WINNER'S CURSE

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The Unmodelled Impact of Competition

Report of the Winner's Curse GIRO Working Party

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Winner's Curse

THE UNMODELLED IMPACT OF COMPETITION

1. FOREWORD

This paper has been prepared by the Winner's Curse Working Party for the General Insurance Research Organisation (GIRO).

While this paper is the product of a GIRO working party, its findings do not represent the official view of the GIRO. Similarly, it does not represent an official view of either the Institute or Faculty of Actuaries. It does not necessarily represent the views of the authors' employers.

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Two former members also contributed significantly in the early stages of our work: Paula Iencean and Steven Loyens.

The original inspiration for setting up this working party came from a presentation a few years ago by David Drury. A set of David's slides have been reviewed as part of the literature review chapter of this report.

The basic model used to illustrate winner's curse was adapted from one built for the Reserving Oversight Committee's working party on the Reserving Cycle. Thanks go to the members of that working party: Ian Hilder, Chloe Paillot, Mark Rothwell, Simon Sheaf & James Toller.

Thanks go to Consumer Intelligence and to directfleetinsurance.co.uk for the data that they kindly allowed us to use. Thanks also go to Watson Wyatt for allowing us to use their technology to compile our broker survey.

Many of the mathematical concepts were explored by Keith Chandler and Andrew Smith in a 1994 paper. That paper does not appear to be available on the internet, but a copy is included in our appendices. Andrew has provided an update on his latest thinking and that is included in Chapter 7.

Additional thanks must go to the following people for their contribution and support:

Tina Aidoo, David Brown, Carmen Burraston, Tim Grant, Daniel Kendrick, Elena Papadopoulou & Andrew Wallace

2. INTRODUCTION

The term "Winner's Curse" was first coined by Capen, Clapp & Campbell in their 1971 paper "Competitive Bidding in High Risk Situations".

In any scenario where parties are given access to certain data and asked to estimate a quantity from that data, a range of estimates will typically arise. The average of the parties' estimates can be a good estimator of the unknown quantity; the so-called "Wisdom of Crowds[1]". This property has been evident in the GIRO prediction surveys, where the mean prediction has scored consistently better than the majority of respondents.

However, there are some circumstances such as auctions where the estimate that matters is not the mean estimate but the extreme estimate, i.e. the highest price at auction or the lowest price for a quoted insurance policy (an example of a reverse auction). In such situations the "winner" is likely to have been "cursed" by either paying too much for the goods at auction or obtaining insufficient premium for the insured risk.

The particular example studied in the aforementioned paper was the auction of and bidding for oil drilling rights in the Gulf of Mexico. The paper postulates the winner's curse as being responsible for the low returns achieved by successful bidders.

The objective of this paper is to outline the theory of the winner's curse, provide some further examples of its operation in practice and, in particular, to illustrate where it may be a key feature of insurance markets.

Chapter 3 provides the theory of the winner's curse using a simple auction model and some extensions to this model.

Chapter 4 provides some interesting examples of situations where the winner's curse may have been evident from major historic events to a money-making swindle.

Chapter 5 provides a review of some of the existing literature on the subject. The members of the working party have provided synopses of some of the Books and Papers on the subject.

Chapter 6 provides results from a hypothetical simulation-based model that illustrates the impact of the winner's curse and the impact of a number of key variables such as the number of competitors, pricing accuracy of the market, impact of a superior pricing model and of alternative strategies to combat the curse.

Chapter 7 comments on the mathematical theory behind the winner's curse. This chapter forms an update to Andrew Smith and Keith Chandler's 1994 paper on winner's curse.

Chapter 8 considers evidence for the existence of the winner's curse. In particular, we study insurance aggregators and the potential for this type of distribution mechanism to be adversely impacted by the Winner's Curse.

Chapters 9 and 10 surmise on the implications of the winner's curse for insurers and customers respectively. Being forewarned is forearmed!

[1] http://en.wikipedia.org/wiki/The_Wisdom_of_Crowds notes the United States Defense Advanced Research Projects Agency ("DARPA") proposed a futures market on political events such as terrorism attacks as being a mechanism for using the wisdom of crowds to assign probabilities to such events.

Chapter 11 explores some interesting related topics, including the Paradox of Choice, the Utility of Winning and the Wisdom of Crowds.

3. THE THEORY OF WINNER'S CURSE

The winner's curse is a feature of auctions which has been observed for many years across different designs of auctions in diverse areas. Auctions of varying complexity are employed in numerous different contexts whether purchasing a house or a 3G license. We will discuss the application of the winner's curse in some of these different contexts in chapter 4.

In this chapter we will consider a highly simplified example of an auction to illustrate some of the basic features of the winner's curse.

A simple model of an auction

Suppose that the following rules apply:

(i) three people are bidding for a picture.
(ii) the bids are made independently.
(iii) only one bid can be made by each person.
(iv) the highest bid wins the picture.
(v) in the event of a tie between the highest bids a random selection between the winning bids decides the winner .
(vi) the highest and winning bid is the amount paid by the winner in exchange for the picture.
(vii) the bidders are not certain of the value of the picture.
(viii) each of the bidders knows that the picture is valued between £62m and £64m.
(ix) each of the bidders makes private assumptions to estimate the value of the picture and makes an integer bid from £62m to £64m with each bid equally likely (i.e. each bidder will bid each potential value with probability 1/3).
(x) the picture is actually worth £63m to each bidder (there is a "common value" to the picture) .

The probability that the winning bid is at different levels is calculated below:

Bid	Probability this is the winning bid
62	= 1/3 * 1/3 * 1/3 = 1/27 (A) = 3.7%
63	= 1 – (A) – (B) = 7/27 = 25.9%
64	= 1- 2/3 * 2/3 * 2/3 = 19/27 (B) = 70.4%

So, the expected value of the winning bid is £63.7m, £0.7m greater than the value of the picture. And in more than 70% of the cases, the winner of the auction pays more than the picture is worth. This is the winner's curse. The highest and winning bid is likely to come from the bidder who has most overvalued the picture.

The analogy can immediately be drawn to the insurance market and in particular to insurance companies bidding for a piece of business. In this case the "winning bid" is the lowest bid offering the relevant coverage for the cheapest premium. The danger for the insurer is that it wins the business because it underestimates the risk.

Observations on the simple model

Increasing the number of bidders makes the winner's curse more prevalent.

If we increase the number of bidders from 3 to 5 the chances of the winning bid being £64m increases from 70% to 87% and the expected winning bid increases to £63.9m.

More uncertainty increases the cost of the winner's curse.

First, we can observe that if there was no uncertainty over the value of the picture we can expect that no one would make a bid greater than the value of the picture. There will be no winner's curse.

We can observe the impact of increasing uncertainty by adjusting our simple 3 bidder model in the following way:

- replace rules (viii) and (ix) with the following

(viii) each of the bidders knows that the picture is valued between £61m and £65m

(ix) each of the bidders makes private assumptions to estimate the value of the picture and makes an integer bid from £61m to £65m with each bid equally likely (i.e. each bidder will bid each potential value with probability 1/5)

Then our adjusted outcome table is shown below:

Bid	Probability this is winning bid
61	0.8%
62	5.6%
63	15.2%
64	29.6%
65	48.8%

Now we can observe that there is a 78.4% chance that the winner pays more than the picture is worth and the expectation of the winning bid is £64.2m, £1.2m greater than the value of the picture.

A rational bidder should adjust his strategy knowing the existence of the winner's curse. A bidder gets a bad signal from winning the auction, namely that all other bidders value the object at less than he does. In the simple three bid auction outlined above each one of the three bidders needs to reduce his bids by £0.7m in order that the expected value of the winning bid is equal to the value of the picture.

Extensions to the simple model

The model described above is highly simplified and does not account for the many real-world features which will lead to different outcomes and could diminish or worsen the likelihood and/or impact of the winner's curse.

Design of the auction:

- The auction may involve the possibility of repeated bids e.g. as is usually used at auction houses for sale of major works.
- The bids may be publicly known.
- Bidders may be aware of differences in each other's pricing models.
- The winner may not have to pay the amount of the winning bid: e.g. in a "second price" auction the winner of the bidding pays the second highest bid.

Value of the object:

- The picture may have a different value to different people; there could be any number of reasons for this from different transaction costs to purely aesthetic reasons.
- There may be different levels of uncertainty on the value of the object for different bidders. One bidder may be more of an "expert" than the others.

Nature of bidders:

- Bidders are likely to make a bid within a continuous range with a non-uniform likelihood of each level within the range.
- There may be an intermediary in the bidding process with influence on the attitude of the bidders.

There is a wealth of literature on these and many other issues relating to the winner's curse in auctions. We refer you to some relevant literature in Chapter 5.

4. EXAMPLES OF WINNER'S CURSE

This chapter considers a number of examples in a range of different contexts.

The rise and fall of Emperor Julianus

Immediately after murdering the Roman Emperor Pertinax (193 A.D.) in his palace, the Praetorian Guard announced that the throne would be auctioned off to whoever offered them the highest price. Two would-be buyers entered the stage: Sulpicianus, prefect of the City and father-in-law of the murdered emperor, who was inside the palace at the time and Julianus, who stood at the palace gate because he could not gain access and competed for the prize by making bids in a loud voice. The bidders gradually raised their offer up to 20,000 sesterces per soldier, until Julianus suddenly raised his bid to 25,000. Fascinated by this massive jump in the bid, the Guard let him in and declared him Emperor.

It is estimated that there were at least 10,000 praetorians and that the winning bid represented about five years' wage per soldier. The total amount that Julianus committed to pay would amount to more than one billion dollars today. Julianus subsequently defaulted on his promise, thus turning the Guard against himself.

Two months later, General Septimus Severus and his army marched to Rome and the Praetorian Guard deserted Julianus. He was murdered and Septimus Severus became Emperor. According to Cassius Dio, who lived in Rome during the period, Julianus's last words were "But what evil have I done? Whom have I killed?"

Oil drilling

After newer technologies allowed off-shore drilling by the Petroleum Industry in the late 1940's, the race for oil companies to secure drilling rights began. The U.S Department of Interior auctioned off-shore oil leases in the Gulf of Mexico and this left oil companies such as Exxon and Atlantic Richfield Company (ARCO) with the problem of estimating how much to bid for each lease site. The bidding process would necessarily award the lease to the most optimistic company. Obviously, companies each had their own experience and different information (e.g. seismic data or hurricane data), notwithstanding the fact that the methods available to determine the volume of underwater oil were recent and rather primitive at the time. Expectedly, companies came out with different estimates.

By 1960, even though many offshore wells were in production, it was well known within the Industry that this business was unprofitable. So, were winning companies too optimistic? This is what some economists had in mind when they initiated studies of the winner's curse in the 1970's (and thus coining the phrase "Winner's Curse") after three ARCO employees discovered in 1971 that oil drilling companies seemed to be suffering unexpectedly low rates of return on their investments, often finding much less oil underground than they had hoped. Based on ARCO's oil-drilling rights bidding history, economists found out that estimates would sometimes differ tenfold between two companies bidding for the same site. Given that the field value would have been approximately the same no matter which company extracted the oil, it is probable that one or more of the companies was overly optimistic in their estimates.

Even when two companies would bid on a site after having entered a joint exploration agreement (thereby levelling the information field), economists found evidence that some companies would significantly outbid others (one bid was 17 times higher than the other competing company's bid). Again, someone was clearly being overly aggressive to win business. The winner's curse was at play, and it distorted the entire off-shore drilling business.

Bidding on the content of a jar

One experiment designed to illustrate the effects of the winner's curse was conducted by the same three ARCO employees mentioned above. They would fill a glass jar with five-cent coins, close it and auction it to the members of a sizeable group. Each prospective buyer was allowed to handle the jar and compare it with a 2-dollar roll of forty five-cent coins before placing a bid. The experiment was conducted a number of times on groups of varying sizes. Whether the bids were audible or sealed, the trio managed to sell the jar for more than its cash value on virtually every occasion. They also observed that accurate estimators had little chance of winning the auction.

Hastings Direct

In 2008, Hastings Direct, one of Britain's largest motor insurers, cancelled around 4,500 policies after discovering that they had been substantially under-priced due to a software error. Apart from having to make new arrangements on a short notice, customers were left with the option of either not being insured or paying higher rates. Hastings Direct was subsequently fined £735,000 by the FSA.

Even though this example does not fit into an auctioning context, a parallel can be drawn in that the winning quotes issued by Hastings Direct to would-be buyers did not assess the cost of risk correctly. Assuming that price is one of the factor which prospective clients take into account to make a decision (which does not seem unreasonable), this means that the Winner's Curse did occur here, even though it did not result from a conscious decision from Hastings Direct.

The Australian public liability crisis

In 2000, the Australian press started to mention examples of social, sporting and professional organisations which were either unable to find Public Liability (PL) cover or were offered protection at prohibitive rates. The extent of this problem grew so as to have the Commonwealth (i.e. federal) Government involved.

It emerged that this crisis had been coming for years. The Insurance Industry had already expressed concern that insurers were charging unprofitable premiums for PL cover, resulting in a number of companies either exiting the PL market or applying a stringent risk selection. The problem was actually hidden by one PL insurer, HIH. HIH was created in 1969 and specialised in worker's compensation and PL insurance. It grew, took over and merged with other companies a number of times until the 1990s. At that time, even though HIH was already a major player in the PL market, it adopted an aggressive pricing approach in order to increase its market share even more. In the late 1990's, competitors began either to withdraw from the PL market or to charge their risks correctly in order to produce shareholder returns. At the same time, market statistics also showed that the market was unprofitable. HIH ignored this and continued to apply their aggressive pricing strategy.

It is now known that HIH behaved that way because they needed cash flow to meet mounting losses. HIH eventually collapsed in May 2000, leaving other insurers free to charge their more realistic rates. Because HIH had charged very low premiums to a large market share for years, the market correction was extremely painful for the insureds.

This is clearly an extreme example of the winner's curse – the winner did not survive!

M&A activity: the 2007 purchase of ABN Amro

If a company has its heart set on an acquisition then it is likely that a number of potential future scenarios justifying the bid will be proposed rather than scenarios against the acquisition. The following story is a good example in that respect.

During 2007, Dutch bank ABN Amro was the target at the heart of a bidding showdown between Barclays Bank and a consortium of banks led by the Royal Bank of Scotland and also comprising Spain's Santander and Belgium's Fortis. Barclays had originally agreed a deal with ABN Amro in April 2007 for a £45.4 billion takeover mostly paid in shares. This deal was derailed by a Dutch court over the fate of ABN's US subsidiary LaSalle. The RBS-led trio then started to express interest in ABN Amro and eventually won the M&A battle in October 2007 with a £49.2 billion offer, attractively mostly paid in cash.

In the wake of this bidding war, the financial press was quick to highlight that victory could come with a bitter aftertaste for the consortium. The first signs of the emerging credit crunch in August 2007 had started to take their toll on the share price of banks in general, and the earnings prospects of banks with a sizeable investment banking business like ABN Amro had dimmed all the more. Some analysts said that it remained to be seen whether the RBS part of the deal would live up to its earning promises.

It is estimated that the winning bid represented more than the December 2008 combined market value of Citibank, Morgan Stanley, Goldman Sachs, Merrill Lynch, Deutsche Bank and Barclays.

Other examples of auctions:

Here are further examples of auction situations where the winner's curse can happen.

- Amongst other things, governments auction radio frequency spectrums, third generation (3G) mobile telecommunication spectrums, CO_2 permits, defence contracts and highway construction contracts.
- In the private sector, airports auction departure gates, auction houses such as Sotheby's and Christies sell art, wine and memorabilia, wholesale electricity markets auction electricity to retailers and banks auction repossessed properties.
- Initial Public Offerings (IPOs) are also an example of where the winner's curse can occur, since bidders need to estimate what the market value of a company stock will be.
- Using the Internet revolution, E-bay created a business model entirely based on e-auctions, supporting a very large number of daily auctions. E-Bay has been the subject of ongoing studies ever since it was created. The reasons for this are that there is a very large volume of transaction records (which makes any quantitative analysis easier to conduct) and that the technology-enhanced platform makes the information very fluid. Estimates of the winner's curse, defined as the monetary difference between the value of an item sold on E-bay and the winning bid on this item, have even been calculated.

5. EXISTING LITERATURE

The following sections highlight the key pieces of existing literature that the members of the working party are aware of. It is not intended as an exhaustive survey of all the literature that exists. Winner's curse is an economic topic that can be applied to a wide range of everyday situations. As such, an exhaustive search of all literature would be unfeasible. However, we hope to have highlighted many relevant pieces of work. Members of the working party will remain keen to hear of any other relevant literature that readers have come across.

Published books

"The Winner's Curse: Paradoxes and Anomalies of Economic Life" by Richard H Thaler

This book provides a popular account of some of the paradoxes arising from behavioural finance. It ranges from the behavioural psychology studies of the Endowment Effect, Preference Reversals amongst others in chapters co-written with some of the experts in this field (Kahneman, Tversky) to racetrack betting biases. The winner's curse occupies one relatively short chapter in the book. There are the familiar examples of auctions of jars of coins, and the seminal paper on the bidding for oil-field drilling rights (Capen, Clapp & Campbell. 1971), which first coined the phrase "Winner's Curse".

The book is an entertaining read but, despite the title, the section on winner's curse is relatively short and introductory.

This book was seen for sale on EBay - but as a "Buy it now" and not as an auction!?!

"Beware the Winner's Curse: Victories that can sink you and your Company" by G. Anandalingam and Robert C Lucas Jnr

This book gave a detailed discussion covering a number of past examples of winner's curse affecting businesses. It discusses the origins of winner's curse research in the field of oil leases and moves on to discuss the 3G spectrum auctions and numerous examples of winner's curse in US corporate mergers and acquisitions.

The authors look at the factors that have exacerbated winner's curse in many of these examples and conclude with a useful chapter on avoiding winner's curse. Management overconfidence and hubris feature highly in a number of the discussions.

The book is very readable, although readers may need some knowledge of American sports. A large number of analogies are drawn from American football, baseball and ice hockey.

"Auctions: Theory and Practice" by Paul Klemperer

Two specific chapters of this book have been reviewed:

Chapter 5: "3G: Overview of the European Auctions"

This text is more about auction design than winner's curse, but there are a few points of note:

- The format of the auction (essentially a sealed bid auction for insurance on price comparison websites) is important in determining the price. Given that we cannot change this format, this isn't especially useful. It might be useful to know in non-personal lines circumstances.
- The more competitors, the lower the price (no surprises).

Collusion between competitors leads to lower competition and mitigates winner's curse. An insurer can legally "collude" by performing competitor analysis and adjusting its prices accordingly.

Chapter 6: "3G: Designing the UK Auction"

This chapter appears to have been published originally under the title "The biggest Auction Ever: The Sale of the British 3G telecom Licences", in the Economic Journal 2002.

The chapter conveys the merits of auctions vs. "beauty contest", explains the aims & the design of the 3G auction and it analyses the problems and the mistakes made. It was written by the lead team that advised on the design of the British auction (the "3G auction").

The paper points out the following arguments for auctions:

- a well-designed auction is the method most likely to allocate resources to those who can use them most valuably
- the difficulty of specifying and evaluating criteria for a beauty contest makes this a time-consuming and opaque process that leads to political and legal controversy, and the perception, if not the reality, of favouritism and corruption
- an auction can raise staggering sums of money to support the public finances—the UK auction yielded about 2.5 percent of GNP

It also discusses the common objections to auctions, such as

- Unfairness to firms "who are forced to bid"
- Increase of consumer prices
- Contraction of investments,

and it comes to the conclusion they are complaints based on misperceptions.

This paper is useful if you want to understand the details for the UK 3G Auction, and the mechanism behind an auction; however, the winner's curse is not specifically mentioned.

Academic research

"The Economics of Insurance Intermediaries" by J David Cummins and Neil A Doherty (2005)

This is a very interesting paper setting out in considerable detail the workings of the commercial P&C market and in particular the role played by brokers and subjecting that market to analysis using various economic tools and analyses.

The paper was produced shortly after the Spitzer enquiry into bid-rigging in the US Commercial P&C market. Spitzer's enquiry also shed light on the common practice of contingent commissions where insurers pay additional commissions to brokers placing business with them - either based on volumes of business placed or possibly even on the ultimate profitability of that business.

Spitzer's enquiry alleged that these practices (even when not accompanied by bid-rigging or other kickbacks) were a priori anti-competitive. The straightforward reasoning was that they aligned the interests of the

intermediary with the insurers and therefore against their customers (the insureds) as the higher the price charged by the insurer (and therefore the worse the deal to the insured) the better the intermediary did.

Cummins uses 1976 work by Rothschild and Stiglitz on adverse selection to argue the exact opposite using the idea of winner's curse.

In essence his argument is that the information asymmetry and complexity of risks in the commercial P&C market and the resulting high risk of winner's curse means that insurers will deliberately quote conservative premiums. By signalling to insurers that intermediaries (who are better informed than insurers about the true cost of the risk) have an interest in placing profitable business, contingent commissions encourage insurers to quote more competitively by reducing their fear of winner's curse.

"Prices and the Winner's Curse" by Jeremy Bulow and Paul Klemperer (2001)
This is a fairly technical, but very good article. It is written more from an economic standpoint than insurance, but it illustrates the winner's curse with several mathematical models. Uses these and some good examples to show some counter-intuitive results around auctions: such as situations where an increased number of bidders in an auction can actually reduce the winning bid, as each is more fearful of others having superior information. Perhaps this could be related to insurance, where a greater number of insurers quoting on aggregators, say, could make the premiums less competitive as each insurer is more concerned about their prices deviating from the rest.

"Managing Online Auctions: Current Business and Research Issues" by Edieal J Pinker, Abraham Seidmann & Yaniv Vakrat (2003)
Although this paper is not specific to winner's curse, it gives the reader a good introduction to the current state of management science research on online auctions. It also presents the most recent studies of online auction activity and develops a broad research agenda for issues identified. It discusses the broad areas of online auctions in detail such as the behaviour of online auction participants, the optimal design of online auctions, the integration of auctions into the ongoing operation of firms, and the use of the data generated by online auctions to inform future trading mechanisms.

"An Empirical Perspective on Auctions" by Ken Hendricks and Robert H Porter (2006)
This is an excellent summary of current theory of auctions and models of optimal auction design. The authors summarise the economics literature on auction markets and the 13 page bibliography is extensive and a good source of further material for the interested reader on both auctions in general and also the winner's curse in particular. The authors focus on empirical evidence to test whether the theoretical models predict real-life behaviours.

There is a mathematical interpretation of winner's curse and, whilst it holds if each bidder bids their ex-ante expectation of value, the paper also points out that this is an inferior auction strategy and that the bids should be tempered by the possibility of winning (i.e. reducing bids as competition increases).

The authors re-analyse the conclusions of the seminal paper on winner's curse (Capen Clapp & Campbell. 1971, "Competitive Bidding in High Risk Situations") given more recent data and conclude that the winner's curse is evident in the data, but that it is also evident that the bidders behaved in a way that was consistent with their awareness of the effect.

"Price Cutting in Liability Insurance Markets" by Scott E. Harrington and Patricia M. Danzon (1994)

This is a highly relevant paper and refers to the winner's curse throughout. It looks into the potential causes of under-pricing in the liability insurance market in the early 1980s that lead to subsequent insolvencies and then the hard market in 1985-1986.

A regression model is used with cross-sectional data to test the significance of moral hazard and heterogeneous information (a winner's curse) in causing the above to unfold. The moral hazard argument is that firms with little franchise value have incentives to hold little financial capital and price low. The heterogeneous information argument considers whether low forecasts relative to full-information conditional expectations and consequent winner's curse effects played a key role in the above crisis.

The conclusion of the paper is that moral hazard was more significant than heterogeneous information in driving this soft market.

The paper is well worth a read. For specific references to winner's curse see pages 512-513 and 520-521.

The criterion used to test the heterogeneous information hypothesis was the inexperience of the insurer in the general liability market. The paper suggests that future research may develop more sophisticated or more appropriate measures of inexperience.

"Behavioral Economics: Reunifying Psychology and Economics" by Colin Camere (1999)

This is a short 4 page article that is not about the winner's curse but it discusses some interesting behavioural economic theories that might help explain the psychology behind what causes it. The article discusses alternative theories that explain why rational behaviour is not always observed in practice. The article puts forward a theory that "people seek risk when gambles involve only losses, such that the best they can do is "break even" whereas they avoid risk when gambles all yield gains (the 'reflection effect')". This fits with the logic of a larger pricing adjustment being required in a soft market than a hard market to offset the effect of the winner's curse.

"Competing Mechanisms in a Common Value Environment" by Bruno Biais, David Martimort & Jean-Charles Rochet (2000)

This is a technical but very interesting economics paper. The author uses a mathematical model of traders competing in an open market, and shows how the mark-ups charged and profits made are expected to reduce as the number of traders increases.

Much of the paper is a more general discussion around market behaviour and trading within a liquid market for a divisible good (rather than an auction for an indivisible item) and so does not relate directly to auctions and the winner's curse.

However, section 6.4 ("common values") does have some relevance to the winner's curse. In this section, the author shows how market makers must all charge a common value when the number of market makers is high, and assuming they all share knowledge of this common value. He contrasts this with the winner's curse which arises when bidding for one indivisible good (rather than a market for shares or bonds, as in his models) and when bidders cannot base their estimate on trades currently taking place, but must rely on private information before the auction is over.

"External Impacts on the Property Liability Insurance Cycle" by Martin F Grace and Julie L Hotchkiss (1995)
This paper finds that trends in combined ratios are linked to underlying trends in key economic variables. However, it finds that shocks in the economic variables have less of an impact on combined ratios (with more of an impact on profitability)

"Good News and Bad News: Representation Theorems and Applications" by Paul R Milgrom (1981)
This gives a neat mathematical explanation as to how the winner's curse phenomenon works, using expected values. It also states that you can offset the winner's curse by adjusting your "bid" appropriately. You need to go through quite a lot of maths first before you get to the points of interest.

This paper focuses on what information can be imparted from competitor's bids:

- If a low insurance premium wins, little can be inferred from the competition's failure to place similar bids.
- When a high insurance premium wins, this indicates that the competition had relatively high estimates of the "correct" insurance premium.

If you win the "auction" then this information in itself should lead you to change your estimate of the "correct" insurance premium (i.e. revise it upwards).

"Is Subsidizing Inefficient Bidders Actually Costly" by Michael H Rothkopf, Ronald M Harstad & Yuhong Fu (2003)
The paper discusses the problem of subsidising a class of competitors believed to be at an economic disadvantage. Apparently, this is a widespread practice, particularly in public sector procurement and dispersal. It considers a model of procurement auctions and shows that a policy of subsidising inefficient competitors can lower expected project cost and also enhance economic efficiency. According to the author his model shows that under reasonable assumptions it is generally better subsidising rather than not doing it.

The author explains the Multiplicative-Strategy Model, both in the symmetric and asymmetric version with two suppliers. Then he considers the generalisation to n-bidders version.

The paper takes the winner's curse theory for granted, although it is just briefly mentioned when the author illustrates the results of symmetric bidding model for varying degrees of competition.

"The Liability Insurance Market" by Ralph A Winter (1991)
This was a very informative article from the Journal of Economic Perspectives. It looked at the US liability market from the 1960's to the early 1990's and commented on the insurance cycle in the market. Winter focused on 6 aspects of market behaviour that characterised the cycle including an information asymmetry between first party and third party insurance markets.

He contrasts these aspects with a model of insurance pricing based on a perfect capital market. This model assumes symmetrical information and that pricing purely reflects the risk.

The argument then follows that the cycle can be explained by uncertainty, asymmetric information (or adverse selection) and expansion of US Tort Law. The paper points out that adverse selection effects were commonly analysed in terms of the individual risks. However, uncertainty and confusion about the direction of tort law meant that estimates of the future varied and that this lead to winner's curse.

These factors combine with an imperfect capital market (e.g. the limited liability of corporations and differing costs of internal and external equity) to create the cycles.

"Modelling Competitive Bidding" by Michael H Rothkopf & Ronald M Harstad (1994)

This paper takes a look at auction theory from a theoretical viewpoint. It examines different types of auction and optimum bidding strategies. However, although the paper considers the impact of departures from the assumptions usually used to model auctions, it does not consider winner's curse directly.

"Bidding Behavior in Competing Auctions: Evidence from EBay" by Sajid Anwar, Robert McMillan & Mingli Zheng (2004)

This paper focuses on purchasers competing to buy commodity products in a traditional auction format rather than the insurance style reverse auction which is vendor led.

Key themes are that, in a traditional auction with multiple auction commodity lots available:

- Those who cross-bid across auctions achieve better prices than those who do not
- Closer grouped auctions (ending 1 minute v 1 hour v 1 day apart) tend to act as closer substitutes
- Cross-bidders tend to achieve marginally better discounts relative to non-cross bidders in auctions closer together
- Purchasers tend to bid on the auction with the lowest standing bid

This paper also differentiates between those who want multiple lots of the same product versus single lots and focuses on those who want single lots.

The authors state that they plan to investigate the behaviour of sellers in a later paper. We have not been able to find this but it may be worth a read as this may better reflect the dynamics of an insurance led auction format.

"Economic Insights from Internet Auctions" by Patrick Bajari and Ali Hortascu (2004)

This paper gives a good understanding of the various mechanisms of Auctions (Type of Auction, Information Asymmetry, Reputation, Reserves and Bidder's Behaviour) and their impact on the selling price.

A whole section is also dedicated to the winner's curse and summarises findings from several papers:

- the larger the number of bidders, the more likely the winner's curse is to apply and the higher the overestimation is likely to be for the winner. [Bajari and Hortacsu (2003)]
- bidders are aware of the winner's curse and react to it. However, a study by Jin and Kato (2002) suggested that the winner may not have corrected enough and still be victim of the winner's curse.
- bidders attempting to correct for the winner's curse may result in items with low informational asymmetry not being suitable for online auction. [Kazumori and McMillan (2003)]

Although not transferable entirely to the world of Insurance and specifically aggregators, it gives leads for the seller to maximise its income such as well designed web pages and type of auction to use.

"The Winner's Curse, Reserve Prices and Endogenous Entry: Empirical Evidence from Ebay Auctions" by Patrick Bajari and Ali Hortascu (2002)

This paper uses data from coin auctions on EBay in Sept/Oct 1998, comments on patterns seen in the data and proposes a model for EBay auctions. EBay auctions work as a proxy auction. They note that most winning

bids are submitted very close to the closing time of the auction and hypothesise that bidders are hiding their own views from rival bidders by submitting bids too late for other bidders to react.

They comment on the effect of winner's curse and differentiate between common value auctions where bidders reduce their bids if there are more competitors and private value auctions. However, they also compare the winning bids to a ready market for collectable coins with published book values. The possibility of arbitrage should theoretically mean less uncertainty in the value than would be seen in insurance.

"The Public Liability Crisis – How did it occur and how has it been resolved" by Tom MacDonald (2007)

A useful paper reviewing the lack of supply of reasonably priced public liability insurance in Australia after the collapse of HIH. Although the paper is not focused on the winner's curse, page 2 is a useful example. It describes how HIH expanded its market share rapidly by under-cutting the rest of the market. HIH was cash-flow constrained and seemed driven by this rather than long term profitability. HIH did not heed the winner's curse caveat of a rapidly increasing market share and although there were many factors contributing to the company's eventual collapse this would have certainly contributed to its woes.

Actuarial research

"Behavioural Economics (CARe)" by David Drury

This presentation is by an ex-colleague of two members of the Working Party (including the Chair). A presentation made by the same author at an internal actuarial conference and some of the discussions resulting on how internal actuarial procedures should allow for the winner's curse, planted the original idea for this Working Party (as mentioned in the foreword).

The presentation at CARe was made a number of years later (in 2007) around the broader topic of behavioural economics but with a primary focus on winner's curse. The presentation initially starts with the beneficial effect of a better known (thanks to a bestselling popular science book) phenomenon "Wisdom of Crowds" - which is that (under certain conditions) aggregating the efforts of a large group of people (e.g. in estimating an unknown quantity) results in better decisions than would be taken by any member of the group, even when some of the members of the group are experts but others are less skilled. The presenter then contrasts this with the imposition of an auction mechanism which then means that the larger the crowd the worse the Curse is for the winning (i.e. lowest) estimators. The presenter then runs a short series of simulations demonstrating the effect with a focus on syndicated reinsurance markets so that the 5th lowest bidder out of 10 reinsurers sets the price for the 4 cheaper bidders as well.

"We're Skewed - the bias in small samples from skewed distributions (CAS Spring Forum)" by Kirk G Leming

This paper shows that the sample average of a skewed distribution varies between the mode and the true mean of the underlying distribution. Exactly where the expected value of the sample falls between those two values depends upon how skewed the distribution is and the sample size.

This feature is then applied to the situation where a group of insurers are bidding for a risk on which they have incomplete information (e.g. a sample of observed losses). It results in the following:

- The more skewed the distribution of this risk is, the more likely it is that bidders will be quoting prices based on downwardly biased sample averages. This increases the winner's curse.

- The more biased the actual losses, or the smaller the sample, the more insurers should be concerned about adding a margin to their bid, so as to compensate for any potential biases in the available information

The situation can be improved by:

- increasing the sample size
- combining the risk with other risks to take advantage of the law of large numbers
- reducing the skewness of the risk distribution by reducing policy limits, restricting policy terms, buying reinsurance

Another interesting thought in this paper is the following. The result of the traditional auction problem is known immediately but for an insurance contract it could take years for the actual result to be known. This creates a lagging feedback mechanism which causes inappropriate pricing to persist for a number of periods (during which other auctions may happen) as opposed to being corrected immediately. This increases the monetary losses of the winner.

"The Winner's Curse in Reinsurance (CARe)" by Christian Svendsgaard

This article has a nice explanation of how winner's curse applies to insurance and reinsurance.

It looks at some basic points:

- When counteracting winner's curse, insurers need to offset premiums by a larger amount if there is less certainty or higher variance around the true answer.
- It is not possible to remove the effects of winner's curse through diversification as it is an expected value phenomenon.
- Winner's curse is worse as the number of insurers increases
- The type of auction is important.
- Winner's curse bias is not normally adjusted for in the real world, rather people react to greater competition by cutting their prices e.g. to get market share.
- Competitor analysis can mitigate winner's curse.

The article also questions whether increasing the accuracy of the estimated price for a contract is cost effective or not. It is assumed that the variance of the estimated price is reduced by further analysis. The article looks at the cost and benefits of improved pricing accuracy and considers whether it is worth employing actuaries or not! It suggests that if nobody has good pricing expertise then an insurer improving its own expertise helps a little. However, if competitors have good pricing expertise and one insurer doesn't then that is disastrous for that insurer.

From Svendsgaard's presentation:

"I have always believed an exception would be made in my case."
- William Saroyan (on his deathbed)

Trade press articles

"Winner's Curse and Insurance (Contingencies)" by Christian Svendsgaard
This is a good introduction to auction theory and the winner's curse and links to the CARe presentation above

"Online aggregators could force motor rates to rise (Insurance Day)" by Richard Banks
This article includes a comment that any weaknesses in a rating structure will be exploited by an aggregator.

"An early example of Winner's Curse in an Auction (Journal of Political Economy)" article suggested by Paul Klemperer and Peter Temin
This article highlighted the case of Emperor Julianus, who become Emperor of Rome when the Praetorian Guard effectively put the position of Emperor up for auction. Julianus outbid rival Sulpicianus promising the Praetorians the equivalent of five years' pay. However, he was unable to keep his promise and his reign only lasted two months. This example was discussed in more detail in chapter 4.

6. MODELLING WINNER'S CURSE

Simulating winner's curse

In order to demonstrate the possible impacts of winner's curse in a price-sensitive insurance market, a series of simple models were set up. This enabled the working party to explore a number of different scenarios and look at the possible outcomes. Each model comes with its own set of assumptions. Therefore, they should be regarded as illustrative examples. Real-life scenarios may be significantly more complex.

A basic model of winner's curse

Our first model is a simple one and is the basis for all later models. It is based on a model originally built for the Reserving Oversight Committee's working party on the Reserving Cycle, where it was used to illustrate how winner's curse may be one element of why rate monitoring exercises have tended to understate the variation in performance through the underwriting cycle.

The model simulates up to 10 independent, but identical insurers each competing for the same risk and trying to price to the same loss ratio.

As information is not perfect, insurers are, in effect, building their pricing models based on an uncertain parameter set. Each insurer's estimate corresponds to a conditional parameter estimate based on different data sets.

We have modelled this by assuming each insurer is trying to price to a 70% loss ratio and that the estimated price from each insurer is normally distributed with a co-efficient of variation of 10% (i.e. the standard deviation is 10% of the mean) around a mean price of 100. Therefore each quote is from an N(100,100) distribution.

This is akin to assuming each insurer's estimate of the expected claims cost (or risk premium) is from an N(70,49) distribution. For the purposes of estimating an expected loss ratio that takes account of winner's curse, we have made the assumption that, although unknown to each insurer, the true underlying risk premium is a deterministic figure of 70. This implies there is no systematic bias in the insurer's estimates. (See also the section on "The Wisdom of Crowds" in Chapter 11).

It may seem unusual to model premiums stochastically when the risk premium of 70 is deterministic. We are in effect assuming that we have greater knowledge about the claims cost than the individual insurers. What really matters is the difference between the claims and the premium, and it is this we are in effect modelling stochastic. Chapter 7 provides a more rigorous mathematical derivation in which both claims and premiums are stochastic, but many of the conclusions can be derived from the simpler model in which claims are constant.

This simulation was run 10,000 times (i.e. each insurer is competing separately for 10,000 identical risks).

In estimating our expected loss ratio we have taken a premium-weighted average loss ratio. This is appropriate when considering a portfolio of such risks or a market-wide loss ratio. However, if estimating an expected loss ratio from an individual risk across of range of pricing scenarios, then readers may consider a simple average of loss ratios to be appropriate. In this model we deal entirely with prior expectations of loss ratios and ignore the random variation from individual claim events that insurers would see in the actual ultimate loss ratios they achieved.

For the purpose of this basic model, it is assumed that the business is placed with the cheapest quote for each and every risk.

Full results are shown in "Appendix 2.1: Basic Model: Demonstrating Winner's Curse" and a summary is shown in the table below.

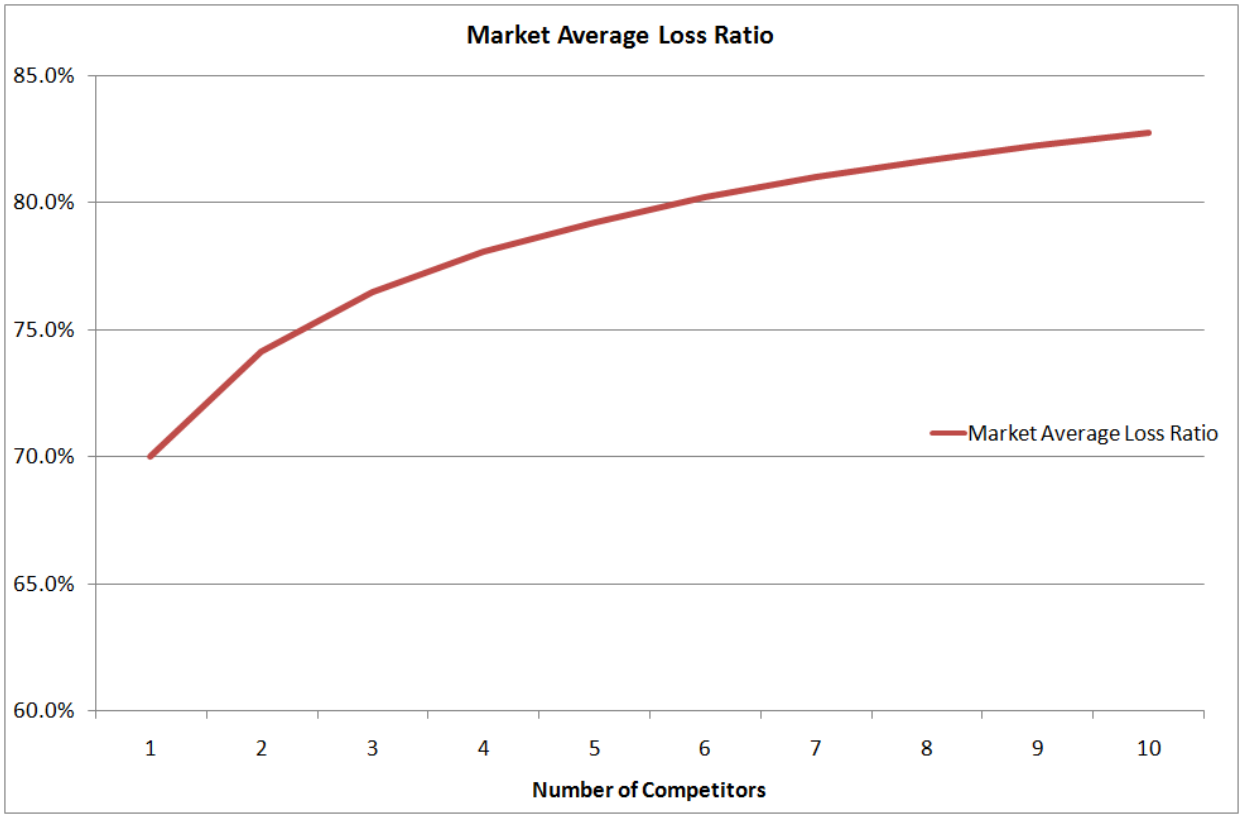
Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.6%	70.0%
2	94.39	-3.1%	74.2%
3	91.51	-2.0%	76.5%
4	89.67	-1.5%	78.1%
5	88.33	-1.2%	79.2%
6	87.27	-1.0%	80.2%
7	86.39	-0.8%	81.0%
8	85.69	-0.7%	81.7%
9	85.07	-0.6%	82.3%
10	84.57		82.8%

* from 10000 iterations

Starting with the first row of the table, we can see that, when there was only one competitor in the market, the average price quoted was 99.99 and this produced a loss ratio of 70%. The average price only differs from the expected price of 100.00 because of stochastic variation in taking 10,000 sample iterations.

When a second competitor entered the market, the first insurer only kept the business when they were cheaper than the new entrant. The average winning quote fell to 94.39 and the two insurers averaged a loss ratio of 74.2%. In other words, the first insurer experienced an effective rate reduction of 5.6% without changing their pricing model. This is an effect that is unlikely to have been modelled in the first insurer's rate monitoring.

Similarly, when a third competitor enters the market, the average winning quote falls to 91.51, and so on. By the time we reach ten competitors, the average winning quote has fallen to 84.57 and the market average loss ratio has risen to 82.8%



The shape of the curve on the chart is concave. This makes intuitive sense. If each insurer is following an identical pricing strategy, then each successive new entrant takes a smaller and smaller share of the market and thereby has a smaller and smaller probability of influencing the "winning" quote. In chapter 8, we will see that this is also consistent with observations based on actual data.

Alternative error structures

The basic model relied on the quotes from individual insurers being normally distributed. This assumption was an arbitrary choice. However, to demonstrate a similar impact under an alternative error structure, the model was re-run using a lognormal distribution with the same mean and variance. Full results are shown in "Appendix 2.2: Comparison of Error Structures".

The summary table below demonstrates that similar effects are still seen.

Comparison of Error Structures

Normal

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.99	-5.6%	70.0%
2	94.39	-3.1%	74.2%
3	91.51	-2.0%	76.5%
4	89.67	-1.5%	78.1%
5	88.33	-1.2%	79.2%
6	87.27	-1.0%	80.2%
7	86.39	-0.8%	81.0%
8	85.69	-0.7%	81.7%
9	85.07	-0.6%	82.3%
10	84.57		82.8%

LogNormal

Competitors	Average "Winning" Quote	Market Price Impact of 1 more Competitor	Expected Loss Ratio
1	99.97	-5.6%	70.0%
2	94.40	-2.9%	74.1%
3	91.67	-1.8%	76.4%
4	89.98	-1.3%	77.8%
5	88.76	-1.1%	78.9%
6	87.81	-0.9%	79.7%
7	87.04	-0.7%	80.4%
8	86.42	-0.6%	81.0%
9	85.88	-0.5%	81.5%
10	85.45		81.9%

Under the lognormal error structure, the impact of winner's curse is marginally less than for the normal error structure. This should make intuitive sense to many readers. The critical part of the probability distribution is the lower end, from which we expect to get the cheapest winning quotes. The positive skewness of the lognormal distribution means there is less variation in estimates at the lower end of the distribution and greater variation at the higher end.

Similarly, we might expect a larger winner's curse effect from a negatively skewed distribution.

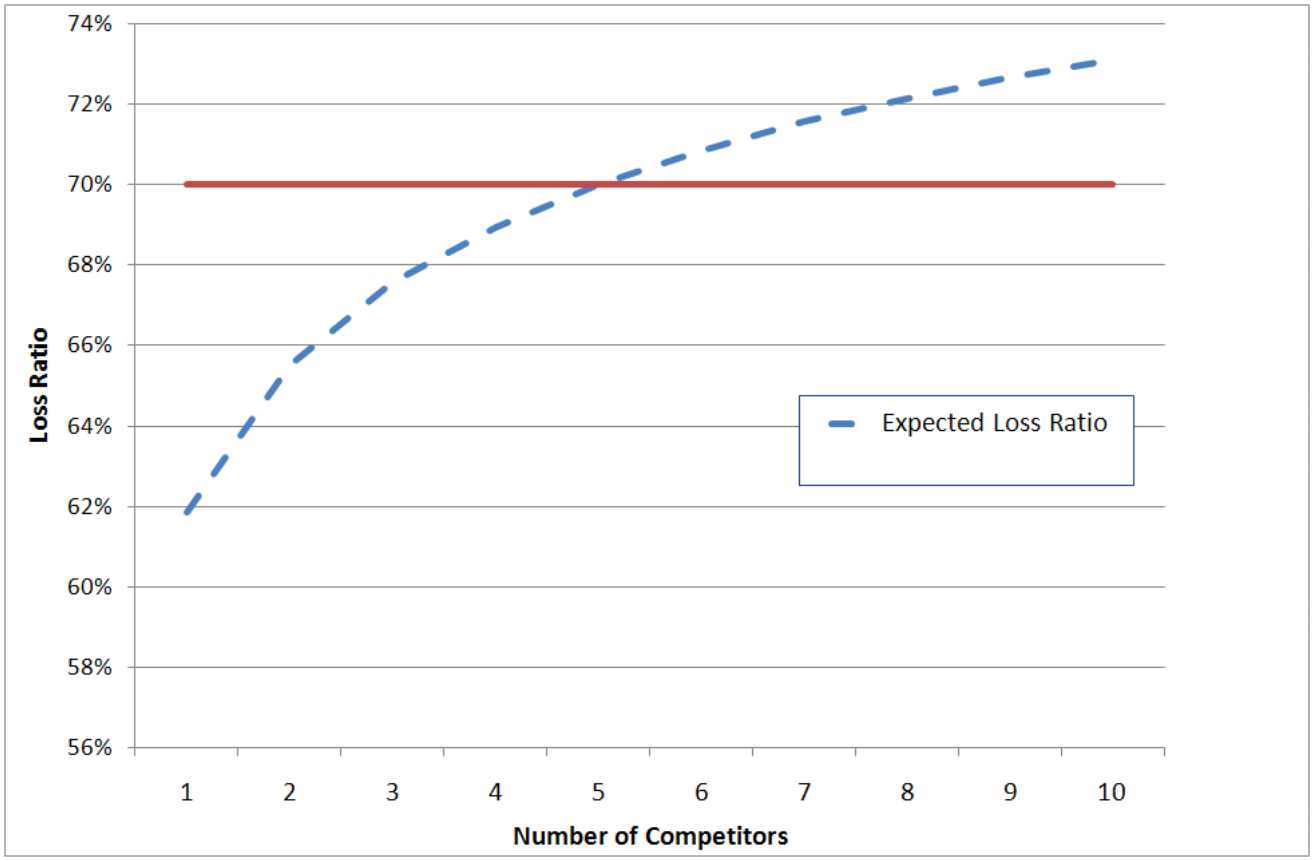
For the remainder of our models we concentrate on adapting the normally distributed model.

Impact of feedback loops

For an insurer that has been operating in a stable market with a largely fixed number of competitors, the historic data used for pricing may already be subject to winner's curse. For example, if in the basic model above, 5 insurers have been competing in a stable market for a number of years, then they are all likely to have reacted to the impact of competition. If they are all targeting the same 70% loss ratio that was seen in the basic model, then a feedback process is likely to have been in place whereby each has responded to higher loss ratios by raising prices. All other things being equal (and assuming each insurer can accurately anticipate inflation, etc...), we might therefore expect to have a new equilibrium where the 5 insurers are achieving their target 70% loss ratio. This is an argument that would fit with rating using a rating model designed around a base rate. However, this would not work with burning cost analyses (for example, using data provided on an individual risk basis by a broker).

Full results are shown in "Appendix 2.3: Impact of Feedback Loops: Source data subject to Winner's Curse".

The chart below shows the impact on an insurer of the market moving from 5 competitors to a higher or lower number.



The shape of the chart remains the same as for the basic model. However, it is rebased at a lower loss ratio.

If the market remains as 5 competitors, then an insurer can expect to maintain their 70% loss ratio. Any increase in the number of competitors will push up the loss ratio and any decrease in the number of competitors will reduce the loss ratio.

It is therefore possible to envisage a theoretical underwriting cycle where there is no change in pricing across the market and no changes in policy terms and conditions – one where the cycle is driven purely by the number of competitors. This sort of cycle may ultimately be driven purely by the availability of capital.

Much of our day-to-day work on understanding the underwriting cycle focuses on rate monitoring. This then feeds into our pricing, our prior estimates of reserving loss ratios and our capital modelling. We should also be mindful of whether winner's curse is an increasing or decreasing factor.

The impact of increasing numbers of competitors is also relevant to the changing dynamics of some of our insurance markets. The key here is not necessarily the total number of competitors in a market place, but can be the number of quotes sought by an insurance purchaser. The rising popularity of aggregator websites means that purchasers can compare more quotes than ever before. One aggregator advertises with the line "Are you paying too much for your car insurance?" Should that be "Have you found the insurer that charges too little for your car insurance?"

> **"Have you found the insurer that charges too little for your car insurance?"**

As a result, motor insurers have been struggling to improve the performance of their private motor books even when each individual insurer thinks it has been raising prices significantly.

Impact of greater or less market-wide certainty over price

The models in "Appendix 2.4: Impact of Greater/Less Market-Wide Certainty over Price" look at the impact of altering the degree of variation seen in market prices.

Where there is greater market-wide certainty over the "correct" price, then we might expect to see prices in a narrow band. If there is less certainty, then might expect to see a wide range of different prices.

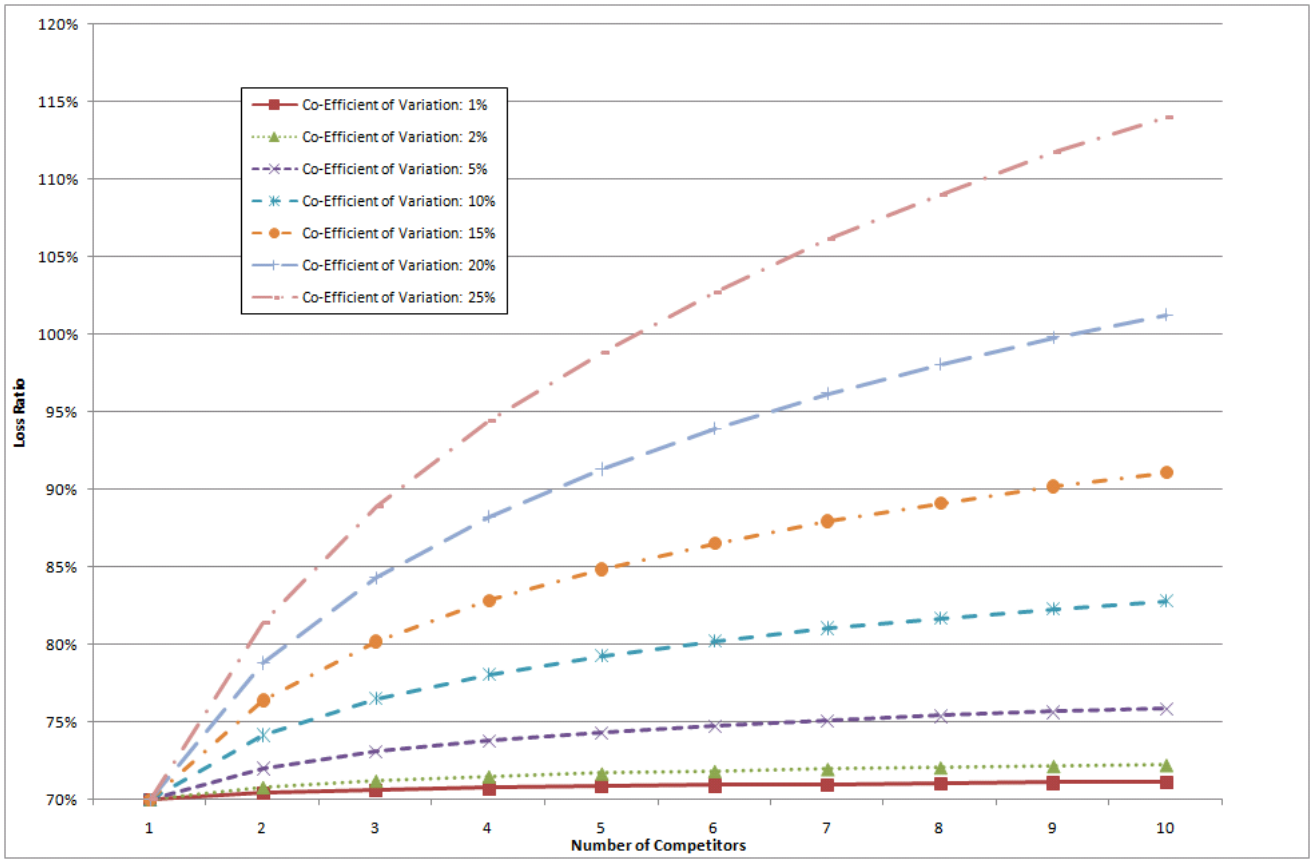
The summary table and chart highlights the resulting loss ratios from adapting the basic model to test different co-efficients of variation.

Expected Loss Ratio							
	Market-Wide Co-Efficient of Variation						
Competitors	1%	2%	5%	10%	15%	20%	25%
1	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
2	70.4%	70.8%	72.0%	74.2%	76.4%	78.8%	81.4%
3	70.6%	71.2%	73.1%	76.5%	80.2%	84.3%	88.9%
4	70.7%	71.5%	73.8%	78.1%	82.8%	88.2%	94.4%
5	70.8%	71.7%	74.3%	79.2%	84.9%	91.3%	98.8%
6	70.9%	71.8%	74.8%	80.2%	86.5%	93.9%	102.7%
7	71.0%	72.0%	75.1%	81.0%	88.0%	96.2%	106.1%
8	71.0%	72.1%	75.4%	81.7%	89.1%	98.1%	109.0%
9	71.1%	72.2%	75.6%	82.3%	90.2%	99.8%	111.7%
10	71.1%	72.2%	75.9%	82.8%	91.1%	101.3%	114.0%

In addition to this simulation approach, the tables can also be calculated by the formula

$$\frac{70\%}{1 - cv * \xi_N}$$

Here, ξ_N is a constant depending on the number of insurers and cv is the coefficient of variation. This is proved in the next chapter.



Clearly, where there is greater variation in prices, there is greater potential to get the price wrong and a greater impact from winner's curse.

Greater variation in price can come from a number of sources and may include the nature of the underlying risk, a lack of quality in the data available, a lack of understanding of changing market or socio-economic conditions or from poorer quality pricing analysis. In chapter 8, we look at actual data and this seems to imply, for example, that there is greater variation in price in the UK household market than in the UK motor market.

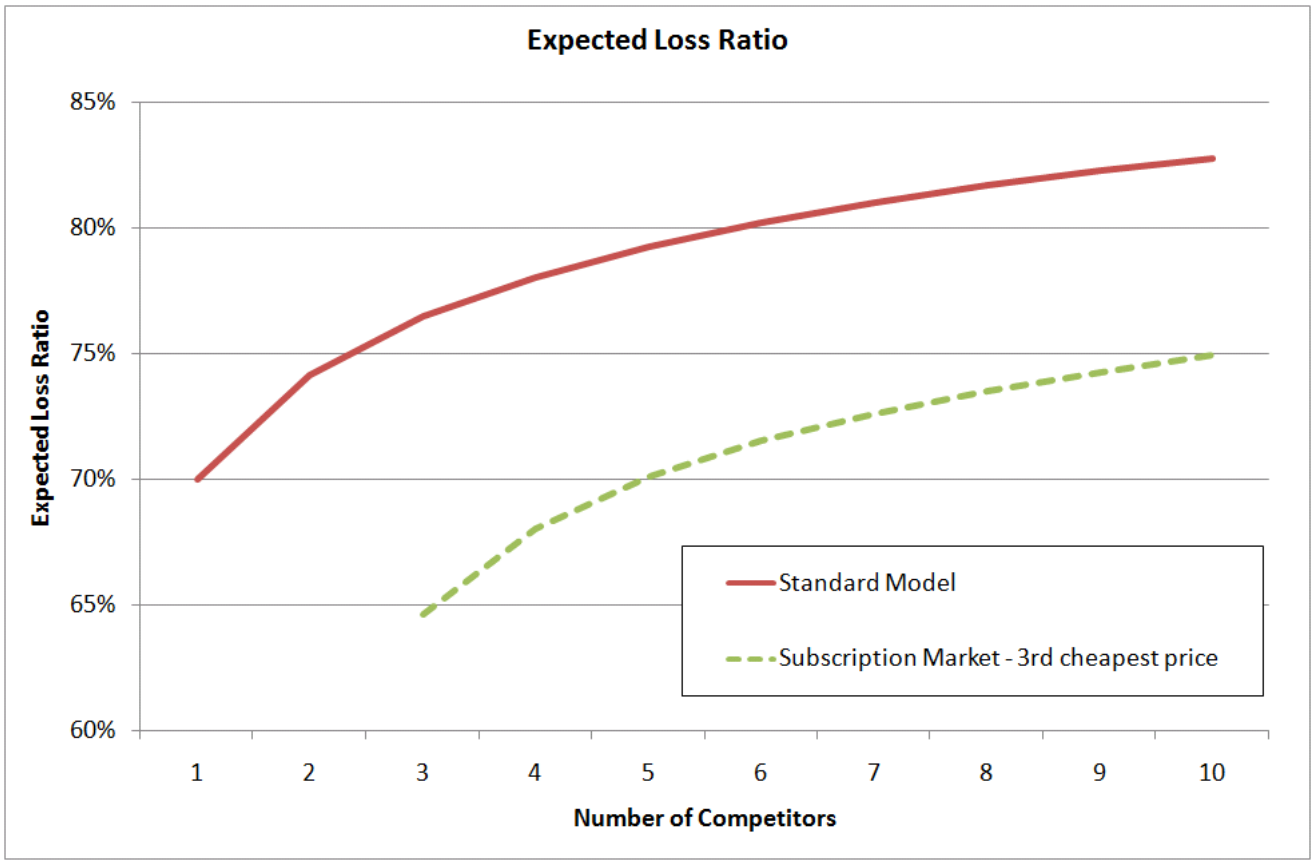
Aggregators are largely involved in markets where there are large volumes of business and where pricing models are reasonably well understood. Even in those markets, there is still a wide variation in quotes offered. However, this model highlights the potential for similar issues away from the aggregator space in more heterogeneous markets or markets with poorer data quality. In those cases, winner's curse can have a significant impact even with relatively few competitors. Should the traditional London Market be taking note too?

Modelling a subscription market

In a subscription market, a broker may need a number of insurers to fully place a piece of business, therefore a price needs to be found that satisfies a sufficient number of insurers. In this model, we look at a risk that requires 3 insurers to be fully placed. Therefore, we assume that the third cheapest quote is the final price.

"Appendix 2.5: Subscription Market" contains full results.

The chart below shows the loss ratio based on taking the third cheapest quote. As can be seen, for 3 competitors, the third cheapest is also the most expensive. It is therefore in the interest of the insured to look further than 3 quotes to place the business. The effects of winner's curse still exist in that the more competitors the higher the loss ratio. However, the effect of needing 3 insurers to place the business is that the loss ratio is reduced.



This effect explains why insurers may push for "best terms" conditions. This is where insurer A provides a quote, but that quote is conditional on being able to place the business fully at that rate. If the broker has to accept a higher rate from another insurer to place part of the business, then that higher rate will also apply to Insurer A.

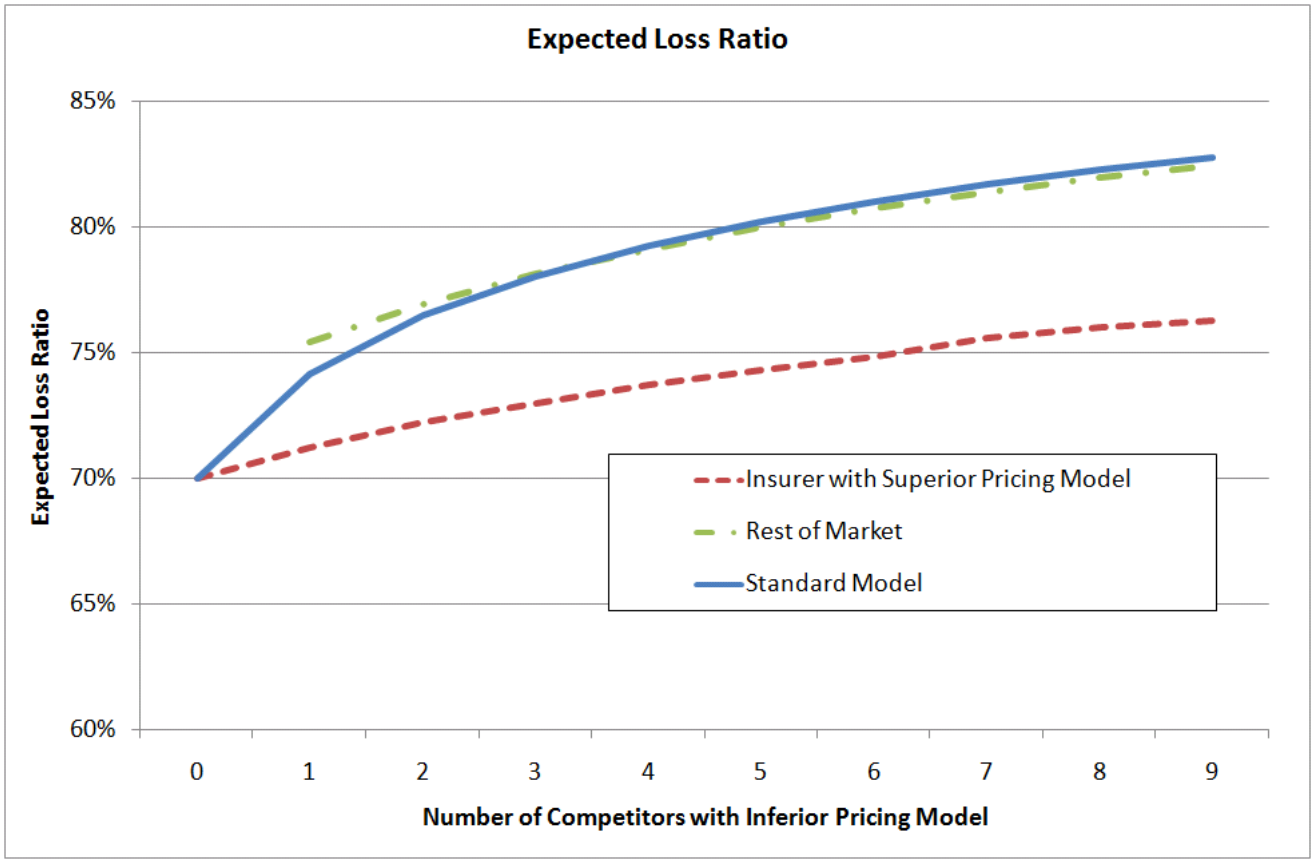
To counteract this effect, brokers and insureds may use vertical pricing. This is where the insurance programme is broken into more numerous excess layers. This reduces the number of insurers needed to fully place an individual layer and therefore reduces the winner's curse benefits that an insurer gets from a subscription market.

Impact of one insurer having superior pricing models

Insurers can seek competitive advantage from improved pricing models. In this version of the model, we look at the impact of one insurer having a superior pricing model. This has been modelled by applying a lower co-efficient of variation to the prices of one insurer. In this example, one insurer has a co-efficient of variation of 5% whilst the rest of the market has a co-efficient of variation of 10%.

Full results are shown in "Appendix 2.6: Impact of One Insurer having superior pricing models".

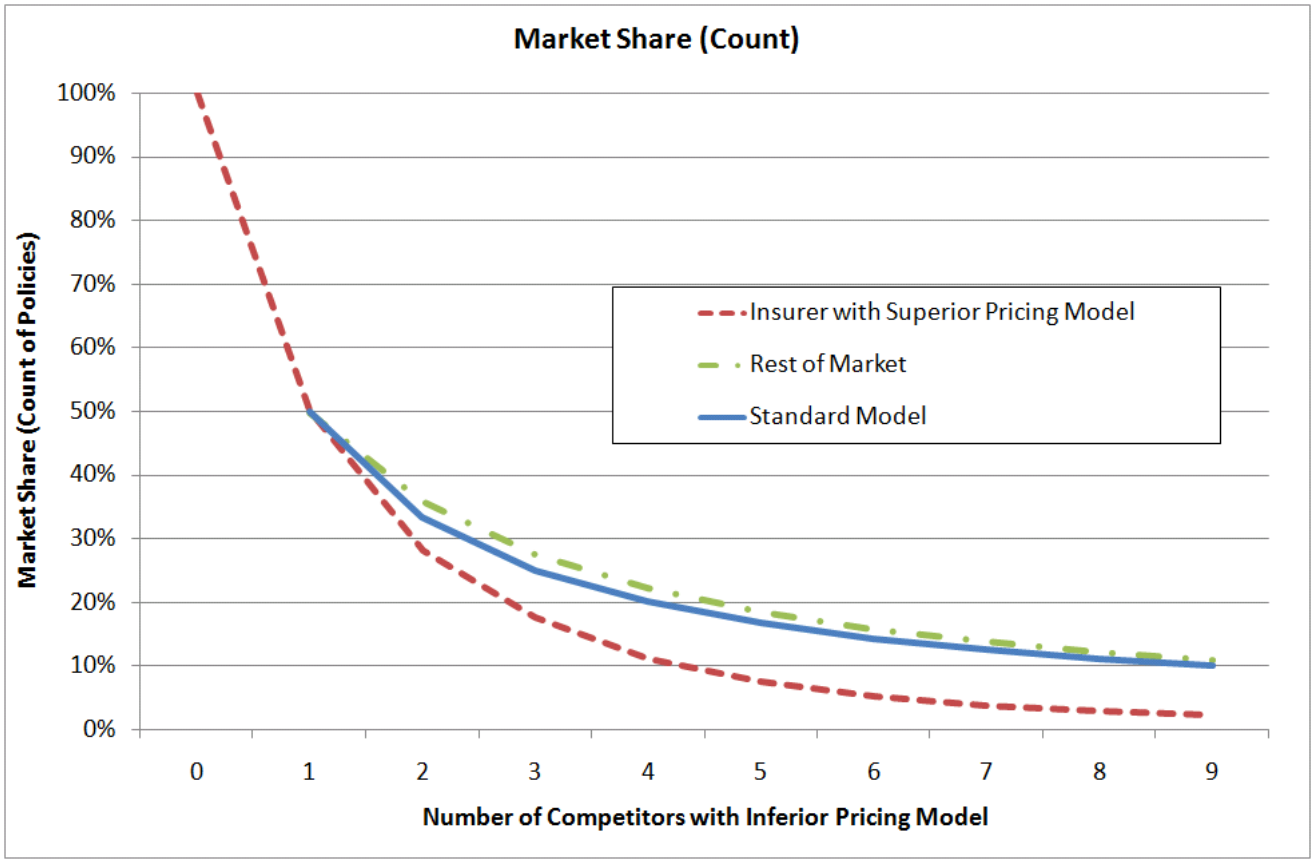
The chart below summarises the loss ratios modelled for the insurer with the superior pricing model and for the rest of the market.



In the chart, the red line represents the insurer with the superior pricing model. The green line represents the average loss ratio for insurers with an inferior model. The blue line represents the market average loss ratio from the basic model where all insurers had the same 10% co-efficient of variation.

As can be seen, the insurer with the superior pricing model has a significantly better loss ratio. This makes intuitive sense. Its chance of getting the price significantly wrong is much reduced.

However, this improvement in loss ratio comes at a cost. By getting the price more accurate, the insurer with the superior model loses business to the other competitors. The insurers with inferior models will underprice sufficiently enough to win the business on a more frequent basis.



As the number of competitors increases, the amount of business going to the insurer with the superior pricing model is significantly reduced. They become an insignificant player in the market. As can be seen from the loss ratio chart, there comes a point when the rest of the market is effectively competing against fewer genuine competitors than in the standard model and their loss ratio is actually marginally better.

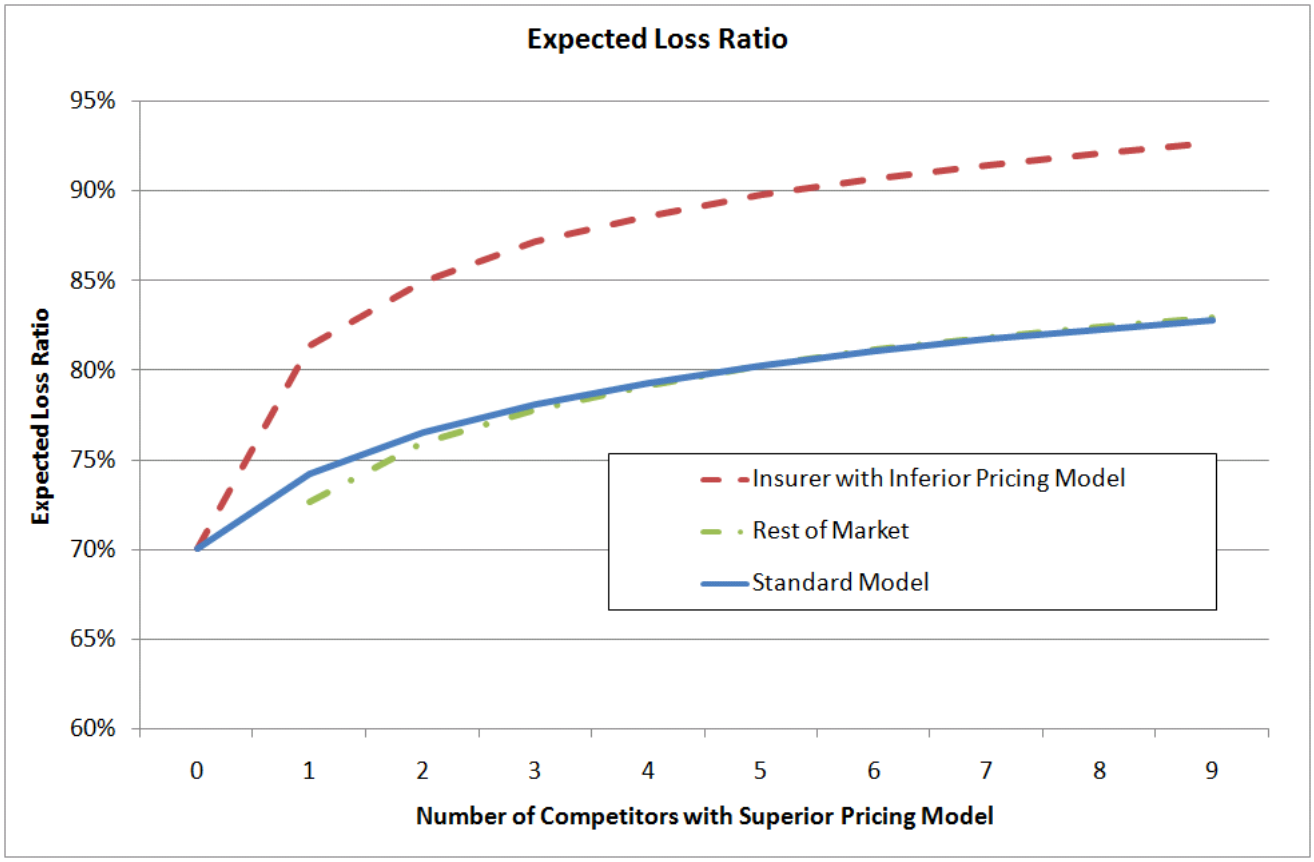
A later model looks at how an insurer with a superior model can leverage better use of their competitive advantage. See "Discounting prices from a superior model"

Impact of one insurer having inferior pricing models

Conversely, we can look at the impact of an insurer having an inferior pricing model. In this case, one insurer has a co-efficient of variation of 20% whilst the rest of the market has a co-efficient of variation of 10%.

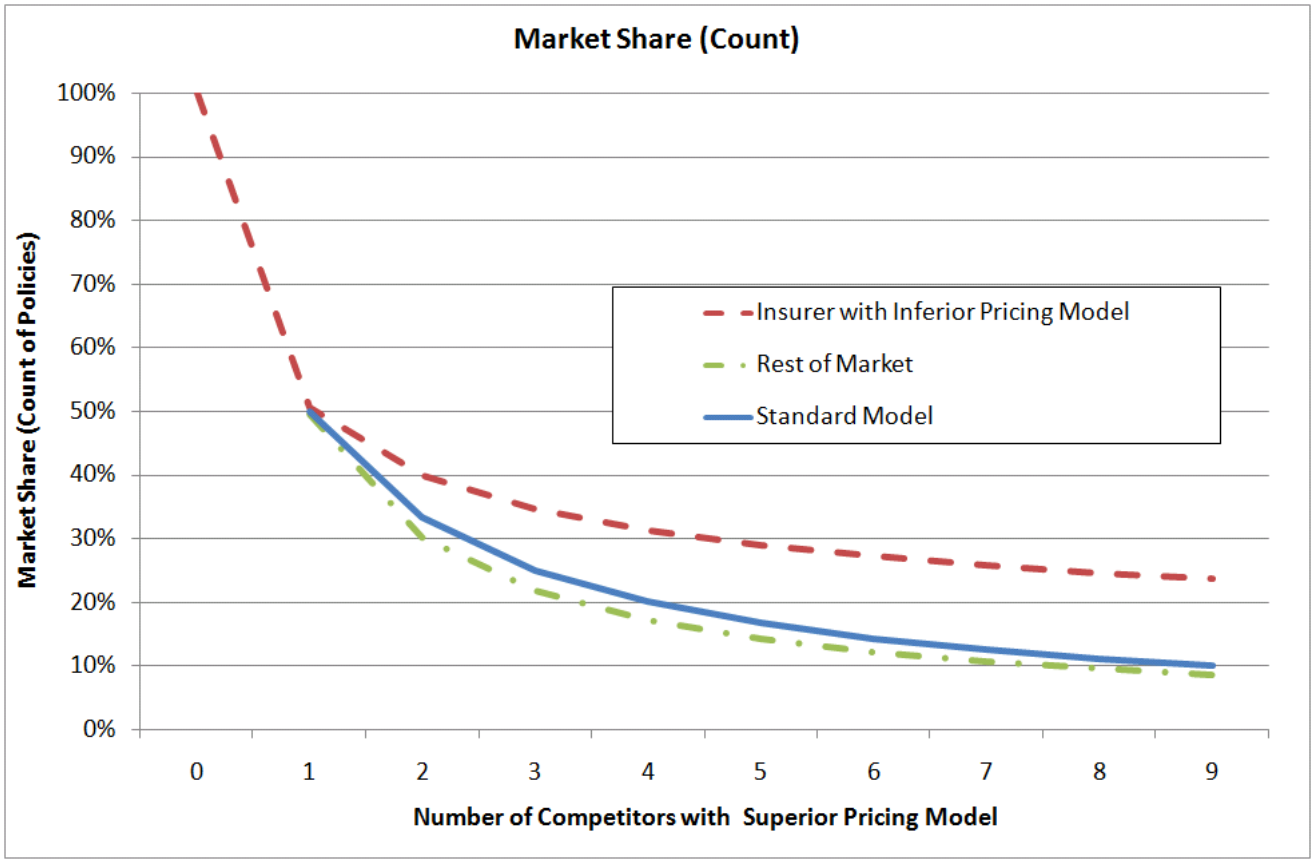
Full results are in "Appendix 2.7: Impact of One Insurer having inferior pricing models"

The chart below summarises the expected loss ratios of the insurers.



As can be seen, the insurer with the inferior model is more likely to pick up some business where it has underestimated the price by a large margin. It therefore runs at a significantly higher loss ratio.

There is a potential double hit here. If the market itself is efficient, then we might expect this inferior-priced business to run at a loss. However, the insurer also picks up a significantly larger market share than its competitors. This might be expected to compound the losses.



Bid Shading

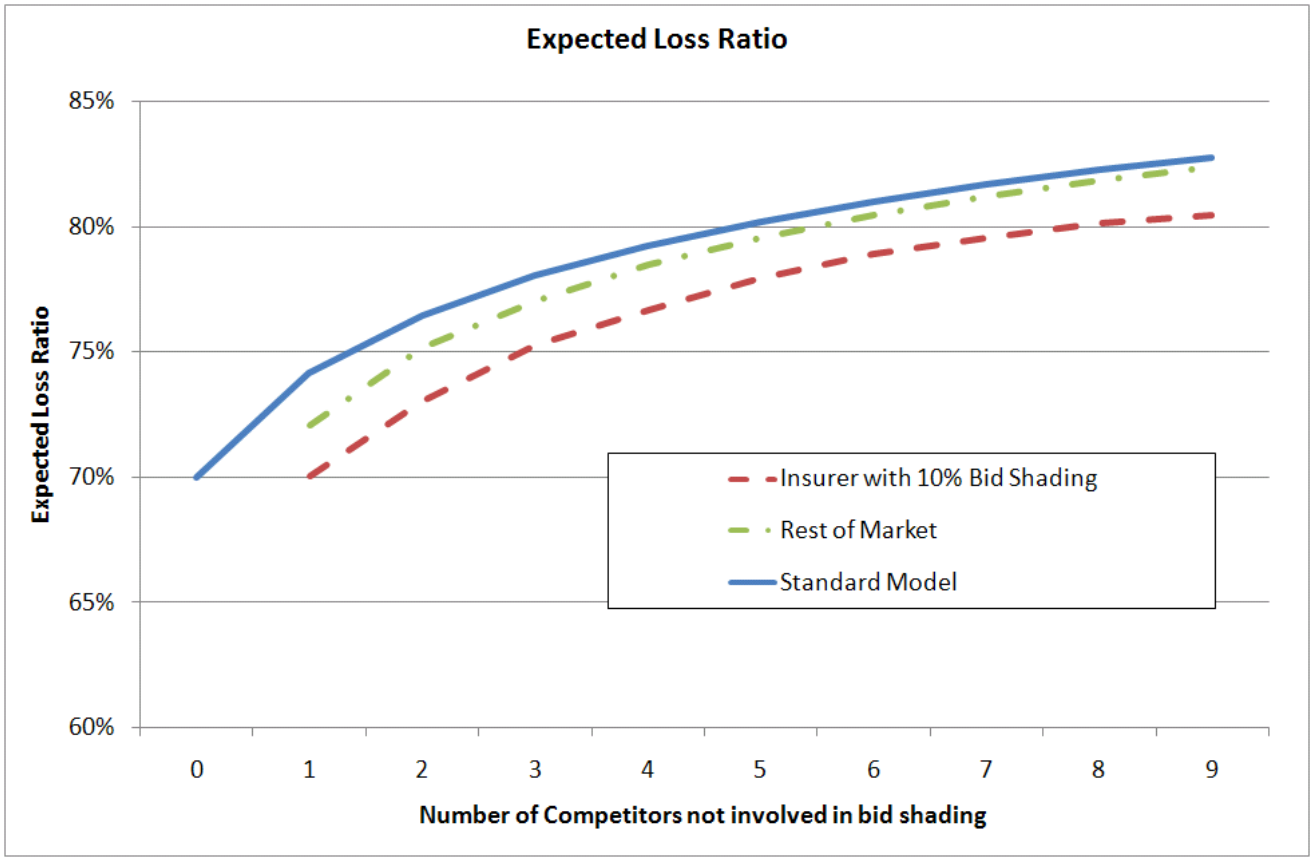
In auction theory, a wise bidder will lower their bid when faced with more competition. In theory, if all bidders act in the same consistent way, then they offset the impact of winner's curse.

Similarly, the argument should follow that wise insurers should increase prices when faced with more competition. If this is repeated market-wide, then we end up with a situation analogous to the "Feedback Loop" model described previously.

In this model we look at the impact on a single insurer trying to do this in isolation. We've modelled a case where one insurer increases prices by 10% over and above the average used in the basic model and by their competitors in this model.

Full results are shown in "Appendix 2.8: Bid Shading".

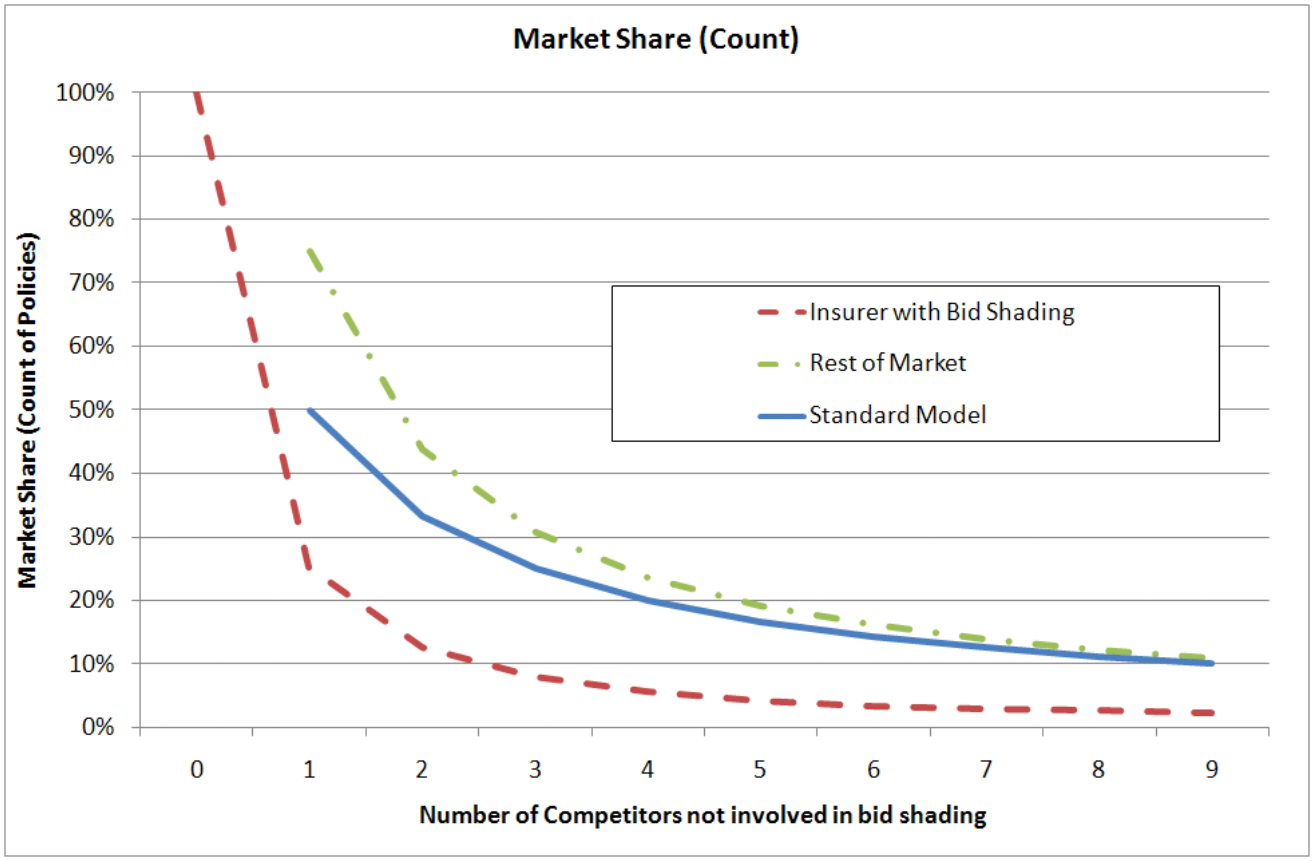
The following chart shows the impact on loss ratio.



The bid shading pricing here has helped reduce the insurer's loss ratio. However, the improvement is not as significant as might be expected from crudely modelling a 10% rate increase through a crude rate monitoring exercises. For example, with 3 competitors, the insurer might expect to see an improvement in the loss ratio from 78.1% (in the basic model) to 71.0% (78.1% divided by 1.1). However, the loss ratio has only improved to 75.3% because of the selective effect of winner's curse. Note that the actions of the insurer have slightly helped the loss ratios of their competitors; the 3 competitors might see their average loss ratio fall from 78.1% to 77.1%.

For a rate monitoring exercise to reflect more accurately the expected movements in underlying loss ratios, insurers may need to consider not only their own rate movements, but also those of their main competitors.

By being the only insurer to adopt bid shading, we might expect the insurer to lose market share.



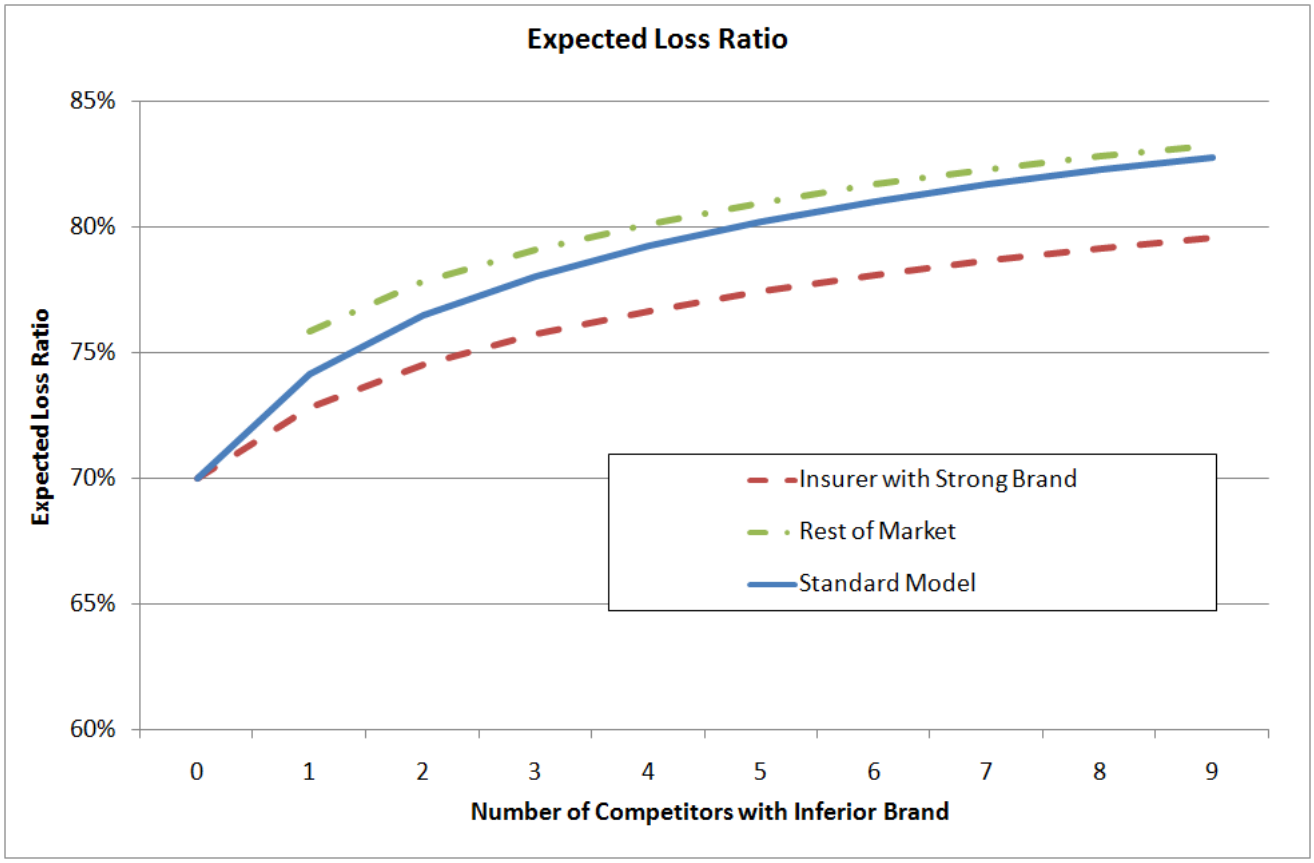
Again, looking at our example where the insurer is in a market with 3 competitors, market share has fallen from 25% to 8%. Clearly, adopting an ex ante pricing strategy poses an optimisation question for the insurer to resolve: finding the right balance between loss ratio and business volume to maximise their chosen target measure (e.g. maximise return on capital or absolute profit). Different insurers will have different expense structures and different capital constraints, so there may be a range of different optimal strategies for different insurers.

Impact of brand value

Often insurers are faced with deciding whether to pitch their products as either a price-lead value offering or a quality service product. In this model, we explore the value of a strong brand or a reputation for good quality service. We've modelled this by looking at an insurer who will win the business if their price is within 5% of being the cheapest rather than actually being the cheapest.

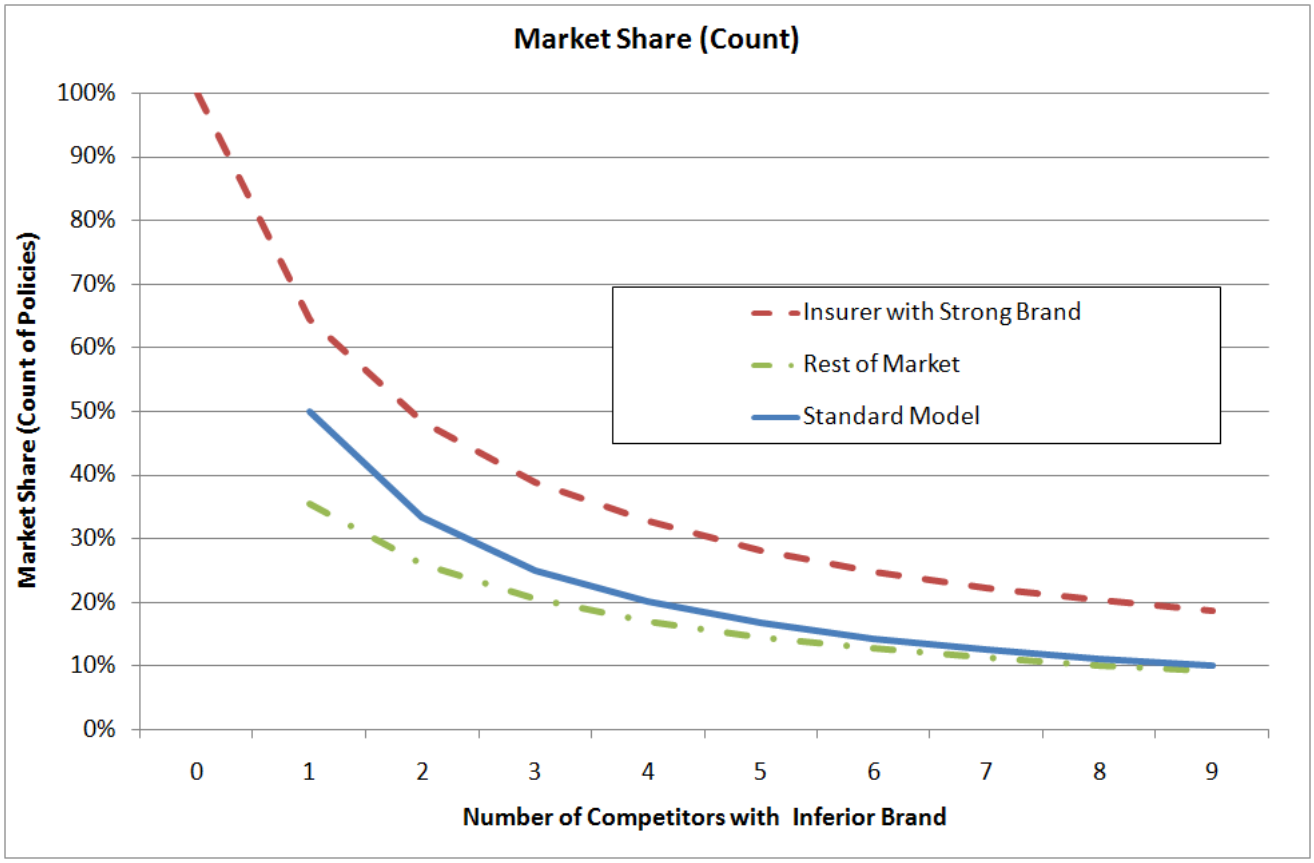
Full results are shown in "Appendix 2.9: Impact of Brand Value"

The impact on loss ratios was as follows:



It can be seen that the insurer with the strong brand can operate at a lower loss ratio. This makes intuitive sense. They will still pick up business when their price is less "wrong" than it would otherwise have needed to be. Conversely, their competitors might need to be more "wrong" than before to pick up business.

There is a potential for a "win-win" here for the strong brand. As the following chart shows, they can also expect to pick up a greater share of business than their competitors.

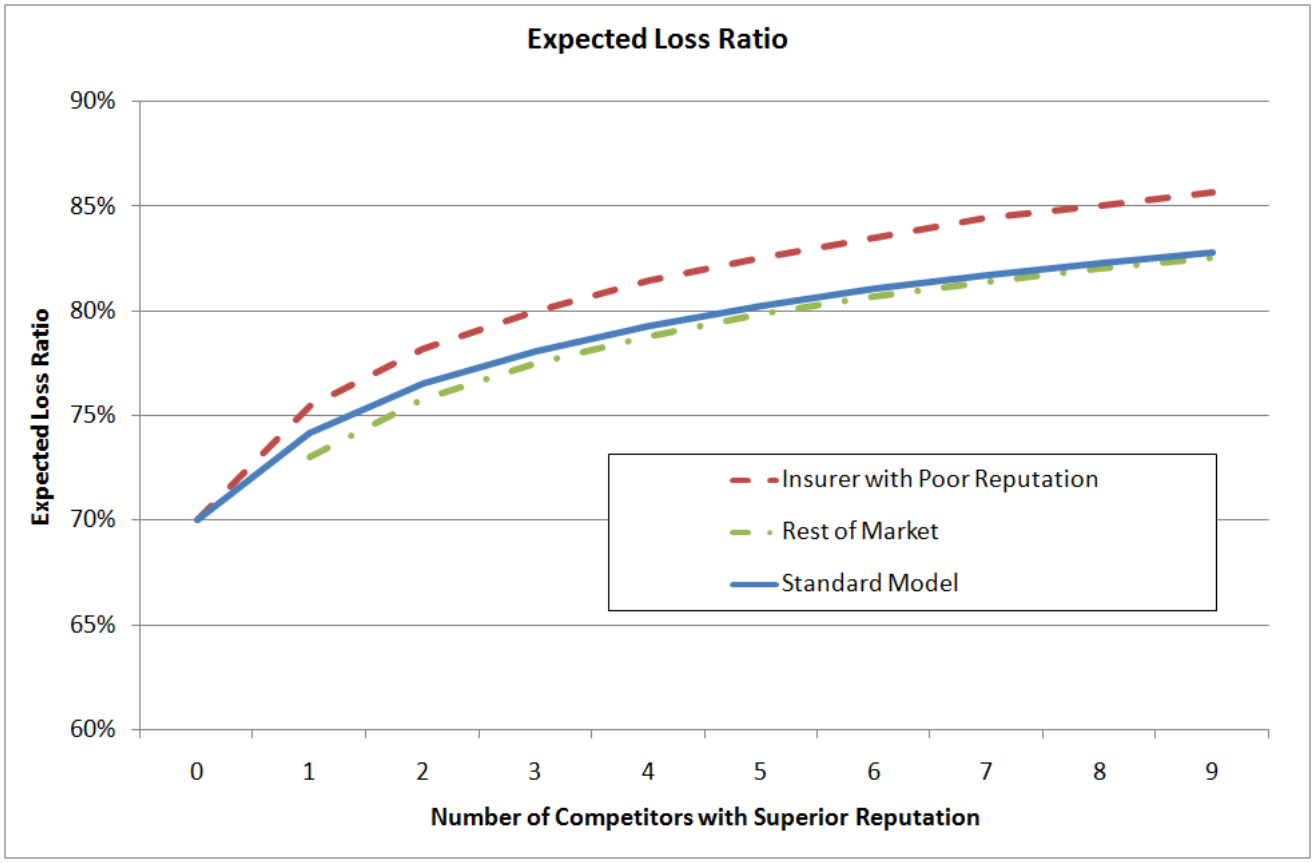


Impact of poor reputation

If a strong brand or a good reputation for service is beneficial to an insurer, then is the converse true for an insurer with a poor reputation? In this model we look at an insurer that can only win business if it is 5% or more cheaper than the next cheapest.

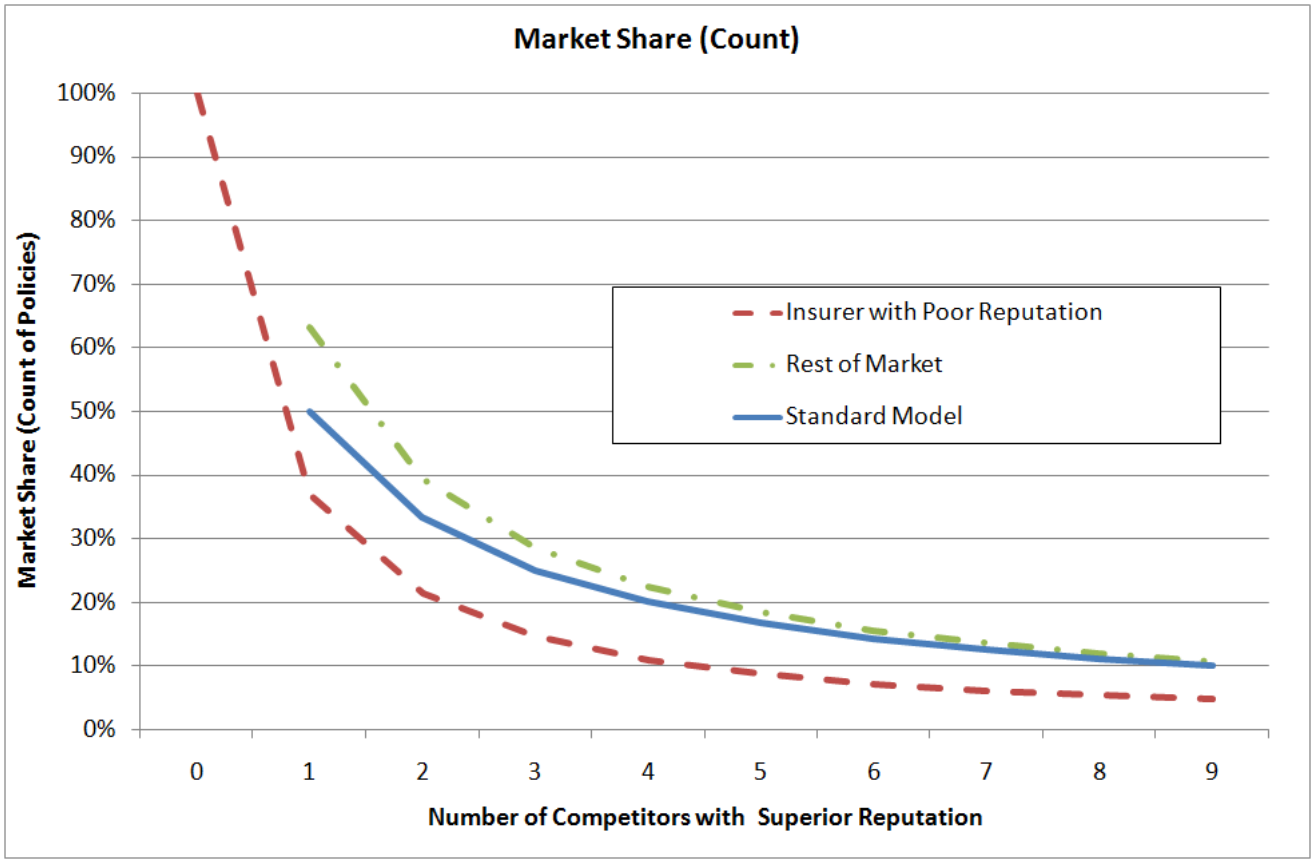
Full results are in "Appendix 2.10: Impact of Poor Reputation"

The following chart demonstrates the implication in terms of loss ratio.



The insurer with a poor reputation runs at a higher loss ratio. This is because their price needs to be significantly lower to win the business – i.e. they need to be more "wrong" than would otherwise have been the case.

As the chart below confirms, this also translates to a lower market share.



Discounting prices from a superior model

In earlier models, we demonstrate a scenario where an insurer with a superior pricing model can run at a lower loss ratio than the rest of the market, but that they lost market share.

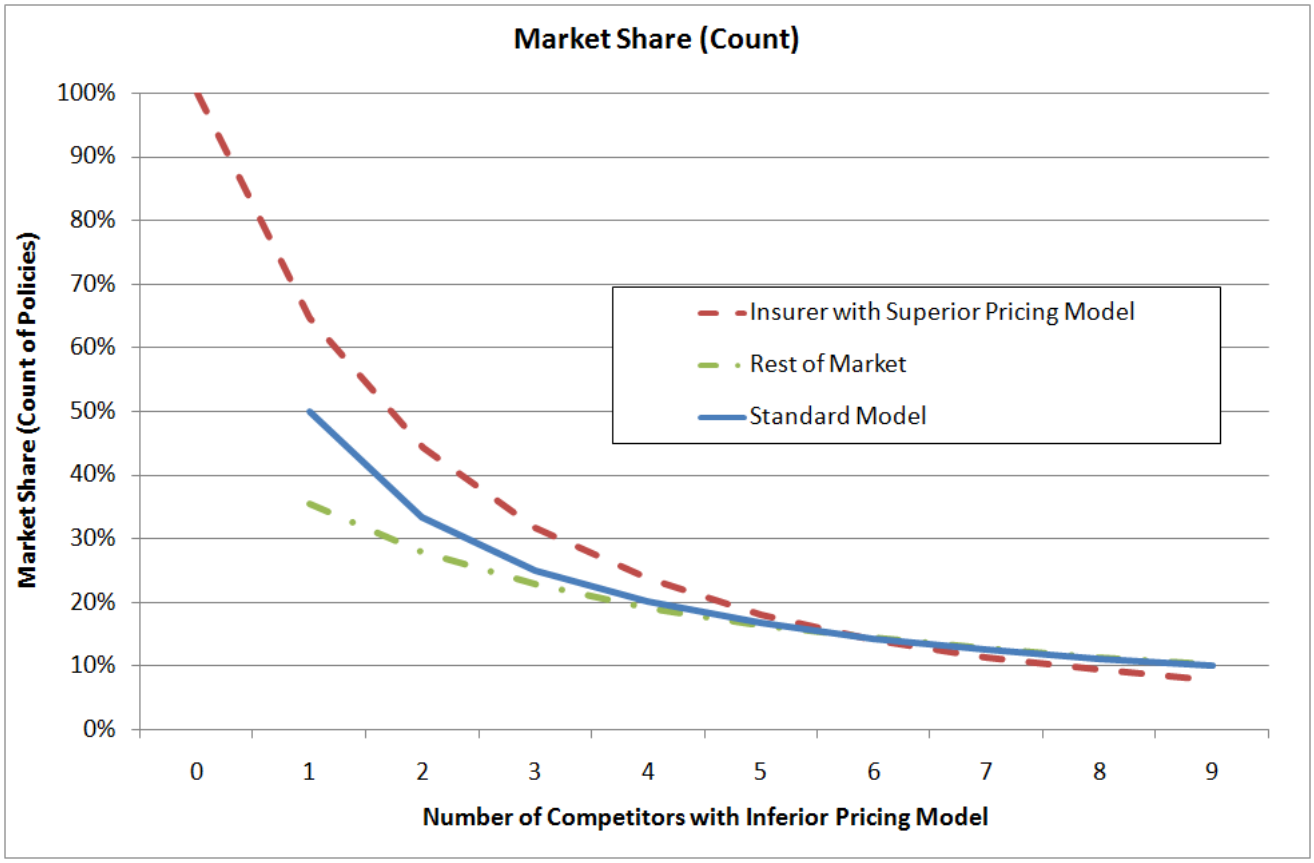
In these models, we look at what might happen if that insurer discounts its price to maintain market share.

SINGLE INSURER

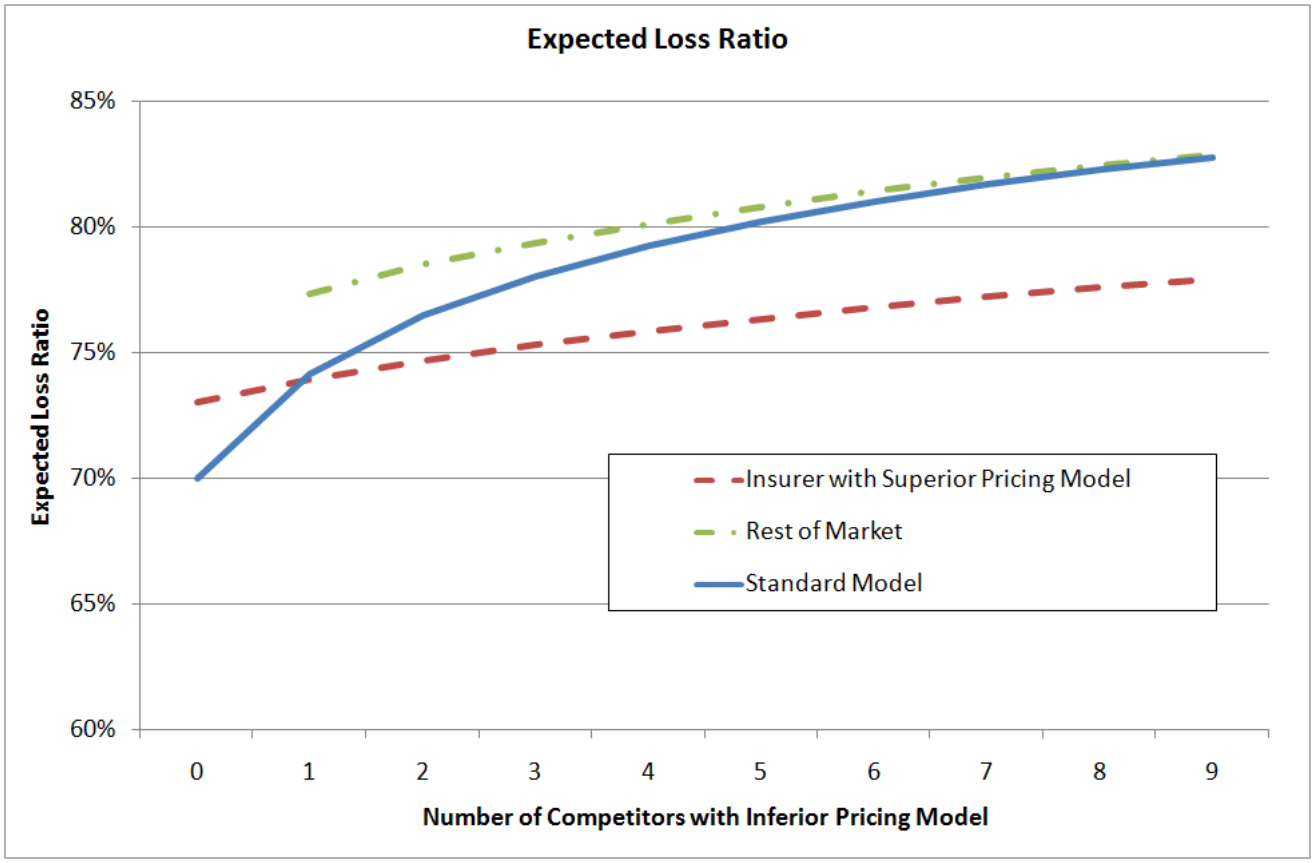
Firstly, we look at a single insurer with this strategy. In this example, one insurer has a pricing structure with a co-efficient of variation of 5% (compared to 10% for the rest of the market), but has reduced all its prices by 4% to offset the reduction in business volumes.

Full results of this model can be found in "Appendix 2.11: Discounting Prices from a Superior Model: Single Insurer"

The following chart demonstrates how this might lead to the same market share when competing against 6 other competitors who all have inferior pricing models.



However, the following graph shows the expected loss ratios, and in this example, the insurer with the discounted, superior pricing model still manages to run at a loss ratio lower than the rest of the market..



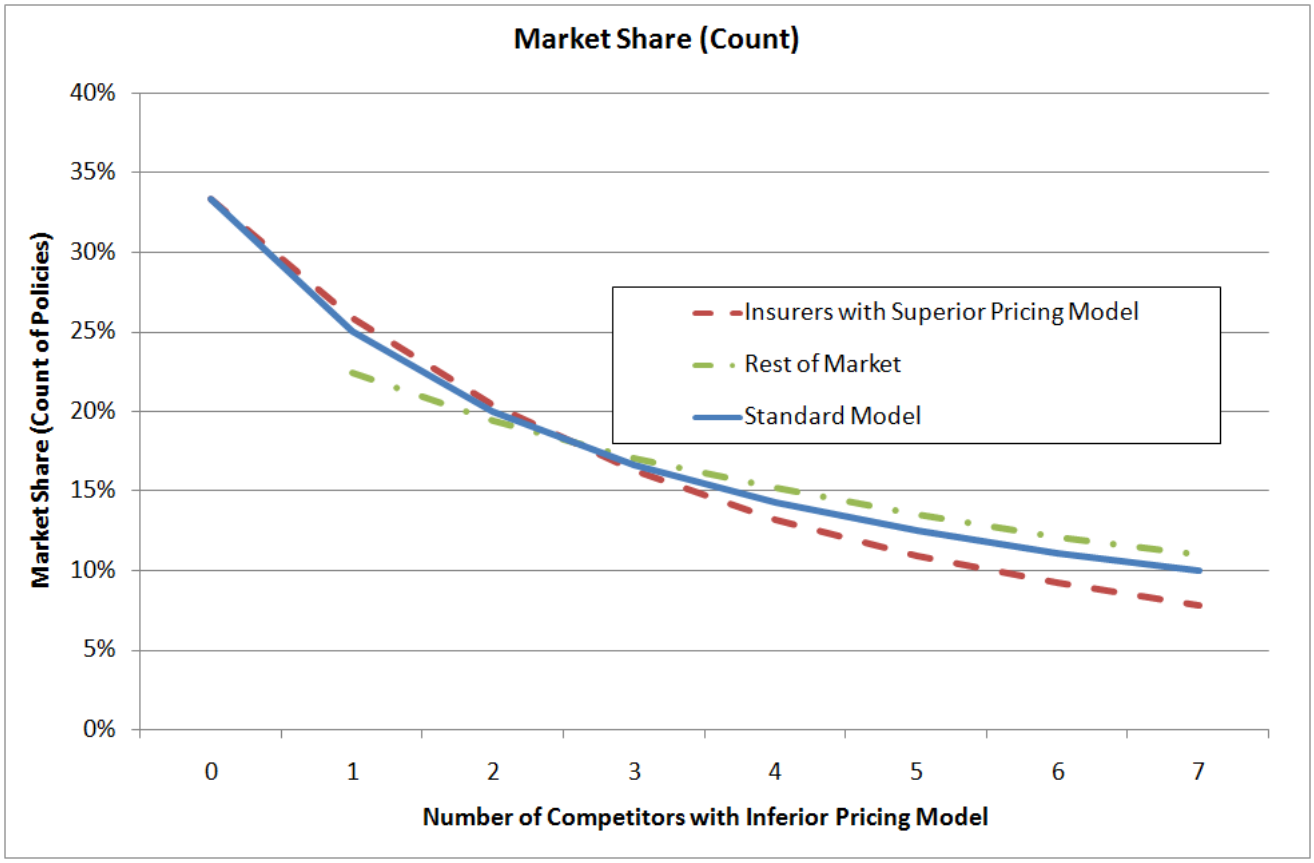
In this example, the insurer with the discounted, superior pricing model still manages to run at a loss ratio lower than the rest of the market. The exact dynamics at play here are likely to depend on the assumptions made and the distribution of prices. However, it demonstrates that there are alternative optimal pricing options that may be available to an insurer with a superior pricing model.

MULTIPLE INSURERS

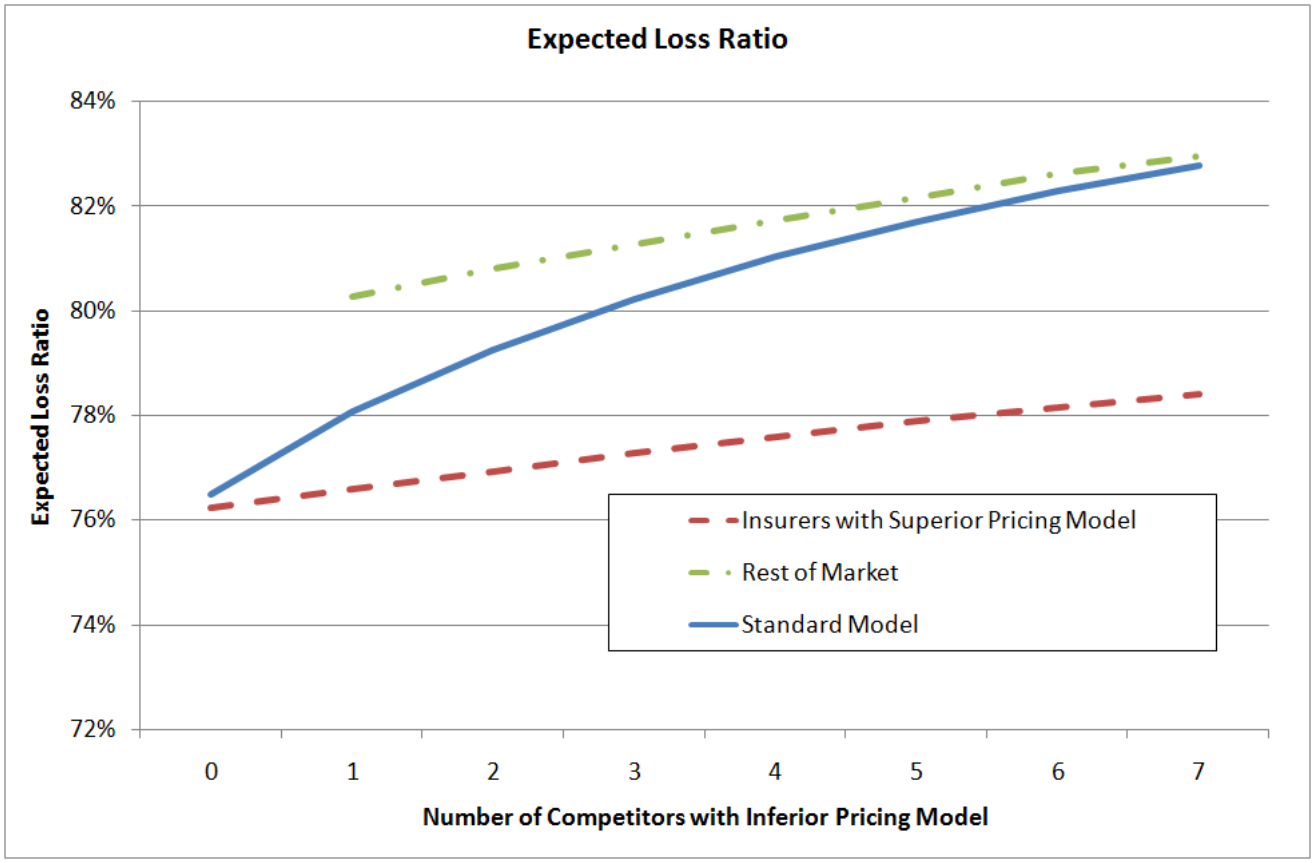
Similar effects can be seen when we expand the model to look at 3 insurers with superior models all discounting their models to compete against each other and against other insurers with inferior models.

Full details can be found in "Appendix 2.12: Discounting Prices from a Superior Model: Multiple Insurers"

The following chart demonstrates that the 3 insurers that have discounted their superior pricing models manage similar market shares to those with inferior models.



Again, we see a scenario where those that have discounted their superior models still manage better loss ratios than those with inferior models – despite the discount! The following graph shows comparative loss ratios.



Discounting prices to maintain market share

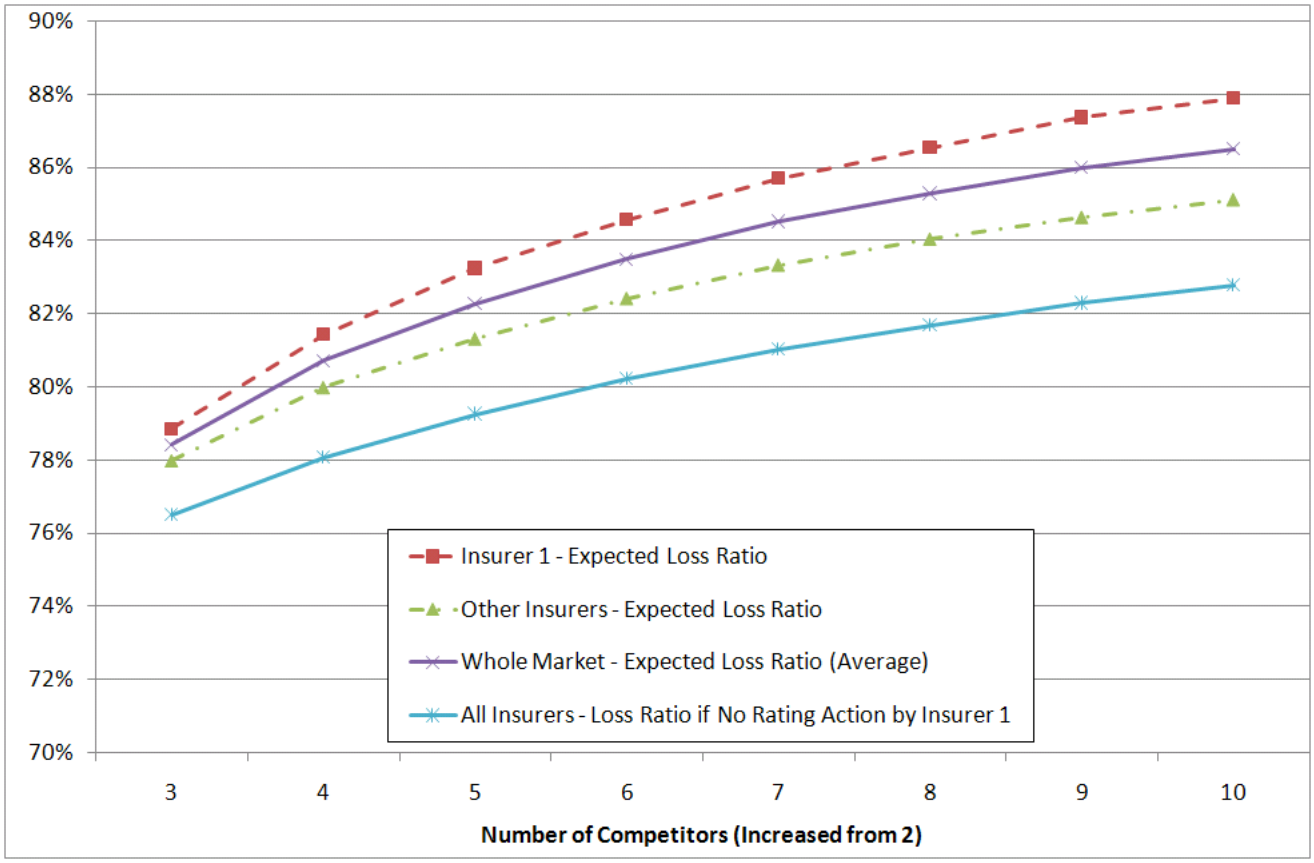
When faced with new entrants to their market and increased competition, many underwriters may be tempted to reduce their rates in order to maintain their market share. In this section, we look at the impact this has on their performance and on their competitors.

The following table and chart illustrate the impact of moving from two competitors to more than two. In this case one of the two original competitors (insurer 1) wishes to maintain their 50% market share.

Moving from 2 to n competitors

For Insurer 1 to maintain market share of 50.0%

Competitors	All Insurers Previous Loss Ratio	Insurer 1 Price Cut	Insurer 1 New Loss Ratio	Other Insurers New Loss Ratio	Whole Market New Loss Ratio	If No Price Change New Loss Ratio	Simple Price Monitoring Predictions Insurer 1	Other Insurers
3	74.2%	5.7%	78.8%	78.0%	78.4%	76.5%	78.7%	74.2%
4	74.2%	8.6%	81.4%	80.0%	80.7%	78.1%	81.1%	74.2%
5	74.2%	10.4%	83.2%	81.3%	82.3%	79.2%	82.8%	74.2%
6	74.2%	11.8%	84.6%	82.4%	83.5%	80.2%	84.0%	74.2%
7	74.2%	12.9%	85.7%	83.3%	84.5%	81.0%	85.1%	74.2%
8	74.2%	13.7%	86.5%	84.0%	85.3%	81.7%	85.9%	74.2%
9	74.2%	14.5%	87.3%	84.6%	86.0%	82.3%	86.7%	74.2%
10	74.2%	14.9%	87.9%	85.1%	86.5%	82.8%	87.2%	74.2%



For example, if we have 2 new competitors, but insurer 1 wants to maintain a 50% share, then they would need to cut prices by 8.6%. Their expected loss ratio deteriorates from 74.2% to 81.4% and the loss ratio of their competitors deteriorates to 80.0%. If insurer 1 had not acted then the impact of competition would have deteriorated the market loss ratio to 78.1%. This demonstrates that insurer 1's actions have a significant impact on their competitors and not just on themselves.

In a simple rate monitoring exercise where each insurer judges the change in its loss ratio by looking at how its own rates have moved, insurer 2 would have expected a loss ratio that remained at 74.2%, whilst insurer 1 would have expected its loss ratio to deteriorate to 81.1%. This highlights, that in forecasting loss ratios, insurers may need to be aware of increased competition levels and the rating actions of competitors as well as their own rating actions.

Similar examples can be drawn from larger markets (e.g. starting with 3, 4, 5, etc.... competitors). In general, the effects decrease with a larger number of starting competitors (some examples are included in the appendices), but can increase dramatically if more than one insurer tries to maintain market share.

7. MATHEMATICAL MODELS - DRAFT

Winner's curse – quantifying the value of information

A previous paper (Smith, 1994 – see Appendix 4) provided a two-player winner's curse model. This chapter is an update on that paper. For tractability, the original multiplicative model is replaced by an additive one.

Means and loss events

An insurance policy has an uncertain loss cost, which we denote by U. This includes claims and associated expenses. The ultimate losses are assumed not to vary between insurers; this implies that all insurers have the same commission and expense structure as well as the same claims handling processes.

Different agents in the markets have different information regarding U and therefore form different estimates of the mean.

We suppose that N insurers are active in the market. Each insurer calculates its own estimate X_i of the mean of U. These are different because different players have access to different information and may analyse it differently. The information includes historic claims experience, analysis and expertise available to each insurer.

Competitive market model

Suppose that each insurer quotes a gross premium equal to some function $\lambda_i(X_i)$ of the estimated loss cost X_i. We usually expect that $\lambda_i(x) \geq x$ for all x. The difference might be interpreted as a planned margin for profit, but this is also the margin to absorb the effect, if any, of winner's curse.

We assume that whichever insurer charges the lowest quote $\lambda_i(X_i)$ wins the business. Let M_i denote the minimum of all the quotes, excluding insurer i.

If insurer i wins the auction, then its quote $\lambda_i(X_i)$ is less than the minimum M_i of the others. In that case, the insurer's profit (or loss if negative) is

$\lambda_i(X_i) - U$

Otherwise, the profit is zero. Using I to denote an indicator function, we can write the profit as:

$$\left(\lambda_i(X_i) - U\right) I\left\{\lambda_i(X_i) < M_i\right\}$$

The expected profit π_i is given, trivially, by

$$\pi_i = \mathbf{E}\left\{\left(\lambda_i(X_i) - U\right) I\left\{\lambda_i(X_i) < M_i\right\}\right\}$$

Simple cases – exchangeable multivariate normal

We can compute some simple cases analytically, for N insurers if all these insurers are copies of each other. Suppose that all the X_i are multivariate normal. Each X_i has mean μ_X and standard deviation σ_X and the correlation between any pair is ρ_X. The ultimate losses have mean μ_U, standard deviation σ_U and enjoy

correlation ρ_U with each of the estimates X_i. Suppose the insurers quote prices that are a multiple β of the cost estimate, plus a flat addition α.

I claim that the effect of winner's curse on each insurer's expected profit is:

$$\xi_N \frac{\beta \sigma_X \sqrt{1-\rho_X}}{N}$$

The aggregate winner's curve, for comparison with the previous chapter, is N times this expression.

Here, ξ_N is the expected value of the maximum of N independent, identically distributed $N(0,1)$ variables. These are known in closed form for small N:

N	ξ_N formula	ξ_N value
1	0	0
2	$\frac{1}{\sqrt{\pi}}$	0.564
3	$\frac{3}{2\sqrt{\pi}}$	0.846
4	$\frac{3\left[\pi - 2\cot^{-1}\sqrt{2}\right]}{\pi^{3/2}}$	1.029
5	$\frac{5\left[\pi - 3\cot^{-1}\sqrt{2}\right]}{\pi^{3/2}}$	1.163

As the insurers are copies of each other, they must all use the same profit load formula. We assume the profit load, in monetary terms is denoted by α, with premiums increasing by a multiple β of each element of estimated cost in excess of its mean. In formulas, each insurer's premium is calculated as

$$\lambda(x_i) = \alpha + \beta X_i$$

We will later need to use the conditional mean of U given all the X_i. By symmetry, this is a function only of the sum of all the X_i. We note that:

$$\mathbf{Var}\left[\sum_{i=1}^{N} X_i\right] = \sigma_X^2 \left\{N + N(N-1)\rho_X\right\}$$

$$\mathbf{Cov}\left[U, \sum_{i=1}^{N} X_i\right] = N\rho_U \sigma_X \sigma_U$$

Therefore, we can find the conditional mean given the vector *X*:

$$\mathbf{E}(U|X) = \mu_U + \frac{\sigma_U}{\sigma_X}\frac{\rho_U}{1+(N-1)\rho_X}\sum_{i=1}^{N}(X_i - \mu_X)$$

To reduce our problem to a standard form, we express the X_i in terms of independent N(0,1) random variables.

Next, let Z_1, Z_2, … Z_N be independent identically distributed N(0,1), and write:

$$X_i = \mu_X + \sigma_X\left\{\sqrt{1-\rho_X}\,Z_i + \frac{\sqrt{1+(N-1)\rho_X} - \sqrt{1-\rho}}{N}\sum_{j=1}^{N}Z_j\right\}$$

We can easily verify that this produces X_i with the desired mean, variance and correlation. We can recalculate the conditional mean of *U* as:

$$\begin{aligned}\mathbf{E}(U|Z) &= \mu_U + \frac{\sigma_U}{\sigma_X}\frac{\rho_U}{1+(N-1)\rho_X}\sum_{i=1}^{N}(X_i - \mu_X)\\ &= \mu_U + \sigma_U\frac{\rho_U\sqrt{1-\rho_X}}{1+(N-1)\rho_X}\sum_{i=1}^{N}Z_i + \sigma_U\frac{\rho_U\left[\sqrt{1+(N-1)\rho_X} - \sqrt{1-\rho}\right]}{1+(N-1)\rho_X}\sum_{i=1}^{N}Z_i\\ &= \mu_U + \sigma_U\frac{\rho_U}{\sqrt{1+(N-1)\rho_X}}\sum_{i=1}^{N}Z_i\end{aligned}$$

We can now compute the expected profit for the first party:

$$\begin{aligned}\pi_1 &= \mathbf{E}\{(\lambda_1(X_1) - U)I\{\lambda_1(X_1) < M_1\}\}\\ &= \mathbf{E}((\alpha + \beta X_1 - U)I\{Z_1 < Z_2, Z_3, \ldots Z_n\})\\ &= \mathbf{E}\left(\begin{array}{l}\left(\begin{array}{l}\alpha + \beta\mu_X - \mu_U + \beta\sigma_X\sqrt{1-\rho_X}\,Z_1\\ +\left[\beta\sigma_X\dfrac{\sqrt{1+(N-1)\rho_X} - \sqrt{1-\rho}}{N} - \sigma_U\dfrac{\rho_U}{\sqrt{1+(N-1)\rho_X}}\right]\sum_{i=1}^{N}Z_i\end{array}\right)\\ I\{Z_1 < Z_2, Z_3, \ldots Z_n\}\end{array}\right)\end{aligned}$$

Now, by symmetry, we note that

$$\begin{aligned}1 &= NI\{Z_1 < Z_2, Z_3, \ldots Z_n\}\\ 0 &= \mathbf{E}\left(\sum_{i=1}^{N}Z_i\right) = N\mathbf{E}\left(\sum_{i=1}^{N}Z_i I\{Z_1 < Z_2, Z_3, \ldots Z_n\}\right)\\ -\xi_N &= \mathbf{E}\min\{Z_1, Z_2, \ldots Z_N\} = N\mathbf{E}(Z_1 I\{Z_1 < Z_2, Z_3, \ldots Z_n\})\end{aligned}$$

Thus, the expected profit is:

$$\pi_1 = \frac{\alpha + \beta\mu_X - \mu_U}{N} - \frac{\xi_N \beta\sigma_X \sqrt{1-\rho_X}}{N}$$

The first term is the expected profit ignoring winner's curse. The last term is the winner's curse effect, that is $\frac{\xi_N \beta\sigma_X \sqrt{1-\rho_X}}{N}$.

Perhaps the most striking fact about this formula is the number of variables that do not occur. The mean estimate and the mean ultimate claims are irrelevant. Even the variance of ultimate claims and correlation with the estimates, are irrelevant. All that matters is the number of insurers, the proportional profit load, the standard deviation of estimates and the extent to which they are correlated between insurers.

Our model is invariant under adding a constant to each of the estimates X_i. It is also invariant under multiplying all the estimators X_i by some scalar k and dividing the loadings β by the same k. In other words, we can get the same premium of €100, whether we express this as an €80 estimate plus 25% load or €50 estimate plus 100% load. However, within our model, not all of these X's would be credible as estimates of U. We might standardise the problem, for example, by requiring the estimates to correspond to conditional expectations:

$X_i = \mathbf{E}(U \mid X_i)$

This implies that $\mu_X = \mu_U$ and $\sigma_X = \rho_X \sigma_U$.

The insurer's optimisation problem

How then does a profit maximising insurer behave?

We assume each insurer seeks to maximise expected profit by choosing a suitable loading function $\lambda(x)$. This decision has to be made in at least partial ignorance of how other insurers are setting their prices.

We might hope to specify a dynamic multi-period model in which insurers continually refine their own cost estimates at the same time as building up profiles of competitor prices. As well as allowing for each insurer to update their responses to changes in competitor pricing, the statistical process of competitor analysis must also allow for the fact that competitors continually update their own pricing methodology in response to perceived changes by others. Such a degree of self-reference results in a complex and unwieldy model.

In the interests of tractability, we make simplifying assumptions about how the other insurers behave, that is, about their own λ functions. We also assume each insurer is aware of the joint distribution of all the X's. In this simplified context, a Nash equilibrium is a set of loading functions $\lambda_i(x_i)$ such that each is optimal for that insurer given knowledge of the other insurers' strategy. This theoretical construction allows us to consider a single pricing decision in isolation rather than modelling a learning experience over time.

In general, there is little that can be said about existence or uniqueness of these Nash equilibriums. To compute them, even when loading functions are linear, requires computation of multi-dimensional normal probabilities. Even in the symmetric case, verification of optimality requires evaluation of hypothetical scenarios where one

insurer changes their λ but others stay the same. This, then, is an asymmetric scenario, so our symmetric closed form solution does not apply. Instead we are forced to adopt numerical methods.

Explicit calculation

For simplicity's sake, let us take a game of two insurers. Their estimates of *U* are denoted by *X* and *Y*, and these are assumed multivariate normal.

As we have already seen, the mean does not affect the winner's curse effect, so without loss of generality, these random variables all have mean zero. Furthermore, we may assume (by scaling *X* and *Y* if necessary) that

$X = \mathbf{E}(U \mid X)$

$Y = \mathbf{E}(U \mid Y)$

This implies the variance-covariance matrix must take the following form:

$$\mathbf{Var}\begin{pmatrix} X \\ Y \\ U \end{pmatrix} = \begin{pmatrix} \sigma_X^2 & \rho\sigma_X\sigma_Y & \sigma_X^2 \\ \rho\sigma_X\sigma_Y & \sigma_Y^2 & \sigma_Y^2 \\ \sigma_X^2 & \sigma_Y^2 & \sigma_U^2 \end{pmatrix}$$

Positive definiteness implies a lower bound on σ_U. Specifically,

$$\sigma_U^2 \geq \frac{\sigma_X^2 - 2\rho\sigma_X\sigma_Y + \sigma_Y^2}{1-\rho^2}$$

Now suppose the first insurer asks a premium $\alpha_X+\beta_X X$ and the second insurer asks $\alpha_Y+\beta_Y Y$. The payoff matrix is then as follows:

Case	Insurer *X* payoff	Insurer *Y* payoff
$\beta_Y Y - \beta_X X \leq \alpha_X - \alpha_Y$	0	$\alpha_Y+\beta_Y Y - U$
$\beta_Y Y - \beta_X X > \alpha_X - \alpha_Y$	$\alpha_X+\beta_X X - U$	0

After some manipulation, we can deduce analytical expressions for the expected profit using the standard normal density function and its cumulative distribution function:

$$\pi_X = \alpha_X \Phi\left(\frac{\alpha_Y - \alpha_X}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\right)$$
$$- \frac{\beta_Y\sigma_Y^2 + \beta_X(\beta_X - 1)\sigma_X^2 - \rho\beta_X\beta_Y\sigma_X\sigma_Y}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\phi\left(\frac{\alpha_Y - \alpha_X}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\right)$$

And

$$\pi_Y = \alpha_Y \Phi\left(\frac{\alpha_X - \alpha_Y}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\right)$$
$$- \frac{\beta_X\sigma_X^2 + \beta_Y(\beta_Y - 1)\sigma_Y^2 - \rho\beta_X\beta_Y\sigma_X\sigma_Y}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\phi\left(\frac{\alpha_X - \alpha_Y}{\sqrt{\beta_X^2\sigma_X^2 + \beta_Y^2\sigma_Y^2 - 2\rho\beta_X\beta_Y\sigma_X\sigma_Y}}\right)$$

These formulas are vastly more complicated than in the symmetric case, with the ultimate volatility σ_U the only parameter not to appear. Nevertheless, we can see some parallels to the result we had before. Each formula consists of a naïve expected profit based on the profit loading and a conversion rate, minus a winner's curse adjustment. Both formulas are first order homogenous in σ and α. The formulas are symmetric, in that we can turn *X*'s profit into *Y*'s profit by swapping all *X*'s for *Y*'s in the formula.

Nash Equilibria

It is possible numerically to identify Nash equilibria by making an initial assumption about *X*'s strategy, optimising Y's behaviour given *X*'s strategy, then re-optimising *X*'s behaviour given *Y*'s strategy and so on, looping until convergence occurs. If this converges, then we have found one Nash equilibrium; however, it does not follow that this is unique.

We first consider the symmetric case where $\sigma_X = \sigma_Y$. In this case, we have an analytical solution to the Nash equilibrium, which is:

$$\alpha = \frac{3\sigma\sqrt{\pi(1-\rho)}}{2-\rho}$$
$$\beta = \frac{3}{2-\rho}$$

It can be demonstrated by differentiation that this is optimal for each party assuming the other party follows this behaviour. The initially surprising result is that $\beta<1$. If $\beta=1$, this implies a constant amount per policy, while $\beta>1$ captures more accurately the current practice where larger amounts are loaded onto higher premium policies. A finding that $\beta<1$ implies that larger loadings are added to policies with lower estimated costs. This makes sense because these policies are likely to be those where my estimate is below those of a competitor.

The case of $\sigma_X \neq \sigma_Y$ appears to be less tractable mathematically, so we consider some example calculations. The working party is grateful to Daniel Kendrick of Warwick University for his help with the numerical calculations. Some example Nash equilibria are tabulated below:

σ_X	1	2	2
σ_Y	1	1	2
ρ	0	0	0
α_X	1.182	1.236	2.363
β_X	0.667	0.410	0.667
α_Y	1.182	1.236	2.383
β_Y	0.667	0.545	0.667

The first and last column show the analytical formula when the standard deviations are equal. In the middle column, we see the effect when player *X* has a pricing information advantage, with a more variable estimate. The result on optimal strategy is surprising. Both players increase their fixed profit loading α, to the same level, so the mean premiums quoted are the same and in equilibrium the market shares remain at 50% for each player. However, both players optimally reduce the proportion of the estimated cost that is reflected in their price quote. With the information advantage player *X* makes the larger reduction from 0.667 to 0.410. In the expected profit, player *Y* now gets a benefit from winner's curse rather than a loss; in other words the expected profit is higher than would be the case if the planned margin α_X were achieved. This surprising result arises because of the way in which the claim estimate is only partly reflected in the premium quoted. Where player *Y* has overpriced the true risk the information asymmetry together with the price cutting implies that Y is more likely to win the business and not less. Player *Y* experiences winner's curse in the same way as before, but to a lesser degree. Thus, surprisingly, where there is a differential ability to estimate claims, it appears that both players benefit from higher profits than would otherwise be the case.

In this section we have only scratched the surface of the possible consequences of winner's curse in a game theoretic setting. At least in theory, traditional approaches of adding a margin for profit and winner's curse appears far from optimal, with better profits available for insurers who add smaller loadings to policies with higher expected claims cost and vice versa.

8. EVIDENCE OF WINNER'S CURSE IN PRACTICE

Profitability of business sold via aggregators

A contemporary example of the winner's curse phenomenon occurs in personal lines insurance on price comparison websites (aggregators). As the number of insurers on the aggregator increases the price the customer pays is "competed down", assuming the customer always chooses the cheapest quote.

This has two implications:

1. We might expect that the aggregator as a whole becomes more competitive. Average premiums would be expected to reduce and the claims ratio increases, assuming a constant total claim amount.
2. The share of the aggregator for each insurer decreases. Different insurers are affected by the increased competition in different ways:
    a. Insurers with better rating structures are more able to resist the deterioration in their claims ratio, whereas insurers with poor rating structures suffer more. However, as argued in chapter 6, we might expect insurers with better rating structures to suffer more from reductions in business volumes.
    b. The mix of business written by each insurer changes. Some insurers write higher premium business, others write lower premium business. Note that high premium does not necessarily correlate with low claims ratio.

The first point implies that everyone is affected by the winner's curse. This effect becomes more pronounced as the number of insurers on the aggregator increases.

The second point implies that different insurers are affected by the winner's curse differently. The better an insurer's rating structure, the less they are affected.

Overview of the model

The personal lines aggregator model was built in Excel and examines the average premium, average claims cost per policy and claims ratio as the number of insurers on an aggregator increases.

The data was sourced from Consumer Intelligence. The household models use data obtained directly from insurers' websites. This data was used to create a fictitious aggregator. The motor models have direct data too, but also data sourced from various real aggregators, such as Confused and Moneysupermarket.

The models assume:

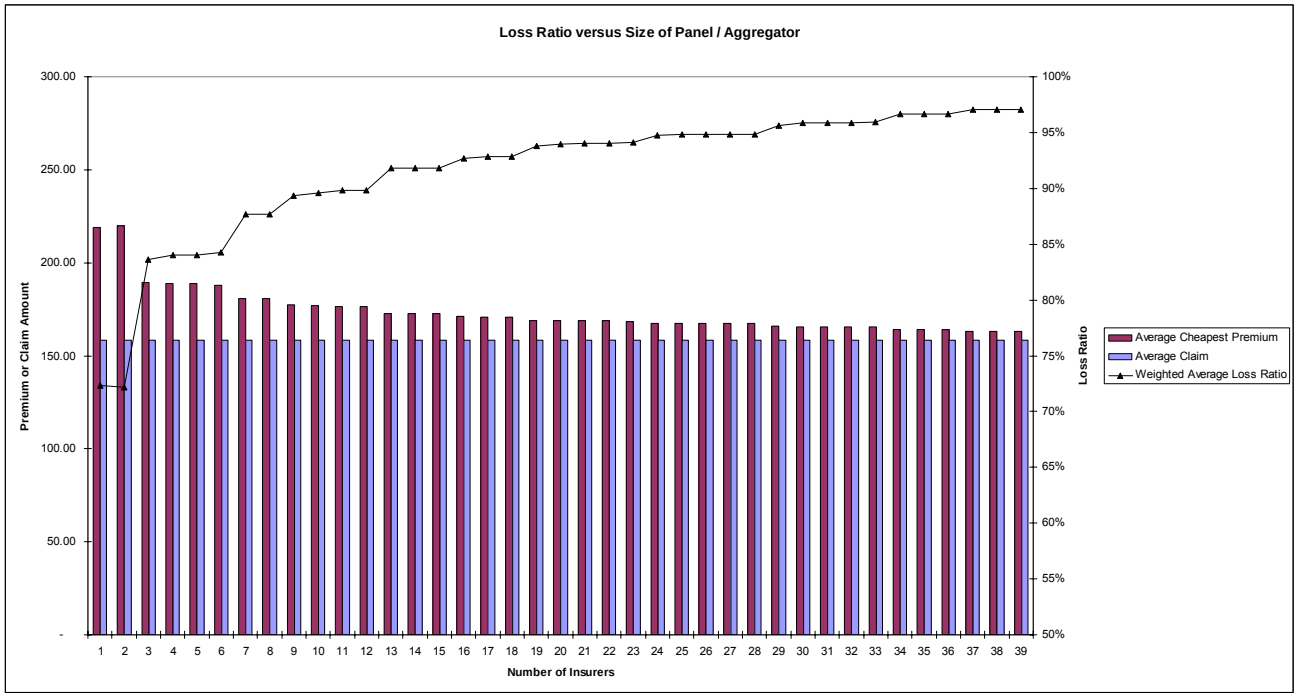
- The cheapest quote is always accepted and there are no brand effects.
- The claim frequencies and amounts are not affected by the insurer that the customer chooses. i.e. every insurers claim settlement processes (e.g. exclusions) are similar.

Mechanics of the model

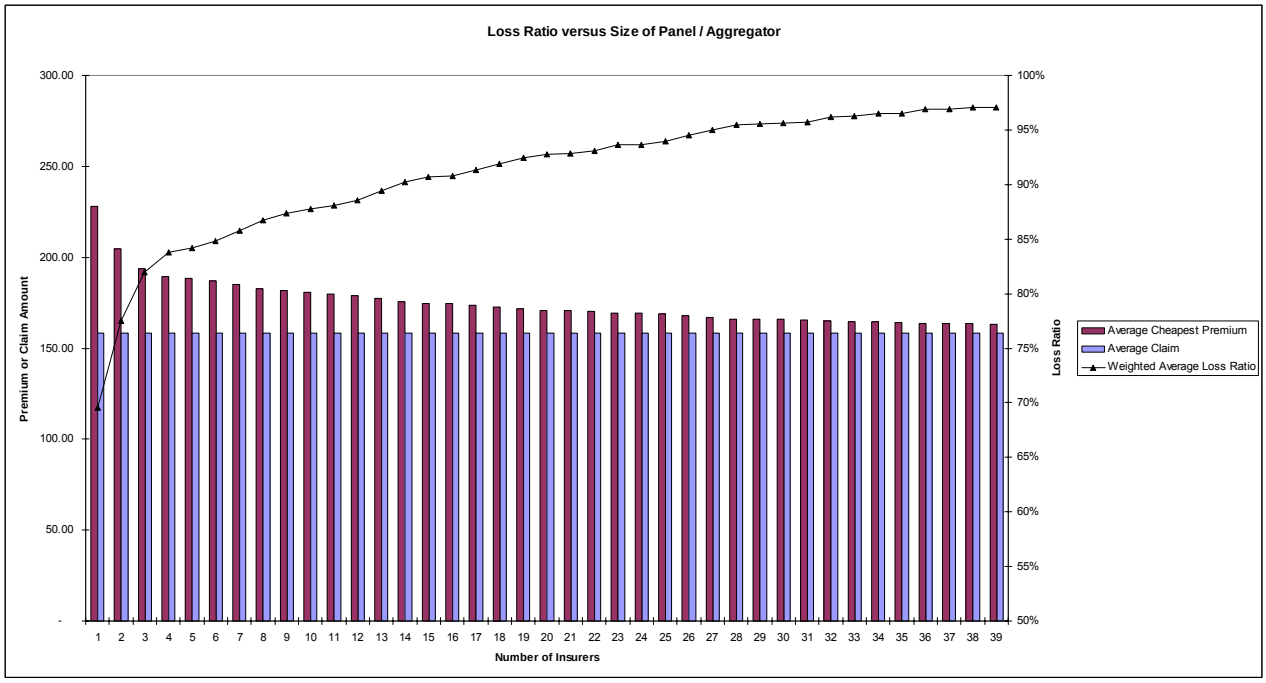
The order in which the insurers are placed on the aggregator affects the results. To overcome this problem, a number of iterations were run, each with a random order of insurers. Averaging about 20 iterations is enough to obtain results free of noise.

The following slides show the effect of increasing the number of iterations for a Household Buildings and Contents model:

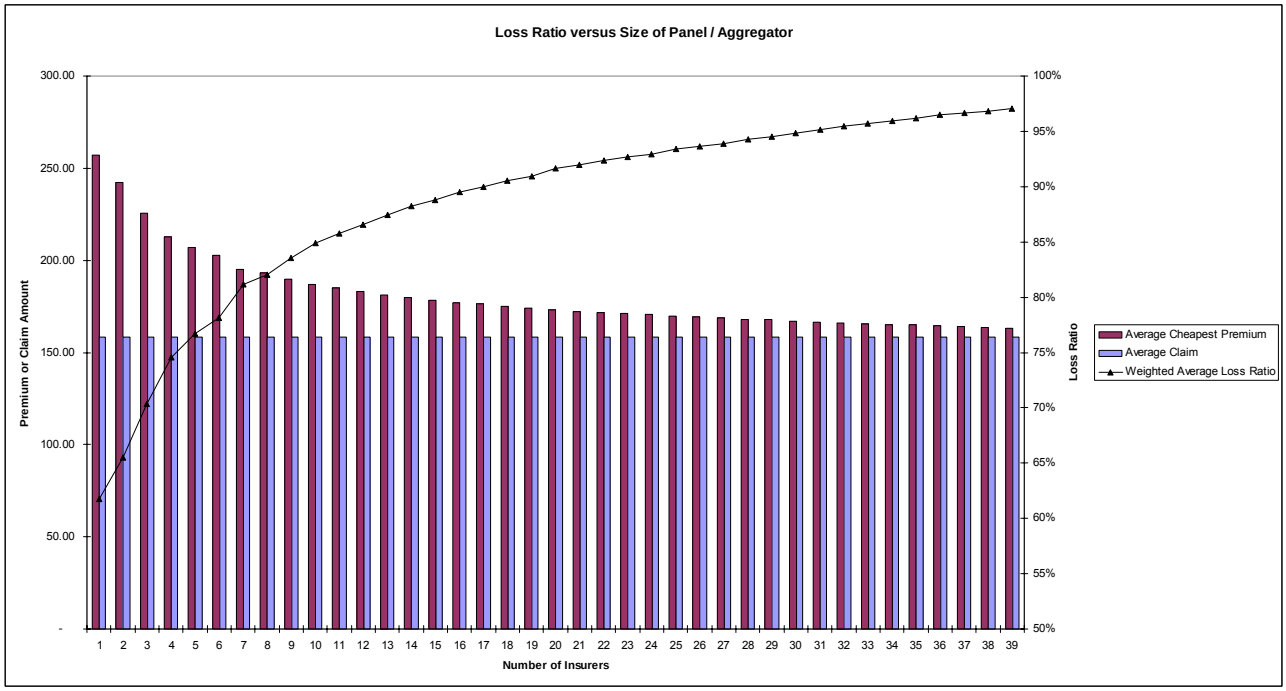
AVERAGE OF ALL INSURERS, 1 ITERATION



AVERAGE OF ALL INSURERS, 5 ITERATIONS



AVERAGE OF ALL INSURERS, 20 ITERATIONS



Impact on all insurers (household)

In the example above (20 iterations), the average loss ratio for all insurers moves from 60% to 97% as the number of insurers on the aggregator increases from 1 to 39. This shows that the winner's curse is a material

issue. Allowance for the winner's curse needs to be made in an insurer's rating structure, or loss ratio performance will be worse than that required.

The impact that the winner's curse has on the loss ratio is directly linked to the number of insurers on the aggregator. The exact number of insurers on the aggregator is more important when there are fewer insurers. When the number of insurers on the aggregator increases from 1 to 2, the loss ratio increases by 7% (from 60% to 67%). However, increasing the number of insurers from 38 to 39 leads to a 0.2% increase in loss ratio.

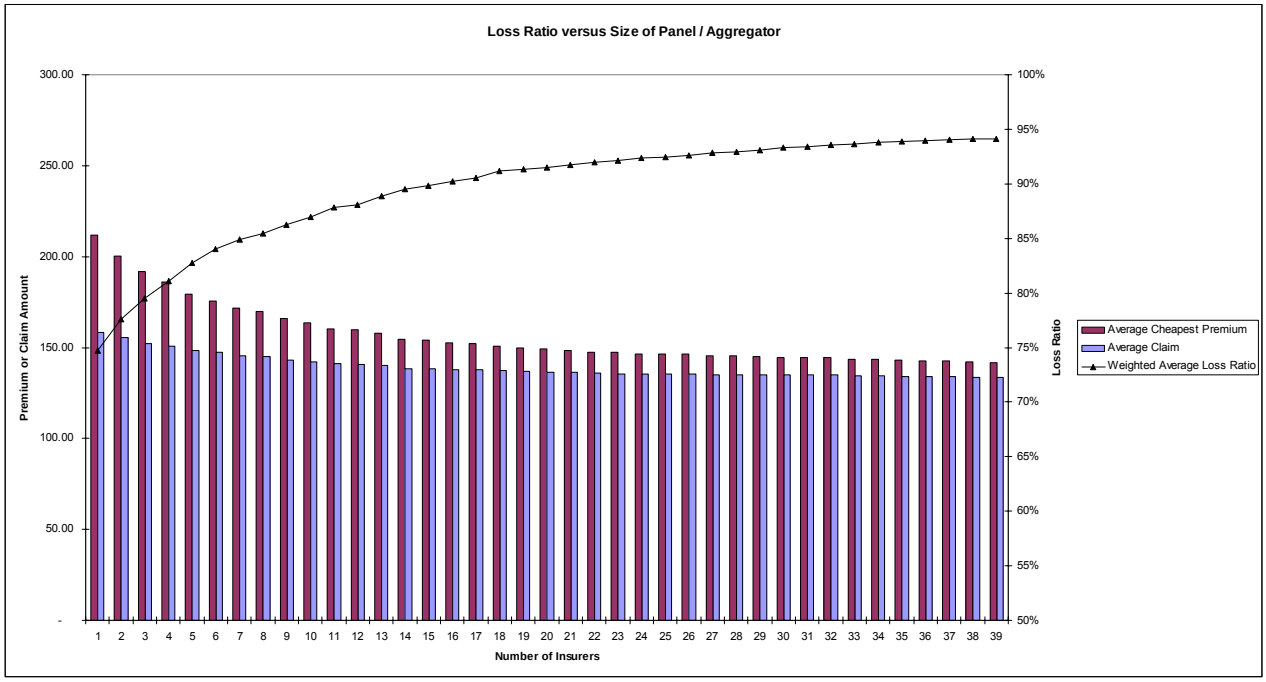
When Insurers first entered the aggregator market they changed from a dynamic of competing against a few other insurers (as customers would not generally make numerous individual quotes) to a panel of 30 or so insurers. This would have been likely to drive their aggregated loss ratio from an estimated 70% (assuming 2 competitors) to 95% loss ratio (assuming 30 competitors). If this insurer wrote, say, 40% of its business on aggregators it would have seen a significant overall increase in loss ratio. This effect would have been less for Insurer's who moved from a Brokered panel to an Aggregated one as the number of 'competitors' would have started from a higher base point, however in this situation they would not have even known which business was sold via the aggregated channel. To compound the issue, once an Insurer has identified the poor loss ratio they have to try to do something about it. If they wish to maintain an overall loss ratio of 70% across all sales channels, they will need to increase rates on both direct and aggregator channels by about 14%. There are many problems with this strategy: a drop in the amount of business written by the insurer and potentially a different mix of business (see below) are two examples.

Impact on individual insurers (household)

Some insurer's rating structures naturally target higher premium business, others low premium business. Some insurers are able to maintain a good loss ratio despite increasing competition, others are less able to.

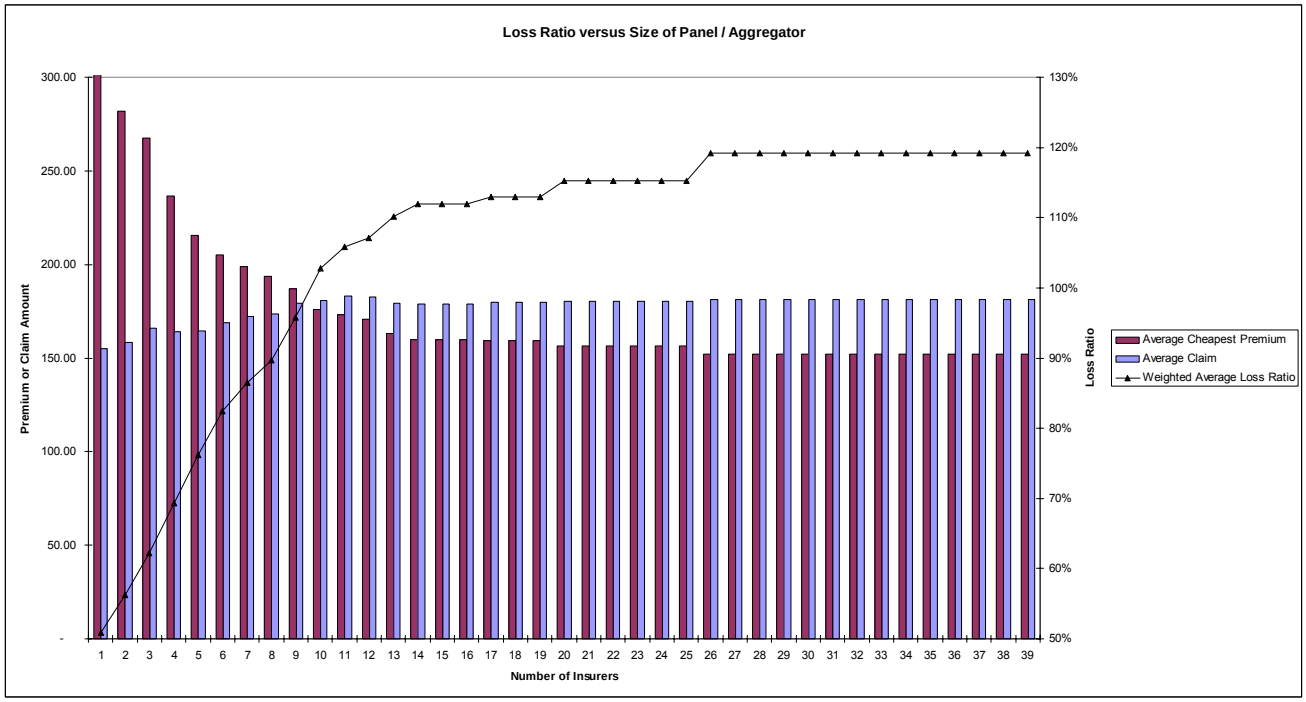
In the following chart, Insurer A appears to be able to maintain a good loss ratio as competition increases and naturally targets lower premium business. [Note that the figures for Insurer A and for Insurer B in the subsequent example are real insurers and the data is based on real quote information.]

INSURER A, 20 ITERATIONS



The claims ratio for Insurer B is healthy when it is the only one quoting, but deteriorates quickly as the number of insurers on the aggregator increases. Insurer B targets higher premium business than Insurer A.

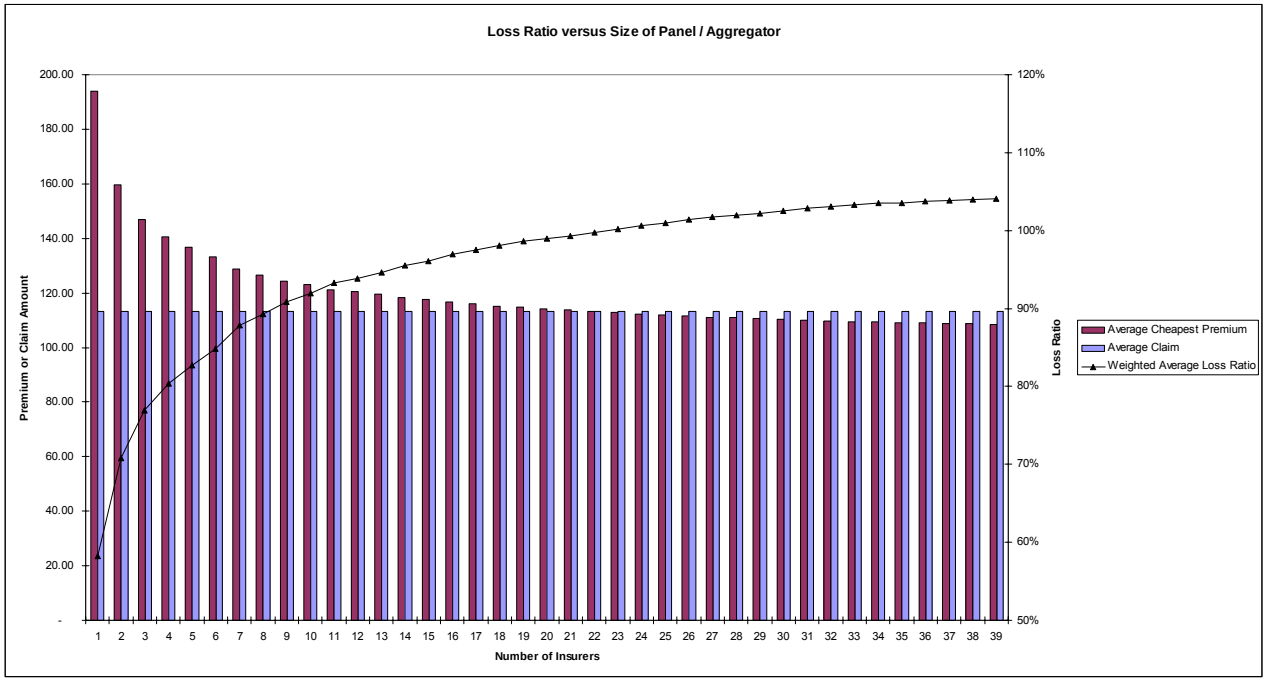
INSURER B, 20 ITERATIONS



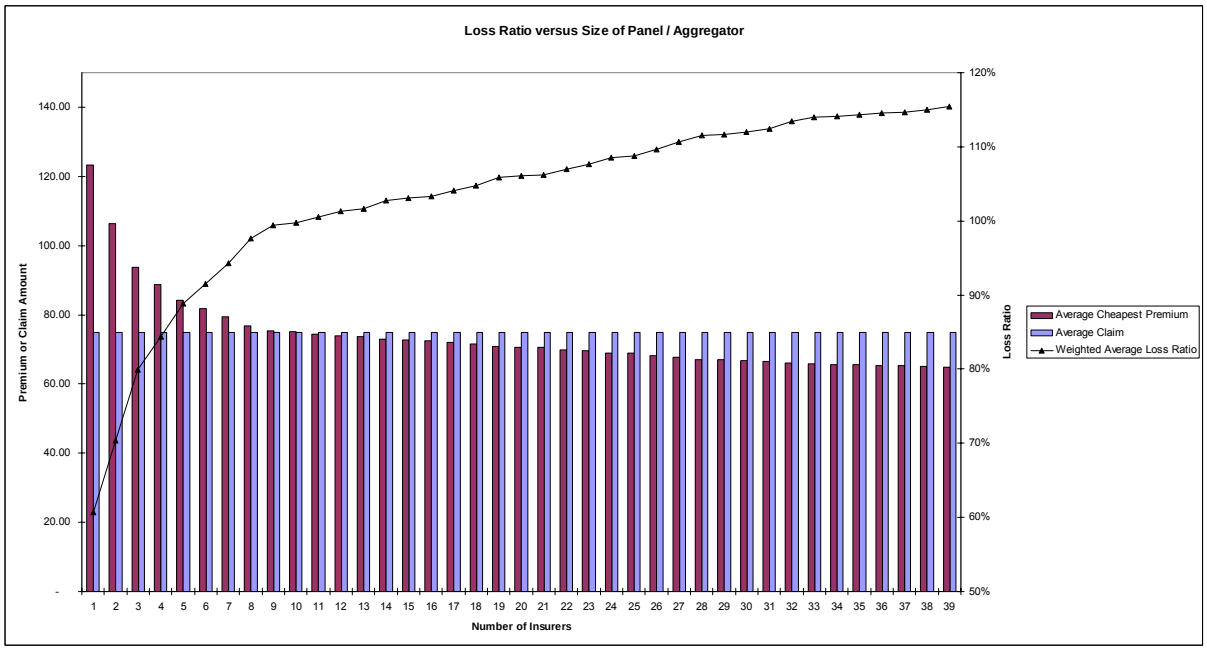
Buildings only and contents only policies (household)

Investigations involving buildings only and contents only policies yield similar results, though the market seems to be more competitive than that for combined business.

BUILDINGS ONLY, WHOLE MARKET, 20 ITERATIONS



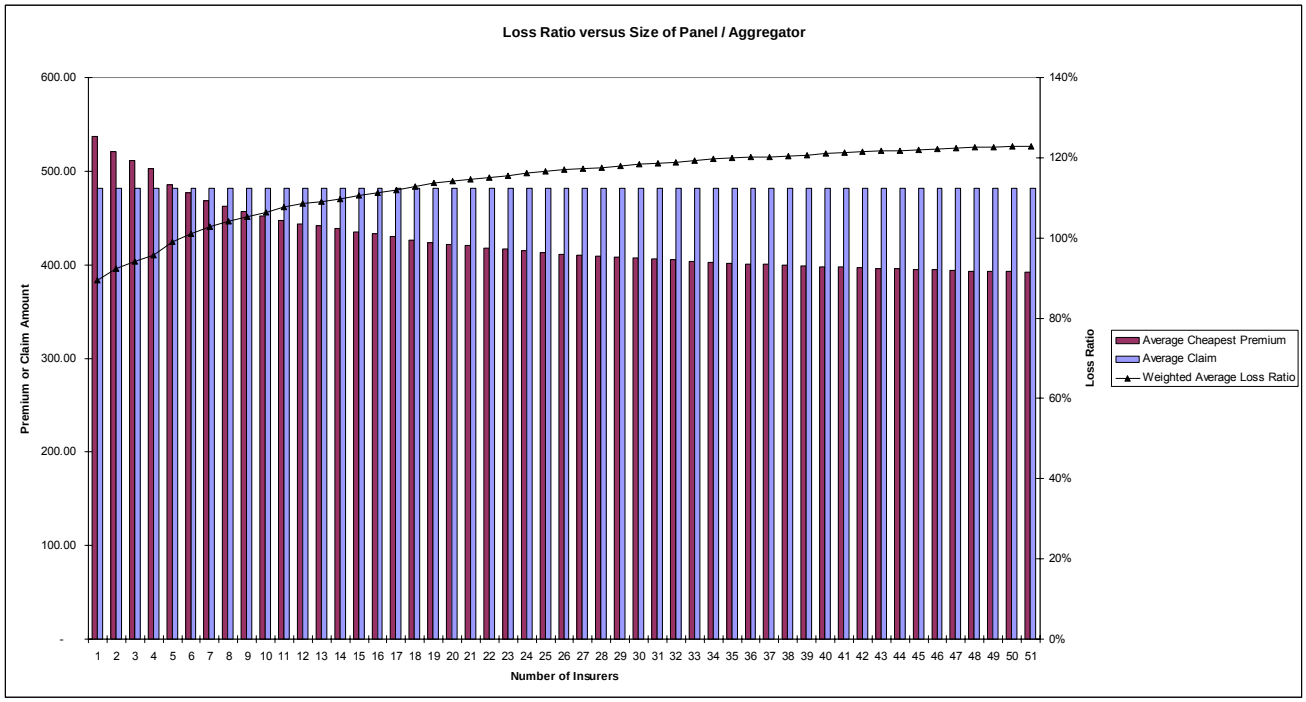
CONTENTS ONLY, WHOLE MARKET, 20 ITERATIONS



Motor

Similar results are also obtained for motor policies. The loss ratio increases from 90% for 1 insurer to 123% for 51 insurers on the aggregator. If we pursue the same example of a "direct" insurer entering the aggregator arena for the first time (see above – "Impact on all insurers (household)") then a rate increase of about 10% is needed to maintain current loss ratios.

This indicates that the winner's curse is also important in motor insurance. However, like-for-like (i.e. within similar sized panels) winner's curse would appear to be more significant on household. The motor market may already have been competitive without the presence of aggregators – motor rating structures tend to be more advanced than household rating structures.



Brand strength

The model is based on the assumption that brand strength has no influence and the best price always wins the business. It would be reasonable to hypothesise (as we discussed in chapter 6) that a strong brand would help to mitigate winner's curse. For example, a customer might choose to purchase from an insurer that they had a preference for, despite the insurer not quoting the cheapest price. However, brand strength is subjective, varies over time and will be influenced by the layout of the aggregator's results screen. Although we are aware of circumstantial evidence of the influence of brand strength, we have not investigated this further.

Reverse auction websites

A reverse auction website for fleets of motor vehicles is available at www.directfleetinsurance.co.uk. The team behind the website gave us some background to the operation of this site, and some transactional data on the auctions to investigate any evidence of a winner's curse on this platform.

Background to the auction site

Those brokers wishing to insure their clients' fleets of vehicles submit information on the fleet to be insured to the website. A number of participating insurers can then see the information on the fleet and submit quotes to insure the fleet.

Data provided by the broker of the fleet owner includes cover details, claims experience over the last three (or five) years, a vehicle schedule, and an optional "sixty second survey" outlining the management of the fleet. The broker also provides a guide price which is an indication of the required rate to obtain the business.

The participating brokers are regional. The majority are independent although some are part of groups. They generally have close ties with their clients who will be served by the broker at a local level.

The brokers can choose the cover that they wish. Certain predefined cover types are available (comprehensive/third party, excess levels, driving warranties, etc.), but each category is chosen by the broker.

There is only 1 stage in the bidding process and an insurer can submit as many bids as they choose to, much like an auction on websites such as ebay.com. For March 2009, there was an average of 1.36 bids per case, rising to 2.125 only for those cases that were closed. Generally a bidder makes only 1 bid, but occasionally they make up to 3 or 4 bids. Based on an average of all bidders there are generally between 1.1 and 1.5 bids per bidder. The bidding process can be extended, but only up to the renewal date.

The auction process

In around 90% of cases, the business gets placed with the lowest bid. On average there was a spread between the highest and lowest bids of approximately 10%. With the exception of a few extreme cases, the largest spreads were generally of the order of 30% to 40%. However, insurers will not quote if they believe they are outside the range of potential winning bids so this restricts the range of bids.

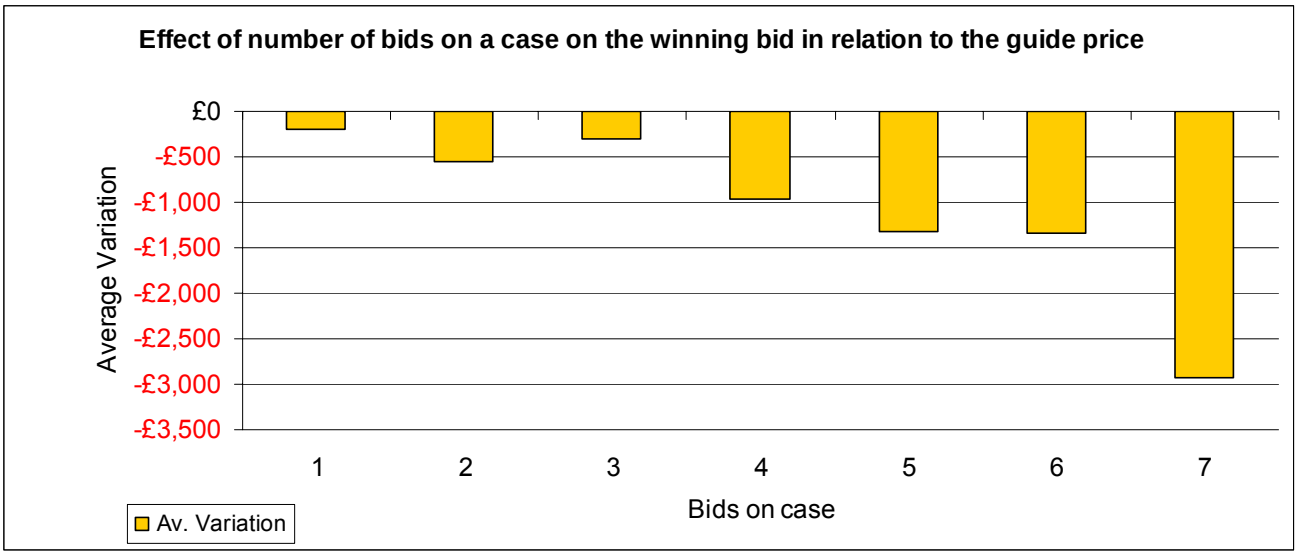
The website owners felt that, since business is conducted through brokers, there is weight put on non-price factors to a greater extent than if the fleet owners themselves were placing the business on the site. One of the key factors is broker commission. Often, brokers will receive more commission off site as well as bonus commissions based on volume with insurers.

The website owners do not believe that the web-based medium changes the placing process in terms of price although giving lesser known insurers more access to the market may well increase competition.

Evidence of a winner's curse

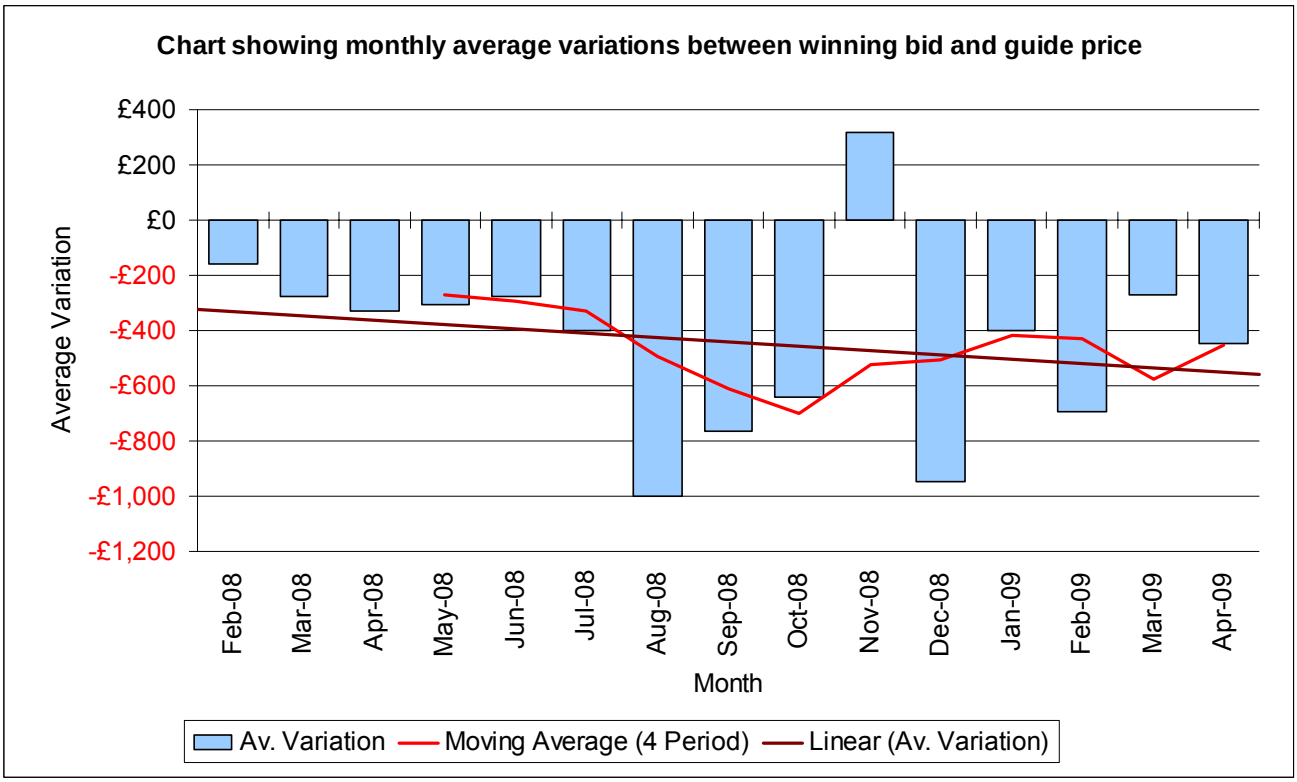
The website owners kindly provided a wealth of information on past bidding processes and auction outcomes, which we were able to analyse when looking for evidence of a winner's curse operating in this market.

We first looked at how the outcome of the bidding process varies as the number of bids increases. We were provided with the outcomes of 'auctions' for a number of fleets, along with the guide price submitted by the fleet owner for the fleet. We have compared below how the average variation of the final price from the guide price, and how the likelihood of a bid closing above or below the guide price varies with the number of bids:



There were an insufficient number of cases with more than seven bids for analysis of these. However, based on the data available, there does seem to be evidence, as may be expected, of more bids driving down the price and increasing the likelihood of the final premium being below the guide price. In fact no cases that have closed with 5 or more bids have closed at a rate higher than the guide price. If we assume that the initial guide price represents a reasonable initial estimate of the premium for the fleet (which may not be the case) then there does appear to be some evidence of a winner's curse operating here.

There also seems to be a trend towards the winning bid being on average further below the guide price as we progress month on month.



This may be expected as more insurers use the site, further increasing the level of competition.

Broker survey

Introduction

As part of our research, we conducted a brokers' survey and, in this section, we present the results we obtained. We have tried to obtain input from a wide range of sources, including commercial and personal lines brokers from different lines of business.

We want to investigate whether winner's curse plays a practical role in the insurance market. The aim of the survey was to give us more insight on this phenomenon by interviewing a number of brokers in the industry. Are brokers aware of winner's curse when they place businesses and when selecting the best deals for their clients? Do they take advantage of this knowledge? How do they think insurance companies try to differentiate themselves?

The survey began with background questions on the classes of business, the market segment, main area the respondent worked in and whether the respondent was aware of winner's curse.

The survey then proceeded to gather information on how the respondent conducted their normal business and their observations on the outcome of their placements.

This survey was placed on a survey website and sent to brokers via working party members and colleagues personal contacts. It aimed to cover a range of brokers from regional to multi-national and including both commercial and personal lines business. A copy of the survey is included in Appendix 3.

A total of 33 replies were received. Although the results may not be statistically significant, the responses do show some interesting results! The results of the analysis are discussed in the next section.

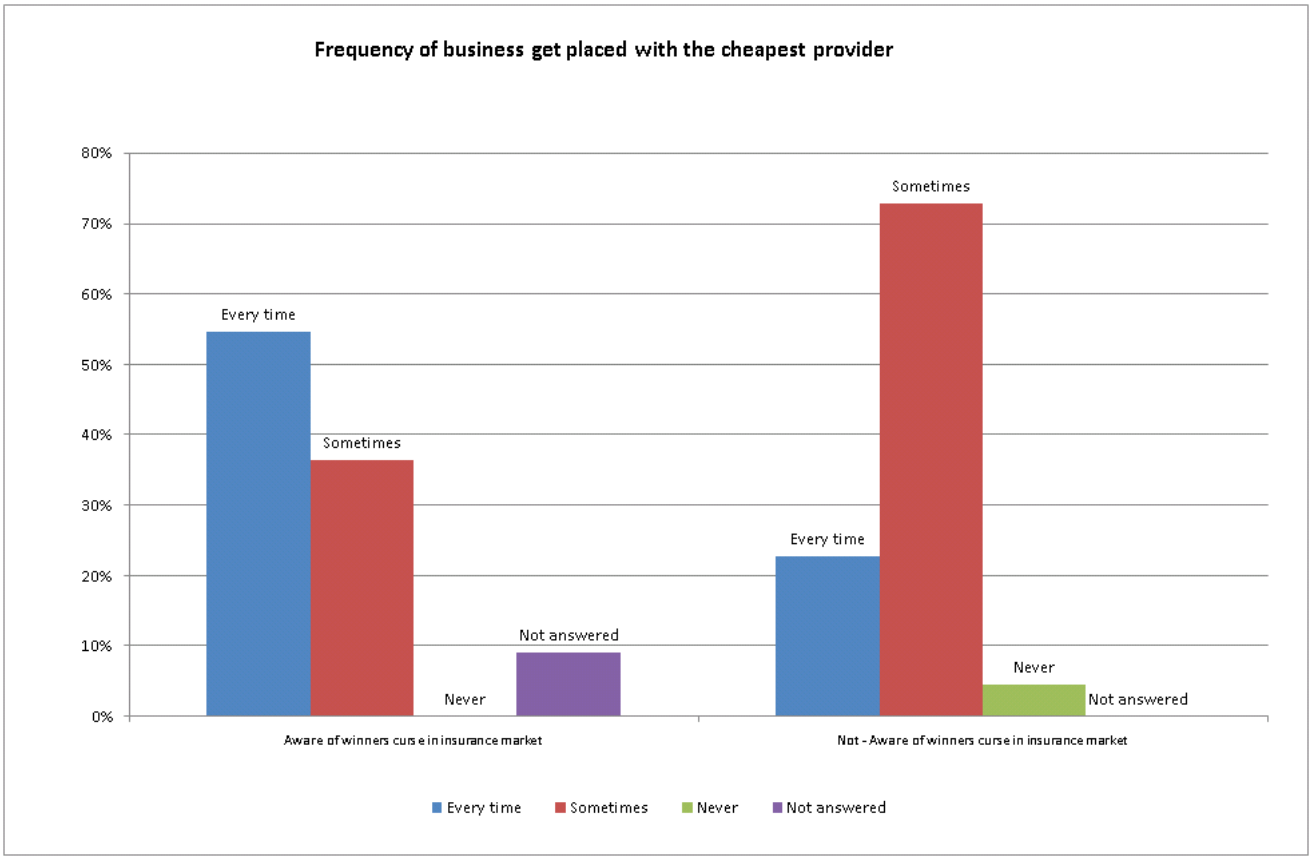
Results

More than half of the respondents to the survey (55%) were broking for one line of business with the remaining respondents broking for more than two lines of business. The common combination of lines of business a respondent involved in was Motor, Property and Liability classes.

Majority of the respondents are involved in multi-markets such as Lloyd's and London Market, large commercial and/or small commercial...etc. Only 8 respondents are involved in personal lines market. There were 25 respondents (76%) involved in direct broking and 8 respondents (24%) in reinsurance broking.

It is interesting to note that 6 respondents (18%) were previously aware of the winner's curse, but surprisingly 11 respondents (33%) were aware of the winner's curse in the market! The numbers do not seem to be consistent. It maybe that some respondents have interpreted the former question as being unprompted awareness and the latter question as relating to prompted awareness. Unfortunately, we cannot follow up the respondents to clarify their replies. This still leaves the majority (67%) of the respondents unaware of winner's curse in the insurance market.

To the relief of insurance providers, 20 respondents (60%) indicated that only 'sometimes' the business was placed with the cheapest provider. Only 11 respondents (33%) indicated that the business was placed with the cheapest providers 'every time'. However, when we drilled down to investigate the results in more details (see graph below), it appears that it is more likely for respondents who were aware of winner's curse to place business with the cheapest provider than those who were not aware of winner's curse.



The above results should be looked at in combination with the next question: factors which were important when placing business. The respondents ranked the following factors in order of importance when placing business (from most to least important):

- Price
- Coverage
- Client preference
- Relationship with providers
- Provider's services
- Brand strength

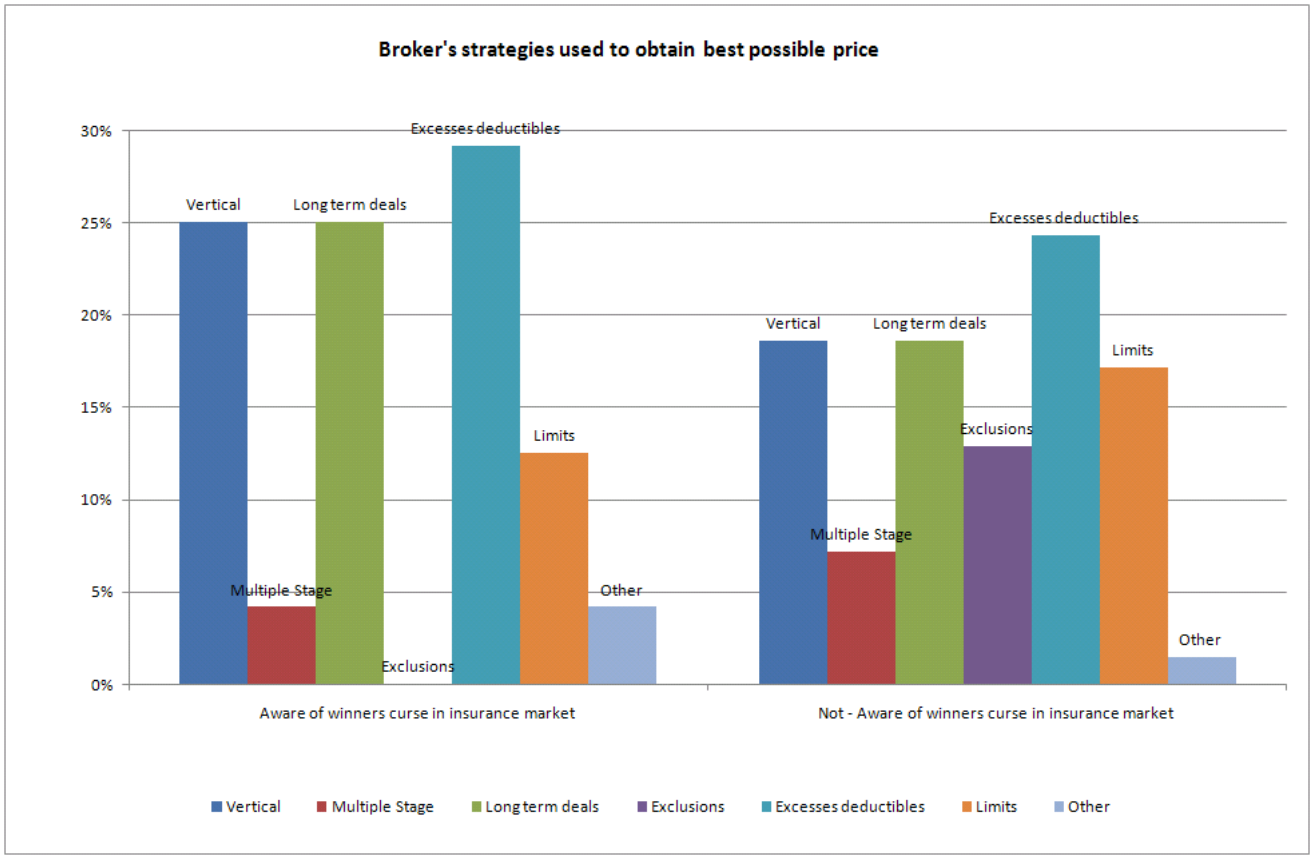
Although business may not be placed with the cheapest providers every time, price is certainly an important factor in the decision making process. It is worth noting that the results of the rankings are very similar whether the respondents were aware of winner's curse in the market or not.

Brokers regularly use different strategies to obtain the best possible price for their clients. Based on the respondents' replies, the strategies are ranked from the most to least common:

- Increasing deductibles and excesses
- Long-term deals or Vertical pricing (splitting risk into several layers of cover, each with different prices)
- Applying limits
- Adding more coverage exclusions
- Multiple stage pricing

Other strategies such as combination of the above or using quotes from other providers as leverage may also be used.

As some respondents were aware of winner's curse in the insurance market, we have split the results by those who were aware and those who were not. From the graph below, it may be observed that three strategies are preferred by respondents that have awareness of the winner's curse.



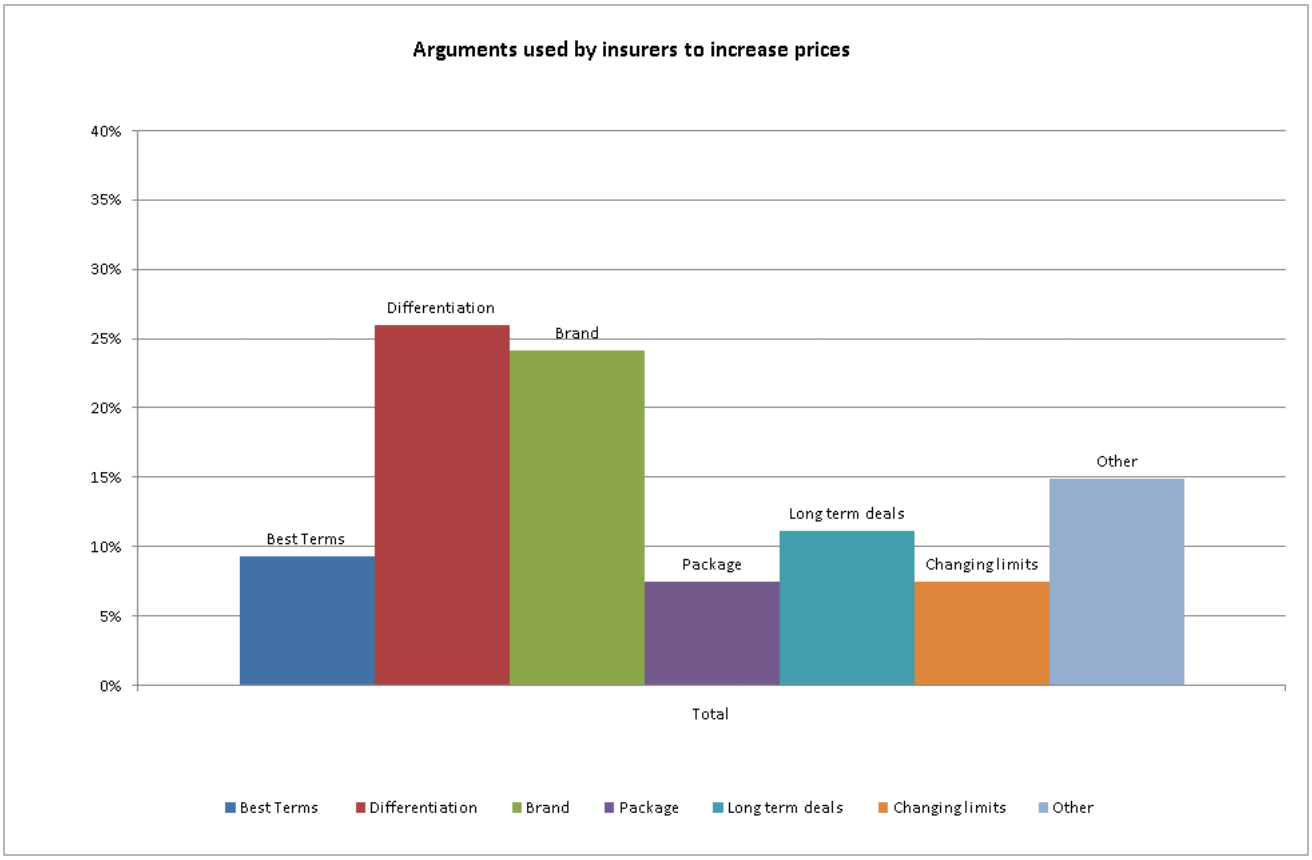
Overall, there were 25 respondents (75%) who would vary their strategies according to the insurance market cycle. There was no significant difference in opinions whether the respondents were aware of winner's curse in the market.

On the other side of the argument, insurance providers would like to charge as much as possible for a given risk. The respondents ranked the following reasons used by providers for increasing prices (ranked from most to least common):

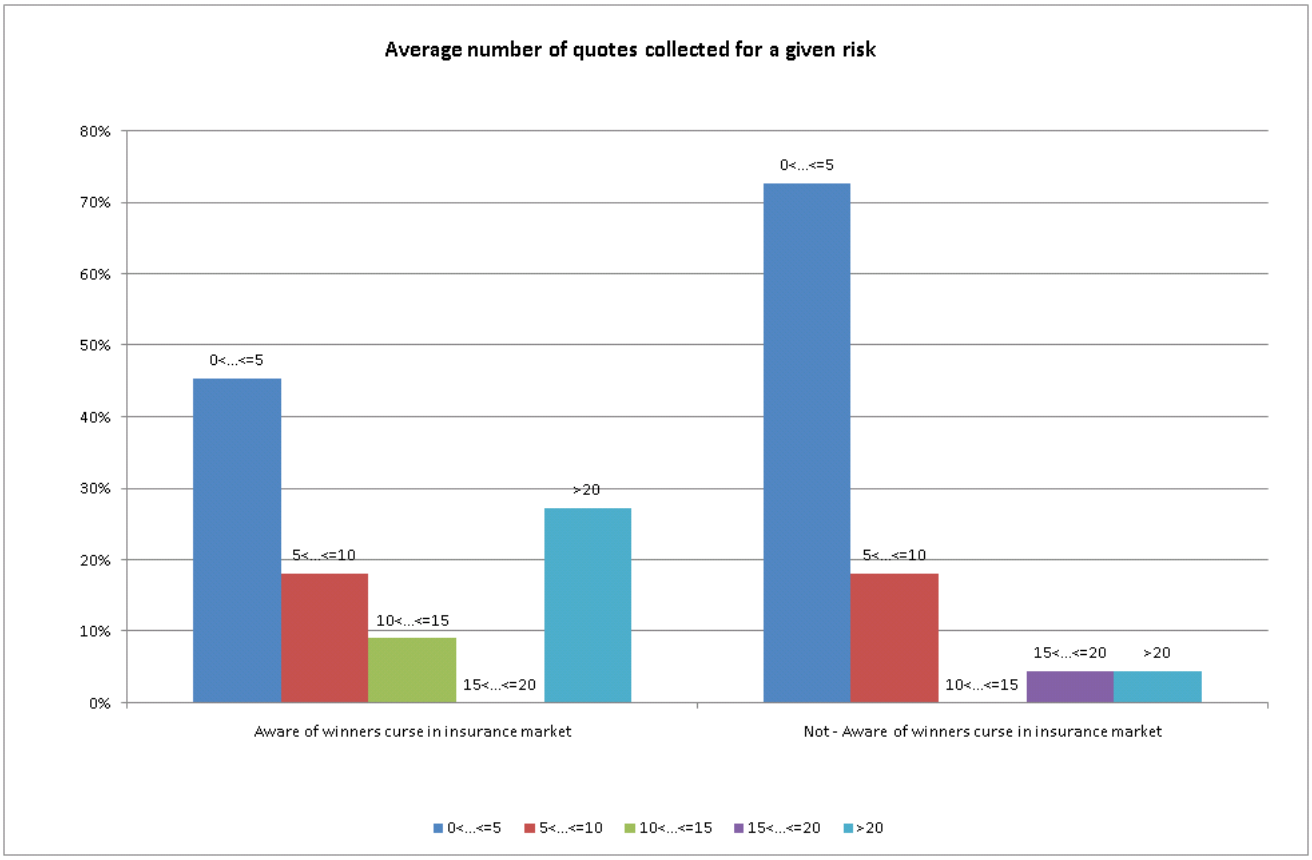
- Differentiation
- Brand strength
- Other reasons – toughening of market / economic conditions or deterioration of risk environment
- Long-term deals
- Best terms (insurers will only accept risks on the same terms as the highest quote taken from another provider)
- Package deals
- Changing limits

As a side note, providers use brand strength as the second most common argument to increase prices (according to brokers). However, the brokers ranked brand strength as one of the least important factors when placing business. Providers could give this some thoughts in the future.

The following graph shows the arguments used by insurers to increase prices.



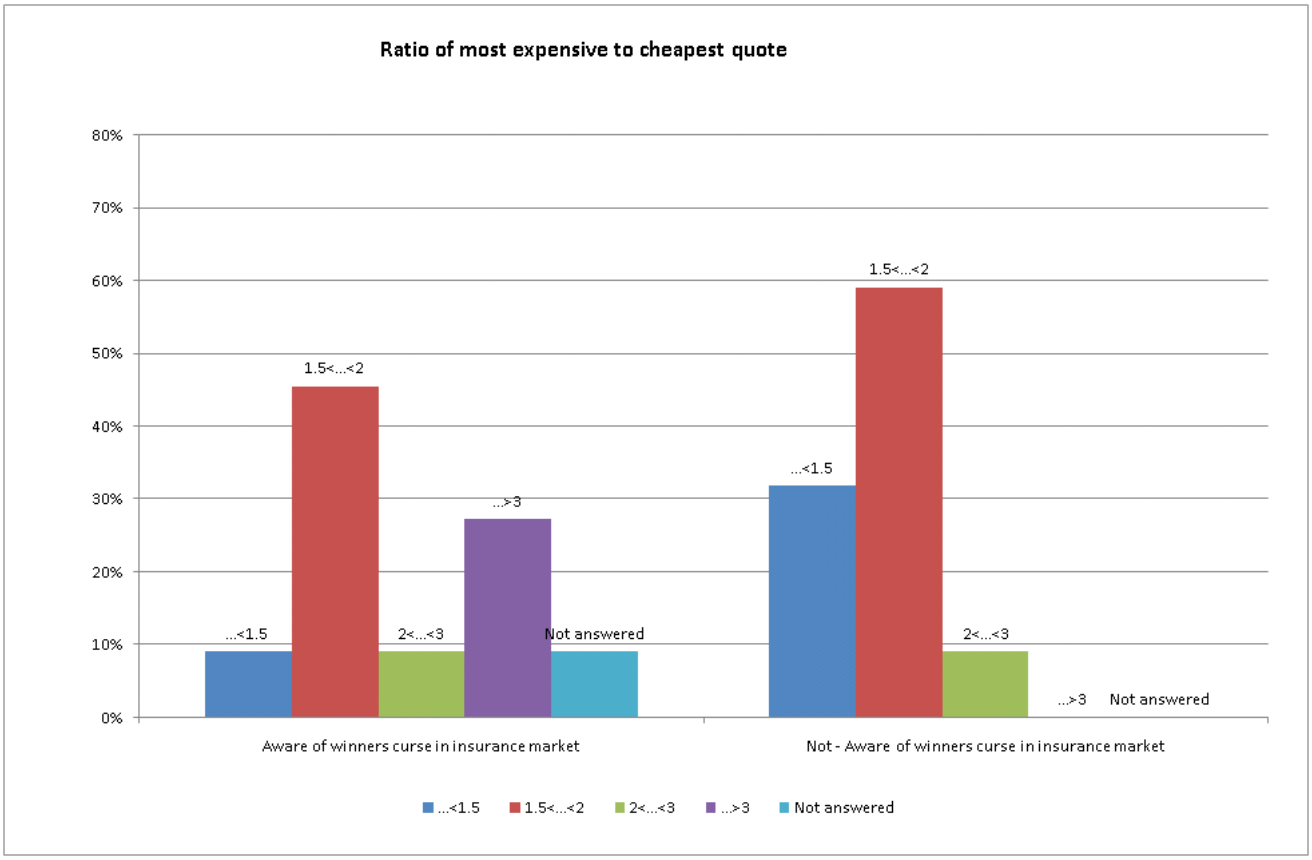
We also asked, in the survey, for a typical number of quotes collected for a given risk. A majority of the respondents (64%) collected less than five quotes on average. Respondents who were aware of winner's curse in the market seem to collect more quotes on average. However, this is partly explained by personal lines business generally collect more quotes than commercial lines. That, and the relatively small number of participants in this survey, means the results are not conclusive.



Typically, (55%) respondents would give the insurer one opportunity to improve their quote. 39% of the respondents would give the insurer two or more opportunities to improve their quote. The remaining 6% did not respond.

Based on the responses, the difference between the highest and the lowest quotes obtained in the first round can vary significantly. Eight respondents (24%) observed that the most expensive quotes are typically less than 50% above the cheapest quote. The majority (55%) observed that the most expensive quote was typically between 50% and 100% more than the cheapest quote. 18% felt it was typically more than 100% more.

The graph below shows that respondents with awareness of winner's curse tend to collect quotes with a wider gap between the most expensive and the cheapest quote. It would be interesting to see if the results are distorted by other factors such as class of business and market areas. However, due to lack of sufficient data we could not analyse this further.



The respondents indicated that it was common to rebroke cover every year (42%) or every two to three years (48%). Unsurprisingly, the majority of responses (61%) indicated that the frequency to rebroke does not change according to insurance market cycle. Nine respondents (27%) would rebroke more often in a hard market compared to only three respondents (9%) would in a soft market. This seems logical as there is less pressure to reduce prices when the market is soft or softening.

In summary, there seems to be evidence of winner's curse in the market and respondents with awareness of winner's curse also seem to behave differently to those without the awareness. For example, business was placed more often with the cheapest provider and strategies used to obtain best possible price were more targeted when the respondent was aware of winner's curse. It is possible that the results are inconsistent due to differing interpretations of the wording of the survey by the various respondents. With a relatively small sample size, it may not be a true representation of the market. However, we believe this survey gave us some insight into how risks are placed by brokers and how winner's curse may be influencing the process.

9. IMPLICATIONS FOR INSURERS

Susceptibility of insurance to the winner's curse

For commercial lines insurers, how many in-house actuaries (of company A) have been told by underwriters that their portfolio has improved and also that they will outperform the results of their competitors (B, C, D and E)? This is backed up by compelling examples of particularly poor business deliberately not renewed (but amazingly written by one of B,C,D or E) or satisfactory business which was lost because one of B,C,D or E wrote it at a huge reduction or on "suicidal" terms. Faced with this compelling evidence the actuaries adjust their loss picks. The same underwriters, in separate discussions with their CEO, speak of the success of their marketing campaigns, new broker and client relationships and new product offerings. The only problem is that company B's (and C, D and E's) underwriters are having the same discussions with their actuaries citing some of the very business won by company A. All the companies are suffering from not understanding the winner's curse.

And for personal lines insurers, already struggling with how to make money when on the panels of large brokers with 10 or more insurers, the rise of the aggregators has dispelled any real doubt that much of personal lines business is an ultra-competitive, lowest price wins auction.

Writing (selling) insurance contracts is much like the auctions discussed in chapter 4 where the phenomenon of winner's curse has been previously observed. Each company is attempting to put a value on a series of future cashflows uncertain as to both time and magnitude - the only difference is that in the case of insurance the cashflows are negative ones so that the bidding company is paid for taking them on and the lowest bid wins.

Almost all areas of insurance are vulnerable to the winner's curse due to some systemic features:

- high **uncertainty** of future cashflows and more particularly the difficulty of modelling and measuring those cashflows (see "implications for insurers' models" below)
- the **nature of the bidding process** - so that the lowest bid wins, even when that bid is significantly out of line with the next lowest
- the "**common-value**" issue with the actual value of the cashflows being the same for all bidders
- the **price-focus** of buyer: in many markets customers place a low value on the non-financial aspects of the insurance purchased
- the high level of **competition**: large number of competitors participate in certain segments

These features are present across many different areas of insurance. The relative impact on personal lines compared to large commercial insurance (incorporating London Market business) is summarised below:

	Personal Lines	Balance of risk	Large commercial
Uncertainty	Value of policy can be estimated to high degree of comfort		Value of policy subject to high degree of uncertainty
Nature of bidding	Buyer not concerned if bid out of line with market		Broker often focused only on lowest price in short term but subscription market mitigates
"Common value"	Cost-base & target segment differs for insurers		Cost-base & target segment differs for insurers
Price-focus	High degree of standardisation Aggregators drive price focus Brand important to some		Terms and conditions vary Service levels & clams handling important to insured Financial rating of insurer matters
Competition	Aggregators drive extremely high level of competition		Fewer players with broker driving competition

Potential measures to mitigate the effect of the winner's curse

Pricing uncertainty

The modelling chapters demonstrated that the effects of winner's curse are greater when pricing information is more uncertain. Ways to reduce this uncertainty may include:

- Ensuring the actuarial control cycle is operating and that the actual results of past years' underwriting/pricing is compared to the expected results from the pricing and suitable adjustments made to the pricing. This is easier on lines subject to less process risk (e.g. not catastrophe exposed) and short-tailed (so that the feedback is quicker). It is also easier when using benchmarking or portfolio level pricing than when every risk is actuarially rated on a burning cost method.
- Improving the pricing process to reduce errors
    - Improve technical models used to price business
    - Improve data used to parameterise models:
        - insist on more/better data from customer/broker
        - analyse more relevant data from what is already available
        - focus on data quality
        - improve management information systems
    - Impose benchmark pricing to ensure that a consistent sensible price is visible for all risks
    - Improve discipline with which pricing models / standards are applied
- Concentrating on niche business where superior expertise can be built
- Taking care when writing a new line of business or growing a small line of business as it is likely that there is a higher level of uncertainty in new entrant's pricing model than their competitors'. Insurers need to be extra vigilant for winner's curse when trying to start or develop lines of business as they are only likely to be successful in growing quickly in those lines where they have underestimated the risk.

In general, the insurance market needs to be aware of winner's curse and market-wide prices need to reflect the impact of winner's curse.

There is a danger of over-reliance on a complex pricing model if it does not take account of the competitive market place. Insurers should challenge the results of complex pricing models with more of a qualitative view of the market and in particular of the phase of the insurance cycle. Interestingly the same idea of applying independent qualitative judgements to complex quantitative models was one of the key actions that distinguished those banks emerging relatively unscathed from sub-prime losses and the credit crunch.

Bidding process

The bidding process itself is important in influencing the likely impact of winner's curse. Key factors include:

- Making use of subscription markets where available. The subscription markets that often apply in commercial insurance (especially in the London market and for reinsurance risks) help to mitigate the winner's curse. In some markets only a small number of recognised lead (re)insurers actually quote the business with other (re)insurers following their price - this reduces the number of competitors. Even in those markets where a large number of (re)insurers quote competitively for the business the broker still needs to have the risk placed 100% and this often means that the final price is say the 5th cheapest quote. Finally subscription markets avoid the risk of (re)insurers making a large mistake as in that event the broker will find they would be unable to place the risk. By contrast a personal lines insurer making a mistake in its pricing and exposed to the merciless operation of the aggregator sites can pick up large volumes of underpriced business in a short period of time.

- Researching intermediary channels. For example, affinity schemes may be more profitable than aggregators for two main reasons:

    - Better pricing information (either actual data held and made available by the affinity partner or simply that the nature of participation in the affinity scheme can reveal something about the customer)

    - Less direct competition

  It remains to be seen if the ubiquity of aggregator sites will ultimately impact on affinity business as it is increasingly easy for affinity customers to check the competiveness of the quote they are receiving.

- Achieving alignment with intermediaries so that brokers are remunerated on the profitability of the business placed with the insurer.

Interestingly, two of these ideas have been the target of anti-competitive investigations by the EU (subscription market) and Spitzer (broker remuneration).

It is important as well for insurers to recognise winner's curse in their own bidding strategy. They can do this by:

- Investigating and analysing the bidding environment e.g. how many competitors, what broker behaviour (see broker survey results)

- Recalibrating their "walk-away" price to recognise winner's curse (see "implications for insurers models" below)

- Avoid creating their own auction by offering a variety of alternatives on complex business with the risk that one is relatively underpriced

Insurers can also use random pricing to judge elasticity and susceptibility to winner's curse. This is more difficult in a large commercial environment due to the small number of high value deals.

Long term deals can help avoid a repeated annual bidding process. However, they may work against insurer if those deals are secured on unfavourable terms.

"Common-value" issues

Most of the theory on winner's curse is based on "common-value" auctions. However, in reality, insurance contracts will come with different cost bases and different capital requirements for different insurers. It may be possible for an insurer to exploit these differences through:

- Superior claims handling techniques that mean that the actual expected costs of claims are lower for an insurer than for its competitors
- Aiming for a competitive advantage on internal costs, acquisition costs or cost of capital (including reinsurance costs) - all of which mean an insurer can charge a lower premium for the same expected claims cost
- Cross-selling additional business. For example, some insurers may charge low basic premiums to attract business but then charge more for optional add-ons.

Alternatives to price

Insurers can reduce the impact of winner's curse by building a proposition that is not solely based on price. Some examples include:

- Building a strong brand which can include financial strength ratings or reputation for superior service
- Building features into products that cannot easily be replicated by competitors
- Build strong direct relations with the customer. This may involve finding better ways to reward loyal customers. Caution may be needed in a broker-lead market as threatening the customer-broker relationship could be counterproductive.
- Refusing to offer terms to customers believed to be purely price-driven.
- Avoiding price comparison distribution channels e.g. panels, aggregators.

Reduce number of competitors

The fewer the number of direct competitors, the less the impact of winner's curse. Insurers may consider the following tactics and strategies:

- Focusing on "niche" areas where level of competition is lower
- Building a strong brand that can act as a barrier to entry for others e.g. the marketing spend required to be successful in certain segments may have this effect
- Merge with / purchase other insurers. This might also reduce uncertainty (better data / models), and mitigate "common value" issue (via lower expense ratio of combined entity). However, insurers should note that the bidding process often involved in mergers and acquisitions is itself subject to winner's curse.

Implications for insurers' models

It is also useful to express winner's curse in terms of ideas that actuaries may be more familiar with.

The real issue of uncertainty involved in winner's curse isn't the more commonly considered and measured process/stochastic risk but the harder to consider parameter and model risk. This can also be thought of in terms of the econometric distinction introduced by Knight (and popularised by Keynes) between risk and uncertainty or Donald Rumsfeld's known unknowns and unknown unknowns.

The issue is not that cashflows are risky and variable; this kind of risk can be dealt with by the law of large numbers and the usual insurance approach of risk pooling. This means that insurers can concentrate on pricing for expected level of claims plus a risk loading (to avoid ultimate ruin).

Instead, the issue is that different insurers have different ways of measuring and modelling this risk, which themselves are prone to errors. In a competitive auction under these conditions insurers will only win business where their model systematically underprices the expected level of claims and/or risk loading, so that not only will the true expected level of claims (regardless of actual outcome) be different to that identified by your model but also systematically higher. The curse of winner's curse is that the effect introduced is one-way, bidders are generally worse off (in expected value terms) than they think they are.

Actuaries are familiar with the idea of positive selection by use of superior pricing models. This works particularly well for a first mover in a market. When, however, a market is developed and saturated with insurers all using complex pricing models and looking at the same types of factors, winner's curse means that models can give over-confidence to insurers who believe that the results of their models will be reflected in the business they actually win. It also means that insurers using different models to the rest of the market but with only limited predictive power are worse off than if they follow the market.

Finally winner's curse can be expressed in Bayesian terms. When considering the profitability of the business written, insurers should not base it solely on the prior loss ratio coming from models that ignore competition, but the posterior loss ratio based on the knowledge that they have won the business in a competitive auction. This loss ratio will be higher than the prior loss ratio; in other words, the fact they have won the business implies that the expected claims are worse than they originally thought they were. In this context the rational response (to increase their pricing to account for winner's curse) can be expressed as adjusting the ex-ante pricing on the ex-post assumption that they win the business.

The underwriting cycle

The five systemic issues discussed above that underpin the susceptibility of the insurance market to the winner's curse are also cited as drivers of the underwriting cycle. The winner's curse helps to explain the general reduction in price levels experienced in the downswing of the underwriting cycle. Eventually, however, losses will emerge and other dynamics will tend to dominate the competitive environment (e.g. capital flight) rendering the winner's curse (for a time!) less important as general price levels rise.

As a simple example, an inexperienced firm entering a new segment

- is more likely to make significant "errors" in their pricing model
- is less likely to understand the operation of the "winner's curse" in this segment
- increases the number of competitors in the segment

Each of these will tend to make the winner's curse more prevalent and could contribute to the "downswing" in prices observed as part of the underwriting cycle.

Other applications of winner's curse for Insurers

Winner's curse does not necessarily only impact on an insurer in selling their inwards insurance. A selection of other areas includes:

- Outwards reinsurance: Insurers can exploit opportunities to use winner's curse in their purchasing of outwards reinsurance.
- Rate monitoring: winner's curse may distort the results of rate monitoring exercises. Predicted changes in performance from rate changes may be unreliable.
- Forecasting: Insurers may need to be aware of the effects of winner's curse when forecasting performance. Future loss ratios may be impacted by changes in competition levels and by the actions of competitors.
- Reserving: Where initial loss ratios for the most recent years are based on forecasts, then they may be under or over-estimated depending on changes in competition or by the actions of competitors. This may be a contributory effect in the observed reserving cycle.
- Mergers and acquisitions: M&A transactions usually involve their own bidding process and much of the existing literature on winner's curse focuses on examples of over-estimating the value of a merger or acquisition.

10. IMPLICATIONS FOR CUSTOMERS

As well as the effect on insurers, the winner's curse can also have a variety of potential effects on the consumers of insurance products.

Direct effects of the winner's curse on customers

Firstly, and perhaps most obviously, the "curse" on the insurer of potentially pricing insurance contracts at lower rates will be a corresponding blessing for customers who can benefit from the lower premiums on offer. As aggregators and auction sites expose the insurer to the potential for more selection and increase the potential for the curse to strike insurers, these effects may be passed on to insurance customers in the form of more competitive premiums.

Secondary effects of the winner's curse on customers

However, in their efforts to mitigate the winner's curse, insurers may raise their premiums, or exit certain markets, or reduce the terms of cover for the same premium, perhaps in a way that is not obvious to the customer. In the long-run insurers who are constantly selected against and are affected by the curse may find their financial survival in question.

In order to combat the effects of the winner's curse, insurers may improve the skill of their pricing and concentrate on areas where they have superior expertise to reduce the scope for errors and the effect of the curse. Those customers currently enjoying relatively low premiums and exploiting these pricing errors could stand to lose out financially from this. Of course, the opposite is true for other customers whose premiums may lower as a result of more accurate pricing.

Customers may also find themselves facing steeper information requirements and scrutiny as insurers seek to minimise any potential errors in their own pricing. This may be problematic for those customers who face increased premiums, or are refused insurance due to this new information disclosed (but could be beneficial for those customers whose premiums fall for the same reason). Even for those customers not facing a significant change in cost, any additional information requirements can increase the time and cost burden of providing and holding extra data.

Insurers may also change their sales methods (perhaps avoiding certain channels), and place more emphasis on relationships or product features rather than solely on premiums in an effort to distinguish themselves from others. Customers of insurance products may benefit from an improved relationship with the insurer, but may need to scrutinise terms and conditions on offer to ensure these remain in line with their expectations.

Wider effects on customers

More broadly, insurers may offer less diversity in the premiums they offer, with a fear of being affected by the winner's curse meaning the insurer is less willing to deviate from market averages. This may make it more difficult for customers with unique requirements to find products on offer at a reasonable cost to meet their needs. This could also anchor premiums around market-accepted points, particularly in less competitive markets, which may mean premiums on offer to customers remain artificially high.

Customers may also find that insurers focus on areas other than premiums to mitigate the effect of the curse, and this has a direct impact on them. For example, if insurers introduce superior claims handling techniques to

reduce the cost of claims and bring this more in line with the premiums charged, customers may find that making claims is more burdensome, or that claims are refused that would have been met in the past.

Any additional systems, processing and time cost needed by insurers to cope with the complex issue of the winner's curse may also be passed on to customers, increasing the final cost to them.

The impact will clearly be different for different types of customers: aggregators for personal lines cover, or commercial lines cover sold through an effective auction process are more naturally affected by the issues of the winner's curse and so it is here that the above affects are most likely to be felt. In other areas of insurance with less competitive bidding, or where reputation, relationships, financial strength or factors other than cost are important, the winner's curse may have less of an impact, and the impact on customers is likely to be correspondingly lower.

11. OTHER RELATED TOPICS

The paradox of choice

Whilst winner's curse means that insurers may suffer where there is a large choice of prices available to the customer, it does not necessarily follow that the customer is any more satisfied.

In Barry Schwatz's 2004 book, "The Paradox of Choice - Why More Is Less", he argues that a wide ranges of choices leads to consumer anxiety. His arguments link back to research by Herbert Simon in the 1950's. Simon classified people as either "maximizers" or "satisficers". A "maximizer" needs know that they have made the best possible decision and therefore finds a wide choice psychologically daunting. A "satisficer" just needs to know that their choice meets a certain threshold and is not worried by whether there is a better solution out there.

This is not a new idea. One fable credited to Aesop (c.620BC – 560BC) has a similar moral:

The Fox and the Cat

A Fox was boasting to a Cat of its clever devices for escaping its enemies. "I have a whole bag of tricks," he said, "which contains a hundred ways of escaping my enemies."

"I have only one," said the Cat; "but I can generally manage with that." Just at that moment they heard the cry of a pack of hounds coming towards them, and the Cat immediately scampered up a tree and hid herself in the boughs. "This is my plan," said the Cat. "What are you going to do?" The Fox thought first of one way, then of another, and while he was debating the hounds came nearer and nearer, and at last the Fox in his confusion was caught up by the hounds and soon killed by the huntsmen. Miss Puss, who had been looking on, said:

"Better one safe way than a hundred on which you cannot reckon."

The utility of winning

For many of us the very act of winning a piece of business brings its own psychological rewards. The very words "winning" and "losing" evoke very different feelings. The competitive urge in us means that winning something in an auction generates positive feelings even if it eventually turns out to be an unprofitable piece of business. For example, we may know that buying a lottery ticket does not represent a good financial investment, but the thought of being able to pay off the mortgage, or retire drives many to keep buying those tickets.

We should be wary of the role this plays in any auction process. Actions that are driven by this "utility of winning" can lead us to suffer from winner's curse.

The wisdom of crowds

This is the theory that large numbers of independent estimates will tend to yield an average estimate that is a better estimator of a value than relying on individual estimates. This builds on a concept noted by the 19th Century statistician, Francis Galton, who observed that the crowd at a county fair accurately estimated the weight of an ox when the average of their individual guess was taken; this was a far more accurate estimate than any estimate made by any of the experts.

In his 2004 book, "The Wisdom of Crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies and nations", James Surowiecki identified 4 elements required to form a wise crowd:

- Diversity of Opinion,
- Independence,
- Decentralisation, and
- Aggregation.

In the context of winner's curse, this can be used to hypothesise that in some of our examples, whilst a winning insurance quote may be the one that is too cheap, the average quote may be a good estimator of the risk.