([70]).
- The provider's most representative betting markets are sampled and grouped by sports for service charge proportion measurement.
- It is recommended that the minimum coverage includes the winner markets for football (full-time 1X2 outcome) and tennis ([71]).

Gaming

- The working assumption is that all games offered by the same provider are homogenous elements (tariffs) for the provider's service.

([68]) Based on the number of tickets available for sale and their price.

([69]) Preferably such that also support an online casino section; if the provider agrees to supply transaction data, this will be helpful for the Gaming category data collection as well.

([70]) The transaction data can be of an annual frequency as the recommendation is to keep the weights fixed during the year.

([71]) Other sports can also be considered, especially if they attract significantly higher bets than football or tennis at the relevant national market.

- The homogeneity of the different games should be assessed to ensure proper stratification, as there may still be reasons to split the available offers into separate homogenous groups ([72]).
- Some representative national providers are sampled so that the casino games of both land-based and online casinos are covered.
- The service charge proportion is collected for each of the sampled providers' games, after which the game assortment is followed monthly for potential changes.
- Ideally, transaction data is obtained to measure the relative weights of the games.
- The weights are kept fixed between assortment changes and updated annually.

If one of the categories proves to pose unexpected practical difficulties (e.g., related to data availability), the inclusion of the games of chance item may happen gradually with a first phase in which only the less challenging elementary aggregates are introduced. In the HICP case, it was decided that inclusion would optimally occur together with the implementation of the new COICOP classification, so it is scheduled to take place in the beginning of 2026.

References

Consumer Price Indices by Ralph Turvey et al., ILO (1989).

Games of chance and HICP, paper by INE, ISTAT and Statistics Finland for the Ottawa Group meeting; 2011.

Harmonized Index of Consumer Prices (HICP), Methodological manual, EUROSTAT, 2024 edition.

Maurizio Montone, *Optimal pricing in the online betting market* (Journal of Economic Behaviour and Organization); 2021.

Mick Silver, *An index number formula problem: The aggregation of broadly comparable items*; IMF Working Papers 2009/019, International Monetary Fund; 2009.

([72]) For example, separating table casino games from the slot machine ones.

Annex I

Framework for the Games of Chance Index calculation

The calculation of a price index for Games of chance takes place in two stages:

1. A representative bet is fixed for a specific game and the share of its expected loss (i.e. the service charge) represents the price for a betting transaction in that game.

2. The price changes for the different games are combined in order to obtain an overall price index for Games of chance.

Step 1: Pricing a game

The **price** for a game in period t is defined as its theoretical service charge multiplied with a representative bet β.

$$p^t = \beta^t - \varphi^t(\beta^t) = \left(1 - \underbrace{\frac{\varphi^t(\beta^t)}{\beta^t}}_{=c^t}\right) * \beta^t = (1 - c^t) * \beta^t$$

Where β^t is a representative bet in period t, $\varphi^t(\beta^t)$ is the expected winning in period t of the representative bet β^t, and c^t is the theoretical rate of return for that game.

This contrasts with the actual rate of return that can be observed in a given period. Let B^t be all betting transactions that occurred in period t for a specific game. For each betting transaction $i \in B^t$, there is a betting amount b_i and a winning amount w_i (which can be zero if there is no amount won in that betting transaction).

$$\widehat{c^t} = \frac{\sum_{i \in B^t} w_i}{\sum_{i \in B^t} b_i}$$

The **net expenditure** of a game in period t is defined as the difference between the total bets played and the total amount of winnings.

$$v^t = \left(\sum\nolimits_{i \in B^t} b_i - \sum\nolimits_{i \in B^t} w_i\right)$$

For consistency reasons, the price times quantity must equal the expenditure, so the **quantity** of a game in period t is implicitly defined as follows:

$$q^t = \frac{v^t}{p^t} = \frac{\left(1 - \widehat{c^t}\right)}{(1 - c^t)} \times \frac{\sum_{i \in B^t} b_i}{\beta^t}$$

Hence, the quantity is obtained by dividing the total bets with the representative bet, corrected with a factor that adjusts for the difference between the theoretic and the actual service charge.

In this framework, the price does not depend on the actual outcomes of the bets played in each period but is defined in terms of the theoretical winning chances. For most games, the service charge could be directly calculated. If that is not possible, the actual service charge can be used as an estimate for the theoretical value. In practice, the theoretical value and the actual value of the service charge should be almost identical in the long run.

Step 2: Game → Games of chance item

Suppose a price and an expenditure for each game in each period are available. This would allow the application of standard index formulas. Moreover, according to the New Zealand method, the value of the representative bet is adjusted using an adjustment factor (for example the price change of the other products).

$$\beta^1 = \beta^0 * I^{0,1}$$

Let N be the set of games. For each game $k \in N$, prices p_k^t and expenditures v_k^t in the two comparison periods $t = 0,1$ are calculated in the first step. A Laspeyres index between periods 0 and 1 is defined as follows:

$$Laspeyres^{0,1} = \sum_{k \in N} \underbrace{\frac{v_k^0}{\sum_k v_k^0}}_{=w_k} * \frac{p_k^1}{p_k^0} = \sum_{k \in N} w_k * \frac{(1 - c_k^1)}{(1 - c_k^0)} * I^{0,1}$$

Note that if the service charge is constant for all games, the Laspeyres index (and any other weighted or unweighted index formula) is identical to the adjustment factor.

Illustration of potential unit value bias

Suppose that there are two games with the following data. In this example, the actual service charge is used as an estimate for the theoretical service charge.

	Period 0			**Period 1**		
	Amount bet (a)	**Amount won (b)**	**(c) = 1- (b)/(a)**	**Amount bet (d)**	**Amount won (e)**	**(f) = 1 – (e)/(d)**
Game 1	150	128	15%	220	195	11%
Game 2	300	150	50%	320	165	48%

The Laspeyres index is then calculated as follows:

	Change in service charge (g) = (f)/(c)	**Adjustment factor (h)**	**NZ price change (i) = (g) * (h)**	**Base expenditures (k)= (a)-(b)**	**Laspeyres weights (l)=(k)/(22+150)**
Game 1	0.7748	1.0200	0.7903	22	12.79%
Game 2	0.9688	1.0200	0.9881	150	87.21%
Laspeyres index					**0.9628** (3.7 % decrease)

Suppose now that the two games are not considered separately but merged together. The amounts would be added accordingly, and a service charge from these aggregated values can be derived.

	Period 0			**Period 1**		
	Amount bet (a)	**Amount won (b)**	**(c) = 1- (b)/(a)**	**Amount bet (d)**	**Amount won (e)**	**(f) = 1 – (e)/(d)**
Games 1&2	450	278	38%	540	360	33%

This would lead to an index according to the New Zealand method of $\frac{33\%}{38\%} * 1.02 = 0.89$ (decrease of 11%).

Annex II

Games of chance main categories

A. LOTTERIES

There are different games of chance of the lotteries type and the most widely spread ones would be covered in the following two categories:

1. Number games (like Euromillions or the classic national lotteries of the 6/49 type, and bingo)
2. Instant lotteries (also known as scratch cards)

The common factor for all types of lotteries is that their editions have fixed price tickets and players would proportionally increase their chances of winning a certain prize category by purchasing more tickets.

Number games

The main difference between the two mentioned subtypes is that in traditional lotteries and bingo the winnings depend on the number of in-play tickets for each drawing. This is so, as the winnings are practically a constant percentage of the total amount used to purchase these tickets. Afterwards, at regular intervals of time, a new drawing round is organised. Drawings are thus independent from each other, unless there is a progressive jackpot (i.e. if there is no winning combination in a certain price category, its envisaged prize fund share is rolled over to the next lottery drawing). Please note that this does not change the service charge proportion for the game in the long run, as the jackpot is sooner or later hit ([73]).

A good feature of the national state lotteries is that they are games of chance that almost never disappear from the market, so replacements are unlikely. In most European national lotteries, the service charge is set between 45% and 55% and is very rarely changed. For example, in the German 6/49 and in Euromillions it is fixed to 50%. This information is most often readily available, but the

([73]) See Excel file (spreadsheet 'Lotteries').

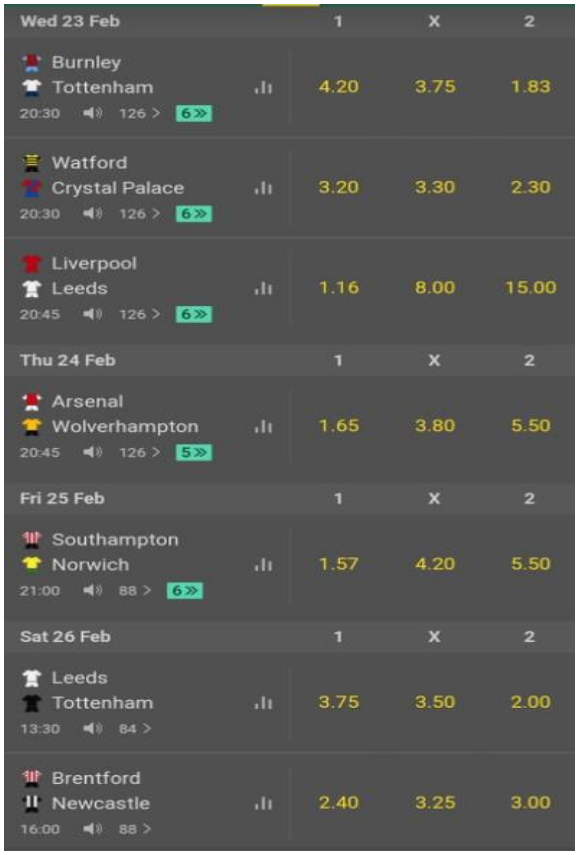
amount of the overall bets and the prize distribution for each drawing ([74]) is usually found at the provider's website, so the service charge percentage can also be calculated indirectly.

Instant lotteries (scratch cards)

There is a wide variety of scratch card games tailored for the different consumer profiles. Players can see directly if and how much they won after their card is scratched. All scratch cards for a certain game are available for sale, so the distribution of the prizes is predetermined and the maximum service charge is usually regulated by law.

The organiser is usually obliged to reveal on the back side of each scratch card the total number of cards in circulation, as well as the prize fund distribution. The service charge proportion for each game can therefore be easily calculated using these numbers ([75]). The service charge and the ticket price can't be changed at the level of an individual scratch card game, so variance occurs only when a game is removed from or added to the sampled assortment offers.

B. BETTING



Unlike casino games, sports betting, as well as betting on different events – horse/hound racing or other special events (political, awards, etc.), is not a game of chance where the probabilities for a certain outcome are known with precision in advance. Bookmakers use sophisticated models to predict the expected chances for a certain outcome in a sports match. Based on these chances, they offer odds, cutting the fair probabilities in their favour, so that profit is formed as a consequence of this margin ([76]). Bookmakers are more exposed on events for which less information is available, so their margin rates are usually higher for such event types.

The player's stake is multiplied by the offered odds coefficient to form the winning if their prediction was correct. The odds offers for each event are publicly available, so it is always possible to calculate the service charge proportion for any bet type. Websites like football-data.co.uk and tennis-data.co.uk offer great data on current and historical odds collected from the leading bookmakers.

([74]) See Excel file (spreadsheet 'Lotteries').
([75]) See Excel file (spreadsheet 'Scratch cards')
([76]) See Excel file (spreadsheet 'Betting').

Data suggests that worldwide, the most popular sports for betting are football and racing, though in certain national markets other sports could also have bigger shares. As a rule, bookies use the same service charge ([77]) for events from the same sport tournament (e.g. a Premier League match in football, an NBA match in basketball, or an ATP game in tennis). As two events can never be the same, following the offers of a representative betting market type is the way to keep the service constant.

Similarly to casino games, players bet against the house. As circumstances may lead to shifts in the chances for the different outcomes, odds can also change before and during the event to reflect the newly available information. However, this happens for the whole betting line, so the service charge proportion practically remains unchanged and in terms of CPI measurement these are not real price changes.

Users have the advantage to choose from hundreds of daily events and bet options. In theory, they could be successful against the organiser in the long run, if they could predict the real chances of the event outcomes so much better than the bookmaker that it even beats their margin. However, numerous studies have shown that the betting markets are generally efficient, so sports betting cannot be considered a game of skill ([78]).

C. GAMING (SLOT MACHINES AND OTHER CASINO GAMES)

Slot machines

Slot machines are the most popular game in casinos and provide the biggest part of casinos' profit. This is because they are typically automated in a way that a single play takes just the press of a button, so it is extremely fast to have a deal. In some countries slot machines constitute a huge part of the gambling sector, as they are found not only in casinos but also in normal bars and cafes all over the country.

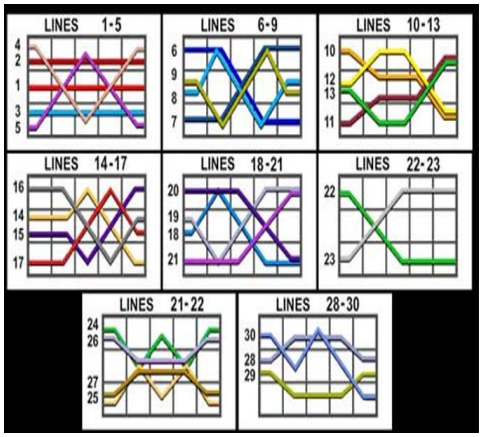
In the previous century, the classic slot machine would have only 3 reels and there were actual slots in which players were inserting coins or tokens, so the price per spin was equivalent and usually fixed. The machines used to be often mechanical and players had to pull a handle to generate a spin (hence the expression 'one-armed bandit'). The winning would depend on a combination of symbols appearing in the 'payline' (the central line of the 3 reels).

Each spin is an independent event, and the service charge is constant as the chances for winning are predetermined and fixed. Thus, the expected payout per bet is inevitably reached in the long run. An example of the RTP calculation for a classic 3-reel slot machine is given in the Excel file ([79]).

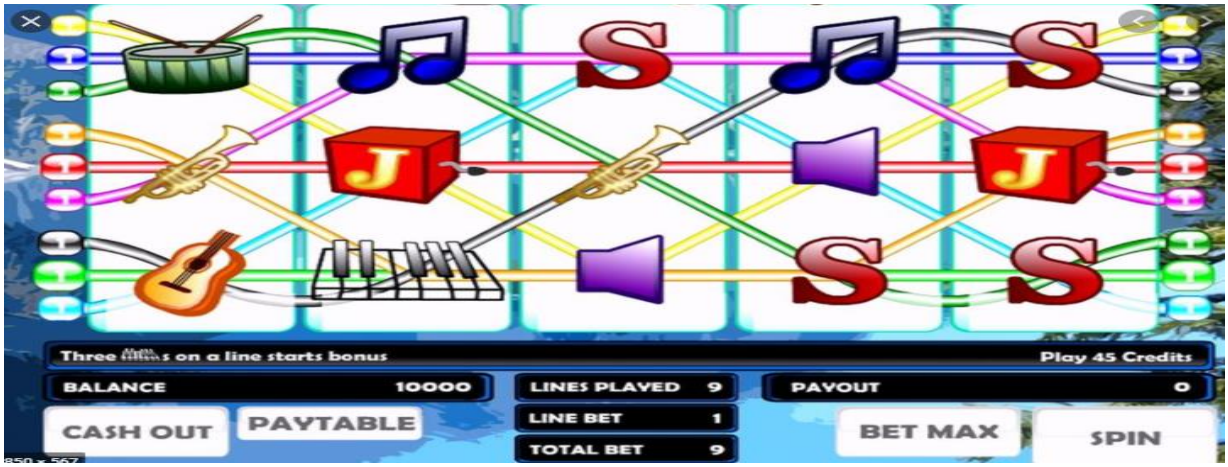
([77]) Though there are always minor rounding differences See Excel file (spreadsheet 'Betting').

([78]) A notable exception are the so called betting exchanges where there is no house that players are playing against but they bet against other users. Thus, 'fair odds' without margins are offered but the exchange is simply charging a commission (usually 2 to 5 % from the users' net winnings) for offering the service. These markets function similarly to financial markets (FOREX, stock exchange).

([79]) See Excel file (spreadsheet 'Slot machines')



Nowadays most slot machines have 5 reels and are electronic. They are essentially random number generator algorithms with predetermined outcome chances for each of the reel symbols. As slot machines are now automated, users can play thousands of spins in less than 1 hour – the matrix of 3 lines x 5 reels allows playing simultaneously on dozens of paylines. The user can select the number of lines played, as well as the bet amount per line (see example). Even if modern slot machines are much more complicated, the method for setting their service charge has not changed: knowing the probabilities for the symbols to occur on the reels and the respective win factor is enough to calculate the service charge proportion for a slot machine game ([80]). As the service charge proportion for a particular slot machine game is generally not a subject to change in time, price changes for the slot machines elementary aggregate will happen only when there is a change in the sample (just like in the case of scratch card games).



The standard service charge is around 20% for land-based automates and around 5% for online slots. The real problem with service charge measurement in slot machines is that in some countries the legislation does not require that the service charge proportion is publicly available. It is likely that the RTP indicator (the service charge proportion) for online casinos is publicly available ([81]), but this is rarely the case for land-based slot machines. A good source for a database or a register of slot machines software characteristics may be the national gambling regulator ([82]) or a related agency (i.e. certified institute of metrology). Usually such an independent auditor would test the software running a simulation of millions of spins to determine if the expected return to player is within the legally allowed range, so the auditors are likely to have a list of the service charge proportion for each licensed slot machine game.

The organiser is also likely to know the default service charges for its automates or would at least have access to some built-in statistics for each slot machine from where these can be directly taken or deduced. Please note that winnings in games of chance are random in the short run and the actual collected service charge proportions could be quite volatile in the initial phases of the games' lifetime.

([80]) See Excel file (spreadsheet 'Slot machines') for an online link to an actual example.
([81]) See some examples from a popular betting site online casino section in the Excel file (sheet 'Examples').
([82]) See Excel file (spreadsheet 'National gambling authorities') for a list of the regulators in the EU countries.

As a result, convergence to the theoretically set margins could take some time. So, if it is necessary to measure the service charge proportions using actual gameplay statistics, this should only be done for slot machine games with at least several months of consumption as the performance of the games in the initial phases of their lifetime could be quite volatile. Also, this measurement should not be based on the net profit approach ([83]) but rather on the total amounts of all bets made and their respective winnings ([84]). In any case, it would be optimal to find casinos that agree to provide transaction data for the different games they offer.

Other casino games

The most popular non-slot machine casino games are table games, such as roulette, baccarat, blackjack and craps. In these games, the player is also betting against the house and their relevant margins are fixed by the rules of the game. An example of measurement of the service charge in roulette is available in the Excel file ([85]). In baccarat and blackjack (as well as in their variations or other less popular card or dice games) the players' betting decisions may impact their expected payout, so the theoretical return to player should be measured against optimal play, which is also fixed and relatively easy to find or calculate.

In short, the measurement of the service charges in the table games does not represent a challenge for the statistical offices. Changes in a table game's service charge proportion can happen only if the casino starts using another variation of this game ([86]) which can simply be viewed as game replacement. As a result, price change in a casino is only possible if there is a change in its games assortment. A list with the service charges for all popular table casino games and their variations can always be found online ([87]).

D. GAMES OF SKILL

In games of skill, players do not bet against the house but against each other and the organizer is charging them taking a fixed percentage of the prizes' distribution. The main games of skill are poker and fantasy sports, and they feature a wide number of variations. Data suggests that in most countries the games of skill weight is relatively small. So, despite of their different pricing mechanism, it could be justified and practical to merge them with some of the bigger categories ([88]).

On a classic table of poker there is a limited number of seats, on which players take turns to call and raise stakes in a hand deal of cards until usually only one player wins the stakes for the deal round. The organiser keeps a fixed percentage (called the ***rake***) of the total amount won in each hand, which is practically the service charge. Rakes are usually around 3% to 5%, rarely changed and always easy to find online.

([83]) The actual net profit ('money in' minus 'money out') outcome would generally define the weights for a given game, but it is not a good criterion to determine its service charge proportion even in the longest run. This is because customers will have some winnings during gameplay, so in practice they are most likely to bet a much higher total amount than what their actual net loss will be in the end.

([84]) See Excel file (spreadsheets 'Slot machines' and 'RTP vs Money in-Money out') for further explanations and two examples.

([85]) See Excel file (spreadsheet 'Roulette')

([86]) For example, if a European roulette is replaced with one of the American type, the winning probabilities will be altered as American roulettes have an additional 00 sector.

([87]) For example wizzardofodds.com/gambling/house-edge

([88]) After all poker is a casino table game, while fantasy sports are a form of sports betting.

A different form of a poker game format is the tournament one. To participate in the tournament, players pay an entry fee and progress in the tournament as long as they have chips. The total prize pool is distributed among the best achieving players according to a predetermined paying grid. The prize fund for the tournament is usually some 10-15% lower than the total amount paid for the entry fees, so this is practically the service charge. It is either directly mentioned or can be calculated using the prize fund distribution described in the tournament room ([89]).

Fantasy sports is a game of skill that has the same mechanics as a poker tournament. The only difference is that instead of betting on combinations of cards users create their own virtual teams with actual sport players, which bring them points depending on their performance in real sport events.

Characteristics of Games of Chance main elementary aggregate categories

		Price (service charge proportion) collection	Variety of offers	Homogeneity of same provider offers	Price change at game level	Weight availability and volatility at game level
Lotteries	Classic	Public or indirectly available	Low	No	Rare	Admin data/Minor
	Instant (scratch cards)	Public	Medium	Yes	None	Available trough proxy/Minor
Betting		Public	High	Yes	Medium	Transaction data/High
Gaming	Slot machines	Public or indirectly available	High	Yes	Almost none	Transaction data/High
	Other casino games	Indirectly available	Low	Depends*	None	Transaction data/High

*In principle, the working assumption is that all games offered by the same provider (online or land-based casino) in the Gaming elementary aggregate are viewed as tariffs for the otherwise homogenous provider's service. However, it is best that statistical offices make that choice on a case-by-case basis, as casinos could feature quite various consumption characteristics. For some national markets or for certain sampled individual providers, there may be good methodological reasons to have additional group(s) for the different casino table games separately from the slot machines.

([89]) See Excel file (spreadsheet 'Games of skill').