Using regression models to isolate the value of a patented feature

Regression models not only can provide a quantitative measure for damages in US patent cases, but also can provide additional insight into topics such as non-infringing alternatives, market equilibriums and cannibalisation that can help to strengthen a damages model

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US$1.169 billion; US$1.05 billion: the recent patent damages verdicts in *Carnegie Mellon University v Marvell Technology Group* and *Apple v Samsung* — two of the largest patent damages awards in US history — are reverberating across the IP landscape as practitioners wonder how the verdicts will fare on appeal.

For patent holders, the decisions signal that monetising intellectual property through litigation can yield significant returns. For patent-infringement defendants, they signal that a failed defence effort can have a devastating impact on a business's bottom line: if the verdict in *Carnegie Mellon University* holds up, Marvell will have to pay out more than a year of profits. (Marvell made a little over US$900 million in 2011.) What these decisions have emphasised, however, is the crucial need to evaluate proof of damages carefully in patent-infringement litigation.

As recent patent-damages jurisprudence has shown, a jury's damages award and verdict is only as good as the damages evidence and analysis that support it. In *Cornell Univ v Hewlett-Packard Co* the district court signalled a shift in damages law when it found that reasonable royalty analysis needed to account for the fact that the patent-covered feature was a "component of a component" in the allegedly infringing product. Subsequent Federal Circuit and district court cases have adopted this reasoning and are therefore increasingly asking patent damages analyses to isolate patented components from the entire value of a product. But in today's technologically advanced world, many components are buried in larger devices and it can be difficult to isolate their value.

Given these heightened demands, courts are increasingly asking for and recognising econometric analysis as a means to help focus the value of patented technology. For example, the chief judge of the Federal Circuit has "suggested the use of econometric studies, customer surveys, regression analysis or other market-wide evidence of demand sensitivities to satisfy this requirement" (*Inventio AG v Otis Elevator Co*, No 06-cv-5377, 2011 US Dist LEXIS 88965, at *14 (SDNY 23rd June 2011); see also *Cornell Univ v Hewlett-Packard Co*, No 01-cv-1974, 2008 US Dist LEXIS 41848, at *9 (NDNY 27th May 2008) (J Rader) (finding probative a demand curve and linking consumer demand to the claimed invention)). Therefore, econometric techniques such as regression analyses, which have long resided in other practice areas, are increasingly used to quantify the value of a patented feature at issue, even if it is a "component of a component".

Econometric and regression analyses have long been used in antitrust cases relating to merger analysis, liability, impact and damages. And while regressions are starting to be used in patent analyses, the antitrust merger analysis model is still a new approach. The merger analysis model can simulate what prices, quantities and profitability would be after the merger of businesses in a particular market. In the patent litigation context, the

merger analysis model can simulate what prices, quantities and profitability would be after taking the infringing component or feature out of an accused device. Therefore, just as a company or manufacturer approaches its business — balancing prices and quantities to maximise profits — so too can the patent damages model.

Patent damages

The patent statute requires that the district court award the patent holder damages adequate to compensate for infringement but in no event less than a reasonable royalty for the use made of the invention by the infringer (35 USC § 284). Because Congress has decreed that a reasonable royalty is the minimum for damages, the reasonable royalty analysis is the most frequently used damages model in patent litigation.

In *Georgia-Pacific Corp v US Plywood Corp* (318 F Supp 1116, 1120 (SDNY 1970), aff'd as modified 446 F 2d 295 (2d Cir 1971)), the Southern District of New York set forth a 15-factor test to determine what should be considered an appropriate reasonable royalty (see box). It is still used widely today and has been endorsed by the Federal Circuit (*Uniloc USA Inc v Microsoft Corp*, 632 F 2d 1292, 1317 (Fed Cir 2011) ("This Court has sanctioned the use of the Georgia-Pacific factors to frame the reasonable royalty inquiry. Those factors properly tie the reasonably royalty calculation to the facts of the hypothetical negotiation at issue")).

Frequently, a patent damages expert begins with a predicate royalty rate for the patent-in-suit and either increases or decreases that number based on a qualitative analysis following the factors laid out above. But in many cases there is not an established royalty for the patent-in-suit, or even a pre-existing licence to it. As a result, parties have presented courts and juries with licences involving other patents or technologies that are allegedly comparable to the patent-in-suit. The Federal Circuit often scrutinises such comparable licenses, questioning whether there is adequate proof on how they are truly similar in technological and economic terms. Thus, the Federal Circuit may look for factors such as the 12th and 13th outlined in the box on this page to be accurately quantified. This is where regression analyses enter the picture.

Regression analyses in antitrust cases

Regression analysis is a set of statistical techniques that uses data to estimate the relationship between a dependent variable (eg, the price of a product) and an independent variable (eg, the features of a product), while allowing for a 'random error' that represents other things that could influence the dependent variable not included in the model. It can be used to identify relationships between these variables and to distinguish true relationships from false ones (*In Re: Polypropylene Carpet Antitrust Litigation*, 996 F Supp 18, 25 (ND Ga, 1997) ("multiple regression analysis is a statistical tool for understanding the relationships among two or more 'variables' ... Use of regression analysis allows one to ... sort out those correlations that are spurious from those that are not")).

In antitrust litigation, the relevant considerations often turn on opposing contentions about what occurred, what caused what occurred and what would have occurred 'but for' some event. Regression analysis and hypothesis testing may be applied in these cases to determine whether an antitrust violation has taken place and may also be used to calculate damages when a violation has been established. This latter analysis is often based on comparing actual prices to the 'but for' price that would have existed in the absence of a violation.

Most relevant to the current topic is antitrust litigation's historical use of multiple regression — a technique that gives quantitative estimates to the effects of various different factors on one or more variables of interest. For example, in the oft-cited *In re: Ampicillin Antitrust Litig*, the plaintiff's expert testified that the price of the drug was too high and had been propped up by illegal antitrust activity (88 FRC 174 (DC Cir 1983)). The relevant question was whether the correlation between the number of firms in the drug market and the drug's price explained anything about causality — in other words, whether the number of firms in the market was causing the price to be too high, therefore showing antitrust tendencies.

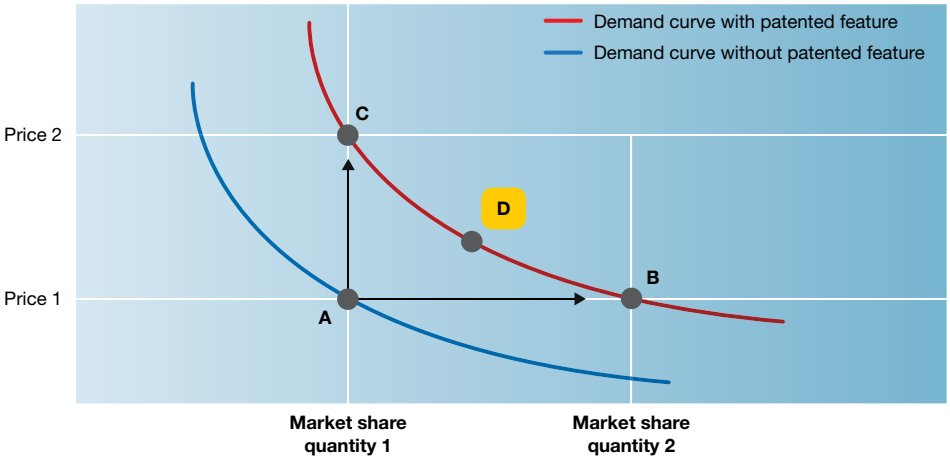
When only two variables (in this case, the number of firms was a variable) are identified and move in the same direction, false relationships can occur. Often, one or two variables are insufficient to settle the issue of false relationships, so multiple regressions are used. Multiple regressions include explanatory variables that are not only relevant to the legal issue, but also those which must be controlled for. Multiple regression, therefore, is an analysis that can explain the relationship between three or more variables. The variable to be explained is called the 'dependent' variable. Other variables are the 'explanatory' variables or 'independent' variables — these variables are thought to aid in the explanation of the dependent variable. At the beginning stages, any variable thought to be potentially

The *Georgia-Pacific* factors

Back in the late 1960s, the Southern District of New York set forth a 15-factor test to determine the appropriate reasonable royalty (*Georgia-Pacific Corp v US Plywood Corp*, 318 F Supp 1116, 1120 (SDNY 1970), aff'd as modified 446 F 2d 295 (2d Cir 1971). The *Georgia Pacific* factors are:

1. The established royalty for the patent-in-suit.
2. Rates paid by the licensee for comparable patents.
3. The nature and scope of the license, including exclusivity and geographic restrictions.
4. Whether the licensor has an established policy to maintain its patent monopoly by refusing to license.
5. The commercial relationship between the licensor and licensee.
6. The effect on derivative or convoyed sales.
7. The duration of the patent and the term of the licence.
8. The established profitability, commercial success, and popularity of the patented product.
9. The utility and advantages of the patented property over the old modes or devices.
10. The nature of the patented invention and its benefits to users.
11. The extent to which the infringer has made use of the invention.
12. The portion of the profit or of the selling price customarily allowed for use of the invention or analogous inventions.
13. The portion of the realisable profit that should be credited to the invention.
14. The opinion testimony of qualified experts.
15. The hypothetical negotiation – the amount that a licensor (eg, the patentee) and a licensee (eg, the infringer) would have agreed upon (at the time the infringement began) if both had been reasonably and voluntarily trying to reach an agreement.

Figure 1. **Regression analysis in determining comparable royalty rates for damages**



relevant is evaluated for potential influence.

In addition to whether a violation has occurred, antitrust cases have used regression analyses to determine whether damages from the violation can be quantified. To do this, another independent or explanatory variable can be introduced that represents the violating activity (in patent infringement context, the infringing product or feature). The coefficient of the violating activity can therefore theoretically measure the effect on price the violating activity had. This approach can be successful if the violating activity covers the relevant time period or if the other explanatory variables can be shown to be independent of the violating activities, and vice versa.

These kinds of analyses can be useful in determining whether the value of a patented feature drives price, market share or profitability, and what that value is. Imagine that an infringing product, such as an airbag system, is integrated into a car. The car's price is likely affected by that airbag system, but by how much? It probably does not drive the entire value of the car. In a multiple regression analysis, the econometrician can collect the relevant features of the car that are likely to affect its price: horsepower, fuel economy, manufacturer, number of cup holders and so on. By holding every other feature constant, a multiple regression analysis can measure what effect the airbag system has on the price — whether it moves it up, down or has no effect at all. The analysis is quantitative, producing a specific numerical measurement of contribution of the feature being tested.

Reliability in courts

The Federal Circuit overruled years of common practice in *Uniloc USA Inc v Microsoft Corp* when it held as a matter of law that the 25% rule of thumb was a fundamentally flawed tool for determining a baseline royalty rate in a hypothetical negotiation (632 F3d 1292, 1312-19 (Fed Cir 2011)). As outlined in the opinion in *Uniloc*, the 25% rule of thumb had been extensively used in patent litigation to determine damages. The Federal Circuit criticised the 25% rule of thumb as being an "abstract and largely theoretical construct" that did not "carefully tie proof of damages to the claimed invention's footprint in the market place".

In contrast, regression can be a scientific analysis that can help to carefully tie proof of damages to the invention's footprint in the marketplace. Moreover, the scientific reliability of regression-based expert testimony has also been tested through the courts for decades (see *In re Chicken Antitrust Litig*, 560 F Supp. 963 (ND Ga 1980) (calculating damages when antitrust violations are alleged for overpayment of a product); *In re Corrugated Container Antitrust Litig*, 441 F Supp 921, 993 (JPMDL 1977); *Key Enterprises v Venice Hospitals*, 919 F 2d 1550 (11th Cir 1990) (calculating damages from exclusionary practices); *Aspen Skiing Co v Aspen Highlands Skiing Corp*, 472 US 585 (1985) (same); *Alan's of Atlanta v Minolta Corp*, 903 F 2d 1414 (11th Cir 1990) (calculating damages from Robinson Patman violations)).

A large number of antitrust cases (including those mentioned above) have included regressions both before and after *Daubert*, so courts have carefully considered the admissibility of expert testimony on regression analyses (*In Re: Polypropylene Carpet Antitrust Litigation*, 966 F Supp 18 (ND Ga 1997) (analysing econometric model selection, including some of the possible different independent variables that could

be included, and then analysing the hidden perils of trying to test a large number of variables in a regression and excluding the ones that don't seem to fit); *Estate of Bud Hill v ConAgra*, 4:94-cv-0198, 1997 US Dist LEXIS 13083 (ND Ga 1997) (admitting expert regression testimony after carefully evaluating whether the error term of the regression formula was independent of the included explanatory variables and whether variables were improperly omitted from the regression study)). In these cases, courts have gone into considerable detail attempting to understand regression analyses and its analytical weaknesses. This well-established body of law should give guidance and support to those seeking to transfer the use of regression analyses into patent law.

Use in patent cases

There are various ways in which multiple regressions have been used in patent cases.

Price premium

One way in which experts have used multiple regressions in patent cases is to measure the price premium that a company or manufacturer enjoys when using the patented feature in a given product compared to that same product using an alternative technology. A price hedonic analysis — which is a multiple regression of the price of product on the products' characteristics — is a common analysis by which to measure this.

Price hedonics has historically been used in economics to estimate how prices 'co-move' with product characteristics. An econometrician will typically amass a large set of characteristics that can be associated with the product in question. Therefore, using a large set of characteristics allows for one to compare the prices of a set of products that utilise the patented technology with a second set of otherwise identical product that does not use the patented technology. This is the kind of scientific method and procedure that can aid in supporting an expert's acceptance or rejection of alternative hypotheses, such as a non-infringing alternative (see *Apple Inc v Motorola Inc*, 11-C-8540, 2012 US Dist LEXIS 105387, at *36 (ND Ill 22nd

Action plan

To address the Federal Circuit's concern with patent damages analysis, parties involved in patent litigation should think of the following:

- While not appropriate in all cases, consider using regression models that have been tested and used both historically in the econometric field and in antitrust litigation.
- Start thinking about the damages analysis very early on in the case, as these types of regression require a lot of data. Some of it – though by no means all – can be obtained from the discovery process.
- Consider using the antitrust merger analysis model instead of just the price premium or market share model; this has the potential of showing the impact the patented technology has on profitability.
- Consider using the antitrust merger analysis model to account for how a patented technology could affect the entire market it is in – the merger analysis has the potential to show how profits would increase or decrease in other businesses if one did not use it or how cannibalisation of other products within a business will change based on the use of the patented technology.

> "Businesses care about profitability. And profitability never looks at just a price point that will give the highest price premium or market share point that will give the highest market share premium. To maximise profitability is to balance both"

May 2012) (J Posner)). The coefficient associated with the patented technology variable is therefore an estimate of the price premium that products using the patented technology enjoy, holding constant the remaining variables, thereby eliminating the possibility that the value is derived from other characteristics of the product (eg, brand name or other technology).

Market share premium

Another multiple regression analysis used in patent cases measures the market share premium that a company or manufacturer enjoys when using the patented feature. The analysis is similar to that of the price hedonics, except that the dependent variable is now market share instead of price. Once again, the coefficient associated with patented technology variable is an estimate of the excess market share premium that products using the patented technology enjoy, weeding out all of the influences that the other factors have on the market share and product success.

When running these analyses, it is tempting to take the price premium number and run it against baseline revenue and profits to come up with a damages number. And it is easy to forget that each of these is only one half of the picture and that, if used independently, could improperly inflate or deflate the impact of the patented technology.

In reality, businesses care about profitability. And profitability never looks at just a price point that will give the highest price premium or market share point that will give the highest market share premium. To maximise profitability is to balance both. Ideally, there is a perfect point at which to fix the price so not to keep quantity from stagnating at constant, but also increase quantity, but not so much to keep price from stagnating at constant. Ideally, a business wants both a price and quantity (market share) premium from the patented technology. This balance is what is plotted on a demand curve at point D.

Merger analysis

Another way in which to view an analysis that takes into consideration both price premium and market share premium is to use regression analysis to estimate what the demand of the patented technology is. A product's demand or demand curve is the relationship between how much a consumer would like to buy of the product and the prices and characteristics of that product. Ultimately, this allows a business to set its products' prices and quantities to maximise its profits.

Using the results of this regression analysis, econometricians simulate a proposed merger and then determine what prices, quantities and profitability would be after the merger – the new equilibrium. When applying the merger analysis to a patent case, the first step is to calculate the initial demand for the product with the patented feature. Then, by turning off the patented feature, a new equilibrium is created. This new equilibrium is a picture of the product's market, in terms of prices and quantities, when the business does not use the patented technology.

Quantitatively, the end result is that the party is able to determine the percentage change in profits of the product's profitability when it uses the patented technology. For one reason or another, businesses may choose to set a lower price point in exchange for a larger market share or vice versa to maximise their profits. This analysis captures that choice and can provide a more realistic and grounded analysis of how a patent can be valued.

The other advantage of this analysis is

that by creating a new market equilibrium, it inherently accounts for profitability and demand movement across multiple businesses and within a business. The merger analysis's market equilibrium includes not only the business in the patent infringement case, but every business or company in that market and all of its products. So by turning off the patented feature, one can see how profitability moves to other businesses which are or are not using the patented feature.

If the various multiple regressions show that a business chooses to price at a lower point to monopolise market share, seeing how much market share or profitability it would lose if the patented feature is turned off can be a valuable qualitative piece of information to add to the damages analysis. Additionally, the model accounts for the fact that a business may have multiple products and understands that when a business offers more than one product, affecting the price of one product can cannibalise sales of other products within the firm's product line. Therefore, with this model, one could head off the argument that an infringing business would just go to another product in its product line.

Greater focus

With the Federal Circuit's increased focus on apportioning and isolating the value of a patented feature, patent infringement litigants must be mindful about how they approach and support the damages analysis. Regression analyses are not only an academically supported and sound approach, but the concepts mentioned above have been used and tested through the courts for decades.

It is important to note, however, that individual regression models cannot be used or applied in a vacuum. For most instances, price premium, market share premium and demand analyses should probably be applied together to gain the most accurate and comprehensive picture.

In appropriate cases, regression models not only provide a quantitative measure for damages, but also provide additional insight into topics such as non-infringing alternatives, market equilibriums and cannibalisation that will only help to strengthen a damages model. *iam*

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