In the first part of their trilogy, Simon Carne and William Letwin ask why economists have any interest in the legal niceties of patent infringement damages calculations

Patent infringement disputes: What's in it for economists?

In patent infringement disputes the principles for determining damages remain essentially the same today as when the earliest legal precedents were laid down over a 100 years ago. But modern methods of doing business mean that the damages suffered when a patent is infringed can often be far greater than could ever have been contemplated in the past, so exposing the litigants to far greater risks. In this environment, the evaluation of damages in intellectual property claims is obviously of critical significance to both plaintiff and defendant.

It is now both practicable and cost-efficient to carry out detailed research into the market in which an infringement has occurred and to use statistical computer analysis to produce evidence to show a court how a patent owner's position in his market was damaged as a result of an infringing act.

The calculation of damages is however no easy matter. The introduction of unauthorised competition into a marketplace that the law said should be protected from competition poses many difficult questions that can be solved with the use of economic analytic tools.

Why are economists interested?

A patent is a legally protected monopoly and economists are very interested in the behaviour of monopolists.

A patentee has the right to prevent others from producing the patented product. He also has the right to let others produce the product in exchange for a royalty fee. If the patentee is not also a producer (for example if he is an inventor) the royalty is, of course, his way of extracting a reward for the time taken and effort to make the invention.

The more interesting case is where the patentee is also a producer. He has to consider whether it is in his best interests to keep all the production rights to himself or to grant a production licence to others — or both. At one extreme, the patentee may be an efficient, profitable producer with plenty of scope to expand capacity of production to meet demand. In that case he is likely to want to retain the production rights for himself, or only give them up in exchange for a very high royalty. A pharmaceutical company may well find itself in this position. On the other hand, consider a tyre company, for example, which has patented a new tyre production process. The new process may give the tyre company a competitive advantage in the market but, unless the company believes that it can realistically take over the entire market to the exclusion of all other manufacturers, there may be a lot more money to be made by licensing the product or the process to other manufacturers.

But what of infringement? A patent infringement may turn a legally protected monopoly into an unauthorised duopoly. Or it may expand the number of competing manufacturers by adding an additional manufacturer, whose pricing strategy is unconstrained by the royalty payment.

In this the first of a three-part series, Simon Carne and William Letwin ask and answer three questions that are fundamental to the relevance of economics to patent infringement disputes:

- Why are economists interested in patents and patent infringement disputes?
- Should the courts be interested in what economists have to say on the subject?
- What have economists got to offer that is not provided by others?

Infringement damages

The introduction of competition into a marketplace that the law said should be protected from uncontrolled competition poses many difficult — but often answerable — questions:

- Did the infringer's sales lower the price for the product — and, if so, by how much?
- Did the infringer capture some of the patentee's own sales or were the infringer's sales entirely self-generated, for example by selling to his own loyal customer base or in a new geographical region or by dint of his own advertising and so on?
- So far as the self-generated sales are concerned — those not captured from the patentee — what royalty is due to the patentee for the unauthorised use of his patent?

These are questions which lawyers have always had to deal with in patent infringement cases. They are questions which involve analysis of monopolistic and competitive market places, questions of pricing,

profitability and creating barriers to entry for competing producers. They also involve issues of risk, reward and benefits from trade: at what price is the patentee better off trading the right to produce in exchange for a royalty rather than keeping the market to himself?

These are all questions that interest economists as well as lawyers.

Should the courts even care?

The patent owner who has seen his rights infringed tends naturally to claim that every one of the infringing items sold by the infringer was "captured" from the plaintiff's rightful sales. Typically, he also likes to claim "price depression", that is, that the infringer's presence, in what should have been a protected monopoly, prevented the patentee from charging as high a price as he did before the infringement. In short, the claim is based on price and quantity, two staples of the economist's traditional diet.

In the absence of special circumstances, the higher the price charged, the smaller the quantity of it that will be sold, as some customers are deterred from buying the product and others buy less of it. The analysis needed to determine this relationship — which economists call the *price elasticity of demand* — can be extensive and sometimes complex. But the results are easily understood by litigators and judges, who can readily appreciate the connection between prices in the shop and demand for the goods.

For example, analysis in a particular case might reveal that, for any decrease in price of 2%, the quantity of products sold would rise by 1%, all else being equal; this giving a price elasticity of 0.5. So, if the infringer's activities forced down the price by 2%, the effect of that alone would be to reduce the plaintiff's gross turnover. Even if the plaintiff had produced and sold 1% more of the product in order to mitigate his loss, this would not compensate him for the revenue lost as a result of the 2% price reduction. He would also have incurred higher costs. The compound effect would be lower gross turnover and higher costs, leading to reduced profits.

The patent owner who has seen his rights infringed tends naturally to claim that every one of the infringing items sold by the infringer was "captured" from the plaintiff's rightful sales

The calculation of damages needs to consider the relationship between price, quantity sold and cost incurred, in order to calculate what the patent owner's profits would have been in the absence of infringement.

The courts are already very familiar with basic economic principles. The idea that changing the price of a good can have an effect on the number you sell is basic commonsense so it is no surprise that the courts accept the concept. But we cannot expect a court to know *by how much* sales would be affected by a given change in price. The court needs expert guidance.

American Braided Wire v *Thompson* (1890) is a leading case which is over 100 years old and is very interesting to economists as well as to lawyers. The story is a familiar one. The plaintiff held a patent for an improved product, in this case a bustle. The defendants infringed for some 18 months. The reason this case is particularly interesting to economists is that the infringers systematically undercut the patentee's price. Each time the price was cut, the patentee reduced his price in response. The court found that the patentee reduced its price defensively, but never aggressively.

On enquiry as to damages, the Official Referee awarded damages on the basis of the loss of revenue —and therefore the loss of profit — brought about by the price-cutting effect together with the further loss of profit on the sales that the infringer captured from the patentee. The Official Referee also recognised that, if the patentee had maintained his original prices, neither the patentee nor the infringer would have made as many sales as they did and the Official Referee reduced the damages by 20% on account of this.

In 1890, when this case was heard, the reduction of 20% may have seemed like a reasonable common sense figure. Indeed, the thought of going to the expense of involving an economic expert to calculate it may have seemed positively unreasonable. But today, when patent infringement claims run into very large sums of money, even a very small change in that 20% figure might bring about major rewards for one or other of the parties.

In fact, as we will illustrate below, it is extremely unlikely that the Official Referee's 20% reduction achieved the result that he intended it to.

In *American Braided Wire*, the damages calculation appears to have ended with the calculation of lost profits. But, in subsequent cases, the court has ruled that, in addition to compensating the patentee for lost profits on the sales captured from him, the infringer must also pay a royalty on the additional sales generated by the infringer's own efforts.

The courts have laid down a number of guiding principles by which these royalties are to be determined. In particular, there is the willing licensor/willing licensee rule. In the *General Tire and Rubber Company* v *Firestone Tyre and Rubber Company* (1975), the House of Lords held that an established or

"going rate" of royalty can be used *if it is applicable to the facts of the specific case*. If either litigant wants to show that the two parties would not have agreed to the going rate, that litigant will have to demonstrate to the satisfaction of the court that the business realities for these two parties were not comparable to the circumstances underlying the existing royalty agreements, for example, by showing that the going rate was not an economic proposition for one or both of them.

What have economists got to offer?

The economist has the skills and the techniques to provide the analysis and the calculations which the courts require. He is also more than happy to follow the principles laid down by the courts, because those principles articulate extremely well with economic thinking. The economist may also be able to provide a more satisfactory analysis.

To illustrate what we mean, we return to the *American Braided Wire* example referred to earlier. The Official Referee awarded the loss of profits as a result of the price suppression effect and the sales made by the infringer.

He also reduced the damages by 20% to reflect the fact that both the patentee and the infringer would have made fewer sales at the higher price that the patentee would have charged in the absence of the infringer and reduced the damages in respect of the infringer's sales by a further 10% to reflect his finding that 10% of the infringer's sales were generated by the infringer's own efforts, not captured from the plaintiff. The Official Referee's findings are indicated in the box below.

There are four figures in the table and they are of critical importance. To an economist, the relationship between those figures says something about the behaviour of the marketplace for bustles in 1890. But if those figures are right, the marketplace for bustles was a very strange marketplace indeed.

Although it appears that the Official Referee has said that both parties would have made 20% fewer sales at the higher prices, that is not actually what is implied by those figures.

It is by no means obvious but, with suitable calculations, it can be shown that only the infringer is treated as having expanded his sales by 20% through the price-cutting effect. The patentee, who made the same price cut, has been deemed to have made only half that increase.

That is possible, but it is inherently unlikely, unless there were some special circumstances, which the Official Referee did not refer to. From reading the judgment, we doubt that the Official Referee intended that result, and we also doubt that he knew he had made it.

The Official Referee's mistake — assuming that the result was unintentional — was that he applied the 20% reduction to the infringer's *profits*, that is price minus cost, whereas in the patentee's case, he applied the same percentage reduction to the *revenue* effect, that is to the change in price, not the profit. Correcting for this inconsistency would reduce the damages by some 15%.

If this were a current case and the figures in the above table were in the patentee's Statement of Claim, or in their expert accountant's report, it would be possible to produce a report for the defendant explaining the error and putting forward an alternative.

Needless to say, economics cannot tell us with complete certainty what would have happened in a complex market in the absence of an infringement, but evidence can be adduced to identify a range within which the loss falls and to estimate, on the balance of probabilities, how much the loss was.

In this way, economic analysis can strengthen the case for either of the litigants, or both, and clarify the basis for the Court's award.

In the next article in this series, we outline the economic analysis of a patent infringement claim.

American Braided Wire — the calculation

1.	Loss of profits brought about by price depression	£7,257.70
2.	Loss of profits brought about by infringer's sales	£4,028.31
3.	Reduction in (1) and (2) to reflect the fact that fewer sales would have been made at the higher price	20%
4.	Further reduction in (2) to reflect the finding that not all of the infringer's sales were captured from the patentee.	10%

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In the second part of their trilogy, Simon Carne and William Letwin look at the methodology of patent damages claims analysis and show how it can assist the courts in their computations

Patent infringement damages: how are they calculated?

In the first article in this series we looked at the relevance of economics to patent infringement disputes and showed how economics can assist litigants and the courts to resolve the damages issues. In this, the second article of three, we outline the economic analysis of a patent infringement claim.

The analysis of damages in a patent infringement case can conveniently be sub-divided into four tasks:

- To establish the actual sales and profits of the patentee and the infringer during the period of infringement. This is done by ascertaining the prices at which the parties sold their goods, the quantities they sold and the costs they incurred.

- To determine the profit that the plaintiff would have earned "but for" the competition by the infringer. Establishing this figure is, of course, the key to the plaintiff's claim for lost profit and, conversely, to the defendant's counter-arguments as to the appropriate award.

- To determine what proportion of the infringer's sales were "self-generated", by investigating the effects of his marketing efforts. The patentee cannot claim lost profits in respect of sales that the infringer generated by his own efforts, but can claim royalties.

- To consider what royalty rate the defendant should pay in respect of his "self-generated" sales.

Sales and profits

Actual

The data concerning prices, costs and volume of sales derive from the accounts of the parties. Broadly speaking, economists would handle this data in the same way as lawyers, their clients, or their clients' accountants and there is no need for further discussion on this point.

Hypothetical

To determine what the plaintiff's profit would have been in the absence of infringement, three critical questions must be addressed:

- What is the relationship between price charged by the plaintiff and quantity sold, *ie* how much could the plaintiff have sold at various prices? Answering that question enables us to calculate the gross turnover he could have earned at various possible prices.

- What is the relationship between total costs and quantity sold?

- Given the answers to the two prior questions, what profit would the plaintiff have earned — in the absence of the infringer — if he had priced the product at a commercial level?

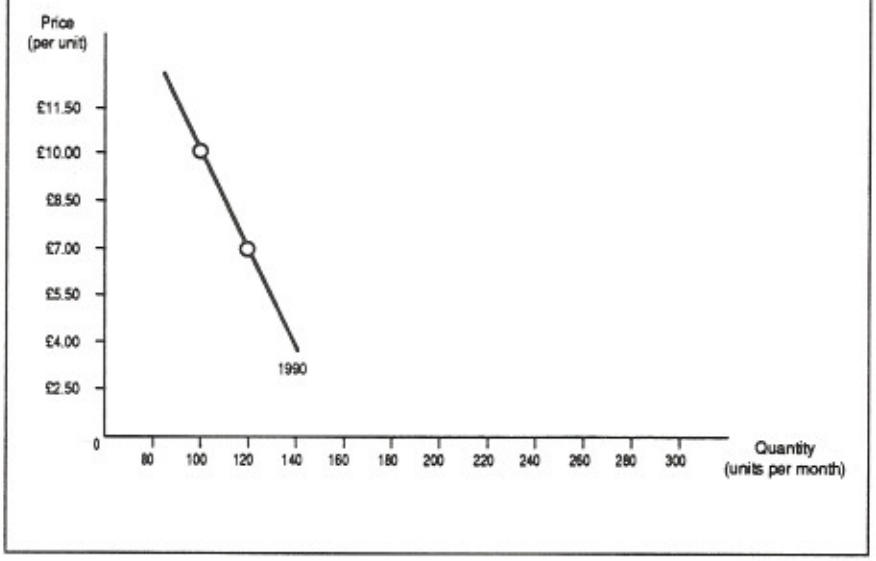
The first question, concerning the relation between price and quantity, is one that economists habitually analyse by reference to what are called "demand curves". One such curve is shown in Diagram 1. It represents something that practically everyone knows from everyday experience: in the absence of special circumstances, the higher the price charged, the smaller the quantity of it that will be sold, as some customers are deterred from buying the product at all and others buy less of it.

The numbers on the graph, which are purely illustrative, show that if the price of the good in question were lowered from £10 per unit to £7 per unit, the quantity sold would rise from 100 to 120 units. If, conversely, the price were raised, the volume of sales would decline.

When the economist sets out to determine what profit the plaintiff would have earned, in the absence of the infringement, his first step is to ascertain the specific shape and position of demand for the plaintiff's product.

In other words, how much would the quantity change for a given change in price, and what is the relationship between quantity and price at any given point on the curve. Also, if the infringement spans a number of years, it will be important to know how the demand curve has changed over time (see Diagram 2).

1: The higher the price, the lower the output



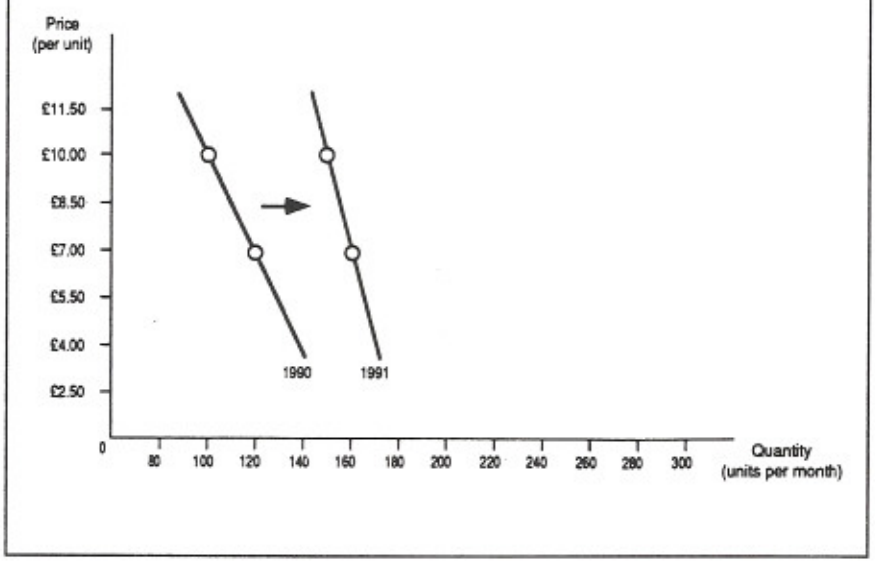
This task can be done relatively easily — though never altogether easily — if the plaintiff had been selling his product for some time before the defendant began infringing. If that is the case, then data is available for determining what has been the shape and position of plaintiff's demand curve at successive moments in that pre-infringement period. Statistical analysis applied to such economic data, analysis known as econometrics, can deliver a projection of demand for the plaintiff's output as it would have been in the absence of the infringer.

The task is slightly more difficult where the plaintiff had not established a track record before the infringer appeared. In such a case, nevertheless, the elasticity of demand for the plaintiff's product can be inferred from the known or ascertainable elasticity of demand for similar products, guided by the economic expert's experience and knowledge of such matters. As to the hypothetical position of the demand curve, that can be inferred by reasoning from the actual demand for both the plaintiff's and the defendant's products.

Turning now to the second question, what are the costs that the plaintiff would have incurred in the absence of infringement in producing the output demanded. This would be answered by econometric analysis of the plaintiff's actual costs in the past. The result would be a reasoned, defensible judgment about the plaintiff's hypothetical cost, in the absence of infringement.

And the final step is to determine from the projected demand and costs what profit the plaintiff would have earned in the absence of infringement. Now it happens that, for any given structures of demand and of cost, there is some price and a quantity associated with that price, which would produce the highest level of profit that the plaintiff could achieve. This figure is a definite benchmark in estimating the profits that plaintiff lost as a consequence of the infringement.

2: How infringements span the years



The infringer's own efforts

How much of the infringer's sales were due to his own marketing efforts and advantages? This is an issue hotly debated by the parties. As usual, such debate tends to produce more heat than light. Economic analysis may shed somewhat more light.

For instance, suppose that the defendant offers evidence about the relationship between his advertising expenditures and the volume of his sales. Diagram 3 shoes how this might look. On the face of it, this might be taken to show that sales peaked shortly after each vigorous advertising campaign. Also, it shows, or seems to show, that the rising trend in the defendant's sales was closely associated with his cumulative advertising expenditure

over the period. If uncontested, this evidence might stand as part of the defendant's argument that he generated a certain volume of sales by his own efforts.

But it is important not to jump to conclusions. The fact that two variables move together does not mean that one caused the other. The famous example amongst the academic fraternity is the rise in teachers' salaries which is closely correlated with the consumption of alcoholic bevefages.

Rather than suggesting that teachers are spending their additional income on the consumption of alcohol, closer analysis suggests that both factors are related to a third one, *viz* a general increase in incomes in the population — so people buy more alcohol (and other consumer items too) and teachers are paid more to reflect society's view of the amount that should be spent on education.

In the case illustrated in Diagram 3, an expert might be able to show that the trend in sales was more plausibly attributable to increase in overall consumer spending on goods of this sort than to the defendant's advertising expenditure. The matter needs to be looked at very carefully. Although the self-generated sales

When the economist sets out to determine what profit the plaintiff would have earned, in the absence of the infringement, his first step is to ascertain the specific demand for the plaintiff's product

issue can be very complex, econometric analysis of relevant data may fortify intuitive presumptions or may cast heavy doubt on them.

The appropriate royalty rate

The royalty that a court will award to the plaintiff in respect of the defendant's self-generated sales is governed by a straight-forward rule of law. The rate is that which would have been agreed by a willing licensor and a willing licensee.

One guide to the appropriate rate, in accordance with that rule, is the "going rate" — the rate previously agreed between this plaintiff and the person or persons whom he has licensed to make and sell the patented good. If such a "going rate" exists, it will be applied in an infringement case — unless one of the parties can persuade the court that in the particular circumstances of the case some other rate is more appropriate than the going rate.

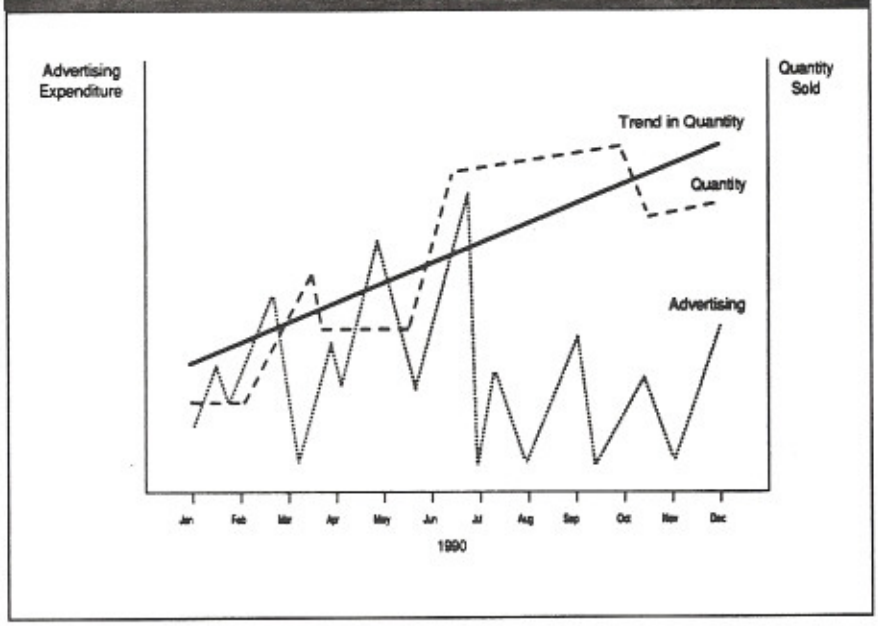
But a greater difficulty arises where there is no going rate, because the plaintiff has never licensed or even offered to licence any competing producer of his patented good. Then the court must decide what rate would have been agreed between the plaintiff and the defendant, had the latter taken a licence rather than infringing.

Now a fundamental premise implicit in the willing buyer/willing seller rule is that the lowest rate that the seller would accept is lower than the highest rate the buyer would accept. This is a common enough phenomenon that many of us experience, for example when haggling with a car dealer. We all know that the list price is negotiable downwards. If a customer is prepared to pay up to £13,000 for a particular car and the dealer's minimum price is £12,000, they can deal — somewhere in the range £12,000-£13,000. But, if the dealer's minimum price is £13,500, they cannot agree because the customer's maximum price is £500 *below* the dealer's minimum.

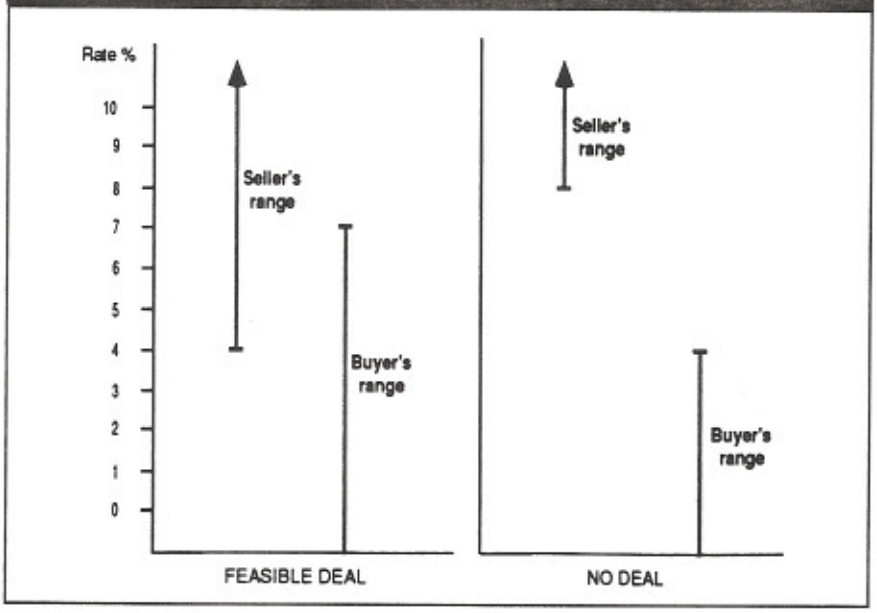
In the case of patents, this condition is illustrated in Diagram 4. In the left panel, the seller would take a royalty of 4% or more, the buyer would take 7% or less — so a feasible bargaining range lies between 4% and 7%, and a meeting of minds can be arrived at. However, it is also possible that the least the seller would take is higher than the most that the buyer would give. If so, there is no feasible bargaining range, and no bargain will rationally be struck.

Now what happens in a patent infringement case if the no-deal

3: Correlating sales with advertisements



4: Sriking a deal — but where?



condition applies? We know what did happen in at least one case, the leading case of *Catnic Components* v *Hill and Smith* (1983). There the plaintiff maintained that a royalty rate of 20% of the defendant's gross sales would be appropriate, because the plaintiff earned a profit margin of almost 25% on its own sales. The defendants contended that the rate should be at most 2.5%, because that was all that they saved in production costs by infringing. Mr Justice Falconer decided that "looking at the matter as a jury sort of question", a fair and reasonable rate pre-tax would be 10%.

It is not for mere economists to question Mr Justice Falconer's decision. But in instances which *appear* to fit the "no-deal" type, economic analysis might help lawyers and their clients. It might be able to show that the rate contended by the plaintiff was unreasonably high in view of economic circumstances in that market. Alternatively it might be able to show that the rate said by the defendant to be his maximum offer was unreasonably low. So even in this "jury sort of question" economists might help the parties — and the court — to a somewhat more precise delimitation of the real gap between the plaintiff's reasonable minimum and the defendant's reasonable maximum. This issue has arisen in the US Courts and is often referred to economists for expert guidance.

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Businessmen look at litigation in one of two ways, say Simon Carne and William Letwin. Either they take a stand on a matter of principle or they regard it as just another form of business transaction. What does this mean in terms of patent infringement?

Patent infringement disputes — an economist's view of risk

Taking a stand when an infringement occurs usually means fighting to win at all costs, righting a wrong or defending an unwarranted attack on one's business. It is a battle in which no quarter is given. A second approach — regarding infringement litigation as just another business transaction — involves an assessment of the business merits of the case: the potential costs and the potential benefits. If the costs outweighs the benefits, the fighting stops.

An economist, or a philosopher, might say that the two approaches were one and the same thing. The only apparent difference is that, in the first approach, the businessman is placing a monetary value on the emotional aspects of winning, or at least on not losing, and factoring that into the business equation. In this article, we will concentrate on the appraisal of litigation from the viewpoint of the manager whose sole interest is to see the value of the company maximised, rather than from the viewpoint of a manager who has personal issues at stake.

Risk or uncertainty?

We talk about *risk* when there are a variety of possible outcomes whose probabilities can be calculated or estimated. This is different from *uncertainty*, which arises when the probabilities are unknown. Risk is a key consideration for any business decision: what are the upsides and downsides that could arise out of a decision? Most business projects have both upsides and downsides: the potential for profit, if they go well, or loss, if they go badly. Some business projects have lots of upside and very little downside. Those are very attractive projects, but also very rare. The converse, a project which has lots of downside and very little upside, is unlikely to be one to be pursued, unless there is no option. For example, an alleged patent infringer facing a claim has no upside — only a range of downsides to be minimised through litigation or settlement.

In the first part of this series, the authors reviewed the usefulness of economics in patent infringement disputes. In the second they showed how economics could be used to calculate the damages suffered as a result of an infringement. In this final article, they examine how to assess the risks and rewards associated with patent infringement.

Risk is not just about the amount of money at stake — it is also about its utility (*ie* its usefulness). If that sounds odd, a simple example will explain what we mean. Consider a game in which we flip a coin and pay our opponent £10 if the coin lands on heads, if he will pay us just £5 if it lands on tails. That is not a bad deal for the opponent — a £10 profit for a win and only a £5 loss for a losing throw. Quite a few people might want to take us up on that offer (if we were foolish enough to make it!). But what if our opponent has only £5 in his pocket and he needs that to pay his train fare home? Now it is £10 for a win and a walk home for a loss. That £5 has more than its normal utility in the circumstances described.

This example illustrates something that is well appreciated in the context of litigation, which is that the costs of fighting are more "affordable" to a big company than to a small one and, therefore, the risk is more worth running for the big company because the downside risk is less damaging.

Now suppose that we invite our opponent to play the game 10 times. He could lose anything up to £50 or gain anything up to £100. But both of those possibilities are extremely unlikely because they involve the coin landing the same way up 10 times in a row. More likely the coin will land on heads sometimes and tails on others, so our opponent will score a mixture of wins and losses. It turns out that on the terms set out above the chances are heavily stacked in his favour. In fact, there is an 83% chance that he will win at least something (in other words, if we played the game with 100 opponents, ten times each, 83 of the

opponents would be expected to win overall).

The extended example illustrates something that may not be so obvious: repeat players — *ie* frequent litigators — will tend to have a better chance of coming out ahead overall than the one-off litigator. For the avoidance of misunderstanding, we need to qualify that result. One cannot, of course, improve one's chances by fighting lots of bad cases! But a repeat plaintiff who fights winnable cases has, in probability terms, a better chance of coming out ahead in the long run than a one-off plaintiff.

The litigation game

In business economics, a *game* is a transaction in which two (or more) players can each make move(s) which may affect the outcome of the transaction. Business management can be characterised as a series of games. Managers can chose the level of risk that they are prepared to take and whether to concentrate that risk on one game or to diversify that risk by playing either a number of different games or the same game a number of times.

Litigation is a game played by a plaintiff and defendant where the moves take the form of pleadings, evidence adduced, settlement offers, etc. The litigation game can be analysed just like any other game.

Let us look first, at the position of the plaintiff, the owner of a patent who resorts, or might resort, to litigation in order to enforce what he believes are his rights. He faces a series of potential costs and benefits that are summarised in Diagram 1. The diagram shows three potential outcomes — win, lose or settle — and, against each one, are listed the monetary events that can arise: the costs of litigation, the damages (whether by award of court of settlement) and the consequential events such as deterring future breaches if the patentee wins or suffering ongoing competition if it turns out that he does not have the right to exclude this particular competitor.

1: Plaintiff's scenario

	Win	*Lose*	*Settle*
Costs:			
• Recoverable	-	(£*)	(£?)
• Not recoverable	(£*)	(£*)	(£*)
Ongoing competition	-	(£*)	(£?)
Award/settlement	£*	-	£?
Incidental events, *eg*			
• deterrence	£*	-	£?
	£*	(£*)	£*

2: Defendant's scenario before liability hearing

	Win	*Lose*	*Settle*
Costs:			
• Recoverable	-	(£*)	(£?)
• Not recoverable	(£*)	(£*)	(£*)
Ongoing competition	£*	-	£?
Award/settlement	-	(£*)	(£?)
Incidental events, *eg*			
• shutdown costs	-	(£*)	(£?)
	£*	(£*)	(£*)

3: Defendant's scenario after liability hearing

	Win	*Lose*	*Settle*
Costs:			
• Recoverable	-	(£*)	(£?)
• Not recoverable	(£*)	(£*)	(£*)
Ongoing competition	-	-	-
Award/settlement	(£*)	(£*)	(£*)
Incidental events, *eg*			
• shutdown costs	-	-	-
	(£*)	(£*)	(£*)

In the diagram, an asterisk denotes the need for a monetary figure to be calculated, for example the award of damages. Negative figures, *ie* costs, are shown in brackets. A dash denotes the absence of a figure. For example, if the plaintiff loses, he does not receive any damages, so that entry is marked with a dash. Finally, in the settlement column, there are some question marks to reflect the uncertainty over whether such a payment will be received. For example, the settlement terms may include the reimbursement of costs that would have been recoverable following a trial, or it may not.

Diagrams 2 and 3 show the corresponding position for the defendant. All but one of the defendant's asterisks are in brackets to indicate that the defendant is mostly concerned with how much he will have to pay — something he wants to minimise — rather than money received. The exception is the "consequential benefit" of winning the liability hearing. A victory at that

stage of the game will enable the defendant to continue to market his product, *ie* the allegedly infringing product. Notice also that the defendant's scenarios include the possibility of having to shut down the operation if a finding of infringement is made against him.

In Diagram 3, dealing with the situation that arises after the liability hearing and before the Enquiry as to Damages, the shutdown costs are not included because they arise regardless of whether the defendant fights on or concedes the plaintiff's demands.

Applying game theory in practice

Diagrams 1, 2 and 3 show just the headings and where the potential entries go. In any actual case, one needs to fill in the missing figures, which is a subject that we addressed in principle in the second article of this series.

In practice, we can make this as simple or as complicated as is appropriate. If there are very large sums of money at stake and lots of data, it might be worth doing some quite complex analysis. On the other hand, if the sums involved are quite small, a back-of-the-envelope calculation might be sufficient.

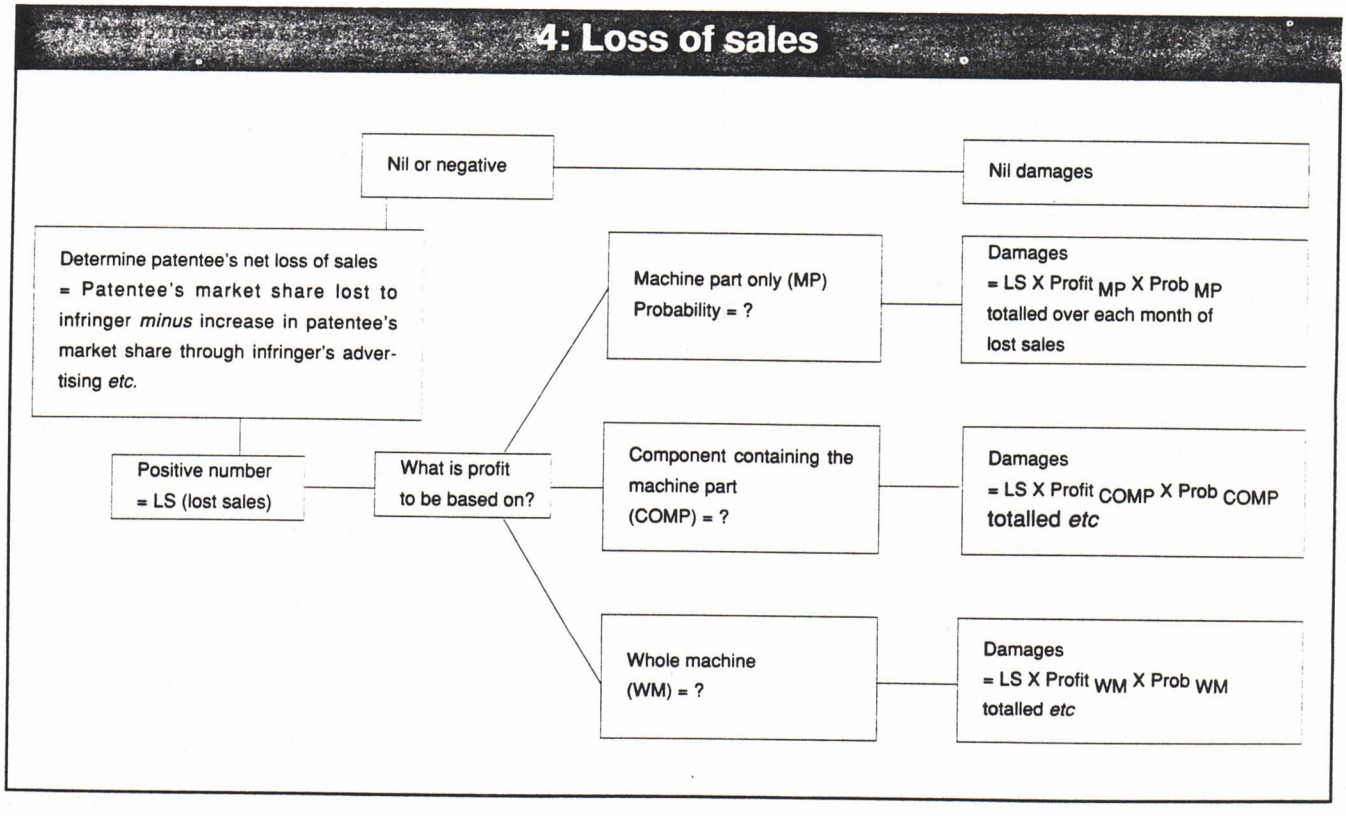
An alleged patent infringer facing a claim has no upside — only a range of downsides to be minimised through litigation or settlement

Diagram 4 shows an analysis somewhere in the middle of the two extremes of complexity. The diagram, which is taken from an actual case, focuses on just one part of the analysis, the damage calculation in respect of lost sales, which is sufficient for illustrative purposes.

The left hand side of the chart (which is where we start) asks how much of the patentee's market share has been lost as a result of the infringer's presence. In this particular case, we had to be quite careful because the infringer had spent a lot of money on advertising and promotion and it is quite possible, therefore, that the infringer's advertising actually generated additional demand for the patentee's own product. If that was the case, we needed to arrive at the *net* loss of business after deducting the gains from new business generated by the infringer's activities.

If that net loss had been nil or negative (*ie* there was no loss or even a net gain) there would have been no damages in respect of lost sales. This possibility is show in the upper branch emerging from the first box. The alternative possibility, *ie* that there was a net loss, is shown in the lower branch.

The next question that had to be considered in this case was what the loss of profit would be based on. The infringing item was a small machine part which went into just one component of a larger machine. Would the court grant damages



based only on the profit associated with the machine part, or on the component or on the whole machine? Those are the three branches emerging from the box which asks the question "What is profit to be based on?"

Each of those possibilities had a probability of being the outcome that the court would have awarded. If one looked at it from a business point of view on the facts of this particular case, it should have been the third possibility (*ie* the whole machine) but it had to be recognised that business logic may not have prevailed. This was a legal matter, so it was really for the lawyers to assess the probabilities.

The boxes on the right hand side of the diagram multiply the number of lost sales by the profit margin under each alternative and apply the probability associated with each alternative. The aggregate of those three figures is the probability adjusted estimate of the damages under the lost sales head.

Similar analysis can be carried out for all the other heads of claim as well as for the "incidental benefits" such as the deterrence effect.

For the purposes of a risk analysis, we need to be aware of the range from worst to best as well as the expected (or probability-adjusted) outcome. Recall the game referred to above, of flipping a coin and getting £10 for a wine and £5 for a loss. If losing means that you walk home *and if that is unacceptable to you*, you will not play the game. But if losing only costs you £5, you might play. If you are a repeat player — 10 times, say — you can virtually discount the chance of 10 straight losses and can take comfort from the 83% probability that you will win at least something. In fact, if you are prepared to lose up to £5 over the whole 10 games, there is a 95% chance that you will meet or exceed that threshold; there is only a 5% chance of losing more than £5.

Applying similar analysis to the litigation game (using the word "game" as we defined it earlier), the patentee can form a view as to how much he is prepared to lose in terms of costs expended fighting the case, along with the likelihood of further infringement if he does not fight or fights and loses. He will look to see what the probability is that the outcome will fall within the acceptable range.

Not a soft touch

We conclude this article with an observation from a real life situation. It concerns some repeat players in the litigation game who have recently woken up to the fact that they have not been behaving as repeat players should. They have been playing the litigation game with a defective strategy.

This example relates to the accounting profession in the US who are frequently faced with negligence claims. That makes them repeat players — reluctantly, it has to be said — but it is just as important to have a winning strategy when you are an unwilling player as it is when you volunteer to play. The Big Six accounting firms in the US have recently published a report in which they say that, in 1991, the average claim against them was for $85m. The average settlement was for only $2.7m which, they say, suggests that "there might have been little or no merit to the original claim against the accountant". But the costs of each claim were, on average, $3.5m, making a total outlay of $6.2m per claim.

It is hardly surprising that on a case-by-case analysis, the firms accept a settlement which is lower than their costs but, as the accountants go on to say, "controlling risk by settling where you did nothing wrong becomes a very expensive strategy for 'winning' the liability game".

What were the alternatives? At least one alternative would have been deterrence: fight the unworthy claims in order to get the message across: "We are not a soft touch".

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