RESPONSIBLE GAMBLING TRUST MACHINES RESEARCH PROGRAMME

Evaluating the impact of the uplift of stakes and prizes on B1 gaming machines in casinos

Authors: David Forrest[1], Ian G. McHale[2] & Heather Wardle[3]

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Prepared for: The Responsible Gambling Trust

[1]University of Liverpool, [2]University of Salford, [3]NatCen Social Research

CONTENTS

Executive Summary

1. Following a review and public consultation, stake and prize limits for category B1 gaming machines in British casinos were raised at the beginning of 2014. Previously the maximum stake had been £2 and the maximum prize £4,000. Under the new regulatory regime, these limits were set at £5 and £10,000 respectively. Moreover, for the first time, a higher maximum jackpot was permitted where machines were linked (on a premises-only basis). This allowed casinos to offer a £20,000 pay-out.

2. This Report examines the impact of these changes in the first year. It uses data from Rank, the largest casino operator in Great Britain. Two data sets were employed. The first consisted of weekly aggregate data (on house win, amount staked, number of spins and stake-per-spin) from each of 23 casinos, covering approximately twelve months before and approximately seven months after Rank's machines were adjusted to implement the regulatory changes. The second consisted of tracked records of casino visits by more than 620,000 individuals who gambled with loyalty cards.

3. Analysis of the casino-level data identified structural changes in the weekly aggregate data as having occurred only around the time that the regulatory changes were implemented. The absence of structural changes at other time points in the data legitimises the application of an 'event study', where a statistical model compares key behavioural differences before and after an 'event', in this case the implementation of higher stake and prize limits.

4. The results of the event study suggest that the uplift of maximum stakes and prizes was associated with an increase in weekly house win from B1 gaming of about 7%. This is close to the industry forecast of 5% quoted in the Impact Assessment issued by the Government in advance of the changes.

5. The modelling suggested a slightly higher increase (about 10%) in the weekly amount staked in B1 machines. Thus casinos appear to have retained (as profit) a somewhat smaller proportion of stakes than hitherto. A potential explanation is that larger prizes tend to be retained by the player rather than recycled into additional play.

6. About 90% of the increase in amount staked derived from an increase in the average stake per spin (the increase in the number of spins was only marginal). At a typical casino, the mean stake increased from about 79 pence to about 88 pence. The data were at a level of aggregation which do not permit us to infer how much of the increase in mean stake was attributable to plays at the new maximum stake.

7. The Report also examined casino revenue from table games. About half of the casinos represented in the data set were located in relatively deprived areas as defined by the Index of Multiple Deprivation. In these casinos (only), there was evidence of substantial displacement of table game expenditure such that customers appeared to be switching spending from tables to machines in response to higher stake and prize limits on machines. No limits are in place for table games. Thus, in poorer areas (where of course not all of the customers will be poor), the gain in industry revenue from B1 machines was offset by a fall in revenue from other gambling products.

8. Among individual players, inspection of three years of records indicated that about 25% of casino gambling visits where their card was used included play on B1 machines and about 20% of all casino gambling visits included only B1 play. A typical B1 visit was associated with a loss on B1 machines of about £20. However, large losses were not uncommon. In 2014, for example, about 20% of B1 visits generated a B1 loss for the player of more than £100 and 3.3% (11,000 individual occasions) a loss of more than £300. Where the player played only machines, the typical duration of play was 50 minutes but, in nearly 6% of visits, the player spent longer than four hours on the machines.

9. Compared with changes observed between 2012 and 2013, the proportion of B1 players losing such unusually high amounts of money or spending such unusually long lengths of time on the machines increased relatively sharply between 2013 and 2014. On the other hand, those exhibiting such "extreme" behaviour remain a quite small minority (though a non-trivial number) of customers.

10. The Report examined, for three years, the transition year-to-year in frequency of use between categories delineated as non-user, new user, infrequent user, frequent user and former user. 'Frequent' was defined as eleven or more B1 visits in the year. There was no significant difference in the transition-rate of infrequent to frequent use between 2012-13 and 2013-14 and therefore no evidence that uplift of stake and prize limits was associated with infrequent users being turned into frequent users.

11. However, there was a sharp and statistically significant increase (from about 60% to 65%) in the proportion of frequent users who remained frequent users in the following year. This implies that a substantial proportion of the (modest) increase in industry revenue from B1 machines was achieved by increasing retention of frequent players.

12. Among frequent players, the spending of the bottom-quarter of customers did not increase at all in the first year of the new regulatory regime. By contrast, the average spend per visit from the top-quarter of customers increased from about £53 to a little more than £60. This implies that the increase in industry B1 revenue was derived disproportionately

from the heaviest players. This is unsurprising because, given that mean stake size was well below the maximum permitted, only relatively heavy players were likely typically to have been regularly constrained by the previous £2 limit.

13. Formal statistical analysis was conducted on the data for the 2,495 customers in the data set who were 'frequent' B1 players in each year 2012-2014. Player loss per visit was significantly higher after the machines were adjusted to accommodate the new stake and prize limits. There was some evidence that younger customers increased their spending by more than older customers and firm evidence that customers whose postcode indicated that they lived in one of the 10% most deprived areas increased their spending by more than average. There was no evidence of differential response as between men and women (before implementation, female frequent users spent more, on average, than male frequent users).

14. The estimated increase in spending per visit for a 25 year old not living in a very deprived area was £5.53 but was £8.00 for a 25 year old living in a deprived area. However, those living in the most deprived areas did not increase their mean duration of visit as much as the rest and actually decreased their frequency of visit.

15. The statistical analysis included variables representing whether a customer ever played late at night and whether a particular visit was itself a late night one. Controlling for age, gender, deprivation of area of residence and other factors represented in the model, those who play at night were found to lose much more per visit than those who do not even on their non-late visits; and, on average, they lose still more when the visit is itself a 'late' one. The differential between late and non-late visits widened after the stake and prize changes were introduced. This suggests that those playing at night disproportionately took up the option to stake at increased levels.

16. No information was available to permit the Report to say whether extra activity induced on B1 machines was harmful. For example, many heavy players experience no harm. They enjoy B1 gaming as entertainment and, if they spent more when they could increase the excitement of the occasion by playing for higher stakes, they were just substituting on the margin between different options open to them for leisure activity. Without further information on individual players, it is not possible to say whether the additional revenue obtained for the industry was associated with a disproportionate increase in harm. However, it is known that risk factors for problem gambling include young age, heavy play and residing in a deprived area. Further, earlier RGT research on B2 machines raised concerns over late night gambling. The statistical analysis suggests that a disproportionate amount of the increase in B1 revenue may have derived from the young, from those living in deprived areas, from heavy players and from those playing late at night. All this suggests that the relative share of industry revenue derived from groups

where harm is most concentrated has increased following the uplift in maximum stakes and prizes

17. All established forms of gambling involve benefit for many and costs borne by others. On the margin, there is some indication that the ratio of total costs to total benefits may have increased for B1 gaming. But it is not possible to say whether any additional harm in some absolute sense offsets the gains from this regulatory change.

18. Future research for the RGT, for example projects on online gaming, may be enabled to reach more definitive conclusions if researchers seek and gain access to individual players to try to ascertain whether their play is harmful. Scores on a problem gambling screen would be an imperfect but potentially adequate proxy to facilitate sharper conclusions than have been possible in this Report.

1 Introduction

1.1 Background

Since the Gambling Act (2005), the regulatory framework governing the availability of machine gaming in Great Britain has been defined according to a taxonomy of machine types separated by the maximum stakes and prizes they offer (see Table 1.1). Category A machines are those with no regulatory limits on stakes and prizes and are permitted only in 'regional casinos'. Since no regional casino has been licensed in Great Britain, no Category A machines are available.

As one moves through categories B, C and D, machines have lower stake and prize limits applied to them but they are permitted to operate in a wider range of locations. Thus, category B machines of various sub-types are permitted only in adults-only gambling-specific premises (such as casinos, betting shops and bingo halls) or members' clubs; category C machines are found in public houses (presumed to be largely adult environments); and the low-stake/ low-prize category D machines are available in 'family entertainment centres' (arcades) where they are accessible to, and indeed allowed to be played by, children.

It is worth noting that this choice of regulatory framework, where accessibility is restricted as stake and prize limits are raised, suggests that those responsible for devising it associated higher stake and prize limits with greater risk. The rules were devised in such a way that, as stake and prize limits became higher, accessibility to the machines was to be made more difficult, to protect vulnerable populations.

It was also recognised that, as the gaming landscape changed, and as inflation altered the real size of limits defined in money terms, it would be appropriate from time to time to revisit the stake and prize limits placed on each machine category. After the implementation of the Gambling Act, 2005 it was initially envisioned that there would be a formal review every three years (the Triennial Review), which had been the case under the pre-2005 regulatory regime. However, the notion of a Triennial Review in fact fell into disuse and only ad hoc changes were implemented after 2005. But, in late 2011, the Government announced that it would reinstate the Triennial Review. In due course, it made proposals and launched a public Consultation which took place between January and April, 2013 ahead of possible revisions to stake and prize limits from 2014. Subsequently, it also committed to a further Triennial Review to be completed by the end of 2016.[1]

[1] Department for Culture, Media and Sport, *Gambling Act, 2005: Triennial Review of Gaming Machine Stake and Prize Limits, Government Response to Consultation on Proposals for Changes to Stake and Prize limits for Category B, C and D gaming machines*, London, October, 2013.

Table 1.1: Machine categories, stakes and prizes and permissible venues

Machine category	Maximum stake (from January 2014)	Maximum prize (from January 2014)	Allowed premises
A	Unlimited	Unlimited	Regional Casino
B1	£5	£10,000 (with the option of a maximum £20,000 linked progressive jackpot on a premises basis only)	Large Casino, Small Casino, Pre-2005 Act casino and Regional Casinos
B2	£100	£500	Betting premises and tracks occupied by pool betting and all of the above
B3	£2	£500	Bingo premises, Adult gaming centre and all of the above
B3A	£2	£500	Members' club or Miners' welfare institute only
B4	£2	£400	Members' club or Miners' welfare club, commercial club and all of the above.
C	£1	£100	Family entertainment centre, qualifying alcohol licensed premises, qualifying alcohol licensed premises and all of the above.
D money prize	10p	£5	Travelling fairs, family entertainment centre and all of the above
D non-money prize (other than crane grab machine)	30p	£8	All of the above.
D non-money prize (crane grab machine)	£1	£50	All of the above.
D combined money and non-money prize (other than coin pusher or penny falls machines)	10p	£8 (of which no more than £5 may be a money prize)	All of the above.
D combined money and non-money prize (coin pusher or penny falls machine)	20p	£20 (of which no more than £10 may be a money prize)	All of the above.

During the Consultation, most controversy centred on B2 machines, which have the highest permitted stake in British machine gaming (£100) and which are typically found in Licensed Betting Offices (limited to four machines per shop). In the event, no change was made on the limits for these machines.[2] However, the Government decided (subject to industry assurances regarding an increased level of player protection[3]) to raise stake and prize limits in the case of B1 machines, which are permitted only in casinos.[4] Previously, the maximum stake on B1 machines had been £2 and the maximum prize £4,000. From January, 2014, these limits were raised to £5 and £10,000 respectively. In addition there was the option of a £20,000 linked progressive jackpot on a premises-only basis.[5] The speed with which these changes were implemented varied by casino operator. For example, Rank, the largest casino operator, converted virtually all of its machines in line with the new limits within the first month of the new regime (January 2014). However, other operators had a slower conversion rate in which the changes were phased in throughout the first half of 2014.

Table 1.2 shows the outcome of the 2013 Triennial Review, with the old and new limits on stakes and prizes for each category of gaming product.

In the Triennial Review Impact Statement[6] issued by the Department for Culture, Media and Sport on September 18, 2013, the Government emphasised the argument that "higher stake and prize gaming machines can support growth in the casino sector", with a knock-on stimulus to machine manufacturing. However, it also acknowledged that there were concerns over whether easing restrictions might increase harm from gambling. The Gambling Commission and the Responsible Gambling Strategy Board (RGSB) had advised that there was little or no empirical guidance in the published literature to help

[2] The relevance to harm minimisation of stake and prize limits for B2 machines was explored in a suite of research studies published by The Responsible Gambling Trust in December, 2014.

[3] Examples of initiatives proposed by the industry to address player protection issues were included in the submission to the Consultation process by the National Casino Industry Forum (http://www.nationalcasinoforum.co.uk/wp-content/uploads/2013/11/NCiFresponse.pdf)

[4] Casinos are permitted also to offer all other categories of machine (except Category A). However, the total number of machines is limited to twenty except in the two 'large casinos' licensed under the terms of the 2005 Act. In practice, most casinos use the limited quota to offer B1 terminals almost exclusively.

[5] Prior to the changes, all operators had some machines linked to provide progressive jackpots but the maximum value permitted was only the same as the maximum stand-alone jackpot, £4,000.

[6]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249274/Triennial_Review_of_Gaming_Machine_Stake_and_Prize_Limits_Impact_Assessment.pdf

assess what these impacts might be expected to be[7] and the Government therefore urged the industry to begin to collect data which would inform a *future* Triennial Review:

> *"We would reiterate the importance of the industry starting to gather proper data now to inform consideration of impacts at any future Triennial Review*"[6].

This Report has been commissioned by the Responsible Gambling Trust to use such industry data, so far as possible, to assess the impact of the 2014 uplift of stakes and prizes in B1 machines during the first year post-implementation. It was anticipated that this assessment would provide valuable input into the decision-taking process in the 2016 Triennial Review and would also contribute more generally to the scant literature on how stake and prize limits impact on the behaviour of machine players.

Table 1.2: Government's final recommendations at the conclusion of the last Triennial Review

Category	Old maximum stake	Old maximum prize	New maximum stake	New maximum prize
B1	£2	£4,000	**£5**	**£10,000***
B2**	£100	£500	£100	£500
B3	£2	£500	£2	£500
B3A	£1	£500	**£2**	£500
B4	£1	£250	**£2**	**£400**
C	£1	£70	£1	**£100**
D non-money prize (not crane grab)	30p	£8	30p	£8
D non-money prize (crane grab)	£1	£50	£1	£50
D money prize	10p	£5	10p	£5
D combined money and non-money prize (coin pusher/penny falls)	10p	£15 (of which no more than £8 may be money prize)	20p	**£20** (of which no more than £10 may be a money prize)
D combined money and non-money prize (other than coin pusher or penny falls)	10p	£8 (of which no more than £5 may be a money prize)	10p	£8 (of which no more than £5 may be a money prize

* with option of maximum £20,000 linked progressive jackpot on premises basis only
** Government considers the future of these machines to be unresolved pending further work which is already underway.

1.2 Benefits and costs from easing restrictions

An assessment of the consequences of the uplift in stake and prize limits on B1 machines needs to be put in the context of what changes might be expected to be observed and whether it is possible to say that the changes observed could be unambiguously regarded

[7] For example, the RGSB advised that "there is currently insufficient evidence to assess conclusively whether the proposed changes to stake and prize limits would cause harm".

as either beneficial or costly to society. Thus, for a complete evaluation, measures of both the principal benefits and the principal costs to society would be required. Generally, the approach of economists is to represent the principal benefit generated by a sector of the gambling industry as its consumption value (typically measured as consumer surplus) to those customers who take 'rational' decisions on where to spend their entertainment budget and who are in full control of their play. Conversely, the principal costs generated by a gambling sector are viewed as deriving from the harm experienced by gamblers (and their families) whose play is chronically or episodically out of control. In major reports on Australian gambling in 1999 and 2010, the Australian Productivity Commission attempted to compare the monetised benefits and costs generated by each sector of the industry and found that, while for most sectors benefit very comfortably exceeded cost, the net benefit was fairly marginal in the case of machine gaming.[8] No similar studies have been conducted for machine gaming in Great Britain.[9]

Such studies are instructive to the extent that they provide templates regarding the nature of benefits and costs to be considered. On the other hand, the task here is different. The policy and research question that this project examines is not whether B1 machines are a 'good' or a 'bad' thing *per se* but whether, on the margin, there have been significant *changes* to the benefits or costs because of the change in stake and prize limits.

In order to better understand the expected costs and benefits arising from the change in stakes and prizes, we reviewed the Government statements in the Impact Assessment and the submissions from groups responding to the public Consultation. This enabled us to identify what benefits and costs various parties identified as likely to follow from the proposed variation in regulations for category B1 machines.

For Government, the principal benefit appeared to be in the stimulus the changes would give to the industry. Its Impact Statement argued that "access to higher stakes and prize gaming machines can support growth in the casino sector" (para. 74). Further, "Increases [in stake and prize limits] for B1 machines would offer a suitable inducement to develop new products".

That said, the Impact Statement quoted industry estimates that enhancement of stake and prize limits to the extent subsequently implemented would lead to an increase of just 5% in its revenue from B1 machines (para. 105). If this seemingly ad hoc prediction was accurate, it might be hard to detect this impact in any comparison of pre- and post-

[8] Australian Productivity Commission, *Australia's Gambling Industries*, Report No. 10, 1999 (Canberra: AusInfo); Australian Productivity Commission, *Gambling. Inquiry Report No. 50*, 2010 (Melbourne: Australian Productivity Commission).

[9] It might be noted that in most Australian states, high stakes machine gaming outside casinos (in hotels and social clubs) is widely available, which it is not the case in Great Britain.

implementation data. Over the preceding two year period, summary data published by the Gambling Commission had shown an annualised rate of growth of B1 revenue of 3.54%, so the industry's expected boost to revenue was of the order of magnitude of annual changes recently experienced in the industry under a constant regulatory regime.

To explore further the possible impact on the industry itself, we conducted in-depth interviews with key industry stakeholders shortly after the new stake and prize regime had begun to be implemented. In these interviews (about which further information is presented in Appendix A), casino industry operators stated that, consistent with their expectations, there had been, at least until then, only a modest increase in stakes following conversion.[10] One operator noted that average stake in its machines had been only £0.80 before the changes, indicating that typical machine users were not strongly constrained by the old regulations (that is, the 80p average stake was well below the maximum level of £2). It could also be noted that consumer response to changes might be muted because the twenty machines permitted in most casinos are often fully in use at busy times, so what can be observed in terms of volume of transactions may not represent completely the true level of consumer demand.

In any case, economists might be sceptical over whether growth in net revenue *per se* should be counted as a beneficial outcome. Forrest (2013)[11] argued that permitting growth in the gambling industry creates no additional long-run output or employment for the economy because extra spending on gambling products is likely simply to displace an equal volume of spending on other goods and services, such as alternative entertainments. The Australian Productivity Commission (2010) took the same view.[12] Rather economists would evaluate the benefit of looser regulation as consisting of the extra consumption value that players would be able to derive from playing machines.

Many current players are unconstrained by the restriction on stakes and prizes because, even given the choice, they would wish to play only within the current limit on the size of a single bet. They are likely to be made neither better nor worse off by a relaxation of the limits. But other players are constrained by, say, a limit of £2 per spin. For example, they would prefer to include some higher bets within their pattern of play to get more

[10] One view was that the increase in stakes had been mainly confined to machines which had been converted to enable participation in new linked jackpots. If this were so, it would indicate that the new option permitted for the first time, to play for an exceptional jackpot (£20,000) with a very low probability of winning, was particularly exciting to some players.

[11] D. Forrest, 'An economic and social review of gambling in Great Britain' (commissioned by The Responsible Gambling Trust), *Journal of Gambling Business and Economics*, 7: 1-33.

[12] "The gambling industries do not create net employment benefits, because they divert employment from one part of the economy to another", Australian Productivity Commission, *Gambling. Inquiry Report No. 50*, 2010 (Melbourne: Australian Productivity Commission), p. 6.1.

excitement: they might find it thrilling and stimulating to gamble from time to time for a higher prize with a higher stake. When they are given the opportunity to choose from a wider range of stake/ prize/ odds options, they will choose some spins above the old staking limit. They may indeed then find the whole experience more satisfying than before and therefore subsequently they (and perhaps even some former tables-only players who will include machines in their casino experience whereas previously the prizes were too small to interest them) may spend more money and time on machine gaming in casinos. Their increased satisfaction may then be signalled by an increase in the net revenue of casinos. Growth in the sector after implementation of the higher limits could then be regarded as indicative of a socially beneficial impact even though extra revenue for casinos is not in itself to be regarded as a benefit (because it may be at the cost of the revenue of other businesses).

But of course not all consumers of the product can be regarded as 'rational' and capable of maximising their own wellbeing within the constraints of their budgets. Gambling is a risky activity in more than one sense because a proportion of players in fact lose control over their consumption to such an extent that they cause harm to themselves and to their families. In the Consultation, many submissions, particularly from faith groups, opposed uplift of stake and prize limits because they thought it risked increasing the harm linked to machine play. For example, Quaker Action on Alcohol and Drugs "strongly disagreed" with permitting higher stakes play, arguing that it would lead to people losing money more quickly and consequently that it would be inconsistent with the third Licensing Objective of the Gambling Commission, which is to protect the vulnerable.[13] In its submission, the Salvation Army implicitly argued for the exercise of the precautionary principle: "In practice, they [above-inflation increases in stake and prize limits] would only be acceptable if detailed research had shown that there was no danger of them leading to an increase in problem gambling". As noted above, there was insufficient research evidence at the time to rule out this danger and the Salvation Army therefore concluded that the existing regulations should remain in place.

The lack of research evidence on whether stake and prize limits mitigate harm is striking. Williams, West & Simpson (2012) produced a comprehensive survey[14] of policies to prevent and mitigate problem gambling, commissioned by the Ontario Problem Gambling Research Centre and the Ontario Ministry of Health and Long Term Care. Their Report runs to 133 pages; but the literature is so sparse that the section evaluating the

[13] One possible mechanism, investigated in a laboratory setting by Parke et al., is that higher stakes may facilitate loss-chasing behaviour as a player tries to win back what he or she has lost by placing a higher bet (A. Parke, A. Harris, J. Parke & P. Goddard, 'Understanding Within-Session Loss-Chasing: An Experimental Investigation of the Impact of Stake Size on Cognitive Control', *Journal of Gambling Studies*, in press, DOI 10.1007/s10899-015-9570-x.

[14] R.J. Williams, B.L. West & R.I. Simpson, *Prevention of Problem Gambling: A Comprehensive Review of the Evidence and Identified Best Practices*, October, 2012, http://hdl.handle.net/10133/3121

effectiveness of limiting stakes and prizes (in any form of gambling) occupies only a few lines more than a single page. They confirm that "*little formal research has been conducted on this issue*" though they make the general observation that stake limits in Europe are more common and lower than in the rest of the World and that problem gambling rates are also lower in Europe. This is somewhat informal evidence but is at least consistent with limits playing a protective role. In their survey, Parke and Parke (2013)[15] note evidence that higher staking behaviour is to an extent correlated with problem gambling status. Again this is suggestive that stake limits impose a stronger constraint on the spending of problem compared with non-problem gamblers.

Few previous studies have gathered direct evidence by looking at the consequences of 'real world' changes in stake and prize limits on gaming machine play. Nichols (1998)[16] published an econometric analysis of the impact of the total removal of the limit (which had been $5) on machine stakes in Iowa riverboat casinos. Admissions increased by nearly 14% in the first year following deregulation and casino win per admission by nearly $6. Together, these figures indicated that the bulk of the additional casino revenue generated derived from spend per visit rather than extra visits. However, it was difficult to tease out precisely the extent to which these changes resulted from the removal of stake limits rather than the other deregulatory change introduced simultaneously, namely the removal of the requirement that the boats sail rather than stay dockside.

There is thus little precedent for carrying out the present assessment of the impact of the uplift of stake and prize limits on gaming machines in 2014. Nor is there firm guidance in the literature as to what findings to expect. With an industry commitment to supply data, as urged by Government, we envisioned that it was likely to be relatively easy to establish the extent of any increase in industry revenue. However, were there to be an increase in revenue, it was likely to be difficult or impossible to separate out how much of the increase came from 'safe' gamblers willing to spend more because the product was now more entertaining and how much from those whose gambling was harmful to themselves or others. Of course, what was feasible to hope to achieve would be determined by what data the industry was able to supply.

1.3 Nature of the data

Representatives of the industry expressed a willingness to cooperate with the project, which essentially was to involve statistical analysis of industry-held data to compare

[15] J. Parke & A. Parke, 'Does size really matter? A review of the role of stake and prize levels in relation to gambling-related harm' (commissioned by The Responsible Gambling Trust), *Journal of Gambling Business and Economics*, 7: 77-110.

[16] M.W. Nichols, 'Deregulation and cross-border substitution in Iowa's riverboat gambling industry', *Journal of Gambling Studies*, 14: 151-172.

various metrics before and after implementation of the new limits on stake and prize levels. We considered three types of data set which might potentially be analysed within the project.

- *Casino-level data*. These show for each period (for example, each week) and for each casino what the aggregate figures were for such as total B1 stakes, total casino win from B1 machines, total number of plays (spins) on B1 machines. In case changes induced a shift from table games to machines once the machine product was revamped, it was also desirable to have equivalent data for table games.

- *Transactional data*. These are extracted from each individual machine, which records all activity. The data are anonymous but algorithms developed in the industry aim to split play into 'proxy sessions' by different users. Algorithms seek to identify the point at which a new user begins to play the machine from criteria including the starting balance, the amount of money put into the machine and the length of time for which no activity is recorded on the machine. Thus it might be possible to explore whether such metrics as average length of session or amount staked per session changed between the pre- and post-implementation periods.

- *Tracked data*. These relate to periods of play which can be linked to particular players because a player 'loyalty' card is inserted in the machine. Such data have the advantage that they allow changes in behaviour to be examined for a fixed population of players. For example, one could then distinguish between an increase in casino revenue associated with more frequent visits and an increase associated with more spend per visit.

Of these, it was envisioned that the first type of data would be relatively straightforward to obtain. However, the size and complexity of transactional and tracked data sets were such that we judged that it was impractical to use both types of data from each casino operator if the project was to be completed in a timely fashion and within the limit of resources agreed by The Responsible Gambling Trust. For example, two of the research team had already begun a separate study for The Trust (due to be completed in 2016) which used tracked data from one operator, Rank. Considerable investment had been necessary to understand the ways in which the data were organised, to clean the dataset (which contained many anomalies[17]) and to put it into a format where it could be interrogated using statistical techniques. The Rank tracked data set was over 28 million rows with tens of columns. Further, an earlier Data Scoping Study[18] had ascertained that there was

[17] For discussion, see Section 3.2 below.

[18]H. Wardle, C. Seabury, H. Ahmed & C. Coshall, *Scoping the Use of Industry Data on Category B Gaming Machines*, December, 2013, London: NatCen Social Research.

considerable heterogeneity across operators in the organisation and level of detail of the data they archived. Therefore it would require substantial resources to prepare a (very large) data set for each operator and the subsequent analysis would have to be conducted separately for each, given they followed different conventions and recorded play to different levels of granularity.

With all these considerations in mind, it was decided, in consultation with The Trust, to limit the present project to the analysis of casino-level data and tracked data from one operator. It was judged that use of the resources required to prepare and analyse transactional data could not be justified. Given that the data were anonymous, it appeared unlikely that transactional data would add significant value if both the other two types of data were used and it would also be necessary to carry out a separate validation of the accuracy with which the algorithms in use had defined proxy sessions of play.

Because members of the research team already had experience of working with Rank data it was decided to focus on the impact of change at this particular operator. Rank seems likely to be representative of the industry. First, it accounts for a large part of the industry, with a market share of about 40% of both venues and revenue. Its estate is fairly evenly distributed geographically and encompasses venues of various types- in city centres, other city areas, suburbs, leisure complexes, etc. We therefore found no reason to expect its customers to respond to the change in regulation in any different fashion from casino patrons generally though we would not expect findings necessarily to be applicable to the two post-Gambling Act (2005) 'large casinos' operating in 2014 or to a few high-end London venues (which do not always have machines in any case). However, as a precaution, we explored observed responses to the regulatory change according to broad casino type (city centre, etc) to form a judgement on whether or how results for other operators might be different because their estates had different mixes of casino type.

The employment of tracked data in preference to transactional data can be justified by their greater reliability in defining player sessions (since play is linked to the card in the machine) and by the fact that we know at least something about each player from the records of the loyalty card scheme (age, gender, residential location from postcode). In contrast to transactional data, differential response by different demographic groups may therefore be explored.

On the other hand, the question must be asked whether the behaviour of players whose gambling is tracked is likely to be adequately representative of the behaviour of all players. This question was also relevant to the research on B2 machines in bookmaker offices, published by The Responsible Gambling Trust in December, 2013. On one level, the problem appears less acute in the case of machine users in casinos. Until the provisions of the Gambling Act (2005) came into force, British casinos were members-only establishments and the culture of issuing player cards and requiring them for entry

continues till now at Rank and some other operators (with the difference that player cards can now be issued with immediate validity whereas there was a waiting period when membership was a legal requirement). Thus, the take-up of player cards is not an issue as it is in the bookmaker sector. However, their use is. Players do not have to use their card to play machine or table games. They may choose not to bother (or even to lend their card to others) because they are insufficiently incentivised by the rewards offered on the loyalty card programme.[19] Therefore the players who select to use loyalty cards may not be a representative sample of all players and, for any individual player, sessions of play where the card is used may not be representative of all his or her sessions during the period.

This issue is hard to address. However, we examined weekly measures of B1 activity aggregated across all sessions where a player card was used and compared them with measures of weekly activity taken directly from casino-level data. We found that the two measures were fairly highly correlated, i.e. the series of B1 activity recorded from player cards tracked quite well the series of total B1 activity recorded at the casino level.[20] This encourages us to trust that analysing tracked data has value in, for example, examining whether trends in play after the policy intervention were different between demographic groups.

1.4 Limitations of the data

The casino-level data permit identification of trends in such series as amount staked and the number of spins (and, from these two, mean stake per spin). The tracked data permit behaviour to be analysed at the individual level to see, for example, whether all demographic groups followed the same trends or whether heavy users of B1 machines responded to regulatory change differently from lighter users or whether patrons of city centre casinos were different from players at suburban venues. However, there are some questions which the data cannot answer.

First, the tracked data are not captured at the atomic level. There is no record at the level of the individual play (spin) on the machine. Rather the player card records activity (amount staked, amount won or lost, number of spins) aggregated across a 'rating period' which may be something like 15 or 20 minutes (or on occasion much shorter since removing the card from the machine defines the end of the last rating period, which may have only just begun). It is impossible then to identify staking patterns or the distribution of bet sizes.

[19] The loyalty card programme at Grosvenor casinos (Rank's brand name in the sector) is known as 'Play Points'. Points are given for spending on slots or table games at any casino in the Group or at its online operation (also for food and beverage spending). Accumulated points can be converted to vouchers for use in the casino or used to 'purchase' electronic goods from a catalogue. Details of the programme and levels of reward are given at secure.grosvenorcasinos.com/play-points

[20] Details are presented in Section 3.1 below.

For example, five spins at £2 over the rating period will register the same as four spins at £1.25 plus one at £5. It is therefore possible to investigate the spending rate for a particular player but not to investigate the distribution of stake sizes.

Second, there is insufficient information about individual players to permit a separation of any growth in casino revenue into growth attributable to 'safe' (recreational/ responsible) gambling and growth attributable to gambling which causes harm. This is in contrast to earlier research for The Trust on B2 machines in bookmaker offices. For part of that research, operators permitted and facilitated a sample of tracked players to be screened for problem gambling (where the researchers then took problem gambler status as a proxy for harmful play). Researchers were then able to search for different patterns of play indicative of either safe or harmful gambling.

In the present case, great policy insight relevant to the next Triennial Review could be derived were it possible to look separately at the impacts of the elevation of stake and prize limits on non-problem and problem-gamblers respectively. However, we do not know which individuals in the data set experience gambling problems and harm and which do not.

Despite the constraints imposed by the data so that we did not know whether an individual suffered from problem gambling, we were hopeful that by using personal details of the players, insight could still be made into which 'type' of player was most affected by the change to prize and stake limits. The personal details on each player available in the data set were age, gender and postcode. Linking postcode to geo-spatial databases, something could also be inferred about the neighbourhood in which an individual lived, for example the level of deprivation in its population (and also, of course, distance from home to casino). With this information set, it was possible to examine, for example, response in total spend or total time playing machines for different sub-groups. This might give indirect ground for concern over the consequences of the new policy regime. For example, suppose those who responded most strongly in terms of spending were young males resident in the most deprived areas. From the *British Gambling Prevalence Survey* and numerous other sources, it is known that young age, male gender and residence in a deprived area are all risk factors for problem gambling. Individuals in the populations described by these risk factors are disproportionately likely to be problem gamblers. Therefore, *if*, for example, casino revenue increased but most of the increase came from the young, the male, and those from deprived areas, then one might say there was a cause for concern. It would be suggestive rather than definitive evidence but might be considered sufficient reason to invoke the precautionary principle when deciding on any relaxation of limits proposed in the future.

2 Analysis of casino-level data

2.1 Data available

Rank Group plc provided us with a weekly time series of principal financial data for individual casinos in its estate between the first week of February, 2013 and the first week of November, 2014. However, for several venues, all 2013 data were missing. And, for one casino with complete date coverage, one relevant financial series was missing. In this chapter, we analyse data only from the sub-sample of 23 (out of 36) casinos for which complete information had been supplied. These casinos were located as follows: Aberdeen, Birmingham, Blackpool, Bolton, Brighton, Bristol, Cardiff, Coventry, Didsbury, Dundee, Gloucester Road (London), Leeds, Luton, Newcastle, Piccadilly (London), Plymouth, Portsmouth Gunwharf, Portsmouth Osborne Road, Salford, Sheffield, Southampton, Stockton, Thanet and Walsall. Remaining casinos in the Rank estate were included in the analysis of tracked data presented in Chapter 3 below and are therefore still considered in this Report.

Data related to each product type available in the casinos: table games, e-roulette[21], B1 machines and food and beverage.[22] For B1 machines, the weekly record included the total number of spins on B1 machines in the particular casino, the total amount staked, and the house win (gross gaming revenue). The range of dates for which the weekly series were available covered approximately twelve months under the old regulatory regime and approximately seven months post-intervention. It should therefore be possible to test from the data whether and to what extent players' behaviour in the aggregate changed in the relatively short-run but of course it cannot be ruled out that further changes would occur in the longer-term, not only as new habits are ingrained in consumers but also as the industry revamps games to take full advantage of the loosened constraints on stakes and prizes.[23]

[21] E-roulette refers to playing live games taking place at tables in the casino but through machines available elsewhere on the casino floor. These machines are not categorised as gaming machines under the Gambling Act (2005) because they are just an alternative way of accessing table games within the casino. It may be speculated that they attract, amongst others, a different type of customer who desires a more private experience than that associated with playing at the table itself.

[22] Blackpool offered four B3 machines but the financial data for this additional product was not used in our study given the revenue flows were marginal and only one casino was involved.

[23] Nichols, in his study of the lifting of staking limits in Iowa (see footnote 16 above), indeed found that revenues moved upwards beyond the first year after deregulation. However, the bulk of the effect was in fact observed within the first few months.

2.2 Detecting structural change

At any given casino, the data series display considerable volatility from week to week and this will be partly due to local factors such as events taking place in the city. But, even when aggregating over all 23 casinos, each data series remains very variable. This makes it difficult to be confident of detecting from visual inspection whether any apparent changes coincided with a particular intervention. But formal statistical analysis has the potential to be able to help resolve any ambiguities.

We used first techniques for detecting structural breaks in a time series and estimating the times at which they occurred. The process of detection here does not depend on the researcher imposing dates when the researcher has reason to believe that there was a structural break: the data are allowed to speak for themselves. By contrast, when regression analysis is employed in an 'event study', it can test whether a variable of interest is predicted to take on different values either side of a pre-specified event, taking into account various other influences such as, in our case, what sort of casino we are dealing with and the characteristics of the population it serves. The two statistical tools are complementary. A regression event study can potentially address more questions but could produce spurious results if, for example, the analyst imposed on the model a single shock occurring at a particular date when in fact there were multiple shocks occurring across the time period of the data. This would bias results on the estimated impact from the shock of interest. Therefore, before presenting regression results, we report on our structural break analysis, which was designed to test for structural breaks in the means and variance of the variables of interest.

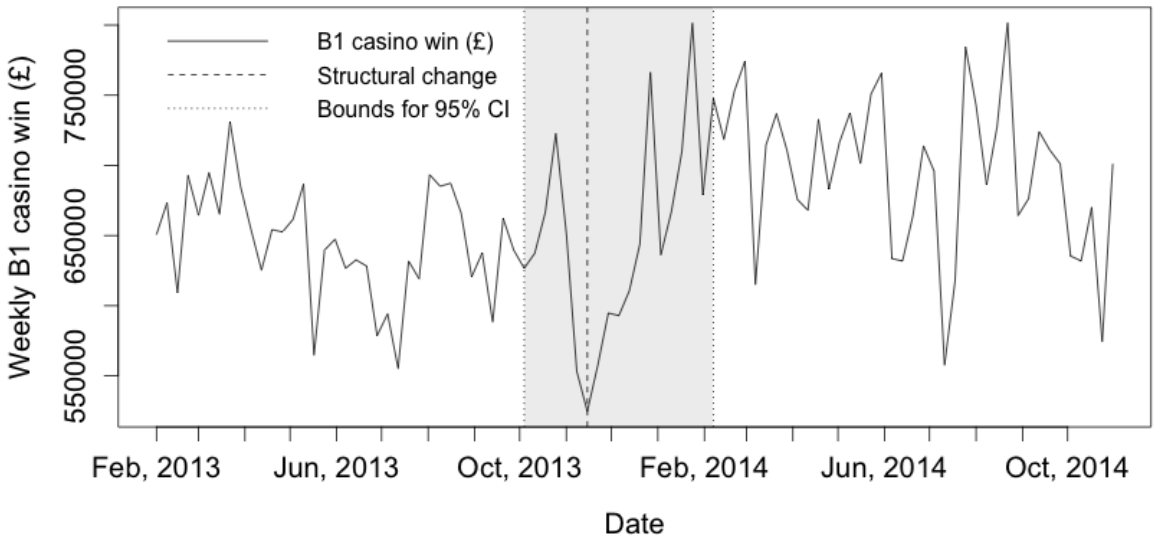
Figure 2.1 plots weekly aggregate house win from B1 machines across 23 casinos between February, 2013 and November, 2014. Analysis was conducted in R software to identify any structural break(s) in the series.[24] Just one structural break was identified and, in Figure 2.1, the shaded area between vertical bars marks the 95% confidence interval for the date at which the structural break occurred. This result suggests that we can be confident of a structural break having occurred in the interval between week commencing October 7, 2013 and week commencing February 10, 2014. This includes the period when

[24] The functions used in R to estimate the break-points implement the algorithm described by Bai & Perron (2003) for simultaneous estimation of multiple break-points. The distribution function used for the confidence intervals for the break-points is given by Bai (1997). The ideas behind this implementation are described by Zeileis et al. (2003).

See: J. Bai & P. Perron, 'Computation and analysis of multiple structural change models, *Journal of Applied Econometrics*, 18: 1-22; J. Bai, 'Estimation of a change point in multiple regression models', *Review of Economics and Statistics*, 79: 551-563; A. Zeileis, C. Kleiber, W. Krämer, & K. Hornik 'Testing and dating of structural changes in practice, *Computational Statistics and Data Analysis*, 44: 109-123.

the machines were adjusted in line with the relaxation in regulation. Of course in this case, the structural break is identified somewhat imprecisely in terms of the width of the band of weeks to which a structural break is assigned. This imprecision reflects high volatility in the data series. For example, there was a dip in casino revenue in mid-November, 2013 and it is hard to distinguish whether increases in revenue subsequent to the deregulation event in January, 2014 represent a switch to a new regime or continue an upward trend originating in late November, after the dip.

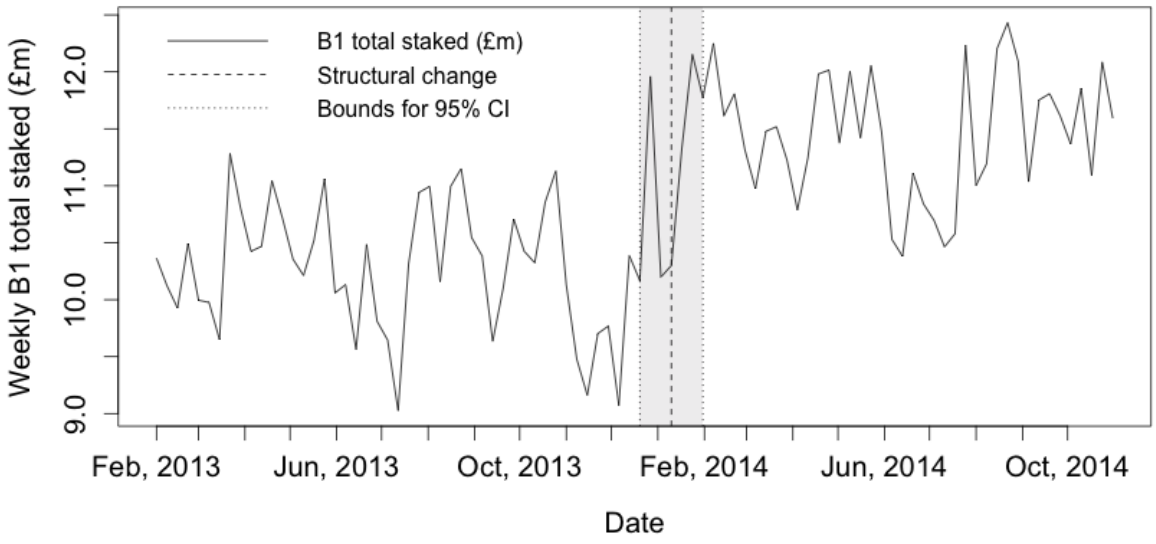
Figure 2.1: Weekly casino win from B1 machines



In view of the potential influence of the observations around the exceptional dip in the series in November, 2013, we asked Rank whether it was aware of any special situation which may have been responsible for the very unusually low revenue from B1 machines. We were informed that the dip was real in that it was not a spurious event associated with faulty recording of activity, nor was it a seasonal effect observed every year. Rather, management believed it to be the result of a computer malfunction which had prevented marketing material, containing offers and promotions, being sent out to customers in the preceding few weeks (about one month). This break in the stream of marketing material was evidently costly for the company. For us, it compromises the identification of the timing of the structural break indicated by the analysis. Intuitively, the problem is that the process of recovery from the effects of the marketing failure become hard to separate out from the effects of the uplift of stakes and prizes shortly afterwards. To help clarify what is going on, we concluded that regression analysis, in the form of an event study, would be valuable since the model specification could allow for exceptional factors driving low activity during a month of observations in late 2013, yet still detect, and measure, any change in the level of casino win associated with the uplift in stakes and prizes.

Figure 2.2 presents the time series for another key statistic, the weekly amount staked in B1 machines in the 23 casinos. Again the confidence interval for the single structural break identified is marked by shading between vertical lines. This time the timing is estimated with somewhat more precision albeit that the confidence interval again appears to have been widened so that it includes part of the recovery in activity after the marketing disruption in November: the confidence interval is bounded by December 23, 2013 and February 3, 2014. The changeover weeks for the machines in the Rank estate were weeks commencing January 20 and January 27. The data are therefore consistent with there being a structural break coincident with the increase in stake and prize limits being implemented. Visual inspection of the chart suggests that, while the series remained volatile week-to-week, there is indeed a strong tendency for the amount staked to be higher after the regulatory change compared with before the regulatory change. For example, the weeks of peak activity post-intervention saw more than £1m extra staked compared with peak weeks pre-intervention.

Figure 2.2: Weekly amount staked in B1 machines



If there was an increase in amount staked in B1 machines, the question arises whether the origin of the increase lay in players making more bets or in an increase in the size of the average bet (or both). Figure 2.3 plots the number of spins recorded on B1 machines across the 23 casinos week-by-week through the study period. This time there is no structural break marked on the chart and this is because none was identified as statistically significant.

If there was no clear-cut tendency for customers to buy more spins after the regime change, yet they clearly staked more, then one might reasonably expect to detect a structural break in the series representing mean stake per spin. Figure 2.4 plots the week-

by-week evolution of the statistic 'mean stake per spin'. A single structural break is identified and the 95% confidence interval extends across only three weeks from week commencing January 6, 2014

Figure 2.3: Weekly number of spins on B1 machines

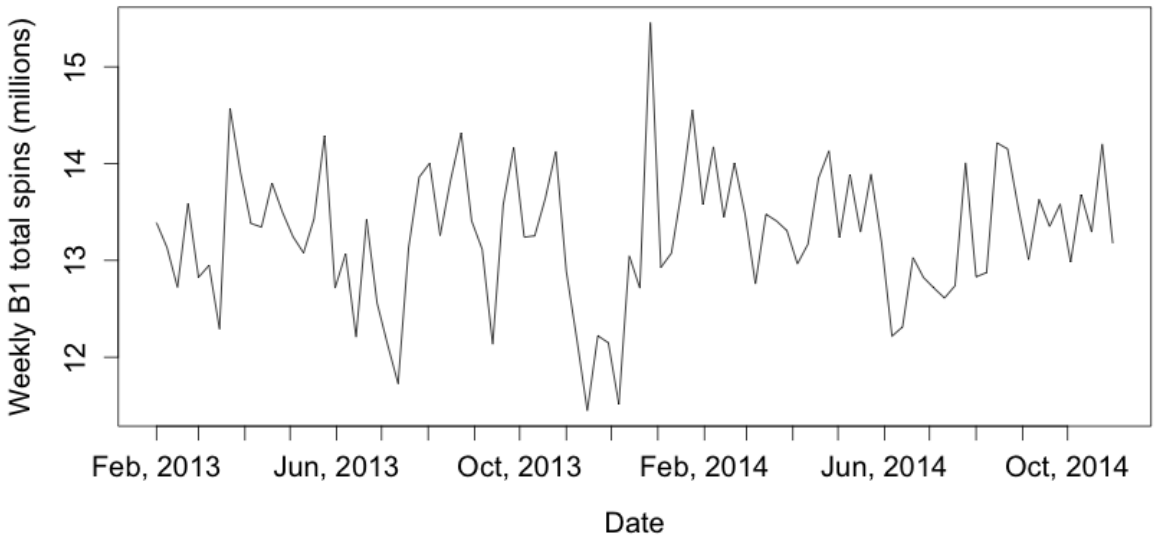
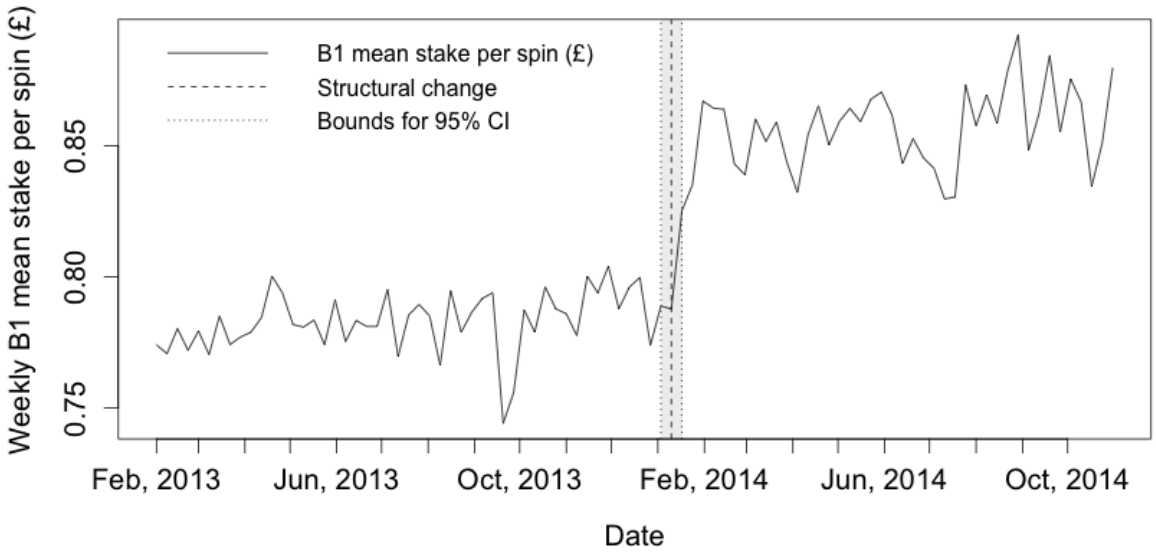


Figure 2.4: Mean stake per spin



to week commencing January 20, 2014. This period includes the first week of the operation to convert B1 machines in Rank casinos and by the end of that week many customers will have had the freedom to play for higher stakes. The very steep increase in mean stake size in week commencing January 27, 2014 is very clearly evident in the plot.

Analysing key indicators of B1 activity, this section has asked whether something happened to behaviour when the change in stake and prize limits was implemented in Rank casinos. Something indeed seems to have happened; but this broad-brush approach does not allow us to detect, for example, whether behavioural change was restricted to, or more marked in, particular types of casino. Regression analyses permit richer conclusions to be drawn. Their use is further validated by our analysis of the structural breaks as only one significant structural break was found in any of the time-series. This permits the data period to be split cleanly between 'before' and 'after' implementation as in classic 'event studies' (though in this case with the complication that a five-week period pre-event will have to be specified as subject to exceptional circumstances, the failure in the marketing system). Had multiple structural breaks been identified, this would have represented a mis-specification which would bias results.

2.3 Regression analysis

2.3.1 Developing the regression models

We have *panel data*, which is to say that there is an observation for each entity (in this case a casino) at each of a sequence of time points (in this case, the 92 weeks between February, 2013 and November, 2014). The number of observations on each variable was 2,116 (23 casinos at each of 92 time points). One of these observations (for one particular week at the Gloucester Road casino) was discarded because of very implausible figures which were inconsistent with each other. Thus the final modelling used 2,115 observations on each variable of interest.

The following regression equations were estimated to explore variation in each measure by a range of factors, including implementation of the change in stakes and prizes:

- Variations in house win on B1 gaming machines
- Variations in amount staked on B1 gaming machines
- Variations in the number of spins on B1 gaming machines
- Variations in mean stake per spin on B1 gaming machines.

Such variation was hypothesised to depend on characteristics of the casino in question *and* on the date of the observation (whether it was before or after the regulatory change).[25] This

[25] Standard tests failed to reveal a seasonal pattern in the data and therefore modelling made no adjustment for time of year. However, a weakness of the data set was that the final weeks of the year are represented only once (2013). To guard against the possibility of potential skewing of results, we re-estimated all the models below with observations from December, 2013 omitted from the analysis. In fact, this made no material difference to the results we report.

is the format of a classic 'event study' where the presence of a new regime is indicated in the data by a binary variable set equal to 1 (and 0 where the new regime is not in place). Such a variable is commonly termed a *dummy variable* (or by some writers an *indicator variable*). The label we give to this particular dummy variable is *post-implementation*. The dummy variable here is 'turned on' from week commencing February 3, 2015, when the new stakes and prizes were available across the whole Rank estate.

B1 machines required manual adjustment (rather than being modified from a central server), so that the programme to adjust the machines extended over two weeks (from January 20th, 2014). We call this two-week period the *transition* and in the data it is represented by its own dummy variable which takes the value 1 for those two weeks and zero otherwise. The purpose of defining the transition period separately in the regression models is to prevent distortion of the comparison between activity before and after the changes made to the machines. Essentially, turbulence in the data over these two weeks is captured by the extra variable and does not therefore affect the influence the other variables are estimated to have. It would be misplaced to hope that the coefficient estimate on the transition variable would be able to capture precisely the immediate reaction of players in the casino when the machines had just been adjusted. For example, in the accounting period (week) during which the changeover took place at a casino, stakes recorded as having been placed in B1 machines will have been placed on a mixture of old and new machines as available on different days. One could not therefore isolate any first day effect from a new product feature (higher stake games) appearing. Nevertheless, it would not be surprising if there were a spike in amounts staked during the transition if players experimented by trying out the new options to stake up to £5 and to use linked machines with the possibility of a £20,000 jackpot win.

We also define a period of five weeks in late 2013 when, as noted above, activity was affected by disruption to the sending out of promotional material. In the models, a dummy variable, which we term *marketing disruption*, is set equal to 1 for all observations relating to these five time points and to 0 otherwise.

The statistical model we employ is a *linear mixed model*. This is a form of *regression*. An equation is estimated which best 'explains' the relationship between the variable of interest (e.g. amount staked) and a set of 'explanatory' variables such as casino type and, most notably here, to the 'switching on' of the dummy variable *post-implementation*, which changes from 0 to 1 when the new stake and prize limits are in place.

Other factors potentially driving a measure such as the amount staked in casino i at time point t include what type of casino it is (e.g. city centre or suburban) and whether it is

close to another casino or close to a bingo hall.[26] It is possible to account for the influence of such factors by adding dummy variables to the model directly to represent the characteristics of each casino. We defined a set of variables which we suspected might make a difference to the amount staked (and other measures of activity to be explored). All these are set out and explained in Box 2.1.

But, even where two casinos are apparently very similar in terms of what is readily observed and measured, there will remain idiosyncratic differences which mean that some venues consistently operate on a bigger or smaller scale of activity compared with the average. In the linear mixed model, this *unobserved heterogeneity* is taken into account through including *random effects* in the model, so that the 'prediction' for each casino at each time point is 'calibrated' to take account of the extent to which it generally operates at a higher or lower level of activity than the average casino for reasons other than those represented by known factors such as casino type. In terms of the equation, each casino has its own constant term (*intercept*). The intercept shown in the results tables gives the baseline forecast for the *average* casino before the influence of the other variables is added.

Each explanatory variable in the regression equation is matched by a corresponding *interaction term* which is equal to the value of the variable itself multiplied by (in this case) the dummy variable *post-implementation*. This interaction term will capture differential response to the switchover to the new regime in a particular type of casino. For example, suppose we estimated the equation for amount staked per week. Suppose the coefficient estimate on *suburban* were positive and the coefficient estimate on the interaction term *suburban*post-implementation* were also positive. This would have the following interpretation:

> Before implementation, relative to the baseline casino (which we have taken as one in a city centre), a suburban casino was expected to generate higher turnover, by the amount of the coefficient estimate on *suburban*. After implementation, the difference associated with a casino being suburban would change by an amount equal to the coefficient estimate on the interaction term *suburban*post-implementation*. In this case, the result would imply that the differential between suburban and city centre casinos became wider after implementation. To put it another way, customers of suburban casinos would have reacted disproportionately strongly to the changes in terms of the amount they staked in B1 machines.

[26] Bingo halls and other casinos represent potential alternatives to the subject casino in that they are destination gambling-specific venues offering machine gaming (often, in the case of bingo halls, with several times the number of machines permitted in the casino). Ambient gambling opportunities are ubiquitous in urban Britain and gaming machines are also available in bookmaker shops and public houses. These are so commonplace that it would be unrealistic to characterise different casinos as facing different degrees of competition from machines in non-gambling-specific premises and therefore the model focuses only on the proximity of bingo halls and casinos.

Box 2.1. The casino-level statistical model

We present models to 'explain' various metrics such as: amount staked in casino *i* in week *t*. The focus of interest is on whether implementation of higher stakes and prizes changed the amount staked in a casino. We divided the data into four periods:

base period- week commencing February 4, 2013 to week commencing January 13, 2014 (but excluding the

marketing disruption period, from week commencing November 11, 2013 to week commencing December 9, 2013)

transition- weeks commencing January 20 and 27, 2014

post-implementation- week commencing February 3, 2014 to week commencing November 3, 2014

In testing for the effects of implementation, we sought to allow for the possibility that there might be systematic differences in player behaviour and in levels of activity at different types of casino location and indeed for the possibility that there would be a different impact from changes in staking limit according to casino typology.

First, we distinguished categories of casinos according to location, creating the following mutually exclusive groups:

city centre - whether the casino is in the central part of a city (e.g. Birmingham, Brighton)

city area – whether the casino is in a city but not the central part, more periphery to the city (Dundee, Newcastle)

suburban – whether the casino is in a more suburban area (e.g., Didsbury).

A dummy variable was created for each of these categories to signify into which category a casino fell. The resulting binary variables *city area* and *suburban* were then added to the equation to be estimated. This then shows whether and how much adjustment should be made to the value of the 'explained' variable (e.g. amount staked in the week) if the particular casino of interest belongs to either of these categories rather than to the default category which we chose to be *city centre*. Necessarily there was an element of subjectivity in assignment of venues between these three categories; but the task was approached carefully and included visual inspection of areas around each casino on Google Earth.

Other dummy variables represented other locational characteristics of a casino:

leisure complex- dummy variable =1 if the casino is in a centre with facilities such as a cinema, shops and chain restaurants

near bingo- dummy variable=1 if the casino is within 100m of a bingo hall (usually a Mecca hall, another Rank brand)

near another casino- dummy variable=1 if the casino is within 100m of another casino.

Further variables were included to represent the area the casino served:

pop density: number of persons per hectare in the area around the point defined by the postcode of the casino.

deprived- a dummy variable set equal to 1 if the casino was located in the top three deciles (top 30%) of Census 'Lower Super Output Areas' ranked according to level of deprivation. This is measured by the Index of Multiple Deprivation which takes into account local area statistics reflecting factors such as incomes, employment, educational achievement and health. In allocating casinos to the most deprived 30% of areas, no account was taken of the fact that indices for England, Scotland and Wales are calculated slightly differently from each other.

In initial modelling, all these explanatory variables were accompanied in the model by interaction terms equal to the value of the variable multiplied by the value of *post-implementation*. For example, in the case of *deprived*, the interaction term is 1 if the casino is in a deprived area and the week of the observation is post-implementation (and otherwise its value is 0).

We adopted a general-to-specific modelling strategy. For each model, we first estimated the equation with all the variables mentioned in Box 2.1 included. Then we deleted explanatory variables which were statistically non-significant (p>.10) and re-estimated. If other variables were then non-significant, they were deleted in their turn. The final results shown here therefore report modelling results after non-significant variables have been discarded.[27,28]

2.3.2 Regression results

House win

Table 2.1 presents the results from modelling the casino win from B1 machines. From another perspective of course, this is the customer loss from playing B1 machines. As in subsequent tables relating to number of spins and amount staked, the area density of population is an important control in predicting activity at a casino. This is to be expected since, to some extent, it proxies the size of the market which the casino serves.

Table 2.1: Regression results for house win (£) on B1 machines

Source: casino data

Variable	Co-efficient	Standard error	p-value
Time period:			
Marketing disruption (Nov 2014)	-3328.13	849.81	<0.001
Transition (Jan 2014)	4616.08	1297.53	<0.001
Post-implementation (Feb - Nov 2014)	1727.81	514.88	<0.001
Population density	89.24	30.79	0.003
Interaction terms:			
Post-implementation*near a bingo club	2665.87	989.50	0.007
Post-implementation*population density	23.45	8.88	0.008
Intercept	*25415.73*	*1640.04*	*<0.001*

[27] However, because *post-implementation* is our focus variable, we always retained it in the model and, for consistency we always retained *transition*.

[28] Technical note: all equations were estimated with a linear functional form. We experimented with adopting a log-linear specification (in which the 'explained' variable is expressed as a natural log) but this always gave inferior goodness-of-fit.

The coefficient estimates indicate highly statistically significant effects associated with the variables representing the *transition* and *post-implementation* periods.[29] During the transition two weeks, there was a substantial spike in the casinos' net revenue from machines that is the more striking given that, for most of the two weeks, not all machines were yet converted. House win increased by an additional £4,616 per week in the two week transition period. Possibly this indicates a tendency for short-term experimentation with what were then novel gaming opportunities. This high level of profitability for B1 machines was not sustained but there was still elevated activity under the new regime compared with the old regime.

Most variables representing casino locational characteristics do not appear in Table 2.1: this indicates that there was no statistically significant difference before or after the changes between, for example, city centre, city area and suburban casinos in the net revenue derived by the operator (controlling for population density). The exception is that, while the main variable indicating close proximity to a bingo hall is absent from the table (because it was statistically non-significant), the corresponding interaction term is present. Its negative sign indicates that, while there was no significant pre-implementation difference in revenue between casinos close to bingo halls (or to other casinos), the response to the uplift in stakes and prizes was less in the former group[30]. It is possible only to speculate on the reason for this finding. Bingo halls provide clients with access both to bingo games and to large numbers of slot machines. Some of these clients may be customers of both the bingo hall and the casino. Any tendency of the enhanced prize opportunities in the casino machines to attract them to spend more in the casino machines may have been dampened because they were tied to the bingo hall machines by their participation in main hall bingo enjoyed before or after play on the bingo hall slots.

To estimate the proportionate increase in house win at an average casino after implementation, we 'predicted' weekly house win for an average casino with *post-implementation* set equal first to 0 and then to 1. The variables representing the two exceptional periods (*transition* and *marketing disruption*) were set equal to zero and other variables to their mean values.

These calculations yielded our estimate that **the weekly B1 house win at an average casino was 7.1% higher following the uplift in maximum stakes and prizes**.

This is of the order of magnitude of the effect quoted as an industry estimate in the Government's Impact Statement, issued prior to authorising the uplift in maximum stakes and prizes (see footnote 6 above). The prediction was for a 5% increase in net-of-prizes

[29] The coefficient estimate on *marketing disruption* is also highly significant and indicates that, across our 23 casinos, the lack of support from sending customers promotional material cost more than £380,000 (over five weeks) in lost gross gaming revenue from B1 machines.

[30] Four of our 23 casinos were in close proximity to a bingo hall.

revenue. But there had been about 3.5% annualised growth in the two preceding years, so that, assuming this underlying growth had continued, the outcome from the uplift was very close to that which had been anticipated.

Amount staked

Regression results for the amount of money staked on B1 machines (per week) are shown in Table 2.2.

Table 2.2: Regression results for amount staked (£) on B1 machines

Source: casino data

Variable	Co-efficient	Standard error	p-value
Time period:			
Marketing disruption (Nov 2014)	-35693.70	6481.70	<0.001
Transition (Jan 2014)	58430.23	9896.57	<0.001
Post-implementation (Feb - Nov 2014)	42495.37	3930.20	<0.001
Population density	1518.77	491.21	0.002
Interaction terms:			
Post-implementation*near a bingo club	-31605.26	7593.08	<0.001
Post-implementation*population density	285.00	67.71	<0.001
Intercept	404033.75	26134.15	<0.001

It might be anticipated that the results on amount staked in a week would closely reflect those on house win. This was the case. There is the same spike in activity during the immediate period of changeover of machines to higher stake and prize limits (during the transition phase the amount staked on B1 machines increased by an additional £58,430 per week). Subsequently volume remains comfortably above that under the old regime, with an additional £51,516 staked per week at a casino located in an area with average population density.[31] Observed characteristics of casinos appear to have little influence on amount staked but the (four) casinos adjacent to bingo halls display less growth from implementation of the uplift than others. For them, the corresponding prediction of increase in amount staked has to be reduced (by £31,605) to £19,911.

[31] Derivation: the coefficient on *post-implementation* (42495.37) has to be adjusted by multiplying the coefficient on the population density interaction term (285) by the population density for the particular casino of interest. The average population density across the casinos is 31.65, so the increase for a hypothetical 'average' casino (not near a bingo hall) would be 42495.37 + (285 × 30.47) = 51,516.

To estimate the proportionate increase in amount staked at an average casino after implementation, we followed a similar procedure as before: we 'predicted' week B1 stakes for an average casino with *post-implementation* set equal first to 0 and then to 1. The variables representing the two exceptional periods (*transition* and *marketing disruption*) were set equal to zero and all other variables to their mean values.

These calculations yielded our estimate that **the weekly amount staked at an average casino was 10.2% higher following the uplift in maximum stakes and prizes**.

That the proportional increase in amount staked was higher than the proportional increase in house win might suggest that casinos became more 'generous' under the new regime. However, Rank has informed us that it initiated no changes in game parameters which would in themselves have changed the ratio of house win to amount staked. It is plausible therefore that the explanation lies in player behaviour.

In behavioural finance, there is the notion of the *house money effect*, which has been applied to analysing the behaviour of gamblers and other actors in financial markets.[32] The concept is that individuals are less inhibited in spending 'house money' which they have just gained than in spending their own money (their prior endowment). This would lead to a tendency to reinvest wins, in the case of slot machines to use winnings to play some more. However, both experimental and naturalistic evidence suggests that the house money effect diminishes with the size of the gain which has been made. And, beyond some size of win, the individual will not recycle any of his or her winnings but will leave the stage, retaining gains.

Following the uplift of maximum stakes and prizes, a proportion of jackpot wins were of a higher order of magnitude than any generated under the old regulatory restrictions. It is plausible that these 'bigger' wins may have been retained by the player, lowering the overall recycling rate of winnings. This would have produced a fall in the ratio of casino win to amount staked, consistent with what we report here. However, whether this explanation could be demonstrated empirically would require further investigation using additional data.

[32] See, for example, R.H. Thaler & E.J. Johnson (1990), 'Gambling with the house money and trying to break even: The effect of prior outcomes on risky choice', *Management Science*, 36: 643-660. For a recent application to online bettors, see N. Suhonen & J. Saastamoinen (2015), 'House money effect and break-even effect in individual gambling choices: Evidence from horse race betting', working paper, University of Eastern Finland, Joensuu.

Number of spins and stake-per-spin

The increase in amount staked per week must necessarily come from some combination of change in the number of plays on B1 machines and change in the average amount staked per play. From the raw data, it was evident that the increase in the number of spins was only marginal and that extra stakes derived mostly from higher stake per spin. Regression analysis enables us to check whether this pattern varied across various categories of casino.

Regression results for the weekly number of spins in a casino are shown in Table 2.3. The pattern is familiar- the marketing problem in late 2013 dented business significantly; there was a sharp spike in the number of spins during the transition fortnight and then a still elevated amount of B1 play post- (compared with pre-) implementation across the casino estate; and the increase in play was somewhat below average at casinos next to bingo halls. However, compared with previous results, there are also additional indications of differential impacts between casinos. Controlling for population density, suburban casinos appear to have exhibited a less than average increase in the amount of play (and casinos in leisure complexes an above-average increase in the amount of play), compared with the whole estate. But it also has to be taken into account that the population density interaction term takes a negative sign. Given that suburban areas typically have a lower population density, what are being picked up here are likely therefore to be idiosyncratic differences across the set of 23 casinos rather than any systematic tendency for customers to have responded differently in suburban and city locations.

Table 2.3: Regression results for number of spins on B1 machines

Source: casino data

Variable	Co-efficient	Standard error	p-value
Time period:			
Marketing disruption (Nov 2014)	-54274.32	7055.61	<0.001
Transition (Jan 2014)	36716.69	10772.84	<0.001
Post-implementation (Feb - Nov 2014)	11091.59	5596.46	0.047
Population density	1213.01	662.14	0.067
Interaction terms:			
Post-implementation*near a bingo club	-17604.89	8776.85	0.045
Post-implementation*population density	-241.87	76.51	0.002
Post-implementation*suburban	-15752.64	7060.41	0.026
Post-implementation*leisure complex	21153.98	6858.68	0.002
Intercept	539799.54	35223.54	<0.001

Any differences between casinos prove to be differences in what was in fact a very small response to the changes in maximum stakes and prizes. To estimate the proportionate increase in number of spins at an average casino after implementation, we followed a similar procedure as before: we 'predicted' number of spins for an average casino with *post-implementation* set equal first to 0 and then to 1. The variables representing the two exceptional periods (*transition* and *marketing disruption*) were set equal to zero and other variables to their mean values.

These calculations yielded our estimate that **the number of spins at an average casino was just 0.4% higher per week following the uplift in maximum stakes and prizes**.

Table 2.4 analyses the mean stake size (per spin).

Table 2.4: Regression results for mean stake per spin (£) on B1 machines

Source: casino data

Variable	Co-efficient	Standard error	p-value
Time period:			
Transition (Jan 2014)	0.0441	0.0155	0.004
Post-implementation (Feb - Nov 2014)	0.0708	0.0075	<0.001
Population density	0.0007	0.0004	0.105
Interaction terms:			
Post-implementation*near a bingo club	-0.0494	0.0119	<0.001
Post-implementation*population density	0.0007	0.0001	<0.001
Post-implementation*leisure complex	-0.0301	0.0096	0.002
Intercept	0.7685	0.0228	<0.001

The post-implementation dummy is very strongly significant and the size of the coefficient estimate suggests an increase in mean stake of about 7 pence (which is a further step-up from what was observed in the transition period); but this has to be modified to take account of the contribution of the interaction terms. For a casino in an area of average population density (31.6 persons per hectare) and which does *not* fall within the categories of 'near bingo' or 'in a leisure complex', the increase in mean stake is from 79 pence to 88 pence.

For an overall result, account has to be taken that the increase in mean stake was somewhat lower in the two categories of casino named in the table. Following a similar arithmetic

calculation as for the previous key statistics analysed, we estimate that **the mean stake per spin at an average casino was 8.8 % higher following the uplift in maximum stakes and prizes**. This implies that much more than 90% of the increase in turnover derived from an increase in stake levels rather than in increase in the volume of play.[33]

With this level of aggregation of data, it is not possible to be more specific about the pattern of change in staking levels. For example, it would be of interest to know how many plays were at the maximum stake level but the data were not available.

E-roulette and table games

We have analysed so far only indicators for B1 machines. But casinos offer two other categories of gambling product, e-roulette and table games. A natural question is whether the increase in B1 sales following the uplift in maximum stakes and prizes cannibalised to any extent the other products available in the casino.

At meetings held with operators in June, 2014, we had detected industry scepticism over whether uplift would have any effect on table games business. There was a tendency to view machines and tables as separate markets, the latter seen as for more experienced gamblers and the former as for 'newbies'. Machines were also seen as something used by those accompanying table game players. The view was that machines had limits on stakes which made them uninteresting to table players and the uplift in maximum stake to (still only) £5 was unlikely to change this. At best, industry representatives felt that some table players might be persuaded to wager at a machine while taking a break for a drink or to make a 'phone call but this would be new business, not displaced activity.

The supposed independence of the two markets does not entirely accord with analysis of individual level data to be presented in Chapter 3 below, where the number of casino visits involving *both* machines play and table play was not trivial. Where two goods are consumed in the same location by the same individual, there is surely at least potential for the individual to change his or her product mix when one of the products is made more attractive in some dimension. In the present case, for example, a gambler may go to the roulette table where there are no stakes limits if he or she is constrained by regulatory limits on the machines- but does not need to any more if the limits are lifted to levels which allow the preferences of the gambler to be satisfied.

[33] During the transition period, the contribution to increased stakes from number of plays was somewhat higher and the contribution from increased mean stake somewhat lower. One interpretation would be that players tried out the new options with additional spins. However, once they were accustomed to the new regime, a high stake spin usually just replaced a lower stake spin which would have been played before the regime change.

Accordingly we estimated similar regression models as before to account for variations in house win on e-roulette and on table games. In the event, neither *post-implementation* nor any of its interaction terms was statistically significant in the e-roulette model. As there was no evidence of cannibalisation, we do not report the results. However, we did detect interesting effects in respect of table games.

Table 2.5 displays results from modelling house win on table games. Again the unit of observation is the casino-week: the equation 'predicts' house win on tables at casino *i* in week *t*. Consistent with the expectations of representatives of operators whom we interviewed, neither *transition* nor *post-implementation* is statistically significant. But, the interaction term *deprived * post-implementation* is statistically significant with a negative sign.

deprived is a dummy variable to flag up that a particular casino is located in an area which fits within the top three deciles of areas ranked according to the official Index of Multiple Deprivation. Twelve of our casinos are located in such areas (and eleven are not). *deprived* did not appear in any of the preceding equation estimates because it was never statistically significant: there was no systematic difference between deprived-area casinos and non-deprived-area casinos in respect of indicators such as house win and amount staked in B1 machines. Here too, for table games, no difference is detected, pre-implementation, between the performance of the deprived-area and non-deprived-area casinos.

Table 2.5: Regression results for house win on table games

Source: casino data

Variable	Co-efficient (£s)	Standard error	p-value
Time period:			
Transition (Jan 2014)	-865.89	5838.95	0.882
Post-implementation (Feb - Nov 2014)	2163.23	2515.01	0.390
Population density	726.80	91.33	<0.001
Near bingo club	-32596.60	10636.84	0.002
Near another casino	39831.38	14299.96	0.005
Interaction terms:			
Post-implementation*deprived	-7624.70	3368.59	0.024
Intercept	34451.74	5390.73	<0.001

However, **post- implementation, there is a fall detected in the weekly house win on table games at casinos located in the most deprived areas.** At the average casino, if in a deprived area, the point estimate of the fall in revenue from table games is estimated as

more than £5,000 per week.[34] In this case, gains for the casinos from B1 business would have been offset by decreased profitability at tables. The implication is that customers of casinos located in deprived areas substituted table play for machine play, to some extent, when constraints on machine stake and prize size were eased. One interpretation is that some customers used tables because they were prevented from placing a wager on the machines that offered them sufficient 'skewness' in returns (loosely the possibility of a 'big' win). For some customers, the old limit of £4,000 on the machine prize was perhaps insufficient to match their preferences and they played at tables when they wished to wager for a bigger pay-off. The new machine limit of a £10,000 jackpot (£20,000 on a linked machine) enables some of these players to be satisfied by machine play. Thus, and contrary to expectations of industry representatives, the higher stake/ prize levels available did apparently interest players who also played tables; but this effect is apparent only for customers of casinos located in deprived areas.

There are some caveats to these remarks. First, there may have been some unknown coincident event which affected business at the tables but, to account for the result, this would have had to have impacted differentially between deprived-area casinos and the rest.[35] Second, most casinos categorised as located in deprived areas are in the North and the effect attributed here to location in a deprived area may in fact reflect regional differences in behavioural response to the regulatory changes.[36] Nevertheless, whatever the explanation, there is some evidence for cannibalisation of the table games product by the slots product. This places a question mark on whether maximum stakes on machine play can restrain spending on gambling very effectively where other (unlimited stake) gambling opportunities are easily accessed: our results suggest that, when the old low limit was in place, some play seems simply to have been displaced to table games (where there are no stake limits).[37]

2.4 Summary of principal findings from analysis of casino-level data

- House win per week from B1 machines at the average casino increased by about 7% following the uplift in stake and prize limits; this was broadly in line with expectations expressed by the industry and used by the Government in the Impact Statement issued before the regulatory changes were introduced. The total amount

[34] This calculation uses the coefficient estimate on *post-implementation* and that on the interaction term.

[35] Further, any 'general' trend affecting table games activity should have produced a change which varied with the population density whereas the interaction term with density was not significant.

[36] There is too much overlap between deprived-area casinos and Northern England/ Scotland casinos to distinguish statistically between deprived-area effects and regional effects.

[37] There are also no limits in online slots play and it is possible that limits on land-venue slots will induce gamblers wishing to play for higher stakes and returns to shift some of their spending to online casinos.

staked per week at the average casino increased proportionately more, by about 10%.

- Although the number of spins on B1 machines increased a little, by far the larger proportion of the increase in total stakes derived from an increase in mean stake size.
- In a typical casino, mean stake size increased from about 79 pence to about 88 pence; the data were not available to show how much of this increase was accounted for by play at the maximum permitted stake.
- There was evidence of differential response in different sorts of casinos but the magnitude of the differences was relatively small in most cases: there is therefore no reason to believe that the estimates here would be radically different for operators with a different mix of casino locations.
- There is some evidence that the increase in revenue from machines at casinos located in deprived areas was offset by a fall in revenue from table games.
- This suggests that some players may have chosen to gamble at tables when the old stake and prize limits were in effect but switched to machines when the stake and prize limits on machines were increased.

The high level of aggregation of the data analysed in this chapter makes it impossible to say anything about differential response to change by different types of individual player. Chapter 3 turns to analysis of tracked data.

3 Analysis of tracked data

3.1 Data available

Player card data supplied by Rank Group plc recorded activity by customers using loyalty cards up to the end of 2014. For this investigation, we confined our analysis to gambling activity in casinos in the years 2012, 2013 and 2014. Over this period, activity was recorded for 641,395 individual card holders.

For each player in the data set, age, gender and home postcode are known (and home postcode gives access to various socio-economic characteristics of the area in which he or she lives). Otherwise nothing is known about the player other than what transactions he or she conducted with Rank. These transactions could be at land or online casinos and could involve, in the case of land venues, purchase of food and beverage rather than, or in addition to, gambling services. However, we discarded from the data the record of any occasion when the contact with Rank was only online or did not involve the purchase of a gambling product. Thus every gambling occasion in the data set we finally employed involved visiting the casino and playing on B1 machines or engaging in table games or e-roulette or some combination of the three.

Activity was recorded to the level of detail of a 'rating period' (which was often of the order of twenty minutes but could be shorter or much longer). For each rating period, the financial outcome was known (player win or loss) but, within the rating period, individual plays were not recorded, so it is not possible to discover anything from the tracked data about staking patterns. Analysis has to be at a higher level of aggregation.

We adopted the 'visit' as our unit of observation. We defined a visit as beginning/ ending with the first/last activity recorded for the player card. Once two hours had passed since the card was last used, any new gambling activity was counted as initiating a new visit. Thus all visits are separated by a gap in tracked play of more than two hours. Naturally some players record two or more visits on particular days but a large majority of visits represent the only visit for the player that day. Altogether, we had data on activity during 7,416,661 individual casino visits.

Machine play may generally be presumed to have been tracked accurately through an automated system recording the 'rating' period for each person and the outcome. This allowed the extraction of reliable data such as the amount won or lost on a visit and the time spent playing machines. However, the recording of accurate details of player activity at tables is highly problematic, particularly for amount staked. Reliance is placed on the dealer to enter details of how much a card holder has wagered over a period of play. Given the demands of the role of dealer, any entry seems likely to be subject to error. Indeed this is conceded on the website which describes the rewards for holders of loyalty cards:

"Customers as a condition of taking part in the programmes agree that Play Points are awarded based on the personal observation of Grosvenor Casino staff which may be subject to error".[38] Given that no casino personnel we asked thought that records were other than very rough and ready, we chose not to use stakes recorded at tables in statistical modelling. However, we will use an indicator variable for whether a player took part in table games at all as patterns of machine play may be different according to whether a card holder engages in B1 gaming only or a mixture of machine and table play.

3.2 Cleaning the data

It is to be expected that, in any data set as large as this one, some obvious errors and anomalies will be observed. We removed players from the data set whenever their history included any of the following:

- the total time spent gaming in a session was negative
- the amount staked was negative
- a visit was recorded as lasting longer than 14 hours
- the player had had a loss more than the loss at the 99.9^{th} percentile (i.e. a loss in the top 0.1% of losses)
- the player had a win greater than the win at the 99.9^{th} percentile (i.e. a win in the top 0.1% of wins)

Of these criteria, the first two represent the impossible and the other three the implausible. In the case of the very high wins or losses, the records removed were close to £1m wins or losses in a single visit. Subsequent inquiry to Rank revealed that this was not coincidental. One of the meters in each machine displayed only six digits and, as a result, reset to zero when reaching 1 million. This caused the system to register a wrong number in the casino win/ loss column. Therefore it was correct to omit the extreme wins and losses. We compared the turnover figures from the tracked data where transactions took place in the 23 casinos analysed in Chapter 2 with the turnover figures for those same casinos from the casino-level data. With the extreme observations included, the loyalty card transactions accounted for more than 100% of total B1 house win, which is highly implausible.

This cleaning of the data resulted in the deletion of 19,514 individuals from the data set, leaving 621,881 for whom at least one visit was observed over 2012-2014. The percentage of females was 26.5%. The percentage of individuals aged under 30 was 48.3%, whilst the percentage aged 60 or over was 6.1%.

[38] www.grosvenorcasinos.com/play-points

3.3 How representative are loyalty card data?

Clearly play registered to loyalty cards is unlikely to be exactly representative of all play in the casino. All customers have been issued with a card but only some choose to use the card (and they may not choose to do so every time they gamble). Since use of the card is a choice rather than a random occurrence, the play observed may follow different patterns from that for other visitors to the casino. This will be the case if the decision to use or not use the card reflects differences in unobserved personal characteristics between users and non-users which also influence how individuals gamble.

Extrapolating from the behaviour of loyalty card holders to that of the whole population of casino customers may therefore be problematic and this is a caveat to be noted when considering results below. On the other hand, so far as we can tell, trends in usage of machines were similar as between loyalty card players and the rest.

In Figure 3.1, we compare

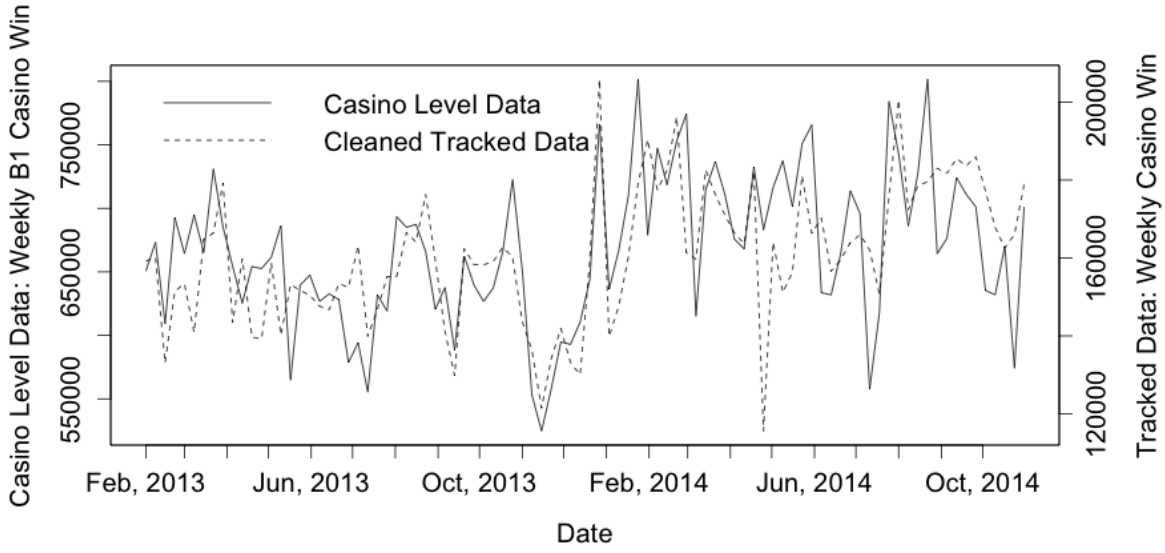
(a) the weekly figure for B1 house win across the 23 casinos for which we had complete casino-level data

with

(b) the weekly B1 losses of players in the tracked data over the same period (where we include B1 use only if it was at one of these 23 casinos).

Over the 92 weeks between the first week of February, 2013 and the first week of November, 2014, tracked player losses account for 22.7% of aggregate B1 house win. Though there are some anomalies, the figure shows that week-to-week variations in tracked player losses broadly reflect variations in casino win from all B1 play. The correlation between the two series is 0.60. This correspondence is encouraging in that, whatever influences the whole population of players in terms of amount of play also seems to drive the level of activity of loyalty card players. There is then reason to believe that what we discover from the tracked data about the responses of different categories of player (for example, by age) to the uplift in stakes and prizes will likely apply in broad terms to non-card users as well.

Figure 3.1: Weekly house win from B1 machines compared with weekly house win from tracked play



3.4 Descriptive statistics for casino visits

From our cleaned data set, we were able to observe more than 3.6m gambling visits to a casino during 2012-2014[39]. This offers an unparalleled opportunity to place into the public domain information on such matters as how much time and money was spent and on what activities (machines, table games, e-roulette). We were interested in the picture painted by these data and in how the picture may have changed following uplift of stakes and prizes at the beginning of 2014.

Tables summarising the data on visits are presented in Appendix B. Here we draw attention first to features of general interest and then to indications of any changes that may have occurred in 2014. Three years data are included to give perspective on any changes occurring from 2013 to 2014. Some series show year-to-year volatility. In these cases one might, for example, be less inclined to associate an increase in an indicator between 2013 and 2014 with the uplift in stakes and prizes if it had fallen in 2013 and was now returning to no more than its 2012 level. These patterns are noted where appropriate.

Analysis of these data shows that:

- more than one-half of tracked players visited a casino and gambled only once in a year (Table B1.1)

[39] 28.4% of visits recorded were by females; this is slightly higher than the proportion of females in the data set indicating either more frequent visits or a greater propensity to use player cards than males.

- fewer than 1% of tracked players were recorded as making more than 100 casino visits in a year (though this still represented more than 1,200 individuals in 2014, for example) (Table B1.1)

- in each year about one-quarter of visits included play on B1 machines (Table B1.2)

- in about four-fifths of these B1 visits, the customer did not take part in any other form of gambling (Table B1.2)

- female visits were very much more likely to include B1 play than male visits (Tables B1.3 and B1.4)

- in about half of all visits including B1 play, the spend (defined as amount lost) was below £20 (Table B1.5)

- in each year, the median player loss per visit on B1 machines was around £20; this is the 'typical' loss a B1 player makes on B1 machines when visiting a casino (Table B1.5)

- the mean loss was higher because of the influence of a relatively small number of visits where spending was very much higher than the average (Table B1.5)

- in 2014, players lost more than £100 in 19.6% of the B1 visits observed in the data (this represents more than 67,000 occasions on which tracked play generated a B1 loss of more than £100) (Table B1.5)

- in 2014, the player lost more than £300 in 3.3% of the B1 visits observed in the data (this represents more than 11,000 occasions on which tracked play generated a B1 loss of more than £300) (Table B1.5)

- whatever the mix of B1, table games and e-roulette played, about one-third of casinos visits featured fewer than 30 minutes of gambling; but in about 6% of visits gambling lasted more than four hours (Tables B1.6-B1.8)

- for visits where only B1 machines were played, the median (typical) time spent playing was about 50 minutes but the mean was higher, raised by a significant number of lengthy visits: in a little over 5% of B1-only visits, more than four hours were spent playing machines (Table B1.8)

These 'highlights' present a broad picture of use of casino gambling services by loyalty card users over the whole period 2012-2014. However, our main interest is in whether any particularly sharp changes were observed coincident with the uplift of stake and prize limits at the beginning of 2014. We note the following:

- the proportion of players with the greatest frequency of visit increased over time but no more from 2013 to 2014 than from 2012 to 2013 (Table B1.1)

- the proportion of visits which were to play only B1 machines increased over time but no more from 2013 to 2014 than from 2012 to 2013 (Tables B1.2-B1.4)

- the median (typical) spend on B1 machines during visits including B1 play increased from £19.25 in 2012 to £19.88 in 2013 but then more sharply to £22.26 in 2014 (Table B1.5)

- the proportion of B1 visits where more than £300 loss was incurred by the player was stable between 2012 and 2013 but increased from 2.71% in 2013 to 3.32% in 2014 (in 2014, we observed more than 11,000 individual visits by players using loyalty cards where more than £300 was lost) (Table B1.5)

- the proportion of B1-only visits where more than four hours were spent gambling had been stable in 2012-3 but increased from 5.1 to 5.7% between 2013 and 2014 (Table B1.8)

The raw data are therefore suggestive of an increase in the number of visits to casinos which involved high spending and/ or high duration of time spent on B1 machines. It is not possible to take a view on how many individuals taking part in the additional high spend sessions are likely to have experienced harm (rather than extra entertainment) because, in contrast to researchers reporting on the use of B2 machines in licensed betting officers, published by The Trust in 2014, we had no information on the problem gambling status of individuals in the data set. In that earlier research, many high spending players were problem-free and no doubt the same is true of high spending players in our data set.

However, there is known to be a correlation between level of spending and propensity to problem gambling and therefore the increase in the frequency of high spending visits may be an issue for concern.

3.5 Changes in player behaviour over time

In this section, we consider transition-rates from year to year in the frequency of use of B1 machines by individual B1 players. For example, we are interested in what proportion of infrequent users in one year become frequent users in the following year and in whether there was any marked change in churn in the year following uplift in maximum stakes and prizes.

We define four categories to describe an individual B1 gambler in year *t*:

(i) *new user*: the player had no previous recorded use prior to year *t* but played in year *t*

(ii) *infrequent user*: the player had prior usage of B1 machines and had then recorded between one and ten visits with B1 play during year *t*

(iii) *frequent user*: the player had prior usage of B1 machines and then recorded more than ten visits with B1 play during year *t*

(iv) *former user*: the player had prior usage of B1 machines but was a non-user in year *t*.

Table 3.1: Transition-rates by frequency of B1 use

Transition type	2012 to 2013 rate %	2013 to 2014 rate %	p-value for test of equality in proportions
New user transitions			
New user to new user	-	-	-
New user to infrequent user	19.8	18.6	<0.001
New user to frequent user	0.6	0.6	0.174
New user to former user	79.6	80.9	<0.001
Infrequent user transitions			
Infrequent user to new user	-	-	-
Infrequent user to infrequent user	53.5	54.6	0.026
Infrequent user to frequent user	1.6	1.6	0.991
Infrequent user to former user	44.9	43.8	0.027
Frequent user transitions			
Frequent user to new user	-	-	-
Frequent user to infrequent user	36.5	32.4	0.057
Frequent user to frequent user	60.3	65.7	0.015
Frequent user to former user	3.2	2.0	0.113

Table 3.1 shows rates of transition between 2012 and 2013 and between 2013 and 2014 within each player type. Interpretation is straightforward. For example, "infrequent user to frequent user" shows that 1.6% of those who were infrequent users in 2013 became frequent users in 2014. Since there may be concern that harm is most likely to be related to frequent use of B1 machines, it is of note that about a third of frequent users in any one year do not remain in this category in the following year- but about two-thirds do.

Our interest here is in whether the pattern of transition-rates was different for 2013 to 2014 compared with 2012 to 2013. It is possible that any variation would have been associated with looser B1 regulation which took effect at the beginning of 2014. The final column of Table 3.1 displays a p-value from a statistical test for difference in transition-rates between 2012-3 and 2013-4. If the p-value is below .05, the difference between the figures in the first two columns is statistically significant at the 95% level of significance. If it is between .05 and .10, we would describe the difference as marginally statistically significant.

There is no significant variation in the proportion of infrequent users who become frequent users. There is therefore no evidence suggestive that occasional players were turned into regular players by the uplift in stake and prize limits. However, there are statistically significant variations in the transition-rates of frequent B1 players. There is a sharp and statistically significant increase (more than 5 percentage points) in the proportion of frequent players who remain frequent players in the following year. There is a (marginally statistically significant) fall in the proportion of frequent players who become infrequent players in the following year.

Together these results imply that **the increase in business when elevated stake and prize levels were introduced was likely to have been achieved to a significant degree through making it more likely that a frequent player of B1 machines would maintain his or her status** rather than change to an infrequent user. This finding could be interpreted as consistent with the notion that some regular gamblers need an increasing level of excitement through higher stakes and prizes or they may become bored or disillusioned and become less engaged with the activity.

Somewhat related is our finding from inspection and organisation of the raw data that, **among frequent users, the increase in B1 revenue came mainly from the heaviest players**. The top quarter of frequent B1 users (ranked by player loss over the year) lost £53.18 per visit on B1 machines in 2013. After the uplift, in 2014, the top quartile spent on average £60.63. By contrast, the lowest quarter ranked by player loss lost an average of £4.31 in 2013 but only £2.02 in 2014. Again the raw data point in the direction that **the gain in casino B1 revenue in 2014 was disproportionately from heavy players**. Of course this is not surprising since heavy players are likely to be those with the highest stakes and the principal change in regulation was to permit higher stake sizes.

3.6 Regression analysis: regular users

3.6.1 Developing the regression models

We focus for the rest of the chapter on *regular users* by which we mean here those players who recorded at least eleven visits involving B1 play in each of the years 2012, 2013 and 2014. 2,495 customers of Rank met this criterion. Given that an effect of the uplift appears to have been to maintain more individuals in the group of frequent gamblers, we believe that a harm minimisation perspective requires special attention to be paid to the behaviour of those who gamble frequently over a lengthy period (in this case 2012-4). As the 2010 Report of the Australian Productivity Commission put it:

> "*Most gambling policy interest needs to centre on people playing regularly on riskier forms of gambling. For these people, the risks and problems loom large".*[40]

Our modelling strategy was to estimate regression equations to 'explain' visit B1 spending, duration and frequency among this group of regular gamblers. The explanatory variables, listed in full in Box 3.1, describe amongst other things the period in which the particular visit fell. These periods are delineated as in the casino-level models reported in Chapter 2: there are indicator variables to indicate the *transition* two weeks when the changeover of machines to higher stake and prize limits was in progress and the *post-implementation* period when the higher stakes and prizes were available on all machines across the estate. The models also take account of the *marketing disruption* in late 2013.

Other explanatory variables relate to the individual. They describe the age and gender of the player, how far he or she lives from the nearest Rank casino[41], and whether he or she plays e-roulette/ table games.

Research for the RGT on patterns of B2 machine use in licensed betting offices[42] drew attention to much higher average stakes during the period 10 p.m. to midnight. To test for late night effects in casinos (which open beyond midnight, usually all night) we also included separate indicator variables for whether the player ever made late night visits to the casino *and* whether the particular visit itself was taking place at night.

[40] Australian Productivity Commission, *Gambling Inquiry Report No. 50*, 2010 (Melbourne: Australian Productivity Commission), p. 1.13

[41] Most players play most of the time at their 'local' casino but some in the data set visit two or more casinos over the data period.

[42] H. Wardle, E. Ireland, S. Sharman, D. Excell & D. Gonzalez-Ordanez, *Patterns of Play: analysis of data from machines in bookmakers*, (London: NatCen Social Research), 2014.

No socio-economic information on the player was available. However, residential postcode allowed us to include a measure of the neighbourhood in which the player lives. In England, the official Index of Multiple Deprivation presents a single index for an area based primarily on Census data and takes into account measures of health, educational achievement, household income, etc in an area.[43] Table 3.2 profiles individuals in our data set in terms of the level of deprivation of the area in which they live. Deprivation is described by the decile of the level of deprivation of the area in which the individual's address lies. The higher the decile number, the higher the level of deprivation. Thus 11.03% of players in the data set live in one of the top 10% most deprived areas in the country.

Table 3.2: Proportion of players living in areas with different levels of deprivation

Decile	Percentage of players in decile
1	9.10
2	8.96
3	9.66
4	9.48
5	9.25
6	10.25
7	10.78
8	10.51
9	10.97
10	11.03

Table 3.2 shows a tendency for the customer base to be skewed towards areas of greater deprivation but the gradient is not very steep. It could fairly be claimed that the set of casinos draws customers from all sorts of areas, wealthy and deprived.

Results on all these predictors reveal patterns as to what sorts of players spend more or less money and time on B1 machines. But our focus is on the effect of the uplift of maximum stakes and prizes. We therefore interacted each explanatory variable with the dummy variable *post-implementation*. The relevant coefficient estimates then reveal differential responses to the regulatory regime change for different categories of customer (for example, by age, gender, level of home area deprivation, etc).

The statistical model we employ is a *linear mixed model*. This permits *unobserved heterogeneity* to be taken into account by including *random effects* in the model, so that

[43] Different indices are used in Scotland and Wales, though the underlying principles are the same.

the ‘prediction’ for each player at each visit is calibrated to take account of the extent to which he or she generally exhibits a higher or lower level of activity than the average player for reasons other than those attributable to known factors such as age and gender. In terms of the equation, each player has his or her own constant term (*intercept*). The intercept shown in the results tables gives the baseline forecast for the *average* player before the influence of the other variables is added.

Box 3.1. The player-level statistical model

There are models to ‘explain’ various metrics such as amount lost by player *i* in week *t*. The focus of interest is on whether implementation of higher stakes and prizes changed the behaviour of regular B1 users. We divided the data into four periods:

base period- week commencing February 4, 2013 to week commencing January 13, 2014 (but excluding the *marketing disruption* period, from week commencing November 11, 2013 to week commencing December 9, 2013)

transition- weeks commencing January 20 and 27, 2014

post-implementation- week commencing February 3, 2014 to week commencing November 3, 2014

In testing for the effects of implementation, we sought to allow for the possibility that there might be systematic differences in player behaviour according to characteristics of the player observed in or through the data set. The following variables are used to capture player-specific characteristics.

age- in years

female- dummy variable=1 if player is female

plays e-roulette- dummy variable=1 if player ever takes part in roulette according to the data set

plays table games- dummy variable=1 if player ever takes part in table games according to the data set

distance to home casino- straight-line distance in km. from home to nearest casino in the data set, calculated from the co-ordinates of the home and casino postcodes

least deprived- dummy variable=1 if player lives at an address in the lowest decile (bottom 10%) of Census ‘Lower Super Output Areas’ ranked according to level of deprivation. This is measured by the Index of Multiple Deprivation (the equivalent indicator in Scotland is termed the Carstairs Index) which takes into account local area statistics reflecting factors such as incomes, employment, educational achievement and health. In allocating addresses to the lowest 10% of of areas by deprivation, no account was taken of the fact that indices for England, Scotland and Wales are calculated slightly differently from each other.

most deprived- dummy variable=1 if player lives at an address in the highest decile (top 10%) of Census ‘Lower Super Output Areas’ ranked according to level of deprivation.

has late visit(s)- dummy variable=1 if player ever makes a late visit to the casino where a late visit as defined as one which either *starts* in the interval 9 p.m. to 9 a.m. or finishes in the interval midnight- 9 a.m. or both.

this is a late visit- dummy variable =1 if the particular visit is a late visit.

In addition, a related visit-specific variable *this a late visit* is a dummy variable which flags whether the particular visit meets the late night criterion.

In initial modelling, all these explanatory variables were accompanied in the model by interaction terms equal to the value of the variable multiplied by the value of *post-implementation*. For example, in the case of *most deprived*, the interaction term is 1 if the player livres in one of the 10% most deprived area and the week of the observation is post-implementation (and otherwise its value is 0).

As previously, we adopted a general-to-specific modelling strategy. For each model, we first estimated the best-fitting equation with all the variables mentioned in Box 3.1 included. Then we deleted all explanatory variables which were non-significant (p>.10) and re-estimated. If other variables were then non-significant, they were deleted in their

turn. The final results shown here therefore report modelling results after non-significant variables have been discarded. The exception is that we always retained the dummy variables representing the transition and post-implementation periods.

3.6.2 Regression results

The following regression models were estimated:

- Amount spent (player loss) per visit
- Time spent per visit
- Number of visits per week

Results are shown in Tables 3.3 to 3.5.

For the results reported in Tables 3.3 and 3.4, the unit of observation is the visit. In Table 3.4, time is expressed in terms of its natural logarithm which permits coefficient estimates to be interpreted as proportionate effects.[44] Table 3.5 shows results for the number of visits per week.[45] Players might respond to regulatory change by modifying behaviour, such as spending, on each visit but might also change their frequency of visit. For example, it is conceivable that many players, allowed to play at higher stakes than before, might spend more each time they go to the casino but might also go less often. Accordingly, Table 3.5 reports results where the unit of observation is the player week and what is modelled is the number of visits by player *i* in week *t*.

When the interaction terms are ignored, the coefficient estimates describe patterns of play before maximum stakes and prizes were increased. From Tables 3.3 and 3.4, there is weak evidence that, on average, female visits where B1 machines are played involve more spending, and strong evidence that they involve longer time on the machines, compared with male visits. The estimate for time spent on slots during female visits (with other variables given) is about one-quarter longer than during male visits, on average.

Age is absent from Table 3.3, indicating that it was deleted for reason of lack of statistical significance. However, it is positive and strongly significant in Tables 3.4 and 3.5.

[44] For example, if the estimated equation included the term 0.24 × *female*, this would suggest that, holding all other terms constant, knowledge that a visit was by a female (rather than a male) would lead one to increase the forecast of time spent by (approximately) 24%. The log specification was not applied to the player loss equation because some observations are negative (the player won money) and there is no natural log defined for a negative number. Coefficient estimates in this equation therefore estimate impacts in pounds.

[45] The data in this model are discrete count data, with values 0,1,2,…. As such we use a Poisson mixed effects model.

Together these results suggest that, among regular players of B1 machines, older customers do not spend any more money than younger customers but they do spend more time. On average, they also play more often.

Other significant factors revealed in the analysis include that players who live further away from the casino tend to spend more and play longer (though, surprisingly, they do not visit with different frequency). The variable *least deprived* is strongly statistically significant in both Table 3.3 and 3.4. Thus players who live in the best-off areas appear to be freer with both their time and their money. However, *most deprived* is absent from both these tables, indicating lack of statistical significance; those in the most deprived areas did not display any tendency to deviate from the average in terms of amount of money and time spent per visit though (from Table 3.5) they attended more often.

Both late visit variables are strongly significant in the spending equation. Players who ever have late night trips to the casino are predicted to spend £6.84 more than other players (with all other characteristics held constant) if their visit this time is not a late one and £8.39 more than other players if this particular visit is a late visit.

The time dummy variable to represent the period of marketing disruption is absent from all tables, i.e. it was never significant. This could be regarded as anomalous given its explanatory power in the casino-level analysis. A likely resolution of the anomaly is that here we consider only players who were regulars over three years. Marketing promotions may target or evoke a response from more marginal customers.

However, our focus is on the effect of higher stake and prize limits. This requires close inspection of results on the dummy variable *post-implementation* and its interaction terms.

We highlight now the principal findings from these key terms as we see them.

- **spend per visit was higher after the change in regulatory regime** (the coefficient estimate on *post-implementation* is very strongly statistically significant); there is some but weaker **evidence that the response to regime change was less pronounced among older players** (the coefficient estimate on *post-implementation * age* is negative but is only marginally statistically significant) (Table 3.3)
- on the other hand, **older people tended to increase their frequency of visit by more than younger people** (Table 3.5)
- The amount of time spent per visit also increased post-implementation (Table 3.4)

- the interaction term to test for differential response to regime change by players resident in the most deprived areas is significant in all three tables
- the point estimates from Table 3.3 predict, for example, that **a 25 year old not living in a deprived area would increase B1 spend per visit by £5.53 per visit post-implementation; but the forecast increase if the individual lived in the most deprived areas would be increased to £8.00**
- on the other hand, calculations from Tables 3.4 and 3.5 indicate that **the increase in duration of play was less for those from the most deprived areas** and, rather than visit more often (the average response), **those from deprived areas tended to visit less often post-implementation**
- the amount spent during late visits already tended to be more than for non-late visits but the differential became wider post-implementation: since there was no differential response in terms of duration of play, it is therefore likely that **late players increased their average stake size particularly sharply**, consistent with earlier B2 research which appeared to reflect a preference for high stakes among late night players

Table 3.3: Regression results for amount spent (player loss) on B1 machines per visit

Source: individual data

Variable	Co-efficient (£s)	Standard error	p-value
Time period:			
Transition (Jan 2014)	2.467	1.772	0.164
Post-implementation (Feb - Nov 2014)	6.897	2.330	0.003
This is a late visit	1.551	0.721	0.031
Has late visits	6.841	2.408	0.004
Distance from home to casino	0.083	0.030	0.005
Plays table games	-4.693	1.506	0.002
Plays e-roulette	-6.313	1.676	<0.001
Least deprived	6.011	2.759	0.029
Female	2.358	1.414	0.095
Interaction terms:			
Post-implementation*age	-0.055	0.036	0.123
Post-implementation*most deprived	2.472	1.358	0.069
Post-implementation*late visit	3.789	1.103	<0.001
Intercept	35.625	2.654	<0.001

Table 3.4: Regression results for time spent (log) on B1 machines per visit

Source: individual data

Variable	Co-efficient (£s)	Standard error	p-value
Time period:			
Transition (Jan 2014)	-0.013	0.013	0.312
Post-implementation (Feb - Nov 2014)	0.045	0.004	<0.001
This is a late visit	0.122	0.005	<0.001
Has late visits	0.099	0.052	0.055
Distance from home to casino	0.002	0.0006	0.002
Plays table games	-0.240	0.032	<0.001
Plays e-roulette	-0.155	0.035	<0.001
Least deprived	0.136	0.058	0.019
Female	0.249	0.030	<0.001
Age	0.008	0.001	<0.001
Interaction terms:			
Post-implementation*most deprived	-0.026	0.010	0.008
Intercept	3.340	0.098	<0.001

Table 3.5: Regression results for number of visits in a week

Source: individual data

Variable	Co-efficient (£s)	Standard error	p-value
Time period:			
Transition (Jan 2014)	0.121	0.013	<0.001
Least deprived	0.151	0.042	<0.001
Age	0.162	0.014	<0.001
Interaction terms:			
Post-implementation*most deprived	-0.070	0.010	<0.001
Post-implementation*age	0.033	0.003	<0.001
Intercept	-0.184	0.015	<0.001

3.7 Key themes

That player losses were higher following the uplift in maximum stakes and prizes should be neither surprising nor in itself a cause for concern. It was, after all, the stated aim of the policy (expressed as an increase in casino net revenue) and is likely to an extent to reflect decisions by responsible players following their preferences. However, there might be some concern where there evidence that the additional spending came to a large or disproportionate extent also from players who were likely to be experiencing harm from their gambling.

We do not have information about the gambling status of individual players as regards whether they were experiencing gambling harm. Our evidence is therefore indirect. It is known from the *British Gambling Prevalence Survey* that young age and living in a deprived area are significant risk factors for problem gambling. From earlier research, it has been suggested also that those who play machines late at night are more prone to be reckless, perhaps because of the influence of alcohol, perhaps because many are vulnerable from the lack of a stable home life.[46] In our analysis of regular B1 players, we have found that greater increases in B1 spending after uplift occurred in these relatively vulnerable groups: the young, those from deprived areas, late night players. From this, it might be extrapolated that, after uplift, operators' revenue contained a higher proportion of money than before from individuals with gambling problems. A caveat is that those living in deprived areas may have had a preference to spend more on occasions when they played B1 machines but they also chose to play on fewer occasions, indicating the possibility of responsible decision taking (on the other hand, it cannot be ruled out that some cut-down in frequency was enforced by unplanned heavy spending at earlier sessions). This is somewhat similar to our finding from the casino-level data that increases in B1 spending at casinos in deprived areas were offset by decreased spending on table games.

Our interpretation of the real changes in behaviour following regulatory change that we have documented is necessarily inconclusive for lack of data. Much more robust conclusions would be obtainable were there to be information on the problem gambling status of at least a sample of player card holders: measures of problem gambling status are a plausible proxy for gambling harm. We stress that Rank plc was never asked to give access to clients to researchers. It furnished us with all the data it had been requested to. But we would recommend that, in future analysis of gambling industry data sets sponsored by The Trust, discussions with the relevant sector of the industry should explore the willingness of operators to permit surveying of card holders to establish whether individuals are safe, at-risk or problem gamblers.[47]

[46] Nova Scotia has responded to concerns by introducing a mandatory overnight shut down of slot machines.

[47] Problem gambling status would serve as a proxy for harmful play but it should be conceded that non-problem gamblers may suffer harm from particular individual sessions of play.

4 Reflections

Casinos offer the opportunity for adults to use machines to play games for money. It is possible to play similar games in other settings, such as on computers, without money being involved. So why do many individuals play in the casino where, on average, the house wins?

A new strand in contemporary economics is 'the economics of suspense and surprise'. Ely et al. (2015)[48] place casinos within the context of a wide range of entertainments (spectator sports, soap operas, murder mysteries) where suspense is crucial to consumer satisfaction: the entertainment is derived from the experience of wondering what will happen next. But suspense depends not only on the presence of uncertainty but also on the consumer caring about which outcome will occur. For example, if the latest episode of a soap opera ends with a character's life in imminent danger, the drama, to be effective, must have been crafted well enough that the audience cares whether he lives or dies, otherwise there is no emotional engagement and hence, no suspense.

In machine gaming, users may face similar uncertainty over whether they will win regardless of the stake and prize involved. But to feel suspense requires also that they care whether the spin makes them a winner and this appears to require, for many or perhaps all players, that *monetary* gains or losses are associated with possible outcomes. *How much* has to be at stake for the experience to be sufficiently suspenseful will vary across individuals, and indeed across time for any particular individual. If there is a regulatory limit on how much money can be put at risk in any one bet, some players (and potentially all players at some time) will *either* be deterred from making an extra play because the reward in terms of suspense will be insufficiently great *or* they will still play but would have derived more suspense/ entertainment if they had been permitted to stake to a higher level.

At the beginning of 2014, there were proportionately large increases in the stake and prize limits applied to B1 machine gaming in British casinos.

From the perspective of this new economics of suspense, the outcome would have been expected to be an increase in revenue from the machines in place. Some customers would have been constrained from spending as much as they would have liked by the old regulatory limit. Permitted to stake more than before, they will have done so because now they can make the experience more suspenseful/ entertaining and, to them, the extra expenditure is justified.

[48] J. Ely, A. Frankel & E. Kamenica, 'Suspense and Surprise', *Journal of Political Economy*, 123: 215-260.

From an empirical perspective, however, the predicted increase in revenue might have been expected to be modest. Prior to regulatory change, the average stake per spin had been much less than £1 whereas the regulatory limit was £2. The choice of stake on most spins was therefore unconstrained for most players most of the time. Evidently the prospective gain or loss associated with a bet of about 80 pence provided enough suspense for the typical player (i.e., although suspense could have been increased by staking higher, it would not be to a degree that justified spending more money).

In this Report, we first examined data from 23 casinos operated by Rank and found what we expected to find: a modest increase in industry revenue from B1 machines following the regulatory change. In fact, the increase in weekly revenue, estimated as 7.1%, was close to that predicted by the industry during the Triennial Review. Although modest, it represents a worthwhile boost to the industry, roughly equivalent to the gain from two years of growth in B1 revenue achieved in 2011-12 against a constant regulatory regime. By far the larger part of the gain derived from an increase in average stake rather than an increase in the number of plays on the machines (which was minimal).

Less predictable was our finding that there was an extent to which the extra revenue gained from B1 machines cannibalised the casinos' other principal product offering, table games. According to industry representatives whom we interviewed at the beginning of the project, the machine and table games markets were largely separate in that they appealed to different types of customer. Nevertheless we found that, for a subset of casinos studied, those located in relatively deprived areas, the increase in revenue from B1 gaming coincided with a fall in revenue from table games, consistent with substitution. It should be noted that most of the casinos in relatively deprived areas were in the North, so that the result could represent a more general regional difference in the response to the change in regulation. Either way, a potential explanation is that some customers had been attracted to the tables because they had been able to purchase more 'suspense' there than on the machines. For customers with lower incomes, the new limits for machines may have been sufficiently generous that they were now able to obtain a satisfactory level of suspense playing machines and they switched to what would have always been their preferred gambling medium in the absence of the old binding constraints.

Potentially this finding has general relevance to the effectiveness of stake and prize limits in mitigating harm from gambling. For example, there is currently vigorous debate on whether there should be a reduction in the £100 limit on stakes placed on B2 gaming machines located in licensed betting offices. Advocates of a reduction in the maximum stake (which is clearly out of line with that imposed in other machine gaming in Great Britain) argue that this would be likely to reduce harm to those who gamble beyond their means. Concern appears especially to focus on harm caused in less affluent areas where many bookmaker shops are located. However, the overall reduction in harm might be disappointing if those who play for high stakes were simply to switch their expenditure to readily accessible alternative gambling media where no maximum stake was imposed.

Overall, the analysis of casino-level data in our Report was able to identify the magnitude of the gain to the casino industry, at least in the short-run, from the uplift in stake and prize limits. However, at this level of aggregation, it was not possible to establish whether the gain was to be celebrated (because consumers were now making more effective use of their entertainment budget given their preferences) or bemoaned (because a large part of the gain might have come from customers whose gambling was problematic and for whom harm might be aggravated by extra spending). The reason is obvious. Casino-level data do not reveal from which players any additional revenue is obtained.

From a responsible gambling perspective, individual-level data are required for there to be a chance for the most relevant questions to be answered. We had access to a large data set recording activity associated with use of loyalty cards at casinos. As with other recent projects sponsored by The Responsible Gambling Trust, the readiness of an operator to share data with researchers is to be noted as encouraging.

Of course, loyalty card use may not be representative of all play. However, we found that aggregate week-to-week tracked activity as recorded from use of loyalty cards was adequately highly correlated with week-to-week total activity as recorded in the casino-level financial series. This implies that the behaviour of loyalty card users is driven by the same forces as that of players generally and this should mitigate concern over potential biases in findings arising from the employment of unrepresentative data.

On the other hand, a limitation of the data is that, while the behaviour of individuals can be observed over time, it is not known whether a given individual is or is not experiencing harm from gambling. Evidence on harm from any additional play following uplift of stakes and prizes is therefore necessarily indirect. For example, *if* the strongest response had been found among young males, this could have been flagged as a potential cause for concern given that prevalence of problem gambling is known to be relatively high for this group. But the evidence would not be definitive in terms of harm generated because most young males are safe gamblers and their greater enthusiasm to take advantage of the opportunity to stake higher than before may simply reflect that this group has a high taste for 'suspense', thrills, etc. We recommend that, for future research projects, The Trust should encourage the industry to permit researchers to contact a sample of customers whose play is tracked to enable them to identify whether individuals are susceptible to harm from gambling. Scores on a standard screen for problem gambling would represent one proxy for harm which might then be obtained and used in analysis.

Despite the limitations of the data, we have been able to provide a series of analyses of how individuals changed behaviour. Some findings were reassuring. For example, players move in and out of the category of 'frequent player' each year. Formal statistical analysis of transition-rates for 2012-2014 showed no tendency for more players to have become

frequent players in the period after the uplift compared with the period before. There is therefore no evidence at all that higher stake and prize limits lead to more individuals using machines frequently.

On the other hand, the change in regulation was associated with a noticeable fall in the rate at which individuals *exited* the category of 'frequent player'. To an unknown extent, this could represent players moving from 'at-risk gambling' to 'safe' gambling but, equally, many individuals who were gambling safely may have continued to do so frequently because the new limits prevented the setting in of boredom with the activity.

The last statistical exercise in the Report consisted of detailed analysis of the most regular players, those who played B1 machines eleven or more times in each of the years 2012-2014. Amongst these regular players, there was no increase in amount lost per visit by the bottom quarter ranked by loss but a significant increase in the amount lost per visit by the top quarter. Thus, among regular users, the increase in B1 revenue came mainly from heavy users. A series of regression analyses showed that there was also a disproportionately large increase in loss per visit among younger people, among those whose residence was in a very deprived area and among those playing late at night (but not among males compared with females). All these have been flagged in the past as risk factors for problematic play and, to that extent, there are grounds for suspecting that the increase in revenue from B1 machines may have been associated with an increase in the proportion of revenue derived from problematic play. Mitigating this finding is that frequency of visit by those living in very deprived areas fell after uplift, potentially indicative that some players preferred to play to high stakes but cut back on the number of visits to control their total spending at the casino.

Appendix A: Interviews with key stakeholders

The first stage of this project mapped out what impacts from Uplift were anticipated or theorised, with the aim of evaluating which ones could be examined using industry-held data. We conducted a series of short consultation meetings with major casino operators, to understand how they had been implementing the changes and what impacts they were anticipating.

The meeting participants included (but were not limited to) representatives of the following casino operators:

- Rank Group plc
- Aspers Group Limited
- Caesars Entertainment UK (previously known as London Clubs International)

Semi-structured interviews were conducted at each meeting using a topic guide to collect information on the following areas: 1) how the stake changes were being implemented, 2) how changes were being or were to be advertised to consumers, 3) What impacts were expected and 4) what considerations should the research team take on board for the evaluation. Interviews were conducted in May 2014, four months after the uplift to B1 stakes and prizes was introduced. Key information gained from the meetings is summarised below.

Implementing the changes

Timeframe

All of the casino operators interviewed stated that they started implementing the Uplift immediately by converting existing B1 machines to the higher stakes and prizes, and by linking machines to provide more progressive jackpots. At least one casino operator introduced some new games at the same time as converting the machines.

The work was completed at different rates by different casino operators. One operator converted half of its machines within seven days and another 40 percent within three weeks. The others completed the work within two to three months. The timing was affected by:

- software availability (updated software was not available immediately for all machines)
-
- staff availability (as each machine had to be converted manually).

Converting machines to higher stakes and prizes

One operator had already converted all (or nearly all) of its machines at the time of the meeting. The other casino operators had converted most of their machines but had left

some unconverted – from 10 percent of all machines in one case to around half in another. They gave three reasons for this:

- data (the unconverted machines were being used as a control group to help the casino operator assess the impact of the Uplift – one of the operators expected to convert the remaining machines by the end of June 2014; others were waiting to see how the different machines were performing before deciding whether to convert more)

- variety (to give customers more choice, on the basis that some players might prefer to play on machines limited to lower stakes and prizes)

- cost (many machines were said to be leased and there was a cost attached to converting them).

Providing more progressive jackpots

As well as converting the machines to higher stakes and prizes, casino operators linked more of their machines to provide more progressive jackpots (including in some casinos where there had been no progressive jackpots before the Uplift). They all kept some stand-alone machines in each casino on the assumption that some players preferred not to contribute any of their winnings towards progressive jackpots.

Future changes

Participants said that they would keep looking at their data on how different types of machine were performing and would use this information to decide whether to make further changes, such as linking more machines. No changes in legislation affecting machines were anticipated over the next year.

Advertising the changes

Most casino operators publicised the Uplift when the changes were introduced, though the extent of advertising strategies used appeared to vary between operators. Individual casinos were responsible for much of this, so there may have been differences between them in the level and type of advertising they carried out. Advertising methods included:

- printed materials, including advertisements on machines and posters around casinos

- emails sent to casino members

- press releases and social media messaging, especially about the first progressive jackpot wins

External advertising (such as press releases) was said to have slowed down after an initial flurry immediately after the Uplift was introduced in each casino, but internal advertising was ongoing. One casino operator said that machine players often knew each other, so it was important to create a buzz when a big progressive jackpot was won.

Anticipated impacts

Overall reflections

Not surprisingly, participants welcomed the uplift – they said that it gave their customers more choice and believed that it may have contributed to increased revenues from machines. But they did not see it as a fundamental change. They felt that the limits on stakes and prizes on machines in casinos in the UK were low and out of line with the rules in the rest of the world. The limit on the numbers of machines in casinos was seen as a bigger issue - participants believed that there was demand for more machines in many casinos, and that a larger market would encourage manufacturers to offer better products in the UK.

Revenue

All of the casino operators reported a modest overall increase in revenue from machines since the Uuplift was introduced, but said that it was too early to draw firm conclusions.

One participant said that there had been a single-digit increase in the average stake on machines in its casinos. Another said that the average stake had increased by 7 percent, and that this was entirely due to an increase on machines linked to progressive jackpots – the average stake on standalone machines had not changed.

There were said to be substantial variations between casinos. For instance, in one casino the number of games played overall had increased by 20 percent since the Uplift (but the number of games played on converted machines had increased by only 9 percent), while in another casino owned by the same company the overall increase was 8 percent (and the increase on converted machines 30 percent). Several possible reasons were suggested, including local events, promotions by casinos, the weather and uneven payments by machines. Participants pointed out that figures from small casinos (which had 20 or fewer machines) were bound to fluctuate from month to month.

Existing machine players

There were conflicting views on how the increase in stakes and prizes might have affected the behaviour of existing players. One participant was under the impression that playing

for a higher stake was a more enjoyable experience because it gave the player more options within a game. He thought that the increase in the maximum stake might have encouraged existing players to play for higher stakes.

In contrast, other participants believed that the increase in stakes and prizes was largely irrelevant to existing players. One operator pointed out that the average stake on its machines before the Uplift was introduced had been only 80p. The vast majority of players had been betting only 50p or £1 per spin, which limited them to prizes of £1,000 and £2,000 respectively. As these people were playing for stakes and prizes below the limits available to them before the Uplift, according to this participant there was no reason to expect them to change their behaviour when the limits were raised. For the same reason, this participant believed that the Uplift would not lead to a rise in problem gambling.

The higher progressive jackpots available since the Uplift were felt to be attractive to many existing machine players, partly because they were available to all players regardless of their stake. One participant described progressive jackpots as "aspirational" – players knew that they were very unlikely to win but were willing to pay a small amount towards them, just in case. Another participant likened progressive jackpots to lottery rollovers which appealed to both regular and occasional players.

Existing table-game players

Players of table games were said to be different from machine players in several respects:

- Motivation. One participant believed that machines tended to appeal to "time-and-device players" who played for enjoyment and had a budget which they stuck to, while "gamblers", who played to make money, preferred table games.

- Spending power. It was generally agreed that high-spending players had in the past had little interest in machines because the stakes and prizes were too low.

- Gambling experience. Another participant said that machines were "entry products" and relatively "idiot proof" while tables were "more for the initiated". It was felt that table games had a cachet – among both players and casino operators – which machines lacked. As a result, players were seen as more likely to graduate from machines to tables rather than the other way round.

Participants believed that, despite the uplift, the stakes and prizes on machines were still too low to encourage "gamblers" or high-spending players to play machines instead of table games (or electronic versions of table games). They said that there was no reason to think that earnings from table games had suffered as a result of the Uplift.

Some participants wondered if the uplift might have encouraged a few table-game players to play machines casually – for instance, when taking a break from a table game to get a drink or make a 'phone call.

New customers

The increase in spending on machines was not thought to be because new customers were being attracted to casinos as a result of the Uplift. Admissions to Rank casinos since the start of the year were said to have been "pretty anaemic".

Some participants thought that some people visiting casinos who in the past would not have gambled at all might now be tempted to play machines. One thought that the "girlfriends and partners" of high-spending table players might not have bothered to play machines in the past, but might now do so when they found themselves in a casino. Another said that "leisure players" (occasional visitors, usually on a night out with friends) might be more inclined to play machines as a result of the higher stakes and prizes.

It was said to be common for every machine in a casino to be in use at peak times, especially at weekends. As a result, even if new customers were interested in playing it might be hard for them to do so.

Suggestions for the evaluation

Areas for investigation

Participants had various ideas for assessing the impact of the uplift. Suggested areas for investigation included:

- average stake (this was said to be important but potentially misleading if looked at in isolation, because players who staked more might play for a shorter time)
- dwell time (how long a player spends on a machine)
- level of overall loss per person
- frequency of play
- number of plays
- number of players
- player demographics

- comparing the behaviour of tracked players (those with loyalty cards) and untracked players

- whether any increases are attributable to new or existing players

Confounding factors

Several potential confounding factors for the evaluation were mentioned by participants:

- Casino-level factors – for instance, changes in products and promotions in casinos during the period under study (such as the introduction of any new games when converting the machines to higher stakes and prizes)

- Local-level factors – developments in the local area, such as the opening of a new entertainment facility or the closure of a large employer

- National-level factors – for instance, seasonal effects and changes in legislation affecting casinos or changes in the national economy

Appendix B: Data on casino visits, 2012-2014

Table B1.1: Number of visits to the casino (percentage of individuals), by year

Source: individual data

	2012 %	2013 %	2014 %
Once	57.58	57.08	55.51
2 to 5	29.16	29.14	29.74
6 to 10	6.29	6.33	6.58
11 to 25	4.47	4.59	4.93
26 to 50	1.54	1.75	1.91
51 to 75	0.49	0.54	0.60
76 to 100	0.21	0.25	0.31
101 to 150	0.16	0.21	0.27
more than 150	0.10	0.15	0.20
N	*298388*	*273853*	*257465*

Table B1.2: Use of B1 machines, e-roulette and table games (percentage of all visits), by year

Source: individual data

	2012 %	2013 %	2014 %
B1 only visits	16.89	18.98	20.78
e-Roulette only visits	25.19	24.21	26.47
Tables only visits	46.06	45.66	41.91
Tables and B1 visits	2.39	2.30	2.13
B1 and e-Roulette visits	4.16	3.83	4.23
Tables and e-Roulette visits	4.42	4.22	3.72
All three played	0.90	0.80	0.76

Table B1.3: Use of B1 machines, e-roulette and table games among men

Source: male individual data

	2012 %	2013 %	2014 %
B1 only visits	11.23	12.82	15.21
e-Roulette only visits	24.75	23.78	26.37
Tables only visits	52.64	52.71	47.79
Tables and B1 visits	2.26	2.17	2.11
B1 and e-Roulette visits	3.42	3.16	3.67
Tables and e-Roulette visits	4.81	4.58	4.08
All three played	0.90	0.78	0.76

Table B1.4: Use of B1 machines, e-roulette and table games among women

Source: Female individual data

	2012 %	2013 %	2014 %
B1 only visits	30.80	33.93	37.23
e-Roulette only visits	25.57	24.79	26.71
Tables only visits	30.31	28.78	23.62
Tables and B1 visits	2.79	2.70	2.47
B1 and e-Roulette visits	6.04	5.50	5.98
Tables and e-Roulette visits	3.55	3.43	3.16
All three played	0.93	0.87	0.84

Table B1.5: B1 spend (percentage of visits which included B1 play)

Source: individual data

Amount spent on B1 machines per visit	in 2012 %	in 2013 %	in 2014 %
Less than £20	51.84	50.56	47.60
£20 to £50	18.66	19.16	18.46
£50 to £75	8.04	8.30	8.65
£75 to £100	5.47	5.57	6.22
£100 to £200	10.00	10.19	11.53
£200 to £300	3.35	3.51	4.21
more than £300	2.64	2.71	3.32
Mean spend (£)	31.53	32.59	38.52
Median spend (£)	19.25	19.88	22.26
N	*290793*	*308470*	*342113*

Table B1.6: Time spent gambling (percentage of all visits)

Source: individual data

Length of visit (minutes)	2012 %	2013 %	2014 %
Less than 30 mins	33.99	34.49	33.47
30 to 59 mins	22.67	22.70	22.12
60 to 89 mins	13.82	13.75	13.70
90 to 119 mins	8.87	8.79	8.99
120 to 179 mins	10.08	9.94	10.46
180 to 240 mins	4.98	4.91	5.24
more than 240	5.59	5.42	6.03
Mean visit length (mins.)	78.02	76.82	80.24
Median visit length (mins.)	49	48	50
N	*1194892*	*1190445*	*1226251*

Table B1.7: Time spent gambling when visits included B1 play (percentage of visits which included B1 play)

Source: individual data

Length of visit (minutes)	2012 %	2013 %	2014 %
Less than 30 mins	32.39	32.35	30.51
30 to 59 mins	19.78	20.22	19.88
60 to 89 mins	13.46	13.64	13.76
90 to 119 mins	9.60	9.50	9.86
120 to 179 mins	11.85	11.80	12.42
180 to 240 mins	6.25	6.13	6.51
more than 240	6.68	6.37	7.07
Mean visit length	85.19	83.92	88.33
Median visit length	56	55	59
N	*290793*	*308470*	*342113*

Table B1.8: Time spent gambling in B1 only visits

Source: individual data

Length of visit (minutes)	2012 %	2013 %	2014 %
Less than 30 mins	40.07	38.81	36.17
30 to 59 mins	18.63	19.33	19.24
60 to 89 mins	11.99	12.39	12.85
90 to 119 mins	8.43	8.52	9.04
120 to 179 mins	10.40	10.49	11.19
180 to 240 mins	5.39	5.37	5.76
more than 240	5.09	5.10	5.74
Mean visit length (mins.)	73.40	74.12	78.74
Median visit length (mins.)	43	45	49
N	*201863*	*225917*	*254797*