The fool and the thief: a study of the UK Gambling Industry

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Abstract

This paper uses UK retail betting shop odds for football matches in both English and European divisions in the period 2000-2010. New entry within the online sector, where retailers are already operating, appears to break what is evidence of tacit collusion in industry betting overrounds. These are the bookmaker's mark-up on an individual match. This break appears at the beginning of the 2008-2009 football season. Whereas previous studies cite new entrants being at a disadvantage in the long run, I observe a new entrant gaining the position of market leader within a 10 year period. Although it looked likely from the outset, this entrant is found not to be the sole reason for the breakdown in the overround. Regulatory change coupled with Fixed Odds Betting Terminals (FOBTs), a new product introduced to the retail sector; provide a complementary hypothesis for explaining the change in the overround.

I am grateful to Bruce Lyons for his continued advice throughout this paper, alongside his teaching in 2009. I am also grateful to Catherine Ball for her help and guidance, and Steve Davies for his teaching in 2010, which was of the thought provoking nature that enabled me to develop this idea. I thank the useful suggestions of various attendees of the CCP Annual Conference 2010 and my peer group at UEA. I also gratefully acknowledge Mark Jeal, a former retail bookmaker turned online professional, for his assistance, knowledge and time given on interviews regarding the background of the industry.

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1.0 Section One.

1.1 Introduction to the UK Gambling Industry

I used UK football betting pre-match prices for the Premier League from three companies between 2000 and 2010. Two of these are the high street market leaders, Ladbrokes and William Hill, the other is the first large online betting website, Sportingbet. The prices come from an online football betting data website. Additionally, I am using explanatory variables such as online market growth, regulatory change and income levels.

The UK betting industry came into the public eye following the 1960 Betting and Gaming Act, which allowed traditional on course bookmakers to take their trade to the high street. This led to a 1990s peak of circa 15000 bookmakers; however the advent of online gambling has resulted in this figure slipping to 8862 in 2009[1]. Company specific data shows this in a different light. The large high street bookmakers, Ladbrokes and William Hill, have increasing numbers of shops opening during this period – a reflection that the industry is moving towards the oligopolistic platform on the high street that we observe today. Ladbrokes acknowledge this consolidation in their yearly reviews.

In the past decade, changes in taxation and regulation have played a pivotal role in altering market structure. Betting duty on a punters (consumers) wager was abolished in late 2001, and the market faced taxation on betting shop profits. In turn, year on year increases were observed in the average stake on betting slips, something which we observe from Ladbrokes end of year reports. Data from Mintel shows a 113% growth in betting from 2001-2005, a period when the popularity of online betting exchanges appears. The Economist states that in 2007 over two-thirds of the British public bet on at least one event. The growth on the interactive sector of the global industry is presented in the following graph from H2 Capital, a leading gambling analyst:

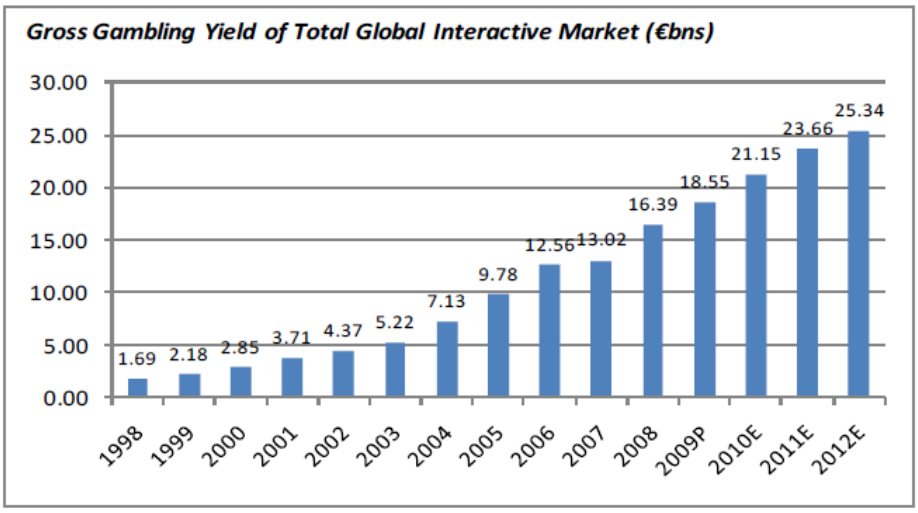

Figure 1: Interactive Gambling Market Growth

[1] Gambling industry statistics 2008-2009, Gambling Commission

The predominant growth has clearly come from interactive markets. This growth has been spearheaded by online betting exchanges. These exchanges differ from traditional bookmakers as they only act as an intermediary in the transaction. This allows punters to not only "back" something to win, but also "lay" it not to. Companies such as Betfair, the world's largest exchange who have 90% of the market in the UK and over half of the online betting market overall, display the best current back and lay prices like a financial market. Revenue comes from taking commission from whichever punter wins the bet. The result is in theory better, truer prices for the consumer. These platforms caused somewhat of a stir with the traditional bookmakers who felt unfairly treated, arguing those "laying" bets on the site should be seen as a bookmaker and taxed accordingly; currently gambling winnings in the UK do not face any taxation. They argued this taxation would push prices more in line with the bookmakers' level. In 2004, William Hill voiced this opinion to the government who conducted a review, but this was fruitless.

September 2007 saw the biggest change to date, with the full implementation of the 2005 Gambling Act. This gave way to increased government regulation of the online gambling market, and positive changes for the retail sector. The predominant change was that for the first time gambling operators were granted permissions to advertise through television and radio. Initially this faced a watershed restriction, however this has since been lifted and the technology exists to see live, "in play"[2] betting prices displayed during half time commercial breaks in televised football matches. Additionally, high street bookmakers were allowed to advertise betting prices in their shop windows, helping turn their image from a quasi-frowned upon outlet to an everyday establishment. Alongside this change for the retail sector was the extension of opening hours. Winter closing hours used to be capped at 6.30pm however this was lifted to create a year round closing hour of 10pm – meaning betting shops could be open for 12 hours a day. That being said, growth is still overwhelming online. The number of active customers for Betfair has grown from 95,000 in 2005 to over 2.5 million in 2009, reaching its 3 millionth customer in April 2010[3]. This incredible growth cannot be matched by the high streets traditional online subsidiaries; data from William Hill show a gain of 170,000 customers from 2005 to 510,000 in 2008.[4] The allowance of advertising is not the only factor that can be attributed to the online growth. Cheaper and more accessible broadband is a variable, as is the glamorisation of gambling towards young people through new media, in the form of films and music videos. Even the new James Bond is seen playing Poker, a game that is becoming increasingly popular with young males, instead of Baccarat.

[2] In play markets are now commonplace in the world of online betting. They allow consumers to bet whilst a sporting event is occurring, i.e. a team to win a football match when they are already leading at half-time.
[3] Source: Betfair PLC Online
[4] 2009 saw William Hill takeover another online company, vastly increasing customer numbers to 1.3 million, however these primarily related to the online casino games sector as opposed to betting. Source: William Hill PLC Online

The final and most important change seen in betting shops is the introduction of fixed odds betting terminals (FOBTs) into the industry. These are virtual mini casinos within a betting shop, offering games such as Roulette and Blackjack on a video screen. They are becoming highly controversial with problem gambling awareness groups, 60% of people referred to NHS problem gambling clinics citing them as one of their problem sources[5]. In 2009 alone they took industry wide profits of close to £1bn[6]. Interestingly, these machines are not allowed in betting establishments in Northern Ireland, only in their casinos[7]. There is widespread belief within the betting community that they are not only becoming the lifeblood of the retail arm of many companies, but that they are in turn hurting other markets. Horse racing slippage, the amount of bets made on races, is down 50% on its peak[8]. We will see how these machines have affected the price level and helped to maintain the levels of competitiveness for William Hill and Ladbrokes later.

The descriptive statistics show that September 2008 is when we observe a structural break in the industry. This asks the question as to whether regulatory change, the advent of online gambling, or FOBTs are the predominant factor for the observed shift toward competitiveness. I will use descriptive graphics alongside econometric analysis to determine which variable proves the most likely to be the cause.

1.2 Research question

This paper seeks to explain how changes in the industry over the past decade have altered the overround and levels of competitiveness within the market. It asks whether econometric techniques alongside theory will accurately show how changes in entry and regulation have affected the market structure. The possibility of previous tacit collusion in betting shop overrounds is fitting given the market breakdown; we will explore the theory behind this later. The initial descriptive statistics show a structural break in this mark-up following previous stability, further argument for tacit collusion. Again, these will be shown and discussed later. We will also look into the plausibility of enhanced prices being used as a leader strategy in order to attract customers to FOBTs. I will now review contributions previous literature has made to the study of market structure. This will be followed by a summary of the theory behind tacit collusion, and its own relation to this industry.

1.3 Literature Review – Papers on market structure

Research of market structure is vast. Papers study various aspects; concentration levels, firm numbers, market shares and firm entry/exit are just some examples. One of the most notable papers in relation to this research is the

[5] http://www.timesonline.co.uk/tol/news/uk/health/article5679309.ece
[6] Source: H2 Gaming Capital
[7] http://www.irishtimes.com/newspaper/ireland/2008/1021/1224454425896.html
[8] The Economist, June 2010

work of Bresnahan and Reiss (1991). Using ordered probit modelling and OLS they investigated how inter-industry competition between firms changed given market size, entry and number of firms in the market. The study was conducted across five retail and service industries. They find the majority of change in prices occurs when the market goes over from a 2 to a 3 firm industry. Little change happens in industries of 4+ competitors post-entry. When it comes to market structure and price information, Foros and Steen (2008) conduct a study on the Norwegian petrol station market's daily prices. They develop a theory of co-ordinated behaviour between the firms present in the market, bearing a resemblance to Edgeworth cycling. Both descriptive statistics using different variables and an econometric model were used, in doing so creating hypotheses of what factors were the main causes for co-ordinated activity. Further analysis in collusive behaviour is offered by Gupta (2002), who presents a paper which looks into anticompetitive behaviour in auction markets, specifically studying the US highway construction market. The paper seeks to discover the number of firms required within a market to break away from collusive prices. Using regression analysis, it is found six to eight bidders are required in the market for it to become competitive. Its results differ from previous studies that find this number to be around five. The above papers all point to what is indeed a commonly acknowledged fact within the literature by the majority – increased concentration is a foundation for higher prices. This bears importance when considering the consolidation in the gambling industry mentioned earlier. The minority of papers which reject this include widely cited works; Stigler (1964) finds that price levels are not overly responsive to firm concentration. In fact, I would draw on a nice quote on oligopolistic industries having to maintain *low* prices from Baumol (1982): *"It tells us that a history of absence of entry in an industry and a high concentration index may be signs of virtue, not vice"*.

Unfortunately, the data available is only from two of the top three firms in the industry, however these are the top two market share holders. When it comes to looking at tacit collusion later, this could be a problem. However, Harrington and Bos (2007) find evidence against the oft-cited thought of expecting to see all firms in an industry to be participating in an explicit cartel. Data from EC cases shows we are more likely not to have every firm participating; the citric acid cartel was composed of firms making up only 60% of global production. They find overall that the most stable cartels are not inclusive of all firms.
Papers on the order of firm entry and first mover advantage are discussed in section 5.

1.4 The theory of tacit collusion

The theory and research on collusion has been explored in depth, yet it still remains one of the greyest areas in Industrial Economics. Given the many facets collusion encompasses detection is difficult; the true number of colluding firms operating today is unknown.

Collusion is generally where observed prices are higher than we would expect to see in full competition. It predominantly comes in two forms; explicit, whereby firms agree on prices/outputs in the form of a cartel, or tacit, whereby firms are not unambiguously discussing prices, however the end result is a higher overall price level. So, what does tacit collusion have to do with this research? As I will now explore, the main well-regarded requirements for tacit, and to an extent, explicit collusion are observable in the industry being studied.

Taking a standard theoretical framework from Motta (2004), we can algebraically show the condition required for sustained collusion. Take an n firm industry within an infinitely repeated game. Current profits for firm i from colluding are denoted by π_i^c and discounted present value collusive profit V_i^c. Let current and discounted profits from deviating follow the notations π_i^d and V_i^p respectively. The discount factor, $\delta \in (0,1)$ and can be expressed in terms of the interest rate r; $\delta = \frac{1}{1+r}$. Using the above, we can express an incentive constraint for each firm for collusion to arise:

$$\pi_i^c + \delta V_i^c \geq \pi_i^d + \delta V_i^p \qquad i = 1, \dots, n$$

Thus, the lower profits from deviating are compared to collusion, coupled with lower profits under punishment, are tantamount to sustainability. Rearranged in terms of the discount factor, we arrive at:

$$\delta \geq \frac{\pi_i^d - \pi_i^c}{V_i^c - V_i^p} \equiv \bar{\delta}_i \qquad i = 1, \dots, n$$

We see from the above that collusion is more likely to arise as the discount figure increases. $\bar{\delta}_i$ Represents the critical discount factor. One key assumption in this model is that of infinite repetition. In Slade (1987) an empirical study of tacit collusion finds that firms *"do better through repeated play than they would if they played the game only once"*. Here, market prices were observed on a daily basis, clearly a strongpoint given the importance of being able to quickly detect cheating. In my market, prices are given weekly, which is also a considerably short period. The shorter gaps in the time period lead to a higher value of δ, increasing the probability of tacit collusion.

1.5 The factors facilitating tacit collusion and papers which explore them

There is a problem with the above and tacit collusion in general, which is how to arrive at an increased price whilst not explicitly co-ordinating. Given communication is illegal, how would a firm like William Hill avoid setting odds too low and losing market share? This is where we move onto the structural factors that facilitate tacit collusion.

Firstly we must recognise that the more observable prices are to firms, the easier it is to collude. As early as 1964, Stigler wrote how increased transparency of prices facilitates collusive practice. There will always be a strong incentive to act competitively by lowering prices to take a larger portion of a market, which naturally must lead to a punishment for a firm. However, if a firm knows any deviation will be observed quickly and a punishment will

occur, they have no incentive to deviate. This is the first characteristic the market meets. This dataset, which contains 10 seasons of Premier League football betting data, comprises of 20 sets of weekly matches. The "prices" – home win, draw and away win, are published during the week and follow nationalised pricing[9]. The odds are displayed on digital screens in the majority of shops, and printed on weekend "quickslips" – satisfying our quality of transparent prices. Many shops openly publish best match odds guarantees, which get bad press from economists. Salop's (1982) findings are presented in Moorthy and Winter (2002) which states these policies remove incentives to undercut a competitor, enhancing the facilitation of a collusive price.

It is well recognised across both the academic literature and completed antitrust cases that a prerequisite for both overt and tacit collusion is a concentrated industry. Chamberlin (1933) is quoted in Tirole (1988) as being one of the first theorists to recognise a small number of identical firms alongside homogenous products would often deviate towards a collusive price. Ivaldi *et al* (2003) on tacit collusion state how collusion is more difficult when there are more competitors. Looking further, we see market share symmetries also having an effect on the likelihood of collusion. Motta (2004) states; *"if firms are symmetric, a lower number of firms is equivalent to a higher degree of concentration, which is therefore associated – ceteris paribus – with more likely (tacit or explicit) collusion."* For our industry, the Gambling Commission report of industry statistics for 2007-08 yields a three firm concentration ratio of 69%[10]. The above statistics also show that the top five firms, again by betting shop numbers, have over 80% of the market, our first sign that tacitly collusive activity could be accommodated. This idea is cemented in an experimental setting by Fonseca and Normann (2008) who conclude as concentration increases and markets become symmetric, prices rise between subjects. These test subjects had no communication, emulating tacitly collusive practice.

However, not all economists put faith in concentration ratios being the foremost element required to facilitate tacit collusion. Vasconcelos (2005) in relation to evaluating anticompetitive effects post-merger states that the *"Herfindahl-Hirschman index does not always provide a reliable guide to assess potential effects on the level of competition in the market"*. In fact, he believes cost structures are the most important element.

The threat of entry is a further factor in collusion. If William Hill and Ladbrokes were publishing prices that amounted to an overround of 150%, there would no doubt be an influx of new entrants. The sunk cost for a bookmaker in this scenario is minimal; a licence, a shop premises and a bankroll. At 150%, the variance of payouts coupled with the exposure of various outcomes is many times smaller than what is observed in the market today, so

[9] In the cases of companies studied. It is predominantly the same for all national chains; however I cannot be sure this is the same for some smaller chains in the UK.
[10] This is based on the number of shops. With revenue, this figure would no doubt be higher.

the bankroll need not be too large. I would hypothesise that the prices we observe could be following an accommodating strategy for existing independents, coupled with a lean and hungry strategy to warn off potential entrants. However, there is a large barrier to entry which I feel should be mentioned. Motta (2004) states, *"if a firm has participation in a competitor, even without controlling it, the scope for collusion will be enhanced."* To explore this further, I digress into another betting market, horse racing[11].

What was once the golden goose of the industry, horse racing has since fallen out of favour with younger customers. Originally, betting shops received radio commentary of meetings, however in 1986 laws changed and televisions were allowed in betting shops. As such, Satellite Information Systems (SIS) was created, aiming to broadcast live races to betting shops. By the late 1990's, it was widely available in shops throughout the UK. Nearly half of the company is owned by William Hill and Ladbrokes. A later change in the pricing policy of the company followed a quantity discount scheme, favourable to the large chains and somewhat discriminatory on independents. This classic example of vertical restraints in action is widely believed in the industry to be partially responsible for the decline of independent licensed betting offices in recent years, as their increased costs meant many could not maintain their position as an effective competitor.

Another feature of an industry that is needed to result in a tacitly collusive outcome is that of product homogeneity. In a market such as gambling homogeneity is present – there are only some very subtle differences between betting shops. Theory shows that since actual and perceived quality differences are grounds for alternative pricing strategies, those markets with homogenous goods who do not attempt to differentiate their product are more likely to sustain anticompetitive measures. In football betting specifically, it is hard to differentiate a betting slip on a win, lose or draw outcome. However, the problem for studies like this comes from the degree to which you can conclude products overall are homogenous. For example, the Nestle/Perrier merger case included the prerequisite that different brands of bottled water were perfect substitutes. This case concluded a merger would result in an increased likelihood of a tacitly collusive state. However, in the Airtours/ First Choice case, it was not contested that package holidays from one company could not be classed as a perfect substitute to another, due to differences in location, hotel quality, etc. This can be applied to our market. Firms such as PaddyPower differentiate their markets by offering rebates if certain events happen. For example, if a certain player scores during a match and your bet loses, you get the original stake back regardless. One of my observed companies, Ladbrokes, offered a free scratch card for any bet of £10 or more on this year's world cup.

[11] The following information comes from a meeting I had with a former bookmaker, since turned online trader, with over 25 years of experience in the industry.

There are further factors which have been explored, however this paper is not meant to be an investigation solely into tacit collusion.

1.6 Structure of remaining dissertation.

I will now review the data being used, some descriptive findings and the results of econometric analysis. I will continue onto concluding my findings.

2.0 Section Two

2.1 Introduction

In section 1.3 we find that entry into an industry where there are already three or more major competitors has little effect on prices. As to how this relates to tacit collusion, it is well established that smaller numbers of competitors make the chances of co-ordination more likely. This industry seems to hang in the balance; there are three large companies in the market. Given this, we may expect to see the new entrant, Betfair, have a substantial effect on overround figures. Coupled with regulatory change and the rise of online betting, this may be further increased.
The next section will explain the dataset, its variables and the model. This will be followed by some descriptive statistics and initial findings. I will then go onto the econometric analysis.

2.2 The dataset

The data comprises of many variables taken from different sources. I find later that some of these bear no statistical significance to the model, but include them here to show robustness of thought.

The main pricing data is taken from a UK football betting website, football-data.co.uk. Yearly data is available from the 2000/2001 season onwards. Previous seasons did not offer single match odds, only “treble” bets, whereby a consumer must get three (or more) outcomes correct in order to win. This was reportedly in place to stop any probability of individual match fixing. The data was vast – each season had individual game statistics for the match date, crowd attendance, referee, half and full time results, yellow and red cards, alongside others.

The overround price is the key to a bookmaker’s profit. This is the mark-up placed across all outcomes for a betting market. An overround of 1.125 implies for every £112.50 a bookmaker receives in bets, they expect to return £100 to punters and make £12.50 profit. For the data in the sample, each set of 360 games had individual overrounds for both William Hill and Ladbrokes. Each set of 360 was then divided into 4 periods, or “quarter seasons”, which over the 10 year period gave 40 observations for study. The William Hill price will form the dependent variable in my analysis. There were a total of 62 missing observations from the 3600 games for Ladbrokes, and 113 missing observations for William Hill. When averaging these prices into seasons, there are no missing observations. The

above was also done for Sportingbet, arguably the first major online bookmaker in the UK that still remains in the marketplace today. Unfortunately, price data is not available for the same fixtures listed for Betfair, who represent a major entrant and threat to the traditional market. The variable used to proxy for their presence in my analysis is the number of customers registered for Betfair. Although Betfair offer a differentiated product in its exchange service, it would be unreasonable to conclude their entry alone has generated a substantial increase in people deciding to place bets on sporting fixtures. Thus, customer numbers are a valid proxy for the amount of custom now taken away or split from the high street. The data was taken from company reports since 2001. The Gambling Act 2005, implemented in September 2007, is a variable presented in binary form, whereby 0 indicates the act is not in place and 1 showing where the changes took hold. The revenue William Hill received from Fixed Odds Betting Terminals is also recorded from yearly company reports. These terminals have seen a huge rise in popularity amongst betting shop customers following their introduction to the community in 2002. It is the view of many in the industry that without these machines high street betting shops would be very few in number given the amount of bets now placed online.

Given problems of endogeneity between the dependent variable, Premier League prices from William Hill, and the explanatory variable of Ladbrokes Premier League prices, I also took data from the same source of matches occurring in the UK Championship (formerly Division One) and League One (formerly Division Two). I also used data from La Liga, the Spanish equivalent of the Premier League. This has gone through the same data cleanup process as the Premier League data, and for William Hill there are 3 missing quarterly observations in total. A final variable is the number of internet users in the UK, which is taken from the ONS.

I will now look at the data in-depth, before moving onto descriptive findings.

William Hill

Variable	Obs	Mean	Std. Dev.	Min	Max
williamhilpl	40	1.114192	.0215666	1.065068	1.125801
whchampion~p	39	1.123465	.0055037	1.095998	1.131373
whleague1	39	1.120637	.0057365	1.102281	1.125739
whlaliga	39	1.121248	.0088209	1.093941	1.126669
whfobtrev	40	1.83e+08	1.32e+08	0	4.16e+08

Figure 2: William Hill Data

The above shows the five variables for William Hill summarized from the dataset. The first is the overround price for the Premier League, followed by the Championship, League 1 and La Liga. The Premier League has the lowest minimum and lowest mean for the four overrounds studied. I would predict this is due to the league being the most popular with UK punters, especially later on in the timeframe when betting exchanges appear, forcing market prices down. We see the lowest value for revenue coming from FOBTs is 0. This is because at the start of this study they did not exist, their inception was in 2002.

Ladbrokes/Sportingbet

Variable	Obs	Mean	Std. Dev.	Min	Max
ladbrokespl	40	1.115616	.0171486	1.065918	1.126175
ladchampio~p	40	1.116597	.0146277	1.07615	1.126051
ladleague1	40	1.11531	.0147441	1.067394	1.124695
ladlaliga	40	1.12293	.0016032	1.117352	1.126598
sportingbe~l	40	1.102685	.0114187	1.081224	1.11655

Figure 3: Ladbrokes/Sportingbet Data

Here we see the price data collected for Ladbrokes. The lowest minimum value is in the Premier League; however the means for all the English leagues are very similar. La Liga never has a price below 1.1173, a possible indication that since there is less interest in Spanish betting markets Ladbrokes focuses their competitive energies elsewhere. I have also included Sportingbet Premier League data to reflect the initial online market. Although it is not used in the econometric study, it appears in the descriptive statistics later. We observe both lower average and maximum overrounds.

Further explanatory variables; Internet users, the Gambling Act and Betfair customers

Variable	Obs	Mean	Std. Dev.	Min	Max
ladbrokespl	40	1.115616	.0171486	1.065918	1.126175
ladchampio~p	40	1.116597	.0146277	1.07615	1.126051
ladleague1	40	1.11531	.0147441	1.067394	1.124695
ladlaliga	40	1.12293	.0016032	1.117352	1.126598
sportingbe~l	40	1.102685	.0114187	1.081224	1.11655

Figure 4: Other explanatory variables

The number of UK internet users is the first variable looked at. Unfortunately I was unable to obtain any indicative data for 2010, as opposed to other variables where I could obtain quarterly results.[12] In 2000 the number of users was 19.8 million, approximately one third of the UK population at the time[13]. We see in 2009, this figure topped 51.4 million, around 83% of the population now having access[14]. When it comes to this variable explaining the overround of William Hill, I would expect to see the number of internet users having a negative coefficient. This is down to the presumption from initial research that the brick and mortar bookmakers were ill prepared for expansion of the online sector and fell victim to online businesses taking the market from underneath them. I faced a problem here in getting yearly data to make into quarters, however upon consulting with others felt it fine to have the same figure over four periods.

The UK Gambling Act is a binary variable, hence the 0 minimum and 1 maximum. It comes in the last quarter of 2007. The sign on this coefficient is slightly tougher to predict. Given the changes it made in advertising, some

[12] For the football price data, this was not a problem – the 2009-10 season finished on the 9th May.
[13] 2001 UK Census data reports the UK population being 58.78 million.
[14] 2009 ONS data, UK population reaches 61,792,000.

would argue that there is now a greater opportunity to differentiate a homogenous product and take market share, with increased possibility of price wars. This being the case, we would expect to see a negative coefficient. However, when prices are more transparent in the marketplace through advertising this can lead to sticky prices and even increased price levels. Studies on comparison websites have shown that price competition between firms is found to monotonically decrease, even though these sites are thought of by the general public as places to hunt out a bargain[15].

Betfair customer numbers are 0 at the start of this study. The first report for the company in 2001 has their customer numbers at 1500. By the end of the 2006-2007 season they had reached 0.5 million, and by the end of the 2009-2010 season this figure stood at 3 million customers. In order to correlate this data with the quarterly price data, and given its importance to the study, I split it into a moving average. To compute these figures, I calculated as follows

$$\frac{2002Y-2001Y}{4} + 2001Q4 = 2002\,Q1 \qquad where\ Y = Year, Q = Quarter$$

The growth was rapid and I believe it will become important in my later analysis. I am aware this leaves a piecewise linear curve; however that is a minor technicality. Clearly, I would expect to see a high statistically significant value on this variable no matter whether we are looking at explaining the differences in overrounds between the two big high street betting shops or their own figures. For the latter, I expect to find a strongly significant negative value. Given a new entrant has taken such a large market share, and is pricing well below the existing competition, it is only natural to assume we will see a drop in the overrounds.

The absolute overround difference

Variable	Obs	Mean	Std. Dev.	Min	Max
ladbrokespl	40	1.115616	.0171486	1.065918	1.126175
ladchampio~p	40	1.116597	.0146277	1.07615	1.126051
ladleague1	40	1.11531	.0147441	1.067394	1.124695
ladlaliga	40	1.12293	.0016032	1.117352	1.126598
sportingbe~l	40	1.102685	.0114187	1.081224	1.11655

Figure 5: Absolute price difference

The above variable measures the absolute difference between overrounds for William Hill and Ladbrokes. We see a very low mean - on average there was a mere 0.4% difference between the overrounds, with one quarter having a minimum of 0.01%. I will analyse this further in the next section, graphical analysis.

[15] See Shy and Aluf (2001)

2.3 Graphical Analysis

To begin, I will look at the overrounds of William Hill and Ladbrokes over time. I will then look at five other graphs which I feel bear importance. Given the number of variables in the dataset I could expand further, however I do not want to detract from the explanatory power of the graphs which follow.

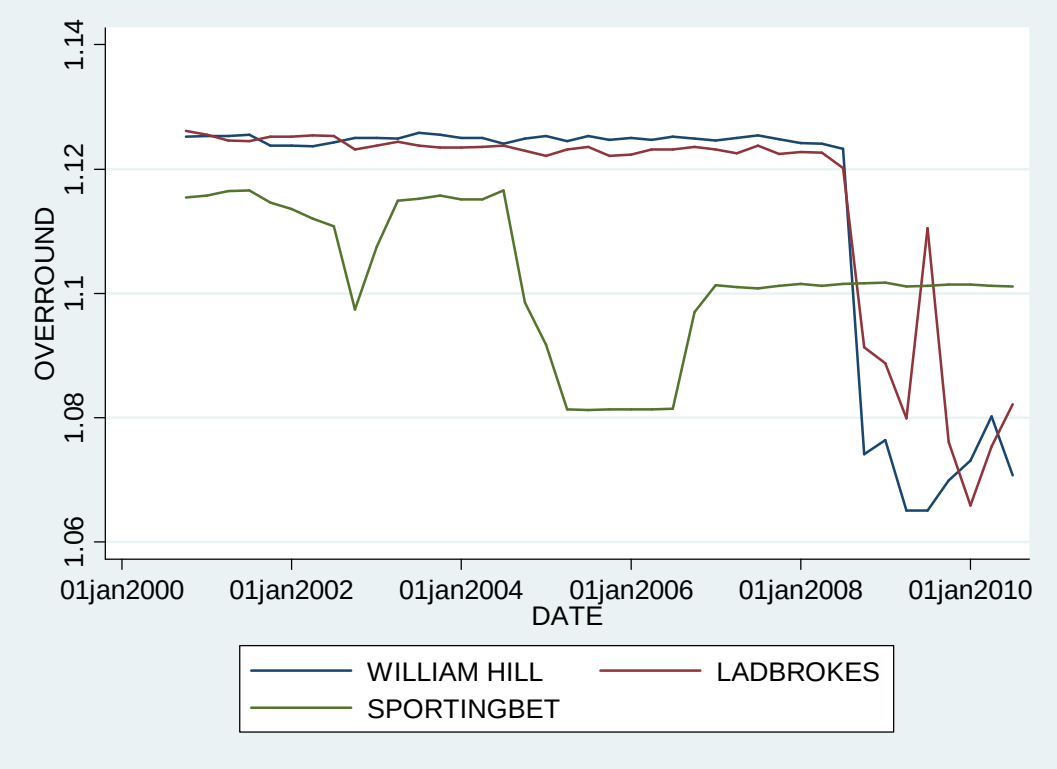

Figure 6: Overrounds over time

The above shows the overrounds for our two predominant high street companies, William Hill and Ladbrokes, alongside Sportingbet, our online comparative. We can observe classic traits of tacitly collusive overrounds between William Hill and Ladbrokes in 2000-2008. Predominantly William Hill have the slightly higher figure, which is interesting given they have the largest market share. It appears there is a structural break in activity in middle-late 2008, which is the start of the 2008/09 football season. It is noteworthy that this breakdown appears to leave a period of jostling where William Hill is offering the greater enhancement of prices[16]. Furthermore, the flux of overrounds is reduced over time, suggesting that they may be moving towards a new equilibrium following the breakdown. First half figures for Sportingbet also suffer a period of unrest, however this disappears around the beginning of the 2006/07 season and we observe relative stability. Ignoring the first trough of the Sportingbet figures, we see the arguable equivalent of the William Hill/Ladbrokes break occurring some four years earlier. As we will observe later, this period is when betting exchanges such as Betfair are gaining in popularity with bettors. This decline in overround could quite possibly be a reaction to increased competition for Sportingbet, who were

[16] In Betting, "enhanced" prices is commonly used to describe odds which are more favourable to the consumer than usual.

until this point the market leader[17]. Now that there is an overview of the overrounds, I will look at the 3 main explanatory variables.

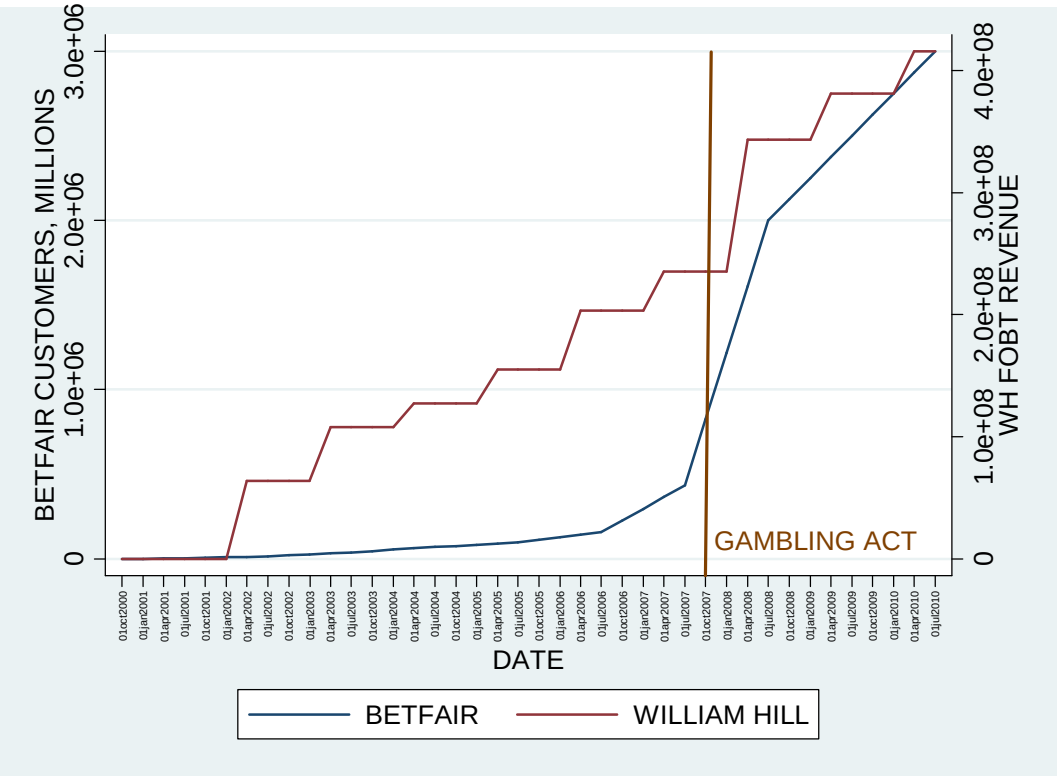

Figure 7: Explanatory variables. Betfair customers (Y axis 1), William Hill FOBT Revenue (Y axis 2), Gambling act implementation.

The above shows the 3 main explanatory variables which I feel will be the most significant in our model explaining the price level. Internet users are omitted. They also rise but are more important as a structural variable for describing Betfairs growth. For robustness purposes it will be included in the econometric analysis. We see that the line for William Hill FOBT revenue shows much more steady growth that of Betfair customer numbers, where there is a rapid expansion. Interestingly, the largest periods of growth for both FOBTs and customers occur at similar times. These periods are both just after the implementation of the Gambling Act, which had significant effects on both companies.

Firstly, it relaxed advertising laws on the television. It is not unreasonable to draw from this that increased advertising from Betfair may be a contributing factor to their customer growth. That being said, a brief investigation of their advertising strategies sees online based advertising alongside sponsorship of horse races and high-end clubs such as Manchester United and FC Barcelona taking much of their focus. William Hill has expanded their TV advertising; this may have drawn more customers into their betting shops. It remains in my

[17] It should be stated that although Sportingbet were indeed the market leader at this point, the UK was a somewhat small proportion of their custom, with Scandinavia being one of the largest.

mind that the second change, extending opening hours, is undoubtedly the underlying cause for the jump in growth preceding the act for brick and mortar bookmakers. Based on the above, it is evident that these three factors, culminating over a similar time frame to that of the structural break, should be significant in our econometric analysis. Untangling which effect is greater will be a challenge. I will now go into some specific analysis using the explanatory variables on the price level.

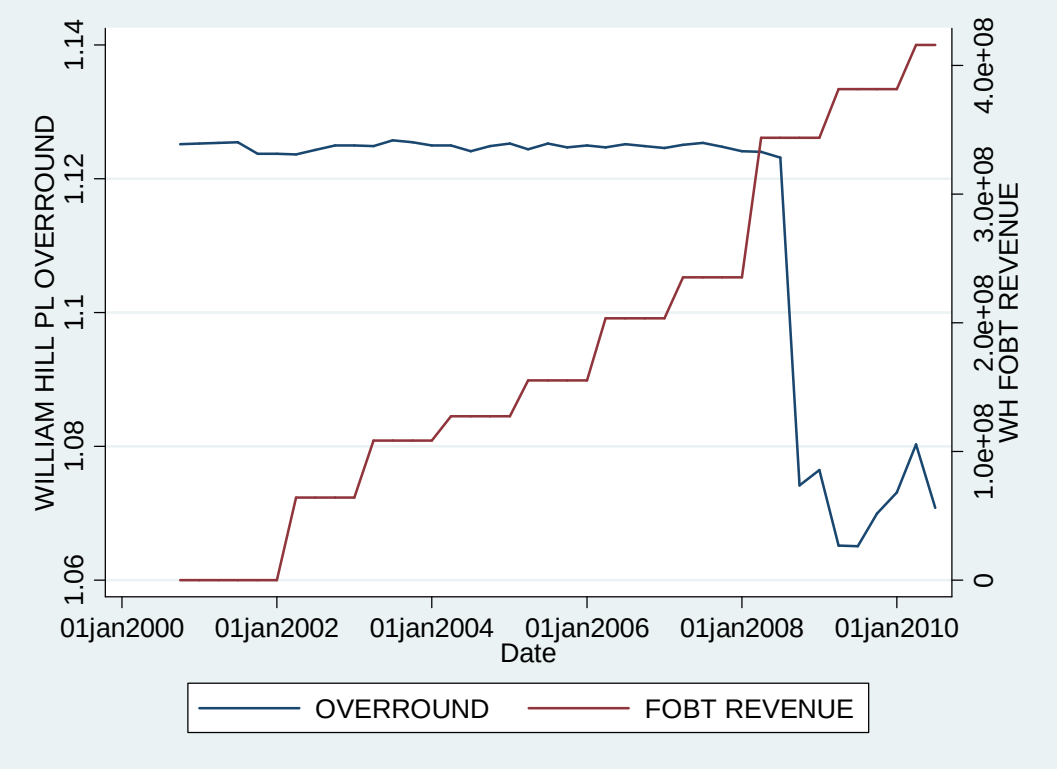

Figure 8: William Hill Overrounds (Y axis 1), Revenue from FOBTs (Y axis 2)

Fixed Odds Betting Terminals are showing strong growth across the period. From their inception in 2001, they now contribute over £400m in revenue per year for William Hill, 48% of revenue in their retail outlets comes from FOBTs versus 52% actual bets[18]. This is a strong argument that these are becoming lifeblood for the retail arm of what now is becoming an increasingly online business.[19] The above suggests that FOBT growth may also be an explanatory factor for the drop in overround prices. A "loss leader" is where a retailer may offer a product at a price which yields a *loss* to them in order to get customers to their premises. This may yield a short turn return, i.e. the customer buying other products from the retailer where previously they would not have visited, or a long term return, where the customer becomes a repeat purchaser as a result of the offer. Given the overround is not negative,

[18] William Hill Annual Report, 2009
[19] The last study of FOBT's was conducted by the gambling commission in 2005. They were found not to be a cause for concern in terms of problem gambling. 2009 figures of their gross win was nearly £1bn – I echo many calls for a review.

it cannot be classed as a loss leader *per se*, however there may be an argument for enhanced retail odds being observed in order to obtain another form of revenue from the FOBTs. This is an interesting hypothesis which is somewhat beyond the scope of this paper to explore, it does however does leave open an interesting facet for future research. This variable will be used in the econometric analysis which follows this section.

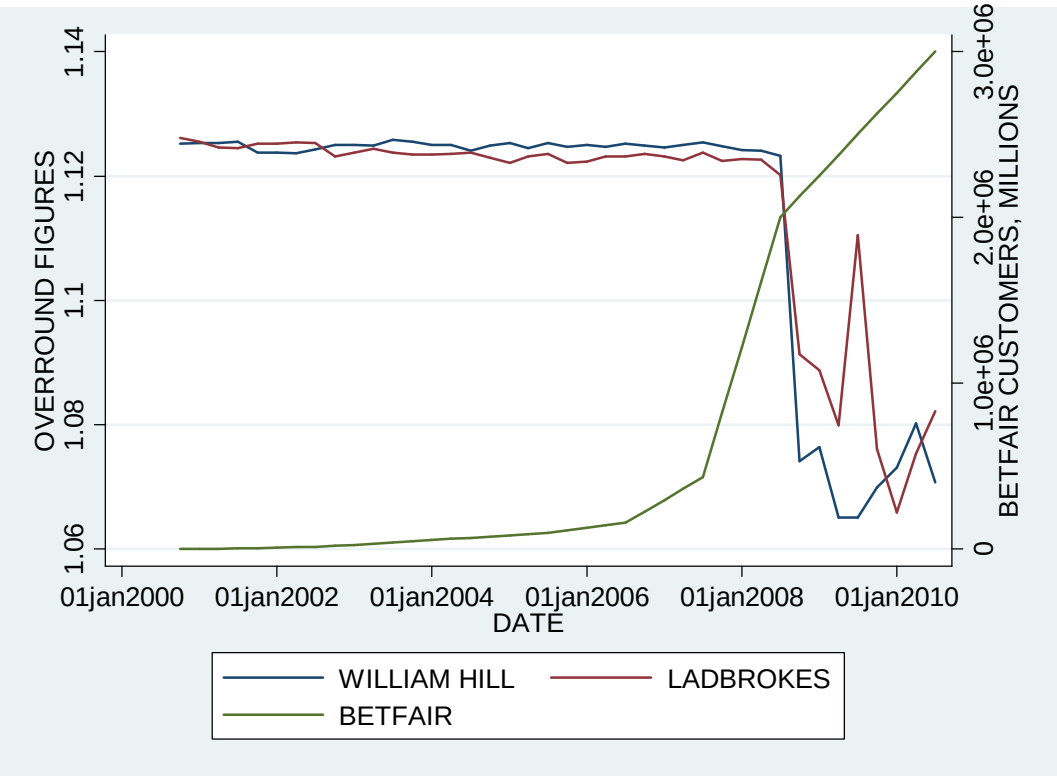

Figure 9: William Hill and Ladbrokes Overrounds (Y axis 1), Betfair customer numbers (Y axis 2)

Again we are using William Hill and Ladbrokes overround figures together, this time with Betfair customer numbers. We can see that since Betfairs inception at the beginning of the dates studied they have reached a peak of 3 million customers. We also see rapid growth between 2007-2008 and a slowdown in 2009-2010. The most important message to take from this graph is that there appears to be a clear correlation between the number of Betfair customers rising and the overround figures decreasing for William Hill and Ladbrokes. Furthermore, the rapid expansion of growth we see in Betfair is immediately followed by the structural break in what we believed could be evidence of tacit collusion. Therefore, one aim in my econometric model will be to establish whether or not Betfair customer numbers have made a significant difference to the price level, and where this threshold of Betfair customers before the break might be. Another aspect of this analysis which I seek to explain is whether or not there is evidence that the curtailing in growth of Betfair customer numbers can be attributed to this enhancement of odds by high street bookmakers. There is more than one effect that needs to be explained here; whether or not Betfairs growth has disrupted tacitly co-ordinated pricing, and whether or not in turn this breakdown has curtailed Betfairs own growth.

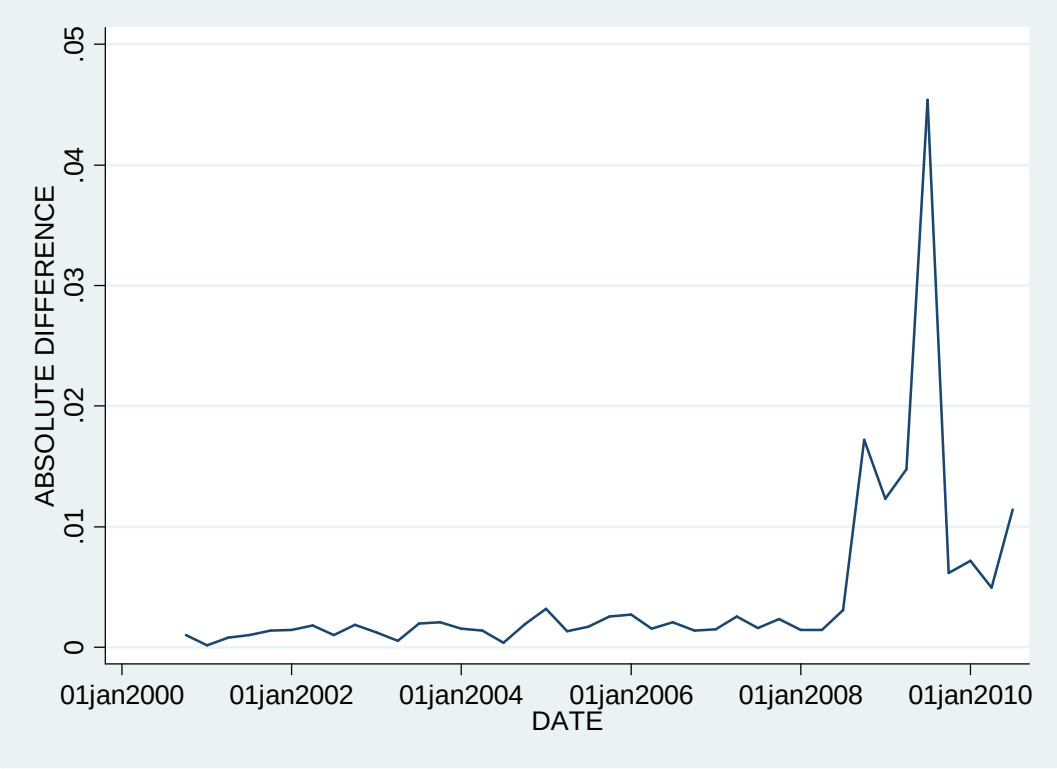

Figure 10: Absolute values of price differences over time.

The explanatory power of our overround figures above can be better presented by using the absolute values. These figures are calculated by subtracting William Hill's overround from Ladbrokes, squaring the result then taking the square root to give all positive figures[20]. The above shows this difference over time. On the Y-axis, 0.01 = 1 percent. We cannot observe a figure above ~0.03 until we reach the beginning of the 2008/2009 season. The difference in prices has its peak at around 0.045, with the height of the flux being mid 2009. It is appearing to settle, however another few years of data would be preferable to see whether or not the companies are able to stabilize into a new equilibrium. This highlights one aspect of tacit collusion; once it is broken a new focal point for price levels can be from one of many multiple equilibria – the above shows the jostling towards this point. The above can leave us with an interesting section in our econometric analysis as to what has caused the flux observed. My main "hunch" is that Betfair customer numbers will be the main factor, although that remains to be seen. I will now look at how Betfair numbers and the above values interact.

[20] In STATA, I used the abs( ) command

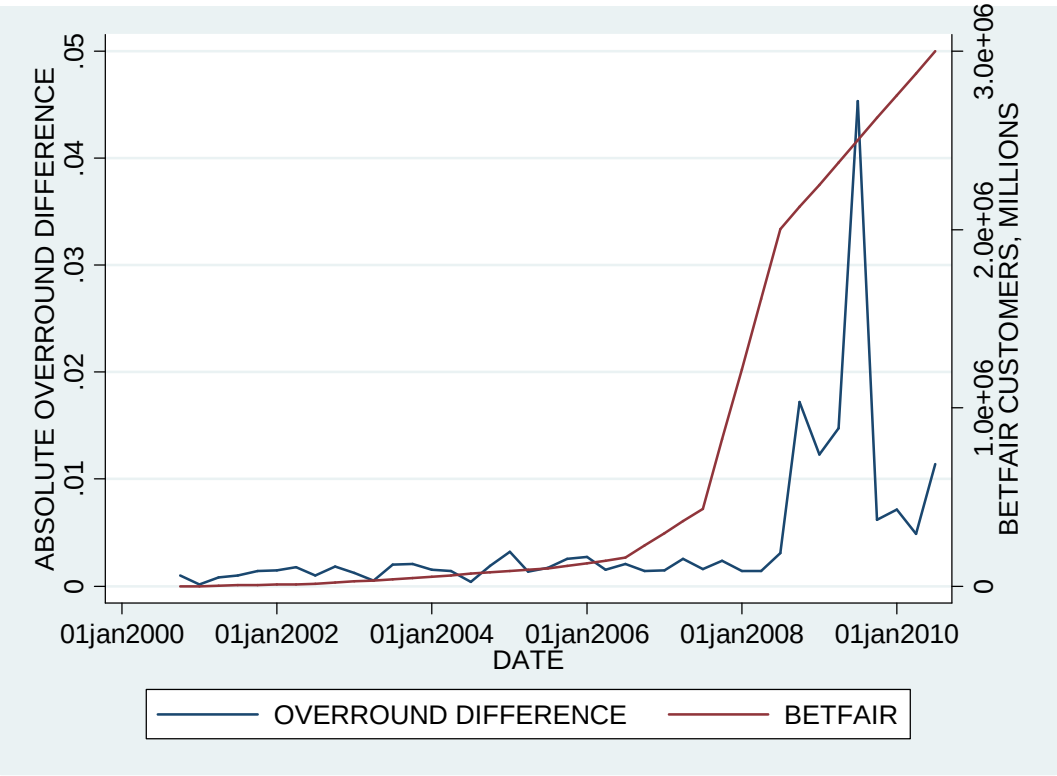

Figure 11: Absolute values of price differences, Betfair customer numbers, over time.

It is unequivocal from this graph that we should see a significant effect of Betfair customer numbers on the difference in prices. There is a clear lag between the upward trend of Betfair prices and the later change in the absolute overround differences, reinforcing the likelihood of Betfair being a large factor for the breakdown. However, we saw when looking at William Hill's overround that there was a drop following a jump in FOBT growth, so we cannot say inexplicably that Betfair is the largest factor.

The above also highlights a previous point well. We can see that Betfair growth does start to tail off from 2008 onwards, which is when we observe our structural break. It may still be then that the competitive shift experienced in retail betting has had a knock-on effect on the online market.

With the graphical analysis complete, I shall summarize what we have seen so far. Section 1 gave an overview of the market, one which is a natural experiment in progress. In the past 10 years various changes to its structure, notably the growth of the online gambling industry, has resulted in a shift away from previous price levels. The theory of tacit collusion discussed in section 1.4 alongside the qualities the data presents leaves it reasonable to say there is some evidence of possible tacit collusion in the industry between the two major players.

The dataset used is informative and a rich resource and section 2.1 gave a good overview of the variables it is composed of. The adaptation to summing data into quarters may be seen as a loss of strength when it comes to the econometric analysis, but this had to be done. The graphical analysis above leaves us with three main questions to address in the analysis, which follows this section.

3.0 Findings and Observations

3.1 Introduction

The econometric analysis is divided into three parts. The first will explain the overround. The second will investigate the question of whether Betfair has caused a drop in the overround, and in turn if this reduction has caused a drop in Betfairs own growth. The final section will look into the threshold of Betfair customers which was crossed causing the structural break, allowing a comparison of what constituted the prices before and after this breakdown.

3.2 Explaining overround changes using Instrumental Variables

In order to evaluate how the various changes in the industry over the period have affected the price level, the correct econometric technique is essential. Here, I will estimate the factors behind William Hill's price level. Given the number of explanatory variables available, it makes sense to use Ordinary Least Squares (OLS) estimation to explain why the dependent variable is at that level. However, it is not that simple. We know that an essential quality for a true OLS estimation is that the error term is unrelated to the regressors, i.e. $E(u|x) = 0$.[21] If this fails to hold, OLS is no longer *consistent* and we cannot rely on it to explain our price level. This is the endogeneity problem. In our case, this is very likely if we regressed the William Hill overround against the Ladbrokes overround for the same football matches. Although they may be pricing independently, the previous graphical analysis indicates the OLS output will appear as if William Hill follow Ladbrokes very closely given how similar their overrounds are. Thus, we must arrive at a solution that resolves the problem.

The most common way around this is to use Instrumental Variables. The Instrumental Variables (IV) regression leaves us with a *consistent* estimator provided the correct instruments are available. Again from Cameron and Trivedi, we can say that "*the instruments, z, are variables that are correlated with the regressors x, that satisfy $E(u|z) = 0$*". Although this sounds simple, it has one major problem, in that getting reliable instruments that are also not endogenous is very difficult. In my approach to this I considered using the number of Ladbrokes shops and Ladbrokes revenue; however these may also be correlated. I arrived at the use of pricing data for similar products but in different markets. Collecting Ladbrokes football betting price data from the UK Championship (formerly Division One), UK League One (formerly Division Two) and Spain's La Liga, I sought to overcome this problem.

[21] See Cameron and Trivedi, Microeconometrics using STATA, (2009)

It was explained in section 2.1 how this data was computed.

After alternating the equation with different combinations of variables, the estimation became:

$$WHpricePL = \alpha + \beta_1 BF + \beta_2 InternetUsers + \beta_3 GA + \beta_4 FOBTrevenue + \beta_5 LADpricePL$$

Where WH= William Hill, PL =Premier League, BF = Betfair customer numbers, GA = Gambling Act, LAD = Ladbrokes.

Given the problems of endogeneity established above, Championship and League 1 data was used to instrument Ladbrokes Premier League overrounds. La Liga was not needed.

Regression results:

Variable	Obs	Mean	Std. Dev.	Min	Max
ladbrokespl	40	1.115616	.0171486	1.065918	1.126175
ladchampio~p	40	1.116597	.0146277	1.07615	1.126051
ladleague1	40	1.11531	.0147441	1.067394	1.124695
ladlaliga	40	1.12293	.0016032	1.117352	1.126598
sportingbe~l	40	1.102685	.0114187	1.081224	1.11655

Where * and ** indicate statistical significance and strong significance respectively

Figure 12: Instrumental Variables Regression of William Hill's price level against explanatory variables

We can see from the above that the Ladbrokes Premier League overround instrumented by Championship and League 1 overrounds is strongly significant. Its coefficient is .78, indicating that it does have a positive effect on the William Hill overrounds. Of course, this does not allow us to say they are using Ladbrokes mark-ups in order to determine their own, however it being strong and positive does help the evidence presented before this in the graphical analysis. The other strongly significant variable is Betfair, which has a negative value. Putting it numerically, 3 million Betfair customers reduce the William Hill overround by 0.031, or 3.1%. As evident in our graphical analysis, we expected this negative value to be the case. As the number of customers for Betfair rise, William Hill finds themselves lowering their overround in order to compete.

The numbers of internet users are found not to be significant in this regression. This is understandable. Although we expect to see the number of internet users affecting Betfair, and Betfair affecting the William Hill price level, this does not mean the internet user level will necessarily affect William Hill.

The final two variables are both found to be significant. The Gambling Act implemented in 2007 is found to have an ever so slightly positive coefficient, something I was not expecting. The extension of opening hours and relaxation of advertising restrictions intuitively suggests more room for competitiveness. However, this suggests it has allowed for a marginal increase in the overrounds. Explanations for this could be because of increased transparency in prices to the consumer; earlier cited papers looked at how transparency levels aid this type of activity. However, the effect is so marginal that although the above is interesting, it is probably not the case. A positive and significant coefficient is assigned to the revenue for FOBTs. If we use this value with the revenue of

FOBTs in 2009, we see it accounts for 0.01 of William Hill's overround.

As an interesting aside, and to grasp how different the IV output was compared to using OLS, I also ran an OLS regression. The results are below:

```
. reg  williamhillpl  bfcust2  internetusers gamblingact whfobtrev ladbrokespl

      Source |       SS       df       MS              Number of obs =      36
-------------+------------------------------           F(  5,    30) =  228.65
       Model |  .009184754     5  .001836951            Prob > F      =  0.0000
    Residual |  .000241018    30  8.0339e-06           R-squared     =  0.9744
-------------+------------------------------           Adj R-squared =  0.9702
       Total |  .009425771    35  .000269308           Root MSE      =  .00283

------------------------------------------------------------------------------
williamhil~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     bfcust2* |  -8.70e-09   3.37e-09    -2.58   0.015    -1.56e-08   -1.82e-09
internetus~s |  -1.08e-10   1.44e-10    -0.75   0.458    -4.02e-10    1.86e-10
 gamblingact |   .0072938   .0038382     1.90   0.067    -.0005448    .0151325
   whfobtrev |   2.96e-11   1.56e-11     1.90   0.067    -2.24e-12    6.15e-11
Ladbroke~l** |   .8390772   .0924882     9.07   0.000     .650191     1.027963
       _cons |   .1833156   .1050935     1.74   0.091    -.031314     .3979452
------------------------------------------------------------------------------
```

Where * and ** indicate statistical significance and strong significance respectively

Figure 13: Ordinary Least Squares Regression of William Hill's price level against explanatory variables.

Under OLS, the only strong statistical significant variable is Ladbrokes price. Betfair customers are significant, whereas the Gambling Act and FOBT revenue are only weakly significant. Internet users are again found to be insignificant.

The differences between the two outputs are below:

Variable	IV Regression	OLS Regression	Difference
Ladbrokes PL	0.7843683	0.8390772	-0.0547089
Betfair Customers	-0.0000000104	-0.0000000097	-0.0000000007
Internet Users	-0.000000000133	-0.000000000108	-0.000000000025
Gambling Act	0.0088488	0.0072938	0.001555
FOBT Revenue	0.0000000000334	0.0000000000296	0.0000000000038

Figure 14: Differences between IV and OLS analyses.

The signs on all explanatory variables are the same. The instrumented variable, Ladbrokes PL, gives a 5 percent lower figure under IV than OLS. We previously applied the Betfair coefficient under IV for the current customer numbers to give a -0.031 change to William Hill's price – i.e. 3.1% reduction of the overround. Under OLS, this figure is -0.029, suggesting it has a slightly less negative impact than IV finds. Internet Users are statistically insignificant in both examples; the difference between the two estimates is very small. The difference in estimates

for the Gambling Act is also small, and remains positive. For FOBT revenue the figure is also still positive, but again is slightly less than the IV estimate. Under 2009 levels of revenue, this would attribute to 0.0118 of the price under OLS, as opposed to 0.013 under IV.

3.3 Observing Betfair growth on William Hill and William Hill overround change on Betfair.

The next part of the econometric investigation seeks to establish an answer to the question which became apparent in the graphical analysis. It could be the case that although Betfair appears to have reduced the price level for William Hill and Ladbrokes, the corresponding change has resulted in Betfairs own growth being curtailed. In order to look at this problem, I will again use Instrumental Variable two stage least squares analysis. Firstly, we run the following regression:

$$William\ Hill\ PL = \alpha_1 + \beta_1 GamblingAct + \beta_2 FOBTRevenue + \beta_3 BetfairCustomers$$

However, we instrument Betfair customer numbers with the number of internet users. I feel this is the most valid instrument as Betfair has a direct effect on William Hill, and internet users have a direct effect on Betfair, but it is doubtful the number of internet users has a direct effect on the retail arm of William Hill. The output is displayed below:

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      36
-------------+------------------------------           F(  3,    32) =   32.18
       Model |  .007766848     3  .002588949            Prob > F      =  0.0000
    Residual |  .001658923    32  .000051841            R-squared     =  0.8240
-------------+------------------------------           Adj R-squared =  0.8075
       Total |  .009425771    35  .000269308            Root MSE      =   .0072

------------------------------------------------------------------------------
williamhil~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     bfcust2* |  -1.89e-08   1.07e-08    -1.76   0.088    -4.07e-08    3.00e-09
 gamblingact |    .011572   .0148121     0.78   0.440    -.0185992    .0417432
   whfobtrev |   1.91e-12   3.68e-11     0.05   0.959    -7.30e-11    7.68e-11
       _cons |    1.12642   .0034878   322.96   0.000     1.119316    1.133525
------------------------------------------------------------------------------
Instrumented:  bfcust2
Instruments:   gamblingact whfobtrev internetusers
```

Where * and ** indicate statistical significance and strong significance respectively
Figure 15: 2SLS Regression of William Hill's price level with Betfair instrumented

We see from the above that Betfair still has a negative coefficient. This number is minute given it refers to each individual customer, but for illustrative purposes if we use the current number of customers (~3 million), this has a value of -0.056.[22] Interestingly, taking the coefficients for FOBT revenue against Betfair and calculating their value

[22] I am aware that only the coefficient for Betfair is statistically significant, and this is weakly so (P<0.1). This is

in William Hill's price has them nearly offsetting each other. However, given the p-value associated with FOBT revenue it is hard to draw much from this.

Now that we have re-established using a different method that Betfair growth is a cause for the drop in overrounds, we will change our structural equation to accommodate the second part of our question; has this drop restrained Betfairs own growth?

This equation becomes:

$$Betfair\ Customers = \alpha_1 + \beta_1 InternetUsers + \beta_2 FOBTRevenue + \beta_3 WilliamHillPL$$

Given the above analysis confirmed that customer numbers affected the price level, we cannot simply regress Betfairs customer numbers on the price level to determine whether this effect is true the other way round. When estimating the above problem econometrically, we must again use IV. The instrument used for William Hill Premier League prices is the Gambling Act. Our previous analysis showed this had a direct effect on the price level, and although it may have made a minor impact on Betfair, the act itself was more for company regulation than consumer gain, and thus serves as a suitable instrument.[23] Below are the regression results:

```
Instrumental variables (2SLS) regression

      Source |       SS       df       MS              Number of obs =      36
-------------+------------------------------           F(  3,    32) =    8.90
       Model | -2.6492e+12     3 -8.8308e+11           Prob > F      =  0.0002
    Residual |  3.3181e+13    32  1.0369e+12           R-squared     =       .
-------------+------------------------------           Adj R-squared =       .
       Total |  3.0531e+13    35  8.7233e+11           Root MSE      =  1.0e+06

------------------------------------------------------------------------------
     bfcust2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
williamhil~l*|  -1.09e+08   6.30e+07    -1.72   0.094    -2.37e+08    1.97e+07
internetus~s |   .0316247   .0644454     0.49   0.627    -.0996463    .1628958
   whfobtrev |  -.0052753   .0092032    -0.57   0.571    -.0240215     .013471
       _cons |   1.22e+08   7.01e+07     1.74   0.092    -2.11e+07    2.64e+08
------------------------------------------------------------------------------
Instrumented:  williamhillpl
Instruments:   internetusers whfobtrev gamblingact
```

Where * and ** indicate statistical significance and strong significance respectively

Figure 16: 2SLS Regression of Betfairs customer numbers with William Hill's price level instrumented

The above gives us our result. Only the instrumented price level is weakly significant. It has a negative value, suggesting as the price increases Betfair customer numbers decrease. To see if I could obtain different results, I also used FOBT revenue as an instrument. These results, are similar, and included in the appendix. Given we

understandable given the instrument used, as it is not the only variable attributable for Betfair growth. However, for the breadth of this paper I feel the results are still interesting.

[23] Furthermore, OLS regressions using Betfair with the Gambling Act as an explanatory variable yields an insignificant result.

expect internet users to effect Betfair customer numbers, this is not a valid instrument, and thus was not used.

Given the problems seen above of a lack of statistical significance, I turn to explanatory arguments in order to explain Betfairs growth tailing off after the flux in the overround figures. Predominantly, the logical explanation is that the growth Betfair experienced is not sustainable. Even if Betfairs odds are better than a high street bookmaker, it is not going to encourage a noteworthy amount of new consumers into the market. The fact the market has grown given the glamorisation of gambling within the media, alongside expansion in all online industries, is much more likely to be a factor in their growth. The curtailing shows signs of the market going towards a saturation point. This is not to say Betfair will stop recruiting new customers; given international markets opening and recent positive occurrences within the US regarding the UIGEA this is most definitely not the case[24]. However, I do feel the above data alongside the logical argument shows that there is little evidence to suggest retail price levels changing have affected Betfairs own growth.

3.4 Threshold Analysis

The final section of econometric analysis concerns finding the threshold of Betfair customers which is attributable to generating the higher variance in the absolute overround differences. In order to do so, I will run regressions of the absolute difference on the explanatory variables with a threshold condition in place. The model is estimated as follows:

$$AbsolutePriceDifference = \alpha_1 + \beta_1 BFCustomers + \beta_2 GA + \beta_3 WHFOBTRev + \beta_4 InternetUsers$$

Which is regressed twice with the conditions: $if\ BFCustomers < 100{,}000$ and $if\ BFCustomers \geq 100{,}000$. These are computed from 100,000 up to 3,000,000, 58 total regressions. I then combine the RSS figures from each pair of outputs, with the lowest total figure yielding the threshold level. I can than observe how the price difference is formulated before and after the change[25].

The full table of combined RSS figures is provided in the appendix. The threshold found is 2.1 million customers. The output is provided below:

[24] The Unlawful Internet Gambling Enforcement Act of 2006 prohibited banking institutions to process transactions from customers to online gambling sites, with exclusion only on Horse Racing. As a result, sites such as Betfair would no longer accept US customers. However, Bill HR2267 of Gambling Regulation, dubbed the "Barney Frank Bill", was passed in congress on the 28th July 2010. It seeks to bring regulation to the industry, and would allow sites such as Betfair back. It will now be passed to the House, followed by the Senate, before its inception. Source: www.govtrack.us.

[25] I thank Peter Moffat (UEA) for his advice on this aspect of the analysis.

Source	SS	df	MS	Number of obs =	32
Model	5.1932e-06	4	1.2983e-06	F(4, 27) =	3.26
Residual	.000010738	27	3.9770e-07	Prob > F =	0.0263
Total	.000015931	31	5.1391e-07	R-squared =	0.3260
				Adj R-squared =	0.2261
				Root MSE =	.00063

ORdiff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bfcust2	5.85e-10	8.52e-10	0.69	0.498	-1.16e-09	2.33e-09
gamblingact	-.0006665	.0009483	-0.70	0.488	-.0026123	.0012793
whfobtrev	-1.26e-12	3.61e-12	-0.35	0.730	-8.66e-12	6.14e-12
internetus~s*	5.84e-11	3.19e-11	1.83	0.078	-7.00e-12	1.24e-10
_cons	-.000454	.0008702	-0.52	0.606	-.0022394	.0013314

Figure 17: OLS Regression of the absolute price difference of prices against the explanatory variables when Betfair customer numbers are <2,100,000.

The output above shows how the price difference is formulated before the break. We see a positive coefficient on Betfair, indicative that the higher Betfairs customer numbers are, the larger the likelihood of a difference in prices. This was expected. 2 million customers would give a figure of 0.00117. This is attributable to ~0.11% of the overround. The number of internet users also has a positive coefficient. This is logical given an increase in internet users may also increase Betfair customer numbers.

The Gambling Act has had a marginally negative effect on the difference. FOBT revenue has a negative coefficient, suggesting as this increases stability of the price level is strengthened. Applied to the 2008 level of revenue, which is the year Betfairs average customers were 2 million, this gives a figure of -0.00029, ~0.029%. It is feasible to say that before the threshold of customer number is broken, FOBT revenue is able to account for roughly a third of any volatility Betfairs presence is causing, an interesting result.

The output of the model when Betfair customers exceed 2,100,000 is below:

Source	SS	df	MS	Number of obs =	4
Model	.000015935	2	7.9673e-06	F(2, 1) =	1.03
Residual	7.7198e-06	1	7.7198e-06	Prob > F =	0.5713
Total	.000023654	3	7.8848e-06	R-squared =	0.6736
				Adj R-squared =	0.0209
				Root MSE =	.00278

ORdiff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
bfcust2	2.99e-08	2.24e-08	1.33	0.409	-2.55e-07	3.15e-07
gamblingact	(omitted)					
whfobtrev	-1.74e-10	1.82e-10	-0.96	0.514	-2.48e-09	2.13e-09
internetus~s	(omitted)					
_cons	-.0075072	.0323344	-0.23	0.855	-.4183546	.4033402

Figure 18: OLS Regression of the absolute price difference of prices against the explanatory variables when Betfair customer numbers are >2,100,000.

The Gambling Act and internet user figures are omitted from the above to avoid multicollinearity. We see that the signs on the coefficients for Betfair customers and FOBT revenue have not changed. However, they have become larger. If we apply the same procedure as before using a value of 2 million customers, Betfair has a 0.0598 impact on overround, ~6%. Using the 2008 level of FOBT revenue, we obtain a figure of -0.041, ~4.1%. So, the growth in Betfair has increased the variance in the overround. However, the continued growth of FOBTs is helping to minimize the impact.

I will now move onto a dicussion of these findings.

4.0 Discussion

I now turn to the main synthesis of findings. Estimated above are models put in place to determine the factors behind the price level, the impact of Betfair customer growth on the price level and vice versa, and the threshold of Betfair customers which saw an increased variance of overround differences between the two high street betting shops. The questions to be asked here are the significance of these findings, how they affect the literature, and an evaluation of the methodology/materials used.

When looking at significance, it is my view that some results are to be held in higher regard than others. The first section on price levels using an IV regression gave light to interesting results. Figure 12 showed Ladbrokes prices have a significant impact on the overround for William Hill. Betfair also had a strongly significant value. FOBT revenue has a significant positive value, but was not the focus of this section. The most important thing to grasp from this part is the significance of the Betfair customer figure. It suggests that the rise in their customer numbers

has reduced the overround, an indication when combined with the graphics that the market was not acting under perfect competition before their entry. Given the nature of Betfair's business, which theoretically has them setting the risk neutral price with commission if a bet is won, makes them a very interesting entrant to study. Unlike a traditional analysis, where an entrant still prices a product to make a profit, this study involves looking at an entrant who comes in pricing a good very close to marginal cost. In doing so, they are now far and away the online market leader. Mueller (1997) wrote; *"If Coca-Cola should somehow manage to squander its advantage as market leader, it would be Pepsi-Cola that displaces it, not some upstart newcomer"*. So, our analysis adds nicely to the small amount of existing literature which challenges this traditional hypothesis that first mover advantage results in longer term increased profitability[26]. One example of this new literature is Boulding et al (2003), who find that this profitability only exists for the first twelve to fourteen years. In our case, William Hill, Ladbrokes and Sportingbet all were present in the online market when Betfair first entered, and had significantly more customers. However, it is clear to see how this lead has eradicated over a short time period.

It is much harder to grasp a clear finding from the Ladbrokes coefficient. Empirically measuring for tacit collusion is very tough given the natural complexities it brings. I would suggest the graphical analysis alongside the theory presented in section 1.4 is able to shed more light on the chance that there is evidence of tacit collusion pre-Betfair entry.

Both the second and third sections should be treated with caution due to the statistical significance on their coefficients. Given how the dataset was processed in order to use all the explanatory variables, this was unfortunately going to be the case. Luckily, for the breadth of explanation this paper sought from its outset, the descriptive analysis provided earlier gives the clearest viewpoint – the econometric analysis is to be seen as a complement that may aid some statistical clarification.

The second section did show importance in its finding that the drop in the retail overround in all probability did not impact Betfairs customer growth. Little research seems to have been undertaken in how new entrants fare after they have successfully taken a large segment of a new market. Looking at the real world we see positive outcomes; retail businesses such as Amazon is a prime example. The model itself is weak though; on reflection a larger amount of data and longer timeframe would no doubt yield better results. However, I again stress the importance of the graphical analysis to show many effects through what we know from both theory and existing literature.
The last finding was the customer threshold level that broke in order to cause the levels of variance seen under the graphical analysis. The model gave a figure of 2.1 million, and left two tables of output which could be looked at to

[26] Another example of the traditional viewpoint is presented well in Pan, Li, Tse (1999)

see how the difference was determined before and after the change. At face value, the findings were interesting. Before the change, Betfairs customer numbers did increase the difference in overrounds, however once the threshold was broken this became much higher. It also led to the finding of FOBT revenue playing an increasing role in stabilizing the overround level. This adds to a previous argument that arose in light of the graphical analysis and through interviews with industry experts; the existence of FOBTs in high street betting shops is keeping them afloat. In turn this leads to a key question which could be developed in further research; are better odds in betting shops solely a result of the existence of the online market, or are we seeing the migration of these odds being offered in order to increase the number of customers through the door who in turn play on the FOBT machines?

In summary, the findings do provide a new contribution to the literature. The econometric analysis used is justified in the choice of instruments and models used, however some problems with the data used lead to the reader needing to be wary of some results. Nonetheless, it brings with it interesting questions for future development.

5.0 Conclusions

I used weekly football betting match odds data from two large UK bookmaking firms alongside explanatory variables. The models looked at how entry of an internet based competitor affected an existing retail oligopoly. Whereas traditional literature on entry puts the entrant at a disadvantage to the existing firm, I observe entry into a parallel developing market has the opposite outcome, an important finding. I show that there is some evidence resembling tacit collusion in the overrounds of Ladbrokes and William Hill. The graphical analysis specifically highlights this well.

The research question asked how levels of competitiveness have been altered throughout the time period. Initially, I thought it was a clear cut case of tacit collusion breaking down thanks to the existence of Betfair and its expansive growth. This, alongside factors such as the implementation of the UK Gambling Act, could only increase competitiveness in the industry. However, through further exploration, the Gambling Act may have compounded something which was already changing the industry; the existence of fixed odds betting terminals within betting shops. A second hypothesis which has been teased out from this research that may explain the drop in overround figures seen is a price war for the market share of retail consumers who come through the betting shop door. It is these consumers who now provide some 50% of revenue on the high street through playing on FOBTs. Thus, the enhancement of betting odds could be explained as a leader strategy to get more customers using this type of product. Given their fixed odds and miniscule variance, they’re a sure bet for the operator.

So, how has this affected the consumer? For the casual punter who has a small bet on the football on a Saturday, it is clear that they are benefitting. Better prices, although stacked in the bookies favour, result in a better outcome for

them in the long run, ceteris paribus. However, this is a matter to be treated with caution. The online and retail industries are turning in a new direction, and young people give the greatest cause for concern. Whereas previously a horse race would be on in a bookmakers a few times an hour, now a tap of a television screen gives access to a whole wealth of gambling opportunities. For the vast majority of online sites, their sports books are joined to their online casino. As a result, stories of problem gambling occurring are regularly seen; an oft-quoted phrase among the online community is *"click a mouse...lose a house"*. Figures for 2009 saw a 20% growth in problem gambling[27], with young people having the sharpest increase. The 18-34 demographic are also the most likely to use internet betting sites, and most likely to bet on football. It was noted earlier that 60% of new problem gamblers listed FOBT machines as the cause.

The implications of this study give rise to the need for a continuation of research in this area. Firstly, collection of this data over the next few years would give us a better indication of whether the two large firms will fall back into a pricing equilibrium, or whether they will continue to jostle for position. With the right data, further research into retail odds becoming a bait and switch strategy for FOBT customers could also give rise to interesting results.
Whether or not the industry was previously operating under tacit collusion is something which I would argue is possible; however I'm sure further analysis could be done on this matter. This paper cannot conclude fully, but it does provide an interesting insight.

When it comes to FOBTs, I would strongly argue there should be a new review on their usage. It is apparent from the research conducted alongside my own industry knowledge that these simple television screens have the ability to cause a wealth of problems in the lives of any recreational gambler. I can only echo the sentiments of charities which exist to assist problem gamblers in the call for their removal from the industry.

[27] http://www.bbc.co.uk/newsbeat/10002246

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Appendix

1. Alternative IV Specification from 4.2

Variable	Obs	Mean	Std. Dev.	Min	Max
williamhilpl	40	1.114192	.0215666	1.065068	1.125801
whchampion~p	39	1.123465	.0055037	1.095998	1.131373
whleague1	39	1.120637	.0057365	1.102281	1.125739
whlaliga	39	1.121248	.0088209	1.093941	1.126669
whfobtrev	40	1.83e+08	1.32e+08	0	4.16e+08

2. Combined RSS results to determine the threshold for Betfair customer numbers over the absolute overround price differences.

Betfair Customer Numbers	Combined RSS
100000	1.1173
200000	1.2411
300000	1.049
400000	1.0785
500000	1.0367
600000	1.0367
700000	1.0367
800000	1.0367
900000	1.1265
1000000	1.1265
1100000	1.1265
1200000	1.1265
1300000	1.0642
1400000	1.0642
1500000	1.0642
1600000	1.0642
1700000	1.132
1800000	1.132
1900000	1.132
2000000	1.132
2100000	**0.9996**
2200000	0.9996
2300000	0.9996
2400000	0.9996
2500000	insignificant
2600000	insignificant
2700000	insignificant
2800000	insignificant
2900000	insignificant
3000000	insignificant